ARCHEOLOGIA MEDIEVALE

Cultura materiale. Insediamenti. Territorio.

Rivista fondata da Riccardo Francovich

Autorizzazione del Presidente del Tribunale di Firenze n. 2356 del 31 luglio 1974

Indirizzi Redazione:

c/o Edizioni All'Insegna del Giglio s.a.s.
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XXXIX
2012

All'Insegna del Giglio

ISSN 0390-0592
ISBN 978-88-7814-568-9

Stampato a Firenze nel dicembre 2012
Tipografia Il Bandino

Archeologia Medievale
XXXIX, 2012, pp. 93-121

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ANIMALS IN THE BYZANTINE EMPIRE: AN OVERVIEW OF THE ARCHAEOZOOLOGICAL EVIDENCE

1. INTRODUCTION

The principle aim of this literature survey is to gain insights into the diet of the Byzantine Empire by analysing how animal husbandry, hunting, fowling, and fishery find expression in excavated bone materials. Thus, archaeozoological reports on Byzantine sites were collected, and their results were compared.

The reconstruction of Byzantine diets has only recently found entrance in the canon of Byzantine Studies. This delay is certainly due to a bias in the written sources. Often they do not tackle mundane observations of the daily grind, but rather deal with outstanding aspects like feasting, or ideological backgrounds such as fasting or diet calendars. Accordingly little is known about the dietary habits of the common Byzantine people. Due to the growing number of archaeological excavations of Byzantine sites during the past two decades and, fortunately, an accompanying increase in the number of archaeozoological reports concerning the period, some preliminary conclusions about the daily meat diet can now be drawn.

This article is based on the author's 2010 monograph *Tiere im Byzantinischen Reich. Archäozoologische Forschungen im Überblick* (Kroll 2010) and gives a short overview on the results of the study. The main intention of this article is to make the principle results and conclusions, up to now only published in German language, available to a wider group of anglophone scholars working in various fields on aspects of Byzantine alimentation. As archaeozoology is a specialised field with a strongly natural scientific background, and articles of this discipline are often published in periodicals or archaeozoological volumes not necessarily to hand or even detectable to members of other disciplines[1], this article also intends to give those alien to the field an easy access to the archaeozoological evidence and to the respective primary sources.

2. AREA OF RESEARCH, MATERIALS, AND METHODS

The Byzantine Empire came into being when the Roman Empire was split into two in the year 395. The eastern part received a new capital, the former city of Byzantion, renamed Constantinople. In opposition to the western part, that declined and fell soon afterwards, the Eastern Empire persisted for over a thousand years and occupied at times the whole eastern Mediterranean region, stretching from the Strait of Sicily to the Crimea and including parts of the former West Roman Empire. Accordingly, the area of research comprises the whole Eastern Mediterranean region and a time span of about a thousand years. Following a customary division, the lengthy time-span was subdivided into three periods. Most of the faunal materials included in the study (47) represent the Early Byzantine Period (395-642; *fig.* 1), during which the Empire attained its maximum expansion under Justinian I (527-565). For the Middle Byzantine Period (643-1204), when the Empire was considerably smaller and included solely parts of Italy, Asia Minor and the Balkans, the state of our knowledge already diminishes (*fig.* 2), and for the Late Byzantine Period (1205-1453) only one archaeozoological report could be found (*fig.* 3). The sites and reports included in this study are listed in *Appendix* 1.

The parameter chosen for comparison is the Number of Identified Specimens (NISP). This factor is specified in most publications, unlike the Bone Weight or the Minimum Number of Individuals. The NISP of every economically relevant species[2], be it domestic livestock and poultry, game, winged game, or fish, attributed to Byzantine strata was gathered in a data base. The identified species and the respective sites where they were detected are listed in *Appendix* 2. Information on other aspects, such as kill-off patterns, sex ratios, or pathologies, was also taken into account. These, however, were not evaluated statistically due to different methodologies applied by the respective operators.

To isolate the factors that determine the composition of the faunal materials, the area of research was split into seven regions plus two specific sites, which were first examined sep-

* Römisch-Germanisches Zentralmuseum Mainz.

[1] The circumstance that the potential of archaeozoology is known on the one hand, but that archaeozoological literature is not easily accessible for scholars of other disciplines on the other, can be concluded by Anthony Bryer's statement: «Osteology and teeth can provide evidence for kill-off patterns, and hence an indication of the size of ancient flocks, but I do not know of any specifically Byzantine sample that has been analysed» (Bryer 2002, p. 103). By 2001 more than 40 Byzantine samples were already analysed and published.

[2] Some materials yielded high amounts of small mammals, reptiles, amphibians and other intrusions. These were only partially taken into account: the commensal rodents black rat *Rattus rattus* and house mouse *Mus musculus* were included, because they are widespread and economically relevant, being pests, see *Appendix* 2.

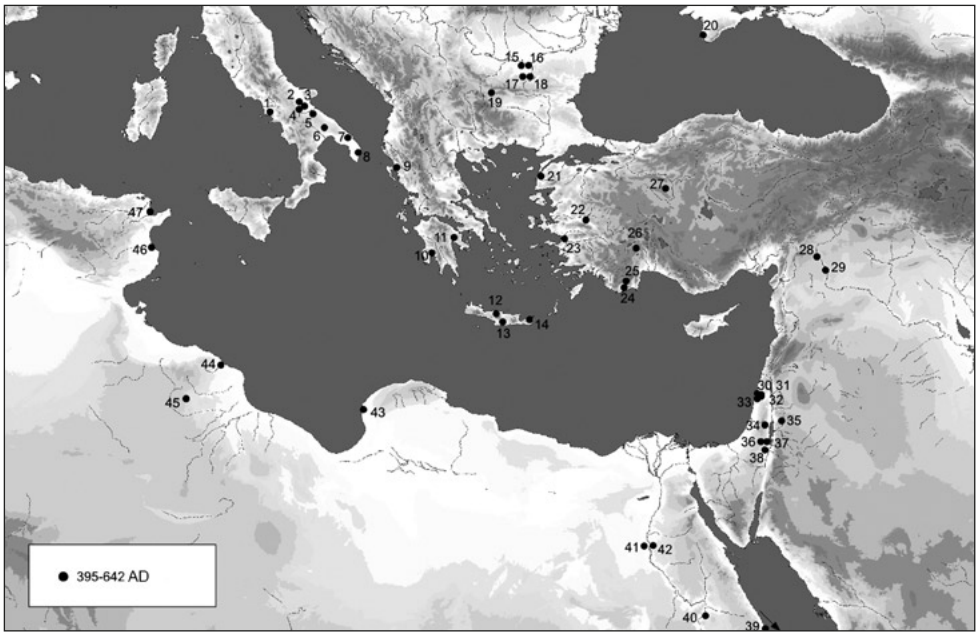

fig. 1 – Early Byzantine sites included in the study 1. Naples; 2. San Giusto; 3. Herdonia; 4. Faragola; 5. Canosa; 6. Belmonte; 7. San Giorgio; 8. Otranto; 9. Butrint; 10. Nichoria; 11. Pyrgouthi; 12. Eléftherna; 13. Gortyn; 14. Itanos; 15. Novae; 16. Iatrus-Krivina; 17. Dichin; 18. Nicopolis ad Istrum; 19. Bela Voda; 20. Cherson; 21. Beşik Tepe; 22. Sardis; 23. Ephesos; 24. Andriake; 25. Limyra; 26. Sagalassos; 27. Pessinus; 28. Zeugma; 29. Ta'as; 30-32. Sumaqa, Shallale, and Raqit; 33. Caesarea; 34. Horbat Rimmon; 35. Tell Hesban; 36. Upper Zohar; 37. En Boqeq; 38. Tamara; 39. Berenike; 40. Shanhûr; 41. Bawit; 42. Amarna; 43. Berenice/Benghazi; 44. Leptis Magna; 45. Libyan Valleys Survey; 46. Leptiminus; 47. Carthage.

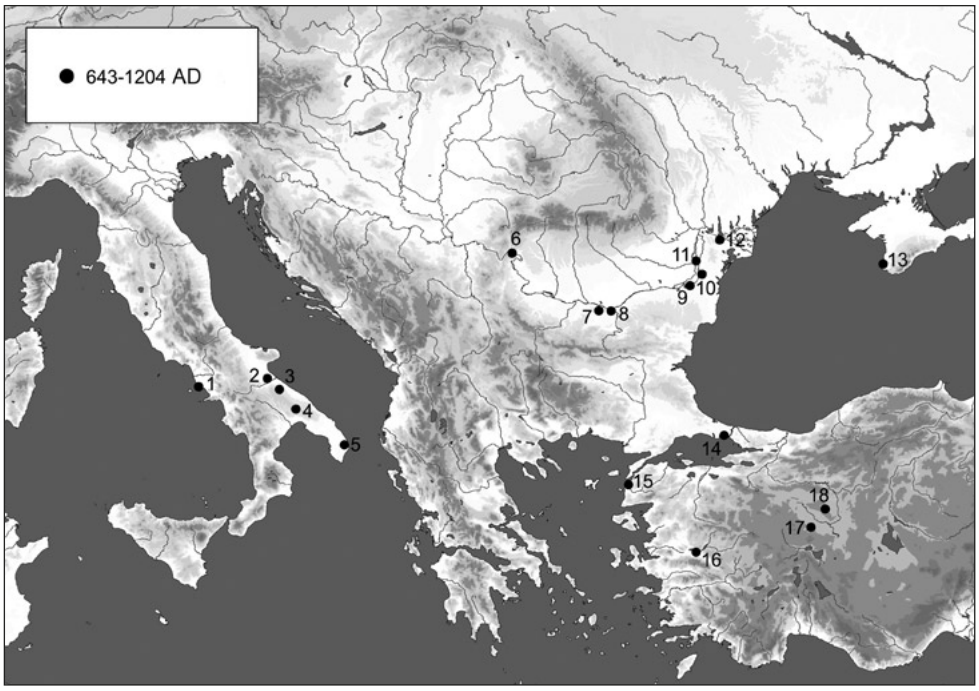

fig. 2 – Middle Byzantine sites included in the study 1. Naples; 2. Herdonia; 3. Canosa; 4. Belmonte; 5. Otranto; 6. Pontes; 7. Novae; 8. Iatrus-Krivina; 9. Oltina; 10. Capidava; 11. Carsium; 12. Noviodunum; 13. Cherson; 14. Constantinople; 15. Beşik Tepe; 16. Sardis; 17. Amorium; 18. Pessinus.

arately (*fig.* 4). The regions are southern Italy, the west coast of the Balkans, including the Peloponnese and Crete, the Lower Danube, Cherson on the Crimea and Constantinople (being the two specific sites), Asia Minor, Syria and Palestine, Egypt and North Africa. This approach was chosen to filter out certain regional idiosyncrasies, which are mainly due to the eco-geography and the historical development of the respective region. In a second step, the results for these areas were compared supra-regionally with each other so to expose distinctions and similarities. A detailed account of the archaeozoological evidence for the regions is not given here, as it would go far beyond the scope of this article[3]. Here, the results of the supra-regional comparison are presented. The role of domestic mammals and poultry, wild fowl, game, and fish[4], is considered in the following.

3. LIVESTOCK HUSBANDRY PATTERNS

As most of the animal remains from Byzantine sites represent food waste, the role of the main domestic meat providers, sheep, goat, cattle and pig, is quite reliably assessable for the respective regions. To begin with, it should be seen whether the dietary habits detected archaeozoologically for the preced-

[3] A detailed list of the bone finds and site-specific idiosyncrasies is given in the first part of the monograph: Kroll 2010, pp. 11-146.

[4] Molluscs are deliberately left out of this article, as the state of research concerning this species-rich and varied animal group is very heterogeneous, and would lengthen this article.

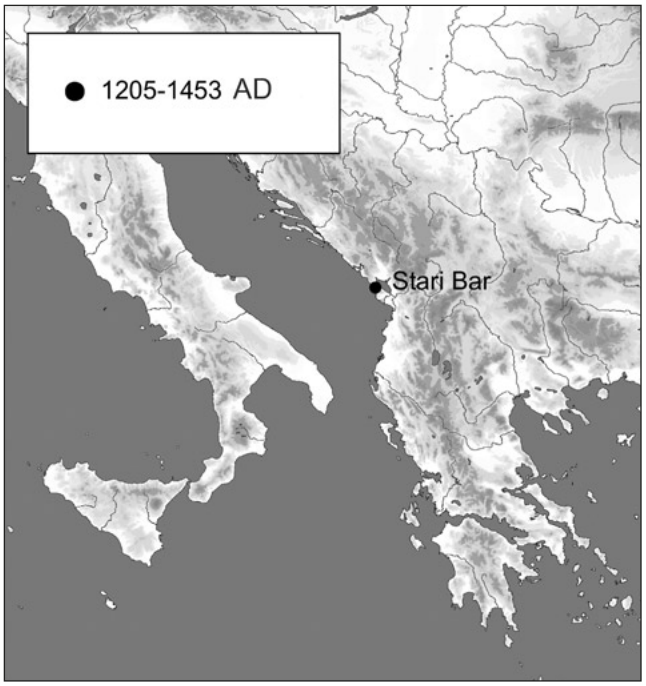

fig. 3 – The only Late Byzantine site included in the study, Stari Bar.

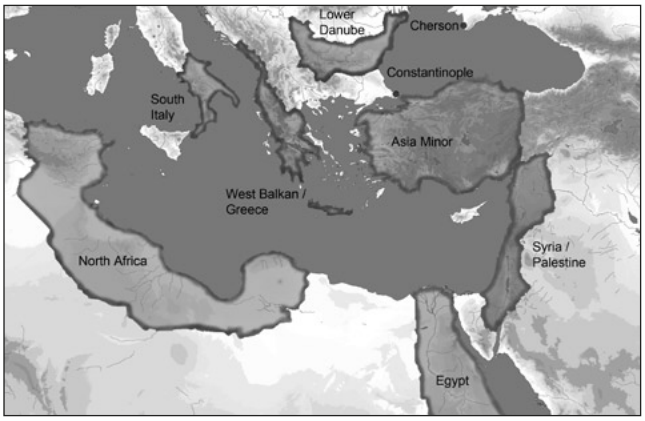

fig. 4 – The respective regions as subdivided in this study.

ing Roman period were maintained, or whether new trends appear. As a foundation for a diachronic comparison, the results published by Anthony King on the Roman meat diet are used (King 1999). To establish comparable backgrounds, the same parameters used by King were also used. For each region, the arithmetical mean and the standard deviation of the percentages of sheep/goat (combined), cattle, and pig were calculated. To enhance the number of samples, the shares attributed to different periods of Byzantine sites were used, instead of the entire materials, provided that the NISPs were sufficient (*tab.* 1). As the bulk of the assemblages is Early Byzantine, and only few materials date to the Middle or Late Byzantine periods, the latter were not evaluated separately. An exception is the region on the Lower Danube, which yielded sufficient data for the Middle Byzantine period. As this region also shows the most pronounced discrepancies in comparison with the Roman period, a detailed evaluation is presented.

In the research area, sheep and goat breeding was already predominant in Roman times (*fig.* 5). In the western regions, North Africa, South Italy, and Greece, livestock husbandry had been based on small ruminants, followed by pigs, and with cattle ranging third, while in the eastern regions, Asia Minor and the Levantine provinces, sheep and goat had been the main domestic species, followed by cattle, with the pig ranging third (King 1999). This ranking order did not change on the transition to Byzantine times in the respective regions, although the shares vary. Already in Roman times, the region on the Lower Danube presented an exception to these two patterns as, since the Iron Age, extensive cattle breeding had been established. According to King's results, the small ruminants ranked second in Roman times, while pig husbandry played only a minor role (King 1999, p. 182). In the Early Byzantine period this picture changes slightly. Cattle were still the main livestock on the Danube, but pig breeding became economically more important. This trend recedes a little towards the Middle Byzantine period, when cattle breeding played an even greater role than in Roman times (*tab.* 1, *fig.* 5). In Late Antiquity this area was under nearly constant attack by peoples pressing from the north, and the archaeologically detectable militarisation of the region (Poulter 2004; Poulter 2007) is a plausible explanation for these economic changes. For the most part, the area's population was military and the garrisons based at the fortified settlements and military forts on the Lower Danube were engaged in mixed farming, as finds of agricultural tools and biological remains show (Poulter 2004; Poulter 2007). It is understood that the local agricultural yield was used primarily to ensure the provisioning of the defensive troops on this northern frontier. As salted pork was part of the army supply (Kolias 1984, p. 199), as it could be stored for a comparably long time, the increasing shares of pigs hint strongly to a locally concerted provisioning system.

While minor variations of shares can be neglected due to the heterogeneity of the sites included and the rather poor amount of data available, apart from the Danubian case, two more pronounced alterations can be detected. Firstly, more cattle were kept in South Italy, mainly to the disadvantage of pigs, but the shares of small ruminants decrease there, too. At the same time, the bone materials of this area show a notable economical heterogeneity, discernible in high, two-digit standard deviations for all main domestic species (*tab.* 1). This cannot simply be attributed to particular eco-geographical reasons, because the natural preconditions for the respective sites do not differ strongly. Like the Danube area, South Italy suffered from severe military conflicts in Late Antiquity with the Vandals and Goths, and it was not only the attacks at home, but also the campaigns abroad that weakened the heartland of the Western Roman Empire and led to an increasing instability in the hinterland (Arthur 2004). This triggered a rural exodus into the cities on the one hand and a reorganisation towards a self-sufficiency of the remaining rural population on the other. The new settlement patterns archaeologically detectable in Apulia (Buglione 2007a; Buglione 2007b), led to an adaption of locally profitable practises suitable for self-sufficiency, like

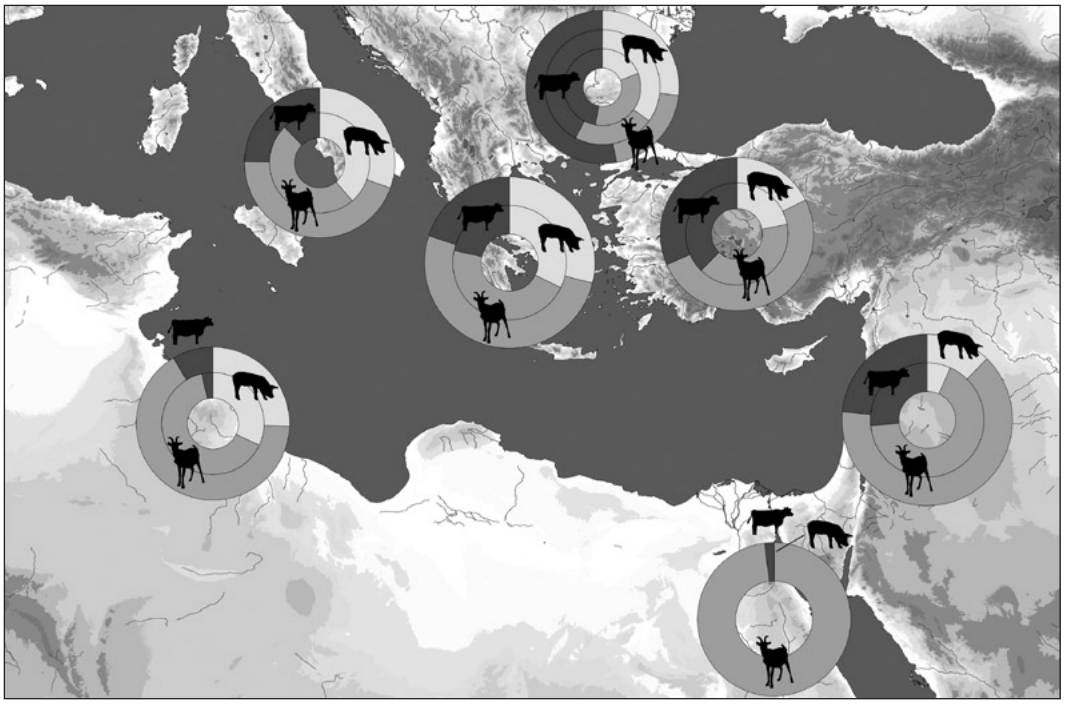

fig. 5 – Arithmetical mean of the main domestic mammal (sheep/goat, cattle and pig) percentages in the regions of the Empire in comparison to Anthony King's results for the Roman Period (King 1999). Inner circle: Roman, outer circle: Byzantine. Lower Danube region: inner circle: Roman, medium circle: Early Byzantine, outer circle: Middle Byzantine. For Egypt, only the Byzantine percentage is depicted.

	Material basis		Cattle		Sheep/Goat		Pig	
	No of cases	Mean size of assem.	Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation
South Italy Roman	6	251	12,4	8,7	48,9	23,7	38,7	17,6
South Italy Byzantine	14	681	24,7	20,4	44,9	12,7	30,4	14,1
Greece/Urban Sites Roman	10	3081	21,6	12,8	46,2	25,3	32,2	25,7
Greece Byzantine	9	550	19,9	9,0	51,3	10,1	28,8	11,0
Danube Roman	4	789	47,0	12,9	34,0	14,2	19,1	9,1
Danube Early Byzantine	15	1491	42,2	18,6	22,8	8,3	35,0	12,0
Danube Middle Byzantine	9	644	52,9	5,4	20,4	5,6	26,7	5,3
Asia Minor Roman	20	636	37,7	25,2	40,4	21,4	22,0	16,6
Asia Minor Byzantine	15	5282	31,6	16,6	50,8	18,7	17,7	9,8
Eastern Provinces Roman	19	487	26,7	17,6	66,6	21,8	6,7	9,2
Syria/Palestine Byzantine	10	1076	23,5	19,3	64,2	19,1	12,3	14,5
Berenike (Egypt) Byzantine	3	4206	2,0	0,4	97,9	0,4	0,1	0,1
North Africa Late Ant. Rom.	15	1098	3,5	2,6	64,5	14,0	31,9	14,6
North Africa Byzantine	13	927	8,6	7,7	65,8	10,6	25,6	11,9

tab. 1 – Arithmetical means and standard deviations of the percentages of cattle, small ruminants, and pig in the regions of the Roman and Byzantine Empire. Roman data (grey): according to Anthony King's specifications (King 1999). Byzantine Data: Based on the sites included in this study.

wool production or tillage. The ruralisation of the cities can, for instance, be traced by the diminishing significance of pig meat in Naples (the only genuine urban site included in this study) on the transition to the 6th century (King 1994; Arthur 1994). Traditionally, for Roman times, urban bone materials are characterised by high amounts of pigs, while a preponderance of small ruminants is typical for rural contexts (King 1999).

Secondly, we encounter increasing shares of small ruminants in Asia Minor, while the percentages of the other two species decline a little (*tab.* 1, *fig.* 5). With the exception of the pig shares, which are generally low, livestock husbandry was based mostly on the small ruminants. Only in some places is a strong emphasis on cattle detectable, notably at the so-called Acropolis of Pessinus, but also at Sagalassos and Limyra[5]. The pasture conditions in Asia Minor, however, do not favour either cattle husbandry or pig breeding. Pisidia, where Sagalassos is located, is one of the hottest regions of Asia Minor, and the area around Pessinus in Central Anatolia was already covered by a meagre steppe vegetation in Byzantine times (Lefort 2002, p. 234). The high shares of cattle in these bone materials accordingly hint to activities that required such intricate cattle keeping. While in Limyra the cattle bones derive from animals culled at a young age (Forstenpointner, Gaggl 1997, p. 424) and thus represent

[5] Ervynck, De Cupere, Van Neer 2003, p. 382 tab. 1; De Cupere 2001, p. 93 tab. 31; Forstenpointner, Gaggl 1997, pp. 421 f., fig. 35.

upscale dietary habits, the aged cattle consumed at Sagalassos and Pessinus suggest that the animals were primarily kept for other purposes. Bea De Cupere assumes that at Sagalassos cattle were kept for agriculture and transportation (De Cupere 2001, p. 141). Causes for the high cattle shares at the Acropolis of Pessinus, however, remain unclear.

For Byzantine Syria and Palestine, the mean shares of the main domestic species do not differ from the respective Roman percentages and the high standard deviations detected are comparable to those calculated by Anthony King for the Roman Period (King 1999). In this region, the eco-geographical circumstances of the sites included in this study are extremely variable, ranging from the floodplain forests along the Euphrates (Zeugma, Ta'as) and Jordan (Tell Hesban), via the lush slopes of the Carmel Mountains (Sumaqa, Shallale, Raqit) and the adjoining coastal area affected by the mild Mediterranean climate (Caesarea), to the arid deserts around the Dead Sea (Rimmon, En Boqeq, Upper Zohar, Tamara). Thus, a marked heterogeneity can be expected, and this also shows in other respects such as the detected game and wild fowl spectra (see below). The significance of the pig is of some relevance for this area, because its absence in the faunal materials is often used as an indicator for an existing Jewish community. Pig finds, however, appear nearly everywhere, and it is only the three Carmel sites that show conspicuously low shares. These, however, yielded only very little material.

The isolated material from the Egyptian Red Sea port Berenike[6] also shows a spectrum dictated to a large extent by environmental conditions. Here too, the keeping of pigs was not feasible, and had cattle not been imported from the fertile Nile valley (Van Neer, Lentacker 1996, p. 348), of these four species only sheep and goat would have been encountered (*fig.* 5).

Two regions show a pronounced homogeneity of their bone spectra. The area including the west coast of the Balkans, the Peloponnese, and Crete, displays a remarkable continuity in animal husbandry practices. This area was only marginally affected by the migrations and conflicts of the Early Middle Ages and especially the Peloponnese and Crete show unimpaired settlement patterns up to the 7th century[7]. The classical Hellenistic livestock pattern relying strongly on the small ruminants and to a lesser extent on pigs and cattle is maintained. In North Africa this pattern also persists. Here, cattle play an even smaller role because, especially in Libya, neither sufficient pasture, nor enough fresh water supplies were available. Furthermore, cattle were dispensable, because dromedaries could take over most of the labour duties elsewhere shouldered by the bovids. In North Africa, the role of the pig diminishes slightly compared with Roman finds, for the most part in favour of the cattle shares. With the exception of a survey of farmsteads in the Libyan hinterland (Van Der Veen, Grant, Barker 1996), all bone assemblages represent urban waste (see *Appendix* 1). The decrease of pig shares is part of a general trend detectable in bone materials stemming from cities of the 4th to the 6th century. This pattern could be spotted in bone assemblages from Naples, Butrint, Carthage and Zeugma[8]. In other cities, like Sagalassos, Tell Hesban, and Berenice/Benghazi[9], the small ruminants were already predominant in Roman times, whilst for other sites a development was not assessable diachronically.

4. UTILISATION OF DOMESTIC MAMMALS

Domestic mammals cannot solely be seen as providers of meat. The animal bones from excavations bear witness to a variety of practical uses, both in death and in life, which must be taken into account in view of their considerable economic importance. As the bones excavated in most cases represent food waste, however, animals not primarily (or not at all) used for nutritional purposes are underrepresented in the assemblages and their significance is thus difficult to assess.

4.1 Meat

Although most of the Byzantine bone assemblages represent food waste, observations concerning butchery ages and animal pathologies can indicate possible lifetime use. The advanced ages of many slaughtered sheep, goats, and cattle point to low quality meat, but it should be emphasized that the assemblages also generally include remains of animals that were slaughtered at a younger age. Throughout the empire, sheep, goats, and cattle were kept both for their secondary products and for their meat, although the shares of the animals slaughtered young are often lower. The fact that elderly ruminants still supplied meat means that the respective percentages calculated for the main domestic species in order to assess their role in the meat diet are not biased by the animals' mixed utilisation purposes.

The pig, which is of no great use during its lifetime, was always culled at the latest when it was fully grown and fodder costs would have begun to outbalance the meat profits. As the Mediterranean vegetation does not favour pig husbandry and in most areas the animals could not be kept on a large scale, pork was a luxury. But in some cases, an even more luxurious consumption of very young piglets is detectable. At Tell Hesban bones of newborn and foetal piglets were recorded, in Limyra pigs were slaughtered at an age of four to six months, and in some areas of Carthage (i.e., those from the German excavations and a 7th c. church complex), remains of approximately two month old piglets were found[10]. Even though the mean percentages of the pig are comparably low, and it ranges in most areas second and sometimes even third among the major domestic species, pork was an important commodity. It was cured through salting and could thus be stored for a comparably long time. In the Early Byzantine Period, pigs were still part of the *annona*, a tax in kind, and pork was an important component of military provisioning (Kolias 1984,

[6] Van Neer, Lentacker 1996; Van Neer, Ervynck 1998; Van Neer, Ervynck 1999.

[7] On the Peloponnes see Hjohlman *et al.* 2005, p. 127.

[8] King 1994, p. 375, tab. 37; Powell 2004, p. 306, tab. 17.1; Nobis 1999, p. 601, tab. 3.1; Rousseau, Guintard, Abadie-Reynal 2008, p. 258, fig. 6.

[9] De Cupere 2001, p. 84, tab. 27 and p. 74, tab. 22; Driesch, Boessneck 1995, p. 75, fig. 5.4; Barker 1979, p. 11, tab. 1.

[10] Driesch, Boessneck 1995; Forstenpointner, Gaggl 1997; Nobis 1999; Reese 1977.

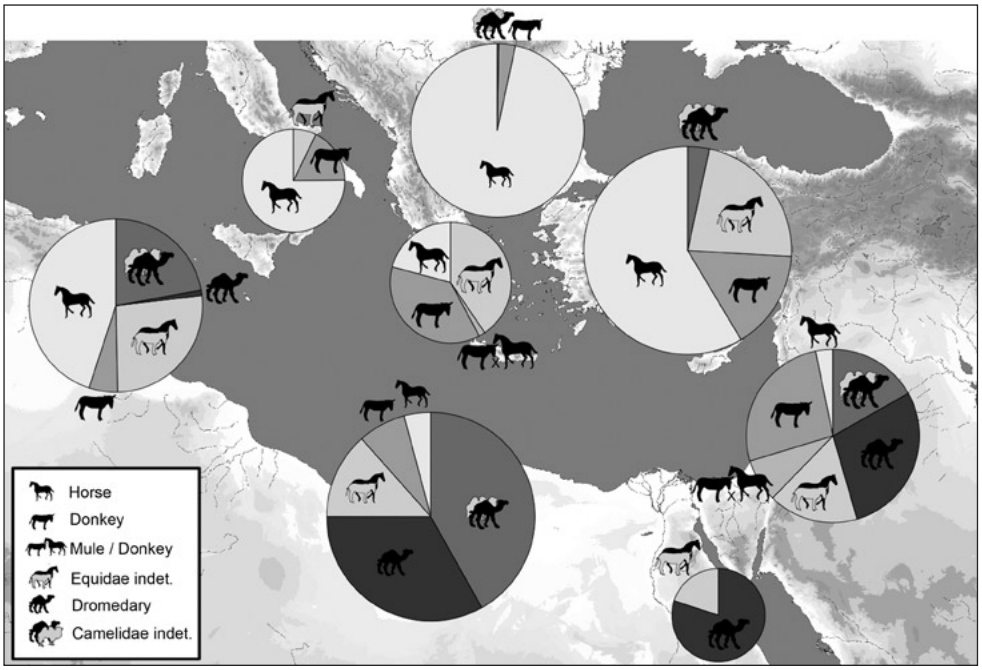

fig. 6 – Arithmetical mean of the beasts of burden percentages in the regions of the Empire. The size of the circles symbolises the relative significance of beasts of burden in the respective regions.

p. 199). Thus, the increasing pig shares in Early Byzantine regions of increased warfare, like the Danube frontier and the Levant, are not surprising. Another advantage of pigs is that they can be kept in small numbers *intra muros*, because they do not depend on extensive pasturing, but need comparably small amounts of nutrient-rich fodder that can be provided by kitchen waste. Hence, in the case of sieges or of an unstable hinterland, pork was a means of survival. While for most of the other domestic mammals – cats, dogs, donkeys, and mules – a meat use is not archaeozoologically detectable, some evidence for horse consumption and a few signs of camel meat use appear. Butchery marks characteristic of meat production were observed on horse bones from Butrint, Iatrus-Krivina, Nicopolis ad Istrum, Yenikapı, Caesarea and Limyra[11]. As the consumption of horse meat has no tradition in the Mediterranean, and in Roman Times was considered only as a last resort in the face of starvation (Toynbee 1983, p. 172), these finds could point to famines and crises. It cannot be ruled out, however, that the multicultural empire comprised population groups that fancied this meat type. A consumption of dromedaries is assumed for some Levantine sites (Ta'as, Upper Zohar, Caesarea, Tell Hesban) and for the Roman period of the Red Sea harbour Berenike[12]. The two first mentioned sites, situated along caravan routes, produced the only Byzantine materials with considerable shares of these animals: generally, camels appear only in very small shares.

4.2 Labour

The two domestic carnivores and a range of ungulates were used for working purposes. Besides their life as pets, cats and dogs were also employed as labourers at home and in the field. Cats were indispensable to keep rodent pests under control. Wherever grain was shipped or stored in high quantities, cats appear amongst the bone finds. Thus, most cat finds stem from harbour sites, like Naples, Caesarea, Berenike and Carthage[13], or from the Lower Danube, whose military inhabitants were engaged in intensive crop farming (*see Appendix* 2)[14]. Inland sites located in areas not involved in large-scale agriculture, for instance in central Anatolia or arid parts of Israel, yielded only scattered cat finds. Dog bones appear in higher numbers and a bit more steadily than cat bones. This animal was employed in various ways, be it as pet, shepherd, guard, or hunting assistant.

The main value of domestic animals for labour, however, lies in their physical strength. Neither agriculture nor the transport of goods, nor travel by land or military campaigns, would have been feasible without the labour of cattle, horses, donkeys, mules, and camels. Each of these animals has its specific advantages for different tasks. Heavy labour was shouldered to a large extent by cattle, because Byzantine harnessing techniques did not allow equids to max out their full traction power (Bryer 2002, p. 107). Thus, cattle, both oxen and cows, were used to pull heavy carts and the plough. Accordingly, bones of cattle advanced in years are omnipresent in Byzantine faunal materials. These regularly show limb pathologies attributed to continuous physiological stress (Bartosiewicz *et al.* 1993). As cattle husbandry is limited by the extent of suitable pasture and the animals' high water demand, the shares of this species are very low in the arid regions of the empire[15]. But even there,

[11] Powell 2004, p. 313; Benecke 2007, p. 393; Beech 2007a, p. 172; Pers. Comm. Vedat Onar, Istanbul; Cope 1999, p. 407; Forstenpointner, Gaggl 1997, p. 426.

[12] Clason 1996, p. 99; Clark 1995, p. 60; Driesch, Boessneck 1995, p. 73; Cope 1999, p. 407; Van Neer, Lentacker 1996, p. 346 and p. 350.

[13] King 1994, p. 387; Cope 1999, p. 406 tab. 1; Van Neer, Lentacker 1996; Van Neer, Ervynck 1998; Van Neer, Ervynck 1999; Schwartz 1984, p. 249 tab. 7; Nobis 1999, pp. 606f. tab. 5.5.

[14] Benecke 2007, p. 385 tab. 1; Makowiecki, Makowiecka 2002, p. 215 tab. 1; Beech 2007a, p. 158 tab. 10.1 and p. 188 tab. 10.24; Bartosiewicz 1996, p. 283 tab. 1.

[15] For instance in the Negev area, at Tell Hesban, Tunisia and in all Carthage materials, Clark 1995, p. 63 tab. 2; Croft 1995, p. 92 (on En Boqeq); Driesch, Boessneck 1995, p. 72 tab. 5.9; Burke 2001, p. 444 tab. 6.7 and 6.9; For Carthage see *Appendix* 1.

a minimum of animals was kept or even imported (as in the case of the Red Sea harbour Berenike; Van Neer, Lentacker 1996, p. 348) to meet the demands, although in these areas camels certainly took over some typical cattle duties, like ploughing the light soils.

Lighter burdens were transported by mule carts or on the back of mules, donkeys, and camels. All these species are often depicted as pack animals in Greek manuscripts. Donkeys were small and thus perfectly suitable for slow transport of light goods in difficult or cramped areas, like mountains, forests, and cities. They were also used for rotating mill-stones, as the *mola asinaria* was not totally replaced by water-powered mills during the Byzantine era. Donkey bones appear constantly in materials of all regions and are particularly often detectable in Greece, Asia Minor and the Levant (*fig.* 6). Mules are less delicate and spirited than horses, and more resilient and stronger than donkeys. Their significance is not easily assessable, however, because the hybrids often remain unidentified among the equid bones. Accordingly, mules are assumed only for a few sites: Eléftherna, Sagalassos, Zeugma, Carthage, and the Theodosian Harbour of Constantinople[16].

Apart from cattle, the labour animal most often represented in the materials is the horse (*fig.* 6). On the Lower Danube, in Italy, Asia Minor, and Carthage, remains of horses clearly outweigh those of other equids and camels. Even though horse bones from Nicopolis ad Istrum show pathologies typical for draught animals (Beech 2007a, p. 175), it can be assumed that this animal was only exceptionally used for purposes other than riding. The small Byzantine horses were less loadable than mules and, furthermore, were the swiftest means of travelling on land. On the Danube, where most of the Early Byzantine inhabitants were military personnel, horses were certainly kept primarily as mounts for the cavalry.

Camels mainly played a role in the arid regions between Libya and Syria (*fig.* 6). Four separate Late Antique finds appear as far north as the Lower Danube, in Iatrus-Krivina, Novae, and Nicopolis ad Istrum[17]. All of them could come from hides, as they are parts of the hooves, and the scattered camel finds are so strongly outweighed by equids that an economic significance is not imaginable. In Asia Minor, some finds were detected at Sagalassos and Amorium, but here, too, the equids outnumber the camels by far[18]. With the exception of a single bone from Constantinople preliminarily assigned to a Bactrian camel[19], all camel finds determinable to species level are from dromedaries. Only in Syria, Palestine, Berenike, and Libya these animals seem to have been of some economic significance. Solely dromedaries are able to cross the deserts of this region carrying goods along the old caravan tracks, neither properly paved, nor equipped at short distances with fresh water sources. Notably high shares of camel bones, however, were only found at Ta'as, an Euphrates harbour, and, notably, at Upper Zohar, a fortified station for travellers and military members amidst the Negev desert[20]. All other sites of these regions yielded only a few camel finds, and it is rather the consistency of their appearance in a number of faunal assemblages, that hints to a common employment of this species in daily life or military activities.

4.3 Milk and Wool

Not only cattle, but also sheep and goats were often culled at an advanced age, which means that they too were of use during their lifetime. Both species are providers of milk and wool or hair. While sheep wool was used for a variety of textiles, ranging from clothing to mattresses, the hair of goats was ideal for (nautical) ropes and bags, because it is more tear-resistant and water-repellent. A variety of archaeological finds, like loom weights, wool combs, spindle whorls and such, encountered for instance at Canosa (Italy), Amorium (Asia Minor), and Cherson (Crimea)[21], affirm the role played by the small ruminants' fleece. Thus, throughout the empire a preponderance of aged sheep and goat is generally detectable. In most cases it is the sheep that predominate among the small ruminants, but there are seven assemblages that break this rule. Goats were predominant at Eléftherna on Crete, Limyra and Sagalassos in Asia Minor, the three Carmel sites Sumaqa, Shallale and Raqit in Israel, and Libyan Berenice/Benghazi[22]. Usually, this is interpreted as a sign of a herbaceous and hard-leaved vegetation in the surroundings that did not suffice for the pasture of sheep.

Milk use, unfortunately, is not so easily detectable in an advanced economy like the Byzantine. The classical dairy kill-off pattern, a combination of aged and young animals (Payne 1973), is rather unlikely to be found, as the meat of lambs and kids was produced for another clientele than that of mature animals and thus would have been subject to different distribution channels. We may nevertheless be sure that the small ruminants were the basis of Byzantine dairies, because the other species in question are far from being as cheap and efficient milk providers. While for most Byzantine sites a dairy use of the small ruminants is assumed or at least cannot be distinguished from wool utilisation, the commonly detected labour use of cattle often excludes their use for milk. The gestation time of cattle is 280 days, nearly two times longer than that of the small ruminants, and over this period the animals had to be well nourished and not exposed to excessive physical strain. As for camels, whose milk is an elixir for desert nomads, nothing is yet known archaeozoologically about possible use of their wool and milk.

5. GAME

Remains of game appear steadily, but generally in very small numbers. The highest shares are detectable in the northeastern parts of the empire, between the west coast

[16] Nobis 1998, pp. 415-417; De Cupere 2001, pp. 66-74; Rousseau, Guintard, Abadie-Reynal 2008, pp. 271 f.; Nobis 1999, pp. 606f.; Yenikapı: personal Communication, Vedat Onar, Istanbul.

[17] Benecke 2007, p. 385 tab. 1; Mackowiecki, Mackowiecka 2002, p. 215 tab. 1; Beech 2007a, p. 158 tab. 10.1.

[18] De Cupere 2001, p. 65; Ioannidou 2012.

[19] The huge amount of bones found during the large scale excavations of the Theodosian Harbour are still worked on. Prof. Vedat Onar kindly sent me some information on preliminary results.

[20] Clason 1996, p. 98 tab. 1; Clark 1995, p. 63 tab. 2.

[21] Buglione 2007a; Ioannidou 2012; Rabinowitz *et al.* 2010.

[22] Nobis 1998, p. 415 tab. 6; Forstenpointner, Gaggl 1997, pp. 421f. fig. 35; De Cupere 2001, p. 83 tab. 26; Horwitz, Tchernov, Dar 1990, p. 292 tab. 2; Horwitz 2004, p. 305 tab. 1; Horwitz 2009, p. 335 tab. 2; Barker 1979, p. 16.

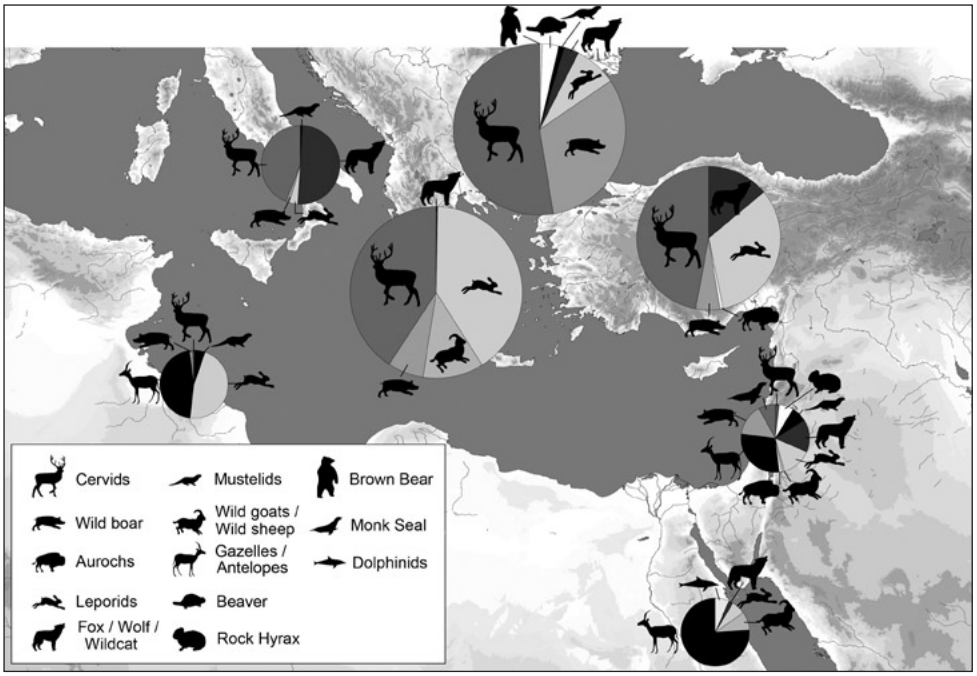

fig. 7 – Arithmetical mean of the game percentages in the regions of the Empire. The size of the circles symbolises the relative significance of game in the respective regions.

of the Balkans, Greece and the Danube, and in Asia Minor (*fig.* 7). Here, the percentages amount in places up to 5 or 9% of the economically relevant species. Only sporadically, a notably high share of game appears, for instance, at the Middle Byzantine fort of Pontes on the frontier to the Bulgarian Empire, and at some isolated farmsteads in the Libyan hinterland[23]. Such an increased share of game – in both cases it is more than 30% of the economically utilised species – suggests that hunting served rather as a means of tackling shortages than as a recreational activity. Less drastically increased shares of up to 10% appear here and there. These can be interpreted as a sign of shortages, for instance in 10th-11th c. Amorium, where wolves were consumed (Ioannidou 2012). Game bones can also be the result of hunting activities that intended to diversify the menu. This can be assumed for the most part of Byzantine sites, because generally only few finds of game are recorded.

The game spectra ascertained indicate hunting in the vicinity of the respective sites. Written sources give evidence that the rural population tried to make some money in selling venison in the cities (Kislinger 1982, p. 93). A long distance sea transport of wild animals or parts of their bodies (cured meat, raw materials for artisans) emerges only at Constantinople, as the bone finds from the Theodosian harbour show[24].

Remains of the leporid family, which comprises hares and rabbits, appear very steadily in nearly all Byzantine bone assemblages throughout the Empire (*fig.* 7), even though the bones are small and hence easily overlooked by the excavators. Positive evidence for the rabbit *Oryctolagus cuniculus* is scarce, however. It was only detected at a Carthage monastery, at Gortyn (Crete), and at Dichin (Bulgaria)[25]. In the case of some other assemblages, the presence of rabbit remains among the leporid bones could not be ruled out. In Byzantine times, the rabbit's natural range by no means comprised a region as large as today, and so it can be assumed that these animals were kept rather than hunted. Byzantine remains of hares *Lepus*, however, are outnumbered among the game only by deer finds. In North Africa and the western Balkan region hare bones constitute nearly half of the game evidenced, and in Asia Minor they also achieve considerable shares. Three hare species were encountered. The European hare *Lepus europaeus* mainly inhabits the north of the empire, that is Italy, the Balkans, Greece, Asia Minor, and Syria. The home of the cape hare *Lepus capensis* is Palestine, Africa north of the Sahara, as well as the African Red Sea coast. The third is the African savanna hare *Lepus victoriae*, which was identified solely in one Carthage context (Nobis 1999, p. 586 ff.).

The deer family Cervidae, including roe deer *Capreolus capreolus*, red deer *Cervus elaphus* and fallow deer *Dama dama*, is particularly well represented among the game finds in the north Mediterranean area between Italy and Asia Minor (*fig.* 7). Roe deer bones appear in most of the Italian assemblages and those of the two eastwardly adjoining regions of the Balkans, but they are also represented at Cherson, Constantinople, Sagalassos, and Zeugma on the Euphrates (see *Appendix* 2). Solely in Greece, the red deer NISPs are lower than those of the roe deer. In Carthage, the barbary stag, a subspecies of red deer, was identified (Nobis 1999, p. 586 ff.). In this region one of the two small red deer populations on the African continent is still located. Bone finds from fallow deer are considerably rarer than those of roe deer and red deer. It was identified in the bone assemblages from Naples, Eléftherna, Gortyn, Noviodunum, Dichin, Constantinople, Beşik Tepe, Sagalassos and Amorium in Asia Minor, and with single finds outside this range in Upper Zohar and Carthage (see *Appendix* 2).

In Palestine, Egypt, and North Africa, the bovid family, including the wild forms and relatives of sheep, goat, and cattle, as well as antelopes and gazelles, played a role comparable

[23] Bartosiewicz 1996, pp. 294 ff.; Van Der Veen, Grant, Barker 1996, p. 242 tab. 8.6.
[24] Personal Communication, Vedat Onar, Istanbul.
[25] Nobis 1999, p. 584; Wilkens 2003, pp. 88f.; Beech 2007a, p. 188.

to the cervids' role in the northern Mediterranean (*fig.* 7). In these three areas, members of this family represent the largest part of identified game. In the southern Mediterranean gazelles were mainly hunted. The northernmost site with a gazelle find is Ta'as in Syria (Clason 1996, p. 98 tab. 1). They were also hunted in today's northern Israel, i.e., in Caesarea and Horvat Raqit, and appear in slightly higher NISPs in the Dead Sea zone[26]. Where determinable to species level, these Palestine gazelles were identified as mountain gazelles *Gazella gazella*. The dorcas gazelle *Gazella dorcas* represents the largest part of game shot at Berenike on the Red Sea and was also detected in Leptis Magna and the Libyan Hinterland[27]. Isolated gazelle finds come from Berenice/Benghazi, Leptiminus, and Carthage. The last was determined as dama gazelle *Gazella dama*[28]. Other inhabitants of the south Mediterranean deserts that appear as scattered finds, are the oryx *Oryx leucoryx*, the hartebeest *Alcelaphus buselaphus*, the barbary sheep *Ammotragus lervia,* and the ibex *Capra ibex* (*Appendix* 2). Furthermore, at Tell Hesban, remains of wild sheep *Ovis orientalis* and wild goat *Capra aegagrus* were identified (Driesch, Boessneck 1995, pp. 85-93). The kri-kri or Cretan wild goat *Capra aegagrus cretica*, recorded in considerable numbers at Eléftherna, is not a genuine wild goat but a savaged domestic goat (Nobis 1998, pp. 417-419). The aurochs *Bos primigenius* was shot at Pontes, Cherson, Amorium, and Tell Hesban. At Cherson another rather rare bovid was detected: the small saiga antelope *Saiga tatarica*[29].

Wild boars *Sus scrofa* were mainly hunted in the floodplain forests on the Lower Danube (*fig.* 7). Here, the animal appears regularly and with quite high NISPs. Westwards and in the areas to the southeast of this region, bones of wild boars are only singularly detectable, for instance, at Faragola and San Giusto in Italy, at Butrint, Cretan Eléftherna, at Cherson, Amorium, Pessinus, and at Zeugma on the Euphrates, as well as Shallale in the Carmel range. The animal appeared numerous at Tell Hesban, and some finds were identified at Carthage[30]. This distribution range conforms with the modern habitats of the animal.

In the floodplain forests of the Lower Danube not only deer and wild boar were hunted, but also the beaver *Castor fiber* (*fig.* 7). Notably high NISPs of this animal were detected in the bone materials from Iatrus-Krivina and Dichin (NISP 16 respectively), but it also appeared at Novae, Nicopolis, Oltina, Capidava, and Carsium[31].

In Byzantine faunal assemblages a wide range of carnivores have been found (*fig.* 7), but with the exception of three species the NISPs and numbers of sites are usually small. The most commonly encountered carnivore is the red fox *Vulpes vulpes* (see *Appendix* 2). Bones of this species appear in all regions except North Africa, though this area is part of its modern range. Especially on the Lower Danube and in Asia Minor the red fox appears regularly in the bone assemblages. Killing foxes certainly served to protect livestock, especially domestic fowl, but also provided wonderful furs. Another canid, the wolf *Canis lupus*, was only detected in the materials from Amorium, where its meat was apparently consumed, and Tell Hesban[32]. The other two carnivores more usually encountered are brown bear *Ursus arctos* and badger *Meles meles*. Remains of the former were found in small numbers at Iatrus-Krivina, Nicopolis ad Istrum, Pontes, Yenikapı, and Sagalassos[33]. Badger bone finds are restricted to the Danube area (they were detected in Iatrus-Krivina, Dichin, Pontes, and Capidava)[34], although the range of the animal comprises the whole northern Mediterranean, Anatolia, and the Levant. The badger lives in dense forests, and it may be assumed that a lack of forests in the vicinity of other sites is responsible for this distribution pattern. Apart from the badger, a range of other mustelids was detected at various sites (see *Appendix* 2). Furthermore, some wild cat bones (*Felis silvestris*) appeared at Butrint (?), Iatrus-Krivina, Cherson, and Tell Hesban[35].

Apart from the aforementioned, some other wild mammals were detected singly (*fig.* 7), such as the crested porcupine *Hystrix crestata,* at a farmstead in the Libyan hinterland (Van Der Veen, Grant, Barker 1996, p. 242). Remains of sea mammals were found only sporadically: oceanic dolphin remains (family Delphinidae) appeared at Yenikapı, Cherson, and Berenike, porpoise remains (family Phocoenidae) were found at Cherson, and at Caesarea bones of a Mediterranean monk seal *Monachus monachus* (family Phocidae) were recovered. These are joined by a couple of big game finds from Berenike: single bones of leopard *Panthera pardus*, lion *Panthera leo*, hippopotamus *Hippopotamus amphibius,* and African elephant *Loxodonta africana* hint to a trade for exotica like fur and ivory[36]. The recent excavations at Constantinople's Theodosian Harbour Yenikapı yielded a variety of exotic animal remains too – we await the archaeozoological results of the project.

6. DOMESTIC (?) POULTRY

The only bird detected in Byzantine bone assemblages that can be attributed to domestic poultry with certainty is the chicken *Gallus gallus* f. dom., because its wild ancestor

[26] Cope 1999, p. 406; Horwitz 2004, p. 305; Clark 1995, p. 60; Driesch, Boessneck 1995, pp. 85-93; Horwitz 1998, p. 66.

[27] Van Neer, Lentacker 1996, p. 340 tab. 20.2 and p. 345 tab. 20.5; Van Neer, Ervynck 1998, p. 364 tab. 17.8; Van Neer, Ervynck 1999, p. 346 tab. 18.10; Caloi 1974, p. 157 and 162; Van Der Veen, Grant, Barker 1996, p. 242 tab. 8.6.

[28] Barker 1979, p. 11 tab. 1; Burke 2001, p. 444 tab. 6.7; Levine, Wheeler 1994, p. 317 tab. 1.

[29] Bartosiewicz 1996, p. 288; Rabinowitz *et al.* 2010, pp. 27 f.; Driesch, Boessneck 1995, pp. 85-93.

[30] For the frequent occurrences in the Danube region consult *Appendix* 2; Buglione 2007a, p. 207; Buglione 2007b, p. 3; Powell 2004, p. 306; Nobis 1998, pp. 417-419; Rabinowitz *et al.* 2010, pp. 27f.; Ioannidou 2012; De Cupere 2001; Ervynck, De Cupere, Van Neer 2003, p. 378; Rousseau, Guintard, Abadie-Reynal 2008, p. 256; Horwitz 2009, p. 335; Driesch, Boessneck 1995, pp. 85-93; Nobis 1999, pp. 586-588.

[31] Bartosiewicz, Choyke 1991, pp. 182f.; Benecke 2007, p. 385; Beech 2007a, pp. 158, 188; Mackowiecki, Schramm 1995, p. 74; Makowiecki, Makowiecka 2002, p. 215; Stanc, Bejenaru 2005, p. 314; Haimovici, Ureche 1979, p. 160; Bejenaru 1995, p. 327.

[32] Ioannidou 2012; Driesch, Boessneck 1995, pp. 85-93.

[33] Benecke 2007, p. 385; Beech 2007a, p. 188; Bartosiewicz 1996, p. 288; Personal communication, Vedat Onar, Istanbul; De Cupere 2001, pp. 38-58;

[34] Benecke 2007, p. 385; Beech 2007a, p. 188; Bartosiewicz 1996, p. 288; Haimovici, Ureche 1979, p. 160.

[35] Powell 2004, p. 306; Bartosiewicz, Choyke 1991; Rabinowitz *et al.* 2010, pp. 27 f.; Driesch, Boessneck 1995, pp. 85-93.

[36] Personal communication, Vedat Onar, Istanbul; Rabinowitz *et al.* 2010, pp. 27 f.; Van Neer, Lentacker 1996, p. 340 tab. 20.2. and 345 tab. 20.5.; Van Neer, Ervynck 1998, p. 364 tab. 17.8; Van Neer, Ervynck 1999, p. 346 tab. 18.10.; Cope 1999, p. 406 tab. 1.

did not inhabit the Mediterranean zone. In some parts of the Eastern Roman Empire it contributed noteworthy to the diet, in others possibly only marginally (*fig.* 8). Generally, more than 80% of the retrieved bird bones come from this bird. Solely at Berenike on the Red Sea and on the Lower Danube other, mostly wild, bird species provide higher shares of about 30%. It can be assumed that the chicken, being a frugal and flexible bird, could be kept in all eco-systems of the Empire, from the lush floodplains of the Danube to the Levantine and African deserts. Nonetheless, the share of the chicken among the domestic animals shows a considerable range of variation in the different regions (*fig.* 8). It must be taken into account, however, that this picture is biased, because the state of research concerning bird bones is decidedly more heterogeneous than our current archaeozoological knowledge concerning Byzantine domestic mammals. Because bird bones are small and delicate, they are less resistant to destruction processes in the soil. Another limiting factor are the applied excavation techniques: if no sieving is carried out, most birds, or at least the smaller species, are underrepresented. Furthermore, bird bones at times remain unidentified because a suitable reference collection is lacking.

On the basis of the available finds, the most intensive chicken husbandry is detectable for two desert forts on the Dead Sea, Upper Zohar and En Boqeq, and at Carthage[37]. The high chicken NISPs at the two desert sites can be attributed to the circumstance that, apart from pigeons and chickens, no other livestock could be held there without problems. Fragments of eggshells from Upper Zohar suggest a dual-purpose chicken husbandry (Croft 1995). Other areas with higher chicken shares are South Italy and some coastal cities of the southern and eastern Mediterranean, like Caesarea and Leptiminus[38]. It might be that the urban inhabitants kept some poultry in their back yards in order to have a steady supply with eggs and meat to hand. On the Lower Danube, Nicopolis ad Istrum is the only Early Byzantine site with notable shares of chicken (Boev, Beech 2007, pp. 244f. tab. 13.1), and in the Middle Byzantine Period only in a few places of the Dobruja a chicken husbandry worth mentioning is detectable[39]. Apart from these places, the region of the Lower Danube, the west coast of the Balkans, Greece, Asia Minor, the Euphrates region, and Egyptian Berenike, can be seen as those areas of the empire where chicken husbandry seems to have played a minor role.

The other classical representatives of domestic poultry, domestic goose *Anser anser* f. dom., domestic pigeon *Columba livia* f. dom. and domestic duck *Anas platyrhynchos* f. dom., are hardly ever distinguished from their wild forms that also inhabited the Byzantine Empire. Furthermore, the bones of members of these families (that is Anatidae and Columbidae) are often solely determinable up to genus level ("goose", "duck", "pigeon") and thus a high share of unidentified domestic poultry can be expected. In Roman times duck husbandry was still restricted to keeping in captivity. It is believed that real domestication did not take place until the Late Middle Ages or Early Modern Times (Benecke 1994, p. 381). Higher NISPs (47) of mallards *Anas platyrhynchos* that could hint at mallard husbandry in the vicinity, were only recorded for Naples (Rielly 1994, p. 408 tab. 52). At Italian Herdonia and at Nicopolis ad Istrum the mallard is also represented with lower, but still recordable NISPs, while at other sites it only appears sporadically[40]. The goose *Anser anser*, on the contrary, had already been domesticated by the Iron Age and played an important role in Roman livestock economies as a supplier of meat, eggs, and down. In the Byzantine Era, goose husbandry was kept up, as comparably high shares of goose bones suggest. The sites with the highest shares of domestic geese are again Nicopolis ad Istrum and Naples, as well as Carthage, Iatrus-Krivina, and Middle Byzantine Carsium[41]. The animal was detected in rather low shares at Beşik Tepe, Butrint, and En Boqeq[42]. The keeping of domestic pigeons appears in the southeastern, non-European parts of the Early Byzantine Empire, whereas it was abandoned in Central Europe at the same time and did not experience a revival until the 6th to 9th centuries (Benecke 1994, pp. 387 f.). A passion for domestic pigeons is archaeozoologically detectable notably for Syria, Palestine (Ta'as, Horbat Rimmon, Tell Hesban, Upper Zohar, En Boqeq), and North Africa (Berenike, Leptis Magna, Carthage)[43]. Apart from this southeastern area between the Euphrates and Carthage, solely at Naples and at Nicopolis ad Istrum, bones of the domestic or rock dove were identified (Rielly 1994, p. 408 tab. 52; Boev, Beech 2007, pp. 244f. tab. 13.1). Finally, peafowl *Pavo cristatus*, an Asian import, was also kept in captivity already in Roman times, and was hatched on specially allocated islands by domestic hens (Benecke 1994, p. 400). They did not only serve as a feast for the eyes, but also as providers of meat. Late Antique presence of peafowl is proven with only a few finds for three regions of the empire: the Lower Danube (Nicopolis ad Istrum), Italy (Naples), and North Africa (Carthage)[44].

7. WINGED GAME

Given the generally low NISPs of winged game in the faunal materials, fowling seemingly did not contribute particularly to the Byzantine diet. Only sporadically, where higher

[37] Croft 1995, p. 95 tab. 1; Lernau 2000, p. 150; for Carthage see most of all Reese 1977, pp. 139f. tab. 2; Reese 1981; Nobis 1999, 613 tab. 13 and pp. 584 f.

[38] Rielly 2004, p. 408 tab. 52 and pp. 407-418; Buglione 2007a; Buglione 2007b; Sutherland 1992, p. 342 tab. 12.1 and pp. 339 f.; Cope 1999, p. 406 tab. 1; Burke 2001, p. 444 tab. 6.8.

[39] As in Capidava and Carsium, see Haimovici, Ureche 1979, pp. 159 f.; Bejenaru 1995, p. 321.

[40] Buglione 2007a, p. 193 tab. 14.1 and p. 196 tab. 14.2; Boev, Beech 2007, pp. 244 f. tab. 13.1.

[41] Boev, Beech 2007, pp. 244 f. tab. 13.1; Rielly 2004, p. 408 tab. 52 and pp. 407-418; Reese 1981; Nobis 1999, p. 614 tab. 15; Levine, Wheeler 1994, p. 317 tab. 5 and p. 315; Benecke 2007, p. 385 tab. 1 and pp. 397 f.; Bejenaru 1995, p. 321.

[42] Driesch, Boessneck 1995, p. 188 tab. 1; Powell 2004, p. 306 tab. 17.1; Lernau H., 2000, p. 150.

[43] Clason 1996, p. 98 tab. 1; Horwitz 1998, p. 66 tab. 1 and pp. 66 f.; Boessneck 1995, pp. 138-158; Croft 1995, p. 95 tab. 1; Lernau H., 2000, pp. 158-160; Van Neer, Lentacker 1996, p. 340 tab. 20.2 and p. 345 tab. 20.5; Van Neer, Ervynck 1998, p. 364 tab. 17.8; Van Neer, Ervynck 1999, p. 346 tab. 18.10; Caloi 1974, p. 157 and pp. 160 f.; Nobis 1999, p. 614 tab. 16; Levine, Wheeler 1994, p. 317 tab. 5 and p. 315.

[44] Boev, Beech 2007, pp. 244 f. tab. 13.1; Rielly 1994, p. 408 tab. 52; Reese 1981; Nobis 1999, p. 586.

shares of bird bones and a rich spectrum were recorded, like at Naples, Iatrus-Krivina, Nicopolis ad Istrum or Upper Zohar, wild fowl might have been consumed on a more regular basis[45]. It must be emphasised, however, that at these sites a more advanced recovery technique was applied, and that bones of wild fowl might be strongly underrepresented elsewhere. The species detected provide information about the types of landscape in the environs of the settlements and are thus pooled below in ecological groups. The highest shares in comparison with the chicken were recorded for the Danube sites and for Berenike on the Red Sea. A decidedly low percentage is detectable for the western Balkans and Greece, but the total NISPs of these sites are partially very low. Given the fact that more than 80 wild bird species were identified in the Byzantine bone materials included in this study (a detailed list is given in *Appendix* 2), a comprehensive account of the spectra can not be given here. The following discussion therefore mainly deals with the ecological groups represented (*fig.* 9) and the most important bird families or species. The aforementioned bird species that cannot be attributed to wild fowl or poultry with certainty are left out of this consideration.

7.1 Waterfowl

In the light of the location of most Byzantine settlements and towns in close vicinity either to the sea or to a river, it is not surprising that fowling activities often resulted in a high percentage of water birds (*fig.* 9). This applies especially for the northeastern and eastern Mediterranean, between the Dalmatian coast and the Lower Danube, as well as for Asia Minor, Syria, and Palestine. Partially (e.g., probably on the Lower Danube) these were killed in their breeding areas, partially they were shot or trapped on their seasonal migrations. In Italy, North Africa, and Egypt, the shares are somewhat lower, but the faunal materials of the two regions first mentioned comprised considerable amounts of ducks and geese that might be wild or domestic, so that a higher share of waterfowl is possible. The bigger part (58%) of waterfowl belongs to members of the Anatidae family, that is ducks, geese, and swans (*fig.* 10). Among these, the ducks are best represented (70%), a notably smaller part of the bones (25%) was identified to geese, and swans appear rather sporadically (5%). As the respective subgroups are still species-rich, only 8% of the ducks (apart from the mallard, eight other species were identified), 22% of the geese (apart from the greylag goose *Anser anser*, four species were identified) and single finds of swans (in Carthage a Bewick's swan *Cygnus columbianus bewickii* and in Iatrus a mute swan *Cygnus olor*) could be determined up to species level[46]. Further 11% of waterfowl were identified as rails (family Rallidae), among which the Eurasian coot *Fulica atra* is most frequent. It was recorded at Butrint, Iatrus, Beşik Tepe, Sagalassos, En Boqeq, and Carthage[47]. Less strongly associated with water is the corn crake *Crex crex*, which also inhabits grain fields. This little bird lives in Central and Eastern Europe and was killed in Palestine, while migrating to or from the South[48]. Among the other waterfowl species detected are pelicans (great white pelican *Pelecanus onocrotalus* and Dalmatian pelican *Pelecanus crispus)*, hunted on the Danube and in Asia Minor, common crane *Grus grus*, evidenced for Iatrus-Krivina, Yenikapı and Carthage, great cormorant *Phalacrocorax carbo,* found in Iatrus-Krivina, Caesarea and Carthage, as well as herons (family Ardeidae, recorded for Naples and Iatrus-Krivina; for other species see *Appendix* 2)[49]. Besides the most obvious reason – the use of meat, fat, and feathers – some other purposes for waterfowling can be assumed. On the one hand, fowling might have been an occupation pursued alongside other activities carried out in the respective areas, and can be seen as a hint that these landscapes were intensively used. On the other hand, waterfowl might have been killed because they competed with people for fish resources.

7.2 Birds that dwell in cultural landscapes

Birds that choose habitats with varied vegetation covers, subdivided into open and semi-open areas, with trees, shrubland, and grassland, i.e., birds that lived in the cultural hinterland of Byzantine settlements and cities, were also a widespread target of fowling (*fig.* 9). Some synanthropic species that build their nest in close vicinity to human abodes were also included in this group. By far the most important family within this ecological group (69%) are the Phasianidae (*fig.* 10). This is most of all due to the appraisal of partridges of the genus *Alectoris*, which account for nearly three quarters of this family's bone finds. These red-legged partridges were already favoured by the Romans and are often depicted in Byzantine mosaics. Four species, neither outwardly nor osteologically well distinguishable from each other, divide the area of the Byzantine Empire between themselves: southwestern Europe is the range of the red-legged partridge *Alectoris rufa*, the Alpine region as far as the Balkans is inhabited by the rock partridge *Alectoris graeca*, Asia Minor and the Near East is populated by the chukar partridge *Alectoris chukar*, and the African part of the Mediterranean area is occupied by the barbary partridge *Alectoris barbara*. It is most of all the chukar that appears in the respective regions of his range in partially high NISPs. At Sagalassos in Asia Minor the chukar partridge was the main target of fowling from the second half of the 5th century onwards (De Cupere 2001, pp. 20-32). In Syria (Zeugma), but most of all in Palestine (Horbat Rimmon, Tell Hesban, En Boqeq, and Upper Zohar), this

[45] Rielly 1994, p. 408 tab. 52; Boev, Beech 2007, pp. 244f. tab. 13.1; Benecke 2007, p. 385 tab. 1 and pp. 402-404; Croft 1995, p. 95 tab. 1 and pp. 87-93.

[46] Please consult *Appendix* 2 for detailed information. Levine, Wheeler 1994, p. 317 tab. 5 and p. 315; Bartosiewicz, Choyke 1991, p. 182 tab. 1;

[47] Powell 2004, p. 306 tab. 17.1; Benecke 2007, p. 385 tab. 1; Driesch, Boessneck 1995, p. 191 tab. 3; De Cupere 2001, p. 134 tab. 40; Lernau H., 2000, pp. 158-160; Reese 1981.

[48] Croft 1995, p. 95 tab. 1 (high NISP); Boessneck 1995, pp. 138-158; Horwitz 1998, p. 66 tab. 1; Lernau H., 2000, pp. 158-160.

[49] Bartosiewicz, Choyke 1991, p. 182 tab. 1; Benecke 2007, p. 385 tab. 1; Boev, Beech 2007, pp. 244 f. tab. 13.1; Driesch, Boessneck 1995, p. 191 tab. 3; Forstenpointner, Gaggl 1997, p. 426; Personal communication, Vedat Onar, Istanbul; Nobis 1999, 615 tab. 18; Cope 1999, p. 406 tab. 1; Rielly 1994, p. 408 tab. 52.

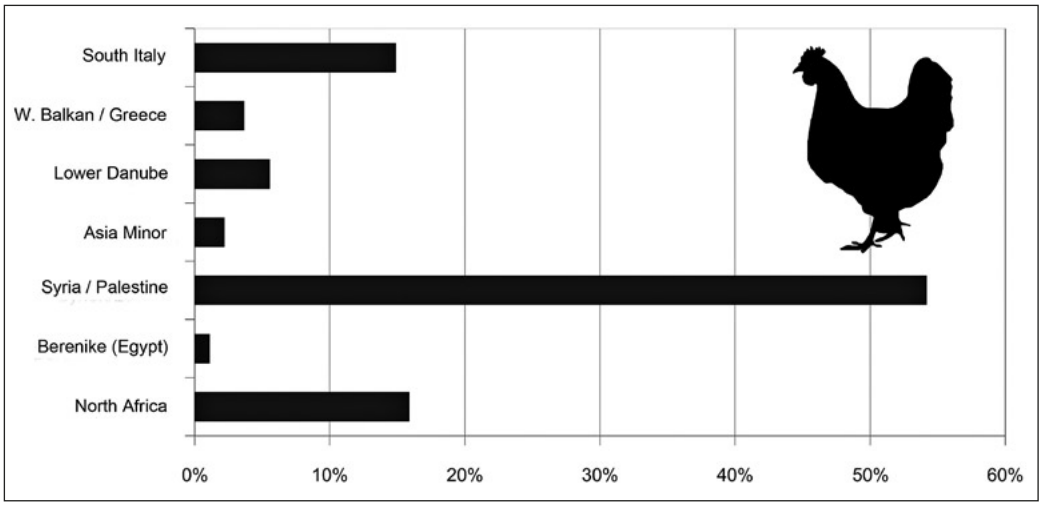

fig. 8 – Arithmetical mean of the chicken percentages among the domestic species (NISP).

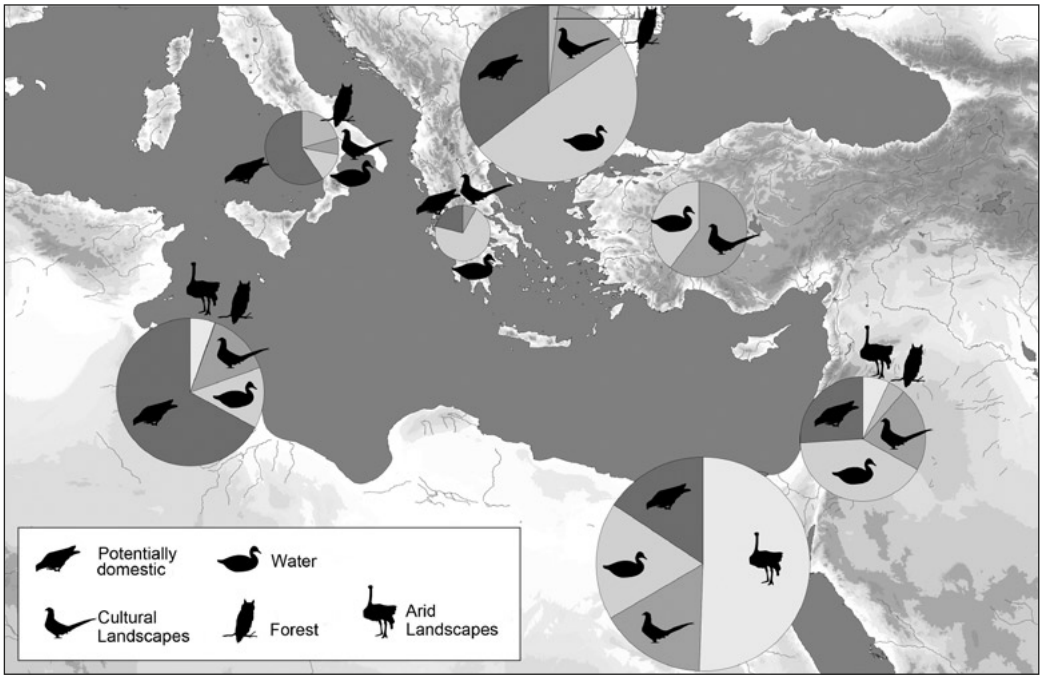

fig. 9 – Arithmetical mean of different bird eco-group percentages in the regions of the Empire (with the exception of the domestic chicken). The size of the circles symbolises the relative significance of fowl in the respective regions.

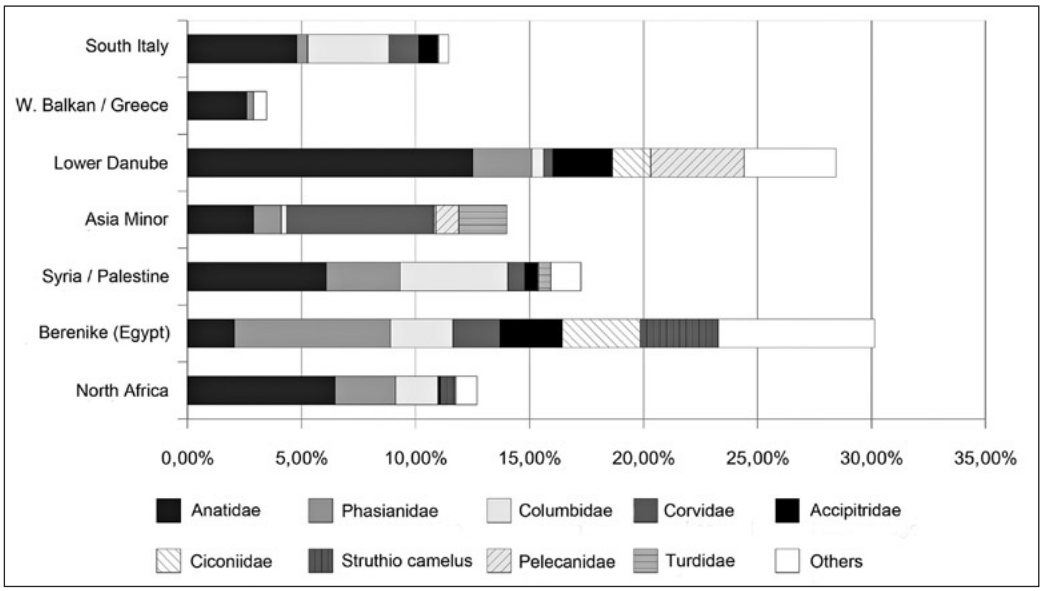

fig. 10 – Arithmetical mean of the most important bird family percentages in the regions of the Empire (with the exception of the domestic chicken).

bird was caught on a regular basis and is still an economically relevant wild species[50]. The caged chukar partridges depicted in mosaics might have been used as decoys, but could also point to a trade and transport of living birds. Two other birds of this family are also worth mentioning. The common quail *Coturnix coturnix* crosses the whole area two times a year and is accordingly reported for all parts of the empire, with the exception of Asia Minor (see *Appendix* 2). The pheasant *Phasianus colchicus*, originally from Asia and widespread in the Roman Empire, however, is rarely encountered in Byzantine assemblages. Solely at Nicopolis ad Istrum a regular pheasant fowling was maintained; apart from this site, however, the bird is only reported for Naples[51]. The second best represented family of this eco-group are the corvids (family Corvidae, 18%; *fig.* 10). These mainly black and very intelligent birds are ecologically extremely adaptable and often live in farmlands and towns. From a variety of Byzantine sites remains of common raven *Corvus corax*, jackdaw *Corvus monedula*, European magpie *Pica pica*, as well as rook *Corvus frugilegus* and carrion crow *Corvus corone* were recorded (see *Appendix* 2). It is unclear whether these animals were killed because they were regarded as agricultural pests, or whether they were even eaten, kept as pets, or just died of natural causes in the cities and settlements. Among the remaining species dwelling in cultural landscapes, are the turtle dove *Streptopelia turtur,* recorded for five areas (Naples, Nicopolis ad Istrum, Beşik Tepe, Upper Zohar, and Carthage)[52], the song thrush *Turdus philomelos* (a winter guest in the Mediterranean area) and the autochthonous blackbird *Turdus merula*, as well as storks (some of the finds attributed to the white stork *Ciconia ciconia;* for more information and more species of this ecological group see *Appendix* 2).

7.3 Forest-dwelling birds

Birds typical for wooded areas rarely appear in the bone assemblages (*fig.* 9). The comparably high occurrence of pigeons or doves (family Columbidae) and the bird of prey family Accipitridae, hints to a slightly greater relevance of these families (see *Appendix* 2). Among the doves detected in Byzantine materials, it is the stock dove *Columba oenas* and the wood dove *Columba palumbus* that prefer tree-covered habitats. As the skeletons of the stock dove and the domestic dove are very similar, two finds from Iatrus-Krivina and Carthage respectively could not be ascribed with certainty to the former. This was possible, however, for stock dove bones from Nicopolis ad Istrum and Ta'as[53]. The wood dove was proved with higher NISPs for Naples, and at Nicopolis ad Istrum, and Sagalassos[54]. Certain wood-dwelling Accipitridae are the cinereous vulture *Aegypius monachus* (Carthage), goshawk *Accipiter gentilis*, sparrowhawk *Accipiter nisus* and common buzzard *Buteo buteo* (all of them found at Nicopolis ad Istrum and Naples; in Naples a nearly complete goshawk skeleton was found). In Naples, furthermore, remains of a long-legged or rough-legged buzzard *Buteo rufinus* or *lagopus* appeared[55]. This mass appearance of Accipitridae could hint to falconry, but could also be attributed to the assumable abundance of prey foraging through the Byzantine rubbish dump at Naples found in the excavations. Furthermore, remains of black stork *Ciconia nigra* (Upper Zohar; Croft 1995, p. 95 tab. 1), Eurasian woodcock *Scolopax rusticola* (Naples, Rielly 1994, p. 408, tab. 52), tawny owl *Strix aluco*, linnet *Carduela cf. cannabina* and chaffinch *Fringilla coelebs* were found (all of them at Nicopolis ad Istrum; Boev, Beech 2007, pp. 244f. tab. 13.1).

7.4 Birds that live in arid and semiarid habitats

Birds that dwell in areas without or with only little vegetation cover, appeared solely in the areas between the Dead Sea, Egypt and Carthage, and it is only at the Red Sea Port of Berenike that they represent most of the sporadic finds of winged game (*fig.* 9). The most common member of this eco-group is the sand partridge *Ammoperdix heyi,* that was detected in the bone materials from En Boqeq and Upper Zohar (in high shares), as well as Tell Hesban and Berenike (sporadically). The latter sites also yielded bones of the Egyptian vulture *Neophron percnopterus*[56]. A relative of this bird, the griffon vulture *Gyps fulvus,* was proved for Carthage (Nobis 1999, p. 615 tab. 18), and remains of brown-necked raven *Corvus ruficollis* appeared in Upper Zohar and Berenike[57].

Bones of the ostrich *Struthio camelus* are rare. This impressive bird was solely recorded for Carthage, Leptiminus and Constantinople (Yenikapı). Fragments of its eggshells were excavated at En Boqeq, Carthage (Church Complex) and Berenice/Benghazi[58].

8. FISHERY

The great importance of fish for the Byzantine economy and diet is apparent from the fact that no other food product of animal origin is so frequently mentioned in the written sources (Chrone-Vakalopoulos, Vakalopoulos 2008). Accordingly, wherever sieving is applied as an excavation technique, thousands of fishbones come to light. As most Byzantine settlements and towns had direct access to freshwater or the sea, fish was freely available and could be caught by anyone. For that reason, fish was not only a daily protein

[50] Rousseau, Guintard, Abadie-Reynal 2008, p. 255 tab. 1 and p. 256 tab. 2; Horwitz 1998; Boessneck 1995, pp. 138-158; Lernau H., 2000, pp. 158-160; Croft 1995, p. 95 tab. 1 and pp. 87-93.

[51] Boev, Beech 2007, pp. 244 f. tab. 13.1; Rielly 1994, p. 408 tab. 52.

[52] Rielly 1994, p. 408 tab. 52; Boev, Beech 2007, pp. 244f. tab. 13.1; Driesch, Boessneck 1995, p. 191 tab. 3; Croft 1995, p. 95 tab. 1 and pp. 87-93; Reese 1981; Nobis 1999, p. 615 tab. 18.

[53] Benecke 2007, p. 385 tab. 1 and pp. 402-404; Levine, Wheeler 1994, p. 317 tab. 5 and p. 315; Boev, Beech 2007, pp. 244f. tab. 13.1; Clason 1996, p. 98 tab. 1.

[54] Rielly 1994, p. 408 tab. 52; Boev, Beech 2007, p. 244f. tab. 13.1; De Cupere 2001, p. 134 tab. 40 and pp. 20-32.

[55] Nobis 1999, p. 615 tab. 18; Rielly 1994, p. 408 tab. 52; Boev, Beech 2007, pp. 244f. tab. 13.1.

[56] Lernau H. 2000. pp. 158-160; Croft 1995, p. 95 tab. 1; Boessneck 1995, pp. 138-158, Van Neer, Lentacker 1996, p. 340 tab. 20.2 and 345 tab. 20.5; Van Neer, Ervynck 1998, p. 364 tab. 17.8; Van Neer, Ervynck 1999, p. 346 tab. 18.10.

[57] Croft 1995, p. 95 tab. 1; Van Neer, Lentacker 1996, p. 340 tab. 20.2 and 345 tab. 20.5; Van Neer, Ervynck 1998, p. 364 tab. 17.8; Van Neer, Ervynck 1999, p. 346 tab. 18.10.

[58] Nobis 1999, p. 615 tab. 18; Schwartz 1984, p. 249 tab. 7; Burke 2001, p. 444; Lernau H. 2000, pp. 158-160; Reese 1977, pp. 139f; Barker 1979.

provider, but also a means of survival in times of shortage and famines[59].

Generally, an exploitation of the fishing grounds in the vicinity of the respective sites is clearly detectable (*tab.* 2-5): the Red Sea Port Berenike shows a typical Red Sea fauna[60]; at Carthage, Naples, and Itanos the local Mediterranean fauna was caught[61]; on the Nile we encounter a purely Nilotic fauna[62], and on the Danube and in inland Asia Minor the typically Eurasian freshwater spectrum is present[63]. Coastal cities that had a river or a sea close by, exploited both marine and freshwater fishing grounds, like Cherson in the Crimea and Ephesos (*tab.* 2*;* 3)[64]. In these two cases, the marine fraction prevails, while at Late Byzantine Stari Bar in Montenegro, the freshwater fish outnumber the marine species by far, in spite of the coastal location of the site *(tab.* 2*)*[65]. Caesarea in Palestine, again, shows balanced shares of local freshwater and marine species (*tab.* 5)[66]. A little more complicated is the situation in areas with little or no fishing grounds in the vicinity of the excavated site. This applies to the arid Dead Sea region, and the Levant in general (*tab.* 5). This area is poor in fish in two regards. On the one hand, the Levantine Sea is markedly less rich in species and individuals as other parts of the Mediterranean Sea. On the other hand, only the Sea of Galilee and the Jordan (as well as further north, in Syria, the Euphrates) could provide noteworthy catches of freshwater fish. This supply situation was insufficient and the area was dependent on fish imports, as the bone finds depict. But where did these come from? The Dead Sea area is located midway between the Red Sea and the Mediterranean Sea. These two inland seas have pronouncedly different marine fish spectra, because the first is part of the Indian Ocean and harbours a typical Indo-Pacific fauna, and the latter is fed by the Atlantic Ocean and has its own adapted Atlantic-Mediterranean fauna. As fish bones are difficult to identify up to species level due to their tremendous species richness, many of them can only be attributed to family. Thus, bone finds cannot always be confidently allocated to one of the three inland seas of the empire (the third is the Black Sea), because a lot of fish families inhabit all three, or at least two of them. The spectra of imported marine families and species detected in the Dead Sea region (tuna and mackerels Scombridae, parrotfish Scaridae and emperors Lethrinidae, *fig.* 5), however, have led researchers to the current assumption that mainly caravans from the Red Sea brought cured fish products to this area (compare Berenike's spectrum, *fig.* 5)[67]. This fish trade certainly was affiliated to other established trade systems along existing caravan routes. However, the fishing grounds of some of the finds, such as grey mullets Mugilidae and sea breams Sparidae, still remain unclear. A comparably small-scale trade with the Mediterranean coast was also detectable in these finds. Such trade connections are evident for some single finds of the Nile perch *Lates niloticus* at Caesarea and Upper Zohar, that must have been imported from the Nile valley[68]. On the Nile, the traditional Roman technique of fish conservation seems to have been kept up, as is shown by Nile perch exports to Palestine and partially long-distance exports of different catfish genera. The long-distance commodity seems to have been the airbreathing catfish *Clarias,* which was found at Yenikapı and Sagalassos. Conserves of *Bagrus* and lizardfish *Synodontis*, which were reported for Berenike, travelled a comparably short distance (*fig.* 5)[69]. But these indications for fish transport in the southeastern Mediterranean and beyond are not the only examples of alien faunal elements in Byzantine fish bone assemblages. In two assemblages from the Danube area, Nicopolis ad Istrum (where remains of flatfish and of the Atlantic mackerel *Scomber scombrus* were detected; Beech, Irving 2007, p. 226 tab. 12.1) and Novae (where whiting *Merlangius merlangus* bones were found; Makowiecki, Iwaskiewicz 1996, p. 53 tab. 2), marine species were encountered (*tab.* 4). This area otherwise relies purely on its abundant freshwater fauna. Furthermore, at Pisidian Sagalassos imports not only of exotic fish from the Nile, but also of marine Mediterranean species, grouper *Epinephelus* sp. and different scombrids, were detected (*tab.* 4*,* Van Neer, De Cupere, Waelkens 1997, p. 572 tab. 1).

A short overview on the fishing economies of the five major fishing grounds, the Mediterranean Sea, the Black Sea (Cherson), the Red Sea (Berenike), the Danube and the Nile (plus adjoining Levantine freshwaters) is presented below. A comprehensive account of the fish species cannot be given here (not even of all families encountered), because the wealth of species is immense.

8.1 The Mediterranean Sea

The identified Mediterranean Sea fish spectra clearly indicate inshore fishing, partially carried out in estuaries (*tab.* 2). Most of the animals detected are bottom-dwelling fish that prefer the temperate shallow waters close to the coasts, and are thus easily caught with gill nets. This applies for the most frequently encountered fish family, the sea breams Sparidae. This family, that comprises 23 Mediterranean species, is still economically important. The most often identified species is the gilthead

[59] As some isotope analyses from Cherson show clearly, see Rabinowitz *et al.* 2010.

[60] Van Neer, Lentacker 1996, p. 339 tab. 20.1 and p. 345 tab. 20.5; Van Neer, Ervynck 1998*,* p. 362 tab. 17.7*;* Van Neer, Ervynck 1999*,* p. 345 tab. 18.9.

[61] Reese 1981; Nobis 1999, p. 617 tab. 21 and pp. 590 f.; Larje 1995, p. 9 tab. 1; Rhodes 1994, p. 422; Mylona 2003, p. 105 tab. 10.1 and pp. 104 f.

[62] Luff, Bailey 2000, p. 103 tab. 12.1; Van Neer *et al.* 2007; Van Neer, Depraetere 2005, p. 162 tab. 2.

[63] Bartosiewicz, Choyke 1991, p. 182 tab. 1; Benecke 2007, p. 385 tab. 1; Makowiecki, Iwaskiewicz 1996, p. 53 tab. 2; Beech, Irving 2007, p. 226 tab. 12.1; Iliev, Boev, Spassov 1992, p. 45 tab. 1; Haimovici, Ureche 1979, p. 158 tab. 1; Stanc, Radu, Bejenaru 2006; Bejenaru 1995, p. 321; Lockyear 2009 online; Bartosiewicz 1996, p. 288 tab. 5; Van Neer, De Cupere, Waelkens 1997, p. 572 tab. 1; Ervynck, De Cupere, Van Neer 2003, p. 382 tab. 1.

[64] Van Neer, Ervynck 2008, p. 211 fig. 2 and p. 213 fig. 4; Forstenpointner *et al.* 2008, pp. 230 f.

[65] Pluskowski, Seetah 2006, p. 109 tab. 6.7.

[66] Fradkin, Lernau 2008, pp. 190 f.

[67] Lernau O. 1999, p. 379; Driesch, Boessneck 1995, p. 98 tab. 5.22; Lernau H. 2000, pp. 172-175; Lernau O. 1995, p. 107 tab. 2 and 108 tab. 3; Lernau H. 1986, p. 100 tab. 2; for a new evaluation, see Van Neer *et al.* 2004, p. 114 tab. 3.

[68] Fradkin, Lernau O. 2008, p. 191 tab. 2; Lernau O. 1995, p. 107 tab. 2 and p. 108 tab. 3.

[69] personal communication V. ONAR; Van Neer, De Cupere, Waelkens 1997, p. 572 tab. 1; Van Neer, Lentacker 1996, p. 339 tab. 20.1 and p. 345 tab. 20.5; Van Neer, Ervynck 1998*,* p. 362 tab. 17.7*;* Van Neer, Ervynck 1999*,* p. 345 tab. 18.9.

sea bream *Sparus aurata*, somewhat less frequent breams of the genus *Dentex* appear, and a few sites yielded bones of porgies belonging to the genera *Pagrus* and *Pagellus*. At one site, Cretan Itanos, the bogue *Boops boops* was consumed (Mylona 2003, p. 105 tab. 10.1 and pp. 104 f.), which today, though commercially fished, is used rather as tuna bait than for culinary purposes. Some finds in the vicinity of the Dead Sea (Upper Zohar, Tamara, Tell Hesban)[70] prove an inland transport of cured Sparidae, be it from the Mediterranean or the Red Sea, where locally fished Sparidae were eaten (Berenike)[71]. Another family frequently recorded in all areas except the Danube and the Nile, are the sea basses and groupers Serranidae (*tab.* 2). Most of all, groupers of the genus *Epinephelus* were fished. They prefer rocky environments where they can hide in crevices during the day. For this reason the preferred fishing device should be the line. The Serranidae family comprises 14 species that inhabit the Mediterranean Sea. Hence, they are rarely identifiable to species level. Drums, member of the Sciaenidae family, which comprises seven Mediterranean species, appear steadily, but only in small numbers. On the Levantine coast the meagre *Argyrosomus regius* was fished, as it still is today (*tab.* 5). But drums were also recorded for Apulian Otranto, Cretan Itanos, Beşik Tepe, Berenike and Carthage (*tab.* 2). These fish, too, were consumed at the Negev desert forts En Boqeq, Upper Zohar, and Tamara, which hints to utilisation of these species for fish conserves[72]. The grey mullets Mugilidae were recorded for only a few sites, but partially with high shares. Seven species of these bottom-dwelling fish live in the Mediterranean, and two of them, the grey mullet *Mugil cephalus* and the thicklip grey mullet *Chelon labrosus* were identified. The find distribution of members of this family shows an emphasis on the Levant, but they were also recorded for Cherson, Ephesos, Berenike and Carthage (*tab.* 2*;* 5)[73].

Only two families detected could have been fished on the open Mediterranean Sea: the Carangidae, living partially in coral reefs near the shore and partially offshore, and the mackerels and tunas Scombridae, that generally live on the open sea, but sometimes have to pass straits on their migrations. During these occasions the Scombrids can seasonally be caught in large numbers: hence, already in Byzantine times a fishing technique employing a gillnet-labyrinth was used, the *epochai* (Trapp 1966). Today, this fishing tradition is still alive in parts of the Mediterranean, for instance in Sicily, where it is called *mattanza*. Thus these animals could hint at open sea fishing, but could also represent the remains of seasonal *epochai* fishing. The number of these open sea fish species is generally lower than the NISPs of coastal fish. Higher shares were recorded for Carthage and for Naples (*tab.* 2)[74]. As these two important harbour cities were involved to a higher degree in large-scale sea trade activities, it is possible that *salsamenta* and *garum*, i.e. salted fish, were handled there. The fatty Scombrids were the preferred species for these specialities. Among the scombrids, remains of which were recorded for all parts of the Empire, the most frequently encountered species is the Atlantic bluefin tuna *Thunnus thynnus*, which was consumed at Naples, Eléftherna, Itanos, Beşik Tepe, and Carthage[75]. Other fish families of the Mediterranean Sea were of comparably minor importance or only fished in few places. The respective species recorded are listed in *Appendix* 2.

8.2 The Black Sea

At present, Byzantine Black Sea fishing economies can only be reconstructed through the results from one single site: Cherson in the Crimea (Van Neer, Ervynck 2008; *tab.* 3). Although this inland sea is fed with a continuous stream of salty waters from the Eastern Mediterranean basin, its marine fauna differs due to this sea's individual hydrological circumstances, particularly its temperature, salinity, and oxygen content. Although some families encountered in Byzantine Mediterranean catches are also present, for instance sea breams Sparidae, wrasses Labridae, and goatfish Mullidae, these families played a minor role in Cherson's fishing. Instead, three species account for the bulk of finds that do not or rarely (in the case of the ray, which was also found at Italian Canosa) appear elsewhere, even though they also inhabit the Mediterranean Sea: the brill *Scophthalmus rhombus*, the anchovy *Engraulis encrasicolus,* and the thornback ray *Raja clavata*. These species again hint to a nearshore fishery. The anchovy was the main object of the local economy that dealt with salted fish products. The huge basins used for this purpose are still visible at Cherson. Anchovy can be caught with nets and in moonless nights they can be easily decoyed with a bright lamp, the *lampara*. The other two species live benthic and are both specialties of the Mediterranean and Black Sea zones. The thornback ray is a boreal faunal element that originally inhabited the more temperate northern waters. Its "wings" are today marketed fresh as well as smoked. The brill, finally, is a tasty flatfish, which is omnipresent on today's fish markets of Istanbul.

8.3 The Red Sea

Most of the fish families discussed with regard to Byzantine Mediterranean catches were also eaten on the Red Sea coast. Basses and groupers Serranidae, Carangidae, sea breams

[70] Lernau O. 1995, p. 107 tab. 2 and 108 tab. 3; Lernau H. 1986, p. 100 tab. 2; Driesch, Boessneck 1995, p. 98 tab. 5.22.

[71] Van Neer, Lentacker 1996, p. 339 tab. 20.1 and p. 345 tab. 20.5; Van Neer, Ervynck 1998, p. 362 tab. 17.7*;* Van Neer, Ervynck 1999*,* p. 345 tab. 18.9.

[72] Jones 1992, p. 346; Mylona 2003, p. 105 tab. 10.1 and pp. 104 f; Driesch, Boessneck 1984, p. 191 tab. 4 and p. 192; Fradkin, Lernau O. 2008, p. 191 tab. 2 and p. 190 tab. 1; Driesch, Boessneck 1995, p. 98 tab. 5.22; Lernau O. 1995, pp. 99-104 and p. 107 tab. 2 and p. 108 tab. 3; Lernau H. 1986, p. 100 tab. 2; Lernau H., 2000, pp. 169-180; Van Neer, Lentacker 1996, p. 339 tab. 20.1 and p. 345 tab. 20.5; Van Neer, Ervynck 1998, p. 362 tab. 17.7*;* Van Neer, Ervynck 1999*,* p. 345 tab. 18.9; Reese 1977, pp. 140 f; Nobis 1999, p. 617 tab. 21 and pp. 590 f; Larje 1995, p. 9 tab. 1.

[73] Lernau O. 1999, p. 379; Fradkin, Lernau O. 2008, p. 191 tab. 2 and p. 190 tab. 1; Lernau O. 1995, pp. 99-104 and p. 107 tab. 2 and p. 108 tab. 3; Lernau H. 1986, p. 100 tab. 2; Van Neer, Ervynck 2008, p. 211 fig. 2 and p. 213 fig. 4; Forstenpointner *et al.* 2008, pp. 230 f.; Van Neer, Lentacker 1996, p. 339 tab. 20.1 and p. 345 tab. 20.5; Van Neer, Ervynck 1998, p. 362 tab. 17.7; Van Neer, Ervynck 1999*,* p. 345 tab. 18.9; Reese 1981; Nobis 1999, p. 617 tab. 21 and pp. 590 f; Larje 1995, p. 9 tab. 1. 1.

[74] Rhodes 1994, p. 422; Nobis 1999, p. 617 tab. 21.

[75] Rhodes 1994, p. 422; Nobis 1998, p. 418; Mylona 2003, p. 105 tab. 10.1 and pp. 104 f; Driesch, Boessneck 1984, p. 191 tab. 4 and p. 192; Nobis 1999, p. 617 tab. 21.

		Naples, IT		Itanos, GR		Stari Bar, CS		Ephesos, TR		Carthage, TN	
		NISP	%	NISP	%	NISP	%	NISP	%	NISP	%
Marine	Serranidae	3	9,1	55	17,9	3	7,9	2	1,8	93	32,6
	Sparidae	2	6,1	128	41,7	-	-	29	26,6	77	27,0
	Moronidae	10	30,3	-	-	-	-	3	2,8	63	22,1
	Scombridae	2	6,1	-	-	-	-	1	0,9	27	9,5
	Scaridae	-	-	77	25,1	-	-	1	0,9	-	-
	Mugilidae	-	-	-	-	-	-	24	22,0	8	2,8
	Sciaenidae	-	-	1	0,3	-	-	-	-	6	2,1
	Others	16	48,5	46	15	4	10,5	3	2,8	11	3,9
Wandering	Salmonidae	-	-	-	-	6	15,8	-	-	-	-
Freshw.	Cyprinidae	-	-	-	-	25	65,8	46	42,2	-	-
	Total	33	100	307	100	38	100	109	100	285	100

tab. 2 – Sites located on the Mediterranean Coast, for which catches of mediterranean origin, partially including eurasian freshwater fish, were evidenced. For Carthage, NISPs of all materials including identified fish bones were totalled. See Appendix 1.

		Cherson, UA	
		NISP	%
Marine	Scophthalmidae	1152	37,6
	Engraulidae	824	26,9
	Rajidae	387	12,6
	Others	155	5,1
Wandering	Acipenseridae	303	9,9
Freshwater	Cyprinidae	148	4,8
	Percidae	86	2,8
	Siluridae	12	0,4
	Total	3067	100

tab. 3 – The spectrum of mixed Black Sea and Eurasian Freshwater Fauna catches, as published for Cherson on the Crimea (Van Neer *et al.* 2008).

		Iatrus, BG		Novae, BG		Nicopolis, BG		Oltina, RO		Pontes, CS		Sagalassos, TR		Pessinus, TR	
		NISP	%	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%
Freshwater	Cyprinidae	668	71,3	17	27,0	227	75,4	138	40,2	8	47,1	167	91,8	136	88,3
	Esocidae	123	13,1	16	25,4	25	8,3	96	28,0	-	-	2	1,1	1	0,6
	Siluridae	127	13,6	14	22,2	32	10,6	66	19,2	-	-	1	0,5	16	10,4
	Percidae	14	1,5	-	-	3	1,0	37	10,8	-	-	-	-	-	-
Wandering	Acipenseridae	5	0,5	12	19,0	2	0,7	6	1,7	9	52,9	1	0,5	1	0,6
	Others	-	-	-	-	10	3,3	-	-	-	-	-	-	-	-
Marine	Div. families	-	-	4	6,3	2	0,7	-	-	-	.	6	3,3	-	-
Nile	Clariidae	-	-	-	-	-	-	-	-	-	-	5	2,7	-	-
	Total	937	100	63	100	301	100	343	100	17	100	182	100	154	100

tab. 4 – Sites located on the Lower Danube and in Central Asia Minor, for which a fish consumption is reconstructable, that was based primarily on the local eurasian freshwater fauna, at times supplemented by imports of alien species. For Pessinus, the fish bone finds from the so-called Acropolis and "Trench K" were totalled. See Appendix 1.

Sparidae, and grey mullets Mugilidae belong to the best represented fish families at Berenike (*tab.* 5)[76]. There coastal fishing is clearly visible, which took place over coral reefs as well as over sandy grounds. The abundance of recorded fish families for this Red Sea harbour is so enormous that they cannot be discussed adequately here. Nevertheless, three families shall be mentioned, that appeared in high shares at Berenike and that were also exported from the Red Sea region to Palestine. The emperors Lethrinidae is the second best represented fish family at Berenike, after the basses and groupers. For the time between the 4th and the 6th c. more than 1000 finds were recorded. These fish live close to the coast in coral reefs and are quite tasty. Their natural range is by and large restricted to the Indo-Pacific Seas, which means that they do not inhabit the Mediterranean. Therefore, the small Lethrinidae NISPs recorded for the Negev sites En Boqeq, Upper Zohar, and Tamara can only stem from the Red Sea (*tab.* 5)[77]. A similar picture applies for the coral reef dwelling parrotfish Scaridae, of which only one species, *Sparisoma cretense*, lives in the Mediterranean Sea (and was detected only at Ephesos and Itanos; *tab.* 2)[78], while the Red Sea

[76] Van Neer, Lentacker 1996, p. 339 tab. 20.1 and p. 345 tab. 20.5; Van Neer, Ervynck 1998, p. 362 tab. 17.7; Van Neer, Ervynck 1999, p. 345 tab. 18.9.

[77] Lernau H. 2000, pp. 169-180; Lernau O. 1995, pp. 99-104 and p. 107 tab. 2 and p. 108 tab. 3; Lernau H. 1986, p. 100 tab. 2, compare also: Van Neer *et al.* 2004.

[78] Forstenpointner *et al.* 2008, pp. 230 f.; Mylona 2003, p. 105 tab. 10.1 and p. 104f.

		Caesarea, IL		Hesban, JO		En Boqeq, IL		Upper Zohar, IL		Tamara, IL		Berenike, EG		Amarna, EG		Bawit, EG		Shanhûr, EG	
		NISP	%	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%
Marine	Sparidae	18	18,2	1	4,2	1	0,3	38	4,9	17	5	445	6,9	-	-	-	-	-	-
	Scaridae	-	-	5	20,8	149	51,2	171	22	189	56,1	906	14,1	-	-	-	-	-	-
	Sciaenidae	5	5,1	-	-	3	1	1	0,1	2	0,6	1	0	-	-	-	-	-	-
	Mugilidae	18	18,2	-	-	-	-	335	43,1	30	8,9	140	2,2	-	-	-	-	-	-
	Serranidae	3	3	-	-	-	-	52	6,7	24	7,1	2385	37	-	-	-	-	-	-
	Lethrinidae	-	-	-	-	4	1,4	4	0,5	7	2,1	1373	21,3	-	-	-	-	-	-
	Scombridae	-	-	1	4,2	-	-	-	-	6	1,8	10	0,2	-	-	-	-	-	-
	Carangidae	1	1	-	-	-	-	4	0,5	-	-	585	9,1	-	-	-	-	-	-
	Balistidae	1	1	-	-	-	-	4	0,5	-	-	152	2,4	-	-	-	-	-	-
	Others	2	2	1	4,2	-	-	61	7,8	2	0,6	440	6,8	-	-	-	-	-	-
Freshwater	Latidae	1	1	-	-	-	-	4	0,5	-	-	-	-	-	-	-	-	-	-
	Cichlidae	13	13,1	8	33,3	66	22,7	18	2,3	14	4,2	-	-	99	3,3	1	0,1	5456	69,5
	Clariidae	37	37,4	8	33,3	68	23,4	86	11,1	46	13,6	-	-	48	1,6	-	-	-	-
	Mochokidae	-	-	-	-	-	-	-	-	-	-	3	0	2525	84	49	6,6	890	11,3
	Cyprinidae	-	-	-	-	-	-	-	-	-	-	-	-	75	2,5	595	80,6	1329	16,9
	Bagridae	-	-	-	-	-	-	-	-	-	-	1	0	174	5,8	1	0,1	1	0
	Others	-	-	-	-	-	-	-	-	-	-	-	-	84	2,8	92	12,5	171	2,2
	Total	99	100	24	100	291	100	778	100	337	100	6441	100	3005	100	738	100	7847	100

tab. 5 – Sites located in the Levant, on the Red Sea Coast (Berenike) and on the Nile (Amarna, Bawit, Shanhûr). In this area, a lively fish trade with Red Sea species (to the Levant) and Nilotic fish (to the Red Sea and the Levant) is detectable. For Berenike, the NISPs of the separately published excavation seasons were totalled. See Appendix 1.

is specifically abundant with parrotfish species. Indeed, more than 900 specimens were excavated at Berenike. With regard to this affluence of parrotfish in this sea it is assumed that the total of the parrotfish finds from the Dead Sea region, of which at least some could be attributed to Red Sea genera, stem from the Red Sea. As with the parrotfish, the triggerfish Balistidae are also represented by only one species in the Mediterranean, but are high in species number in the Red Sea. The Mediterranean species, the grey triggerfish *Balistes carolinensis*, was recorded only for Caesarea (*tab.* 5; Fradkin, Lernau 2008, p. 191 tab. 2 and p. 190 tab. 1). In Berenike, these colourful coral reef dwellers belong to the seven best represented families. Four not specifically determinable triggerfish finds from Upper Zohar are also assigned to Red Sea connections.

8.4 Eurasian Freshwater fishing between the Balkan and Asia Minor

As already stated, freshwater fish played a major role at some places in the northeastern Mediterranean. This applies especially to the Danube area, where the state of research concerning fishing is particularly good (*tab.* 4). But also some coastal towns and cities, Stari Bar in today's Montenegro, Crimean Cherson, and Ephesos, show more or less mixed marine and freshwater fishing (*tab.* 2*;* 3). The excavations at inland sites of Asia Minor, Sagalassos and Pessinus, again yielded mostly freshwater fish, as is to be expected[79]. The most important freshwater fish family used in this region are the cyprinids. Before turning to these, however, the anadromous sturgeons Acipenseridae shall be briefly discussed, because most of these anadromous fish wander upstream for spawning and spend the rest of the year in marine grounds. Hence, in case of the sturgeons it is not directly obvious whether the animals represent freshwater or marine catches. The small sturgeon family was of particular importance at 10th to 13th c. Cherson (*tab.* 3), as the high NISPs in the bone assemblage depict. This might be linked to a nascent caviar production, as it is testified by written sources for this period (Jacoby 2009). Here, they could have been caught on the Black Sea shore as well as in rivers. Sturgeons also regularly appear in bone materials from the Danube area, for which it seems likely that they were caught in the river itself or, in case of the Middle Byzantine Dobruja sites, its delta (*tab.* 4). The sturgeon finds from Sagalassos and Pessinus, as it is currently understood, seem to have been caught in the Mediterranean, where they still lived in Byzantine times (Van Neer *et al.* 2004). Shifting attention to the purely freshwater dwelling families, the largest of these are the cyprinids. They inhabit most parts of the world and about 2100 species are known. Given the wealth of species, a lot of finds can not be assigned to specific species, though a considerable number can be shown to have existed in the Danube area (see *Appendix* 2). The most frequently recorded fish is the carp *Cyprinus carpio,* with the highest NISPs. Remains of this fish were found at Stari Bar and in all assemblages of the Danube area and Asia Minor that included identifiable fish remains[80]. The domestication of the carp commenced in the Early Middle Ages, significantly supported by the monasteries, though whether the bone finds represent wild or domesticated carps is not discernible osteologically. It can be assumed, however, that

[79] Bartosiewicz, Choyke 1991, p. 182 tab. 1; Benecke 2007, p. 385 tab. 1; Makowiecki, Iwaskiewicz 1996, p. 53 tab. 2; Beech, Irving 2007, p. 226 tab. 12.1; Iliev, Boev, Spassov 1992, p. 45 tab. 1; Haimovici, Ureche 1979, p. 158 tab. 1; Stanc, Radu, Bejenaru 2006; Bejenaru 1995, p. 321; Lockyear 2009 online; Bartosiewicz 1996, p. 288 tab. 5; Pluskowski, Seetah 2006, p. 109 tab. 6.7; Van Neer, Ervynck 2008, p. 211 fig. 2 and p. 213 fig. 4; Forstenpointner *et al.* 2008, pp. 230 f.; Van Neer, De Cupere, Waelkens 1997, p. 572 tab. 1; Ervynck, De Cupere, Van Neer 2003, p. 382 tab. 1.

[80] Pluskowski, Seetah 2006, p. 109 tab. 6.7; Bartosiewicz, Choyke 1991, p. 182 tab. 1; Benecke 2007, p. 385 tab. 1; Makowiecki, Iwaskiewicz 1996, p. 53 tab. 2; Beech, Irving 2007, p. 226 tab. 12.1; Iliev, Boev, Spassov 1992, p. 45 tab. 1; Haimovici, Ureche 1979, p. 158 tab. 1; Stanc, Radu, Bejenaru 2006; Bejenaru 1995, p. 321; Lockyear 2009 online; Bartosiewicz 1996, p. 288 tab. 5; Forstenpointner *et al.* 2008, pp. 230 f.; Van Neer, De Cupere, Waelkens 1997, p. 572 tab. 1; Ervynck, De Cupere, Van Neer 2003, p. 382 tab. 1.

the wild populations, especially in the Danube, but also in the rivers of Asia Minor, were sufficient to provide these carp catches. Another frequently encountered cyprinid is the barbel *Barbus* sp., which was detected not only at Nicopolis ad Istrum and Noviodunum, but also at Ephesos, Caesarea in the Levant, and on the Nile[81]. Together with the cyprinids, two other Eurasian freshwater species are particularly well represented in the Danubian assemblages. The pike *Esox lucius* is omnipresent in the bone materials of this area and also appears sporadically at Cherson, Sagalassos and Pessinus. The wels catfish *Silurus glanis*, a predator that can grow very large, was recorded with a high NISP at Iatrus-Krivina and also appeared in all other Danubian materials as well as at Sagalassos and Pessinus (*tab.* 4). The perch family Percidae, finally, is represented by two species, the European perch *Perca fluviatilis* and the Zander *Stizostedion lucioperca*. The latter was recorded at Cherson as well in most Danubian assemblages, while an occasional catch of the European perch seemingly was restricted to the Danube and its tributary rivers. For less frequent Eurasian freshwater species, see *Appendix* 2.

8.5 Freshwater fishing in Egypt and the Levant

As already stated, freshwater fish played a major role on the Nile and in the Levant (*tab.* 5). As opposed to Eurasian freshwater fish, which was consumed only in the areas of its natural occurrence, Nilotic species were exported to the Red Sea, the Levant and even as far as Constantinople and Sagalassos[82]. An import of alien fish species to the Nile, however, is not detectable: not one single bone of alien fish was reported. The three nilotic fishbone assemblages that were analysed show markedly different species spectra (*tab.* 5)[83], which leads to the assumption that local fisheries specialised in certain species and the respective salted products they provided. Airbreathing catfish of the genus *Clarias* were fished and processed at Amarna and Bawit. One member of this family, the African sharptooth catfish *Clarias gariepinus* lives in the Levant and was target of local fisheries of the area. It was recorded for Caesarea, Tell Hesban, En Boqeq, Upper Zohar and Tamara, partially in large numbers (*tab.* 5)[84]. It is assumed that all Levantine *Clarias* finds stem from this species. Another family primarily inhabiting the Nile are the Cichlidae, often depicted in paintings and reliefs of Pharaonian times. Thousands of bones from these popular food fish were found at Shanhûr on the Nile, while Cichlids were more rarely fished at Bawit and Amarna. Again, one cichlid family member that was recorded for Caesarea (Fradkin, Lernau O., 2008, p. 191 tab. 2 and p. 190 tab. 1) lives in the Levant, *Tilapia zillii*. Other Levantine *Tilapia* finds from Tell Hesban, En Boqeq, Upper Zohar and Tamara, are ascribed to this species, too (*tab.* 5)[85]. A small part of the three Nilotic assemblages represents fish of the Bagridae catfish family, which occurred as a single find at Berenike (Van Neer, Ervynck 1998, p. 362 tab. 17.7). Here, remains of a lizardfish (family Synodontidae) were also detected, which represent the bulk of finds at Amarna, while they were only sporadically caught at Shanhûr and Bawit. The Nile perch *Lates niloticus* appeared with only a few finds at Amarna, although the recorded specimens at Caesarea and Upper Zohar point to a certain trade importance of this species (see above). The occurrence of other Nilotic and middle eastern freshwater species can be seen in *Appendix* 2.

9. CONCLUSION

The archaeozoological record, though still inadequate in temporal as well as spatial dimensions, already reveals a considerable variety of different animals that were utilised, at least for the Early Byzantine period. In these early centuries of the East Roman Empire, traditional livestock husbandry practices were pursued and only slightly adjusted to the requirements of current events. Apart from the domestic animals, that were indispensable during their lifetime for a lot of daily activities, fish was certainly often consumed, be it local freshwater species or marine catches. The significance of game and winged game seems to be rather limited, but some sites, that yielded huge amounts of bone finds because an advanced recovery technique was applied, give reason to hope that future research will further broaden the species lists, and back these first impressions with more evidence. All in all, a positive trend is visible: today, archaeobiological investigations are often budgeted right from the start of projects, and often they are crucial for the resolution of the main research questions. Furthermore, the significance of the smaller, partially non-domestic species (like fish and wild birds) for the reconstruction of landscape and water uses as well as activity zones is acknowledged more and more, and this leads to an increasing application of advanced recovery techniques. If Byzantine archaeology follows this path, many questions that are still difficult to assess – for instance the role of domestic poultry, diverse fish, and winged game species – will one day be answered.

Acknowledgements

I wish to thank Paul Arthur, Department of Cultural Heritage, University of Salento, not only for his suggestion to write this paper and to submit it for Archeologia medievale, but also for his diligent proofreading. Furthermore, I want to thank Falko Daim, Römisch-Germanisches Zentralmuseum Mainz, for the opportunity and encouragement to work on this fascinating topic. And a special thanks to all archaeozoologists whose painstaking work provides the basis for this overview!

[81] Beech, Irving 2007, p. 226 tab. 12.1; Lockyear 2009 online; Forstenpointner *et al.* 2008, pp. 230 f.; Fradkin, Lernau O., 2008, p. 191 tab. 2 and p. 190 tab. 1; Luff, Bailey 2000, p. 103 tab. 12.1; Van Neer *et al.* 2007; Van Neer, Depraetere 2005, p. 162 tab. 2.

[82] Van Neer, Lentacker 1996, p. 339 tab. 20.1 and p. 345 tab. 20.5; Van Neer, Ervynck 1998, p. 362 tab. 17.7; Van Neer, Ervynck 1999, p. 345 tab. 18.9.; Fradkin, Lernau O. 2008, p. 191 tab. 2; Lernau O. 1995, p. 107 tab. 2 and p. 108 tab. 3; personal communication V. Onar; Van Neer, De Cupere, Waelkens 1997, p. 572 tab. 1.

[83] Luff, Bailey 2000, p. 103 tab. 12.1; Van Neer *et al.* 2007; Van Neer, Depraetere 2005, p. 162 tab. 2.

[84] Fradkin, Lernau O. 2008, p. 191 tab. 2 and p. 190 tab. 1; Driesch, Boessneck 1995, p. 98 tab. 5.22, Lernau O. 1995, p. 99-104 and p. 107 tab. 2 and p. 108 tab. 3; Lernau H. 1986, p. 100 tab. 2; Lernau H. 2000, pp. 169-180; see also Van Neer *et al.* 2004, p. 136.

[85] Fradkin, Lernau O. 2008, p. 191 tab. 2 and p. 190 tab. 1; Driesch, Boessneck 1995, p. 98 tab. 5.22, Lernau O. 1995, pp. 99-104 and p. 107 tab. 2 and p. 108 tab. 3; Lernau H. 1986, p. 100 tab. 2; Lernau H. 2000, pp. 169-180.

APPENDIX 1

List of sites included in the study

Italy

Site: Naples, Via Carminiello ai Mannesi (Italy)
Location: *fig.* 1, 1.
Dating of the finds: 2nd-7th/8th c.
Archaeozoological reports: King 1994 (Mammals); Rielly 1994 (Birds); Rhodes 1994 (Fish); Cretella 1994 (Molluscs); all in Arthur 1994.
Information on: domestic mammals, domestic poultry, game, winged game, identified fish, molluscs, others

Site: Herdonia (Italy)
Location: *fig.* 1, 3.
Dating of the finds: late 5th c.-10th c.
Archaeozoological reports: Buglione 2007a; Buglione 2007b (preliminary online report).
Information on: domestic mammals, domestic poultry, game, molluscs

Site: Faragola (Italy)
Location: *fig.* 1, 4.
Dating of the finds: 6th-7th c.
Archaeozoological reports: Buglione 2007a; Buglione 2007b (preliminary online report).
Information on: domestic mammals, domestic poultry, game, unidentified birds, unidentified fish, molluscs, others

Site: Canosa, San Pietro (Italy)
Location: *fig.* 1, 5.
Dating of the finds: 7th/8th-9th/10th c.
Archaeozoological reports: Buglione 2007a; Buglione 2007b (preliminary online report).
Information on: domestic mammals, domestic poultry, game, unidentified fish, molluscs

Site: San Giorgio (Italy)
Location: *fig.* 1, 7.
Dating of the finds: late 5th-early 6th c.
Archaeozoological reports: Buglione 2007b (preliminary online report).
Information on: domestic mammals, domestic poultry, game

Site: Belmonte (Italy)
Location: *fig.* 1, 6.
Dating of the finds: late 5th-early 8th c.
Archaeozoological reports: Buglione 2007b (preliminary online report).
Information on: domestic mammals, domestic poultry, game

Site: San Giusto (Italy)
Location: *fig.* 1, 2.
Dating of the finds: late 5th-2nd half 6th c.
Archaeozoological reports: Buglione 2007b (preliminary online report).
Information on: domestic mammals, domestic poultry, game, molluscs

Site: Otranto (Italy)
Location: *fig.* 1, 8.
Dating of the finds: mid 4th-late 11th c.
Archaeozoological reports: Cartledge *et al.* 1992 (Mammals); Sutherland 1992 (Birds); Jones 1992 (Fish); Reese 1992 (Molluscs); all in D'Andria, Whitehouse 1992.
Information on: domestic mammals, domestic poultry, game, winged game, identified fish, molluscs, others

Westcoast of the Balkan, Peloponnes and Crete

Site: Butrint (Albania)
Location: *fig.* 1, 9.
Dating of the finds: 3rd c.-mid 6th c.
Archaeozoological reports: Powell 2004.
Information on: domestic mammals, game, winged game, identified fish, molluscs, others

Site: Nichoria (Greece)
Location: *fig.* 1, 10.
Dating of the finds: mid 4th-mid 6th c.
Archaeozoological reports: Sloan, Duncan 1978.
Information on: domestic mammals, domestic poultry, game, molluscs, others

Site: Pyrgouthi (Greece)
Location: *fig.* 1, 11.
Dating of the finds: late 5th-early 6th c.
Archaeozoological reports: Mylona 2005; Lymberakis, Mylona 2005 (Microfauna); both in Hjohlman *et al.* 2005.
Information on: domestic mammals, game, unidentified birds, unidentified fish, others

Site: Eléftherna (Crete, Greece)
Location: *fig.* 1, 12.
Dating of the finds: 5th-7th c.
Archaeozoological reports: Nobis 1998.
Information on: domestic mammals, domestic poultry, game, winged game, identified fish

Site: Gortyn (Crete, Greece)
Location: *fig.* 1, 13.
Dating of the finds: 6th/7th c.
Archaeozoological reports: Wilkens 2003.
Information on: domestic mammals, domestic poultry, game, others

Site: Itanos (Crete, Greece)
Location: *fig.* 1, 14.
Dating of the finds: 5th-7th c.
Archaeozoological reports: Mylona 2003 (Fish).
Information on: identified fish

Site: Stari Bar (Montenegro)
Location: *fig.* 3.
Dating of the finds: 13th-14th c.
Archaeozoological reports: Pluskowski, Seetah 2006.
Information on: domestic mammals, domestic poultry, game, winged game, identified fish, molluscs, others

Lower Danube area, Dobruja and Thrace

Site: Iatrus-Krivina (Bulgaria)
Location: *fig.* 1, 16.
Dating of the finds: 1st-10th c.
Archaeozoological reports: Benecke 2007; Bartosiewicz, Choyke 1991; Bartosiewicz, Choyke 1995.
Information on: domestic mammals, domestic poultry, game, winged game, identified fish, molluscs, others

Site: Novae (Bulgaria)
Location: *fig.* 1, 15.
Dating of the finds: 2nd-10th c.
Archaeozoological reports: Makowiecki, Makowiecka 2002; Makowiecki, Schramm 1995 (Bishop's residence); Makowiecki, Iwaskiewicz 1996 (Fish).
Information on: domestic mammals, game, unidentified birds, identified fish, molluscs, others

Site: Nicopolis ad Istrum (Bulgaria)
Location: *fig.* 1, 18.
Dating of the finds: mid 3rd c.-late 6th c.
Archaeozoological reports: Beech 2007a (Mammals, Reptiles); Boev, Beech 2007 (Birds); Beech, Irving 2007 (Fish); Beech 2007b (Molluscs); Parfitt 2007 (Microfauna); all these in Poulter 2007; Beech 1997 (preliminary report).
Information on: domestic mammals, domestic poultry, game, winged game, identified fish, molluscs, others

Site: Dichin (Bulgaria)
Location: *fig.* 1, 17.
Dating of the finds: Early Middle Ages.

Archaeozoological reports: first preliminary results in Beech 2007a (Mammals), p. 188 tab. 10.24 and Beech, Irving 2007 (Fish), p. 235 tab. 12.4.
Information on: domestic mammals, game, identified fish.

Site: Bela Voda (Bulgaria)
Location: *fig.* 1, 19.
Dating of the finds: 3rd-6th c.
Archaeozoological reports: Iliev, Boev, Spassov 1992.
Information on: domestic mammals, domestic poultry, game, winged game, identified fish, others

Site: Oltina (Romania)
Location: *fig.* 2, 9.
Dating of the finds: 10th-11th c.
Archaeozoological reports: Stanc, Bejenaru 2005; Stanc, Radu, Bejenaru 2006 (Fish).
Information on: domestic mammals, game, unidentified birds, identified fish, molluscs, others

Site: Capidava (Romania)
Location: *fig.* 2, 10.
Dating of the finds: Middle Byzantine
Archaeozoological reports: Haimovici, Ureche 1979.
Information on: domestic mammals, domestic poultry, game, winged game, identified fish, molluscs, others

Site: Carsium (Romania)
Location: *fig.* 2, 11.
Dating of the finds: 11th c.
Archaeozoological reports: Bejenaru 1995.
Information on: domestic mammals, domestic poultry, game, winged game, identified fish, molluscs

Site: Pontes (Serbia)
Location: *fig.* 2, 6.
Dating of the finds: Middle Byzantine
Archaeozoological reports: Bartosiewicz 1996.
Information on: domestic mammals, domestic poultry, game, identified fish, others

Site: Noviodunum (Romania)
Location: *fig.* 2, 12.
Dating of the finds: 11th-14th c.
Archaeozoological reports: Lockyear 2009 (online preliminary report).
Information on: domestic mammals, domestic poultry, game, identified fish

Between Crimea and the Bosporus

Site: Cherson (Crimea, Ukraine)
Location: *fig.* 1, 20.
Dating of the finds: 6th-13th c.
Archaeozoological reports: Rabinowitz *et al.* 2010 (archaeological report with mentioning of archaeozoological results); Van Neer, Ervynck 2008 (Fish).
Information on: domestic mammals, domestic poultry, game, winged game, identified fish, others

Site: Constantinople, Theodosian Harbour Yenikapı (Turkey)
Location: *fig.* 2, 14.
Dating of the finds: Middle Byzantine
Archaeozoological reports: personal communication, Vedat Onar, Istanbul.
Information on: domestic mammals, domestic poultry, game, winged game, identified fish, others

Site: Constantinople, Saraçhane (Turkey)
Location: *fig.* 2, 14.
Dating of the finds: 10th-12th/13th c.
Archaeozoological reports: Kosswig, Saraçhane (short listing of finds).
Information on: domestic mammals, molluscs

Asia Minor

Site: Beşik Tepe (Turkey)
Location: *fig.* 1, 21.
Dating of the finds: Byzantine
Archaeozoological reports: Driesch, Boessneck 1984.
Information on: domestic mammals, domestic poultry, game, unidentified birds, unidentified fish, molluscs, others

Site: Sardis (Turkey)
Location: *fig.* 1, 22.
Dating of the finds: 1000 BC-1800 AD
Archaeozoological reports: Deniz, Calislar, Özgüden 1964.
Information on: domestic mammals, game, unidentified birds, molluscs, others

Site: Ephesos, Vediusgymnasium (Turkey)
Location: *fig.* 1, 23.
Dating of the finds: late 5th-late 7th c.
Archaeozoological reports: Forstenpointner *et al.* 2008.
Information on: domestic mammals, domestic poultry, game, winged game, identified fish, molluscs, others

Site: Limyra (Turkey)
Location: *fig.* 1, 25.
Dating of the finds: 6th/7th c.
Archaeozoological reports: Forstenpointner, Gaggl 1997.
Information on: domestic mammals, domestic poultry, winged game, others

Site: Andriake (Turkey)
Location: *fig.* 1, 24.
Dating of the finds: 6th c.
Archaeozoological reports: Forstenpointner *et al.* 2007 (Molluscs; Purple Dye production).
Information on: molluscs

Site: Sagalassos (Turkey)
Location: *fig.* 1, 26.
Dating of the finds: 1st-6th c.
Archaeozoological reports: De Cupere 2001; De Cupere, Waelkens 1998 (preliminary report); Van Neer, De Cupere 1993 (preliminary report); Van Neer, De Cupere, Waelkens 1997 (Fish); Van Neer *et al.* 2000 (Fish trade).
Information on: domestic mammals, domestic poultry, game, winged game, identified fish, molluscs, others

Site: Amorium (Turkey)
Location: *fig.* 2, 17.
Dating of the finds: 7th-11th c.
Archaeozoological reports: personal communication, Evangelia Ioannidou, Ankara; Ioannidou 2012.
Information on: domestic mammals, domestic poultry, game, unidentified birds, unidentified fish, others

Site: Pessinus, so-called Acropolis und Trench K (Turkey)
Location: *fig.* 1, 27.
Dating of the finds: Early Roman-late 11th c.
Archaeozoological reports: Ervynck, De Cupere, Van Neer 2003 (Acropolis); Ervynck, De Cupere, Van Neer 1993 (Acropolis, preliminary report); De Cupere 1994 (Trench K).
Information on: domestic mammals, domestic poultry, game, winged game, identified fish, molluscs

Syria and Palestine

Site: Zeugma (Turkey)
Location: *fig.* 1, 28.
Dating of the finds: 3rd c. BC-10th c. AD
Archaeozoological reports: Rousseau, Guintard, Abadie-Reynal 2008.
Information on: domestic mammals, domestic poultry, game, winged game, molluscs

Site: Ta'as (Syria)
Location: *fig.* 1, 29.
Dating of the finds: 2nd half 7th-mid 11th c.
Archaeozoological reports: Clason 1996.
Information on: domestic mammals, domestic poultry, game, winged game, others

Site: Sumaqa (Israel)
Location: *fig.* 1, 30.
Dating of the finds: Late Roman-Byzantine
Archaeozoological reports: Horwitz, Tchernov, Dar 1990; Lernau O., 1999 (Fish).
Information on: domestic mammals, game, unidentified birds, identified fish, others

Site: Shallale (Israel)
Location: *fig.* 1, 31.
Dating of the finds: Byzantine-Mamluk
Archaeozoological reports: Horwitz 2009; Mienis 2009 (Molluscs).
Information on: domestic mammals, domestic poultry, game, molluscs, others

Site: Raqit (Israel)
Location: *fig.* 1, 32.
Dating of the finds: Late Roman-Byzantine
Archaeozoological reports: Horwitz 2004; Mienis 2004 (Molluscs).
Information on: domestic mammals, domestic poultry, game, molluscs, others

Site: Rimmon (Israel)
Location: *fig.* 1, 34.
Dating of the finds: 3rd-7th c.
Archaeozoological reports: Horwitz 1998.
Information on: domestic mammals, game, unidentified birds, unidentified fish, others

Site: Caesarea (Israel)
Location: *fig.* 1, 33.
Dating of the finds: 5th-7th c.
Archaeozoological reports: Cope 1999; Fradkin, Lernau O., 2008 (Fish).
Information on: domestic mammals, domestic poultry, game, winged game, identified fish, others

Site: Upper Zohar (Israel)
Location: *fig.* 1, 36.
Dating of the finds: late 5th-early 7th c.
Archaeozoological reports: Clark 1995 (Mammals); Croft 1995 (Birds); Lernau O., 1995 (Fish); Reese 1995 (Molluscs); all in Harper 1995.
Information on: domestic mammals, domestic poultry, game, winged game, identified fish, molluscs, others

Site: Tamara (Israel)
Location: *fig.* 1, 38.
Dating of the finds: late 5th-early 7th c.
Archaeozoological reports: Lernau H., 1986 (Fish).
Information on: identified fish

Site: En Boqeq (Israel)
Location: *fig.* 1, 37.
Dating of the finds: 4th-7th c.
Archaeozoological reports: Gichon 1993 (archaeological report with mentioning of archaeozoological results); Lernau H., 2000 (Birds, fish).
Information on: domestic mammals, domestic poultry, winged game, identified fish

Site: Tell Hesban (Jordan)
Location: *fig.* 1, 35.
Dating of the finds: 4th-7th c.
Archaeozoological reports: Driesch, Boessneck 1995; Boesneck 1995 (Birds, Reptiles, Amphibians); Lepiksaar 1995 (Fish); all in Labianca, Driesch 1995.
Information on: domestic mammals, domestic poultry, game, winged game, identified fish, others

Egypt

Site: Berenike (Egypt)
Location: *fig.* 1, 39.
Dating of the finds: 4th-6th c.
Archaeozoological reports: Van Neer, Lentacker 1996; Van Neer, Ervynck 1998; Van Neer, Ervynck 1999.
Information on: domestic mammals, domestic poultry, game, winged game, identified fish, molluscs, others

Site: Bawit (Egypt)
Location: *fig.* 1, 41.
Dating of the finds: late 6th/early 7th c.
Archaeozoological reports: Van Neer *et al.* 2007 (Fish).
Information on: identified fish

Site: Amarna (Egypt)
Location: *fig.* 1, 42.
Dating of the finds: 5th-6th c.
Archaeozoological reports: Luff, Bailey 2000 (Fish).
Information on: identified fish

Site: Shanhûr (Egypt)
Location: *fig.* 1, 40.
Dating of the finds: late 6th/early 7th c.
Archaeozoological reports: Van Neer, Depraetere 2005 (Fish).
Information on: identified fish

North Africa

Site: Berenice/Benghazi (Libya)
Location: *fig.* 1, 43.
Dating of the finds: 1st-7th c.
Archaeozoological reports: Barker 1979.
Information on: domestic mammals, domestic poultry, game, identified fish, molluscs, others

Site: Leptis Magna (Libya)
Location: *fig.* 1, 44.
Dating of the finds: 4th/5th c.
Archaeozoological reports: Caloi 1974.
Information on: domestic mammals, domestic poultry, game, winged game, molluscs, others

Site: Libyan Valleys Survey (Libya)
Location: *fig.* 1, 45.
Dating of the finds: 1st-7th c.
Archaeozoological reports: Van Der Veen, Grant, Barker 1996.
Information on: domestic mammals, game, others

Site: Leptiminus (Tunisia)
Location: *fig.* 1, 46.
Dating of the finds: 3rd-7th c.
Archaeozoological reports: Burke 2001.
Information on: domestic mammals, domestic poultry, game, winged game, others

Site: Carthage (Tunisia)
Location: *fig.* 1, 47.
Dating of the finds: 1st-7th c.
Archaeozoological reports: Nobis 1999 (German excavations); Schwartz 1984 (British excavations, city walls); Levine, Wheeler 1994; Zaouali 1994; both in Hurst 1994 (British excavations, harbour); Reese 1977 (American excavations, House of the Greek Charioteer, Church Complex); Reese 1981 (American excavations, Cisterns); Larje 1995 (Fish, swedish excavations).
Information on: domestic mammals, domestic poultry, game, winged game, identified fish, molluscs, others

APPENDIX 2

List of detected species

The structure of this list is based primarily on the economic and ecological groups, to make them more transparent. Within these groups the respective families are arranged alphabetically by their scientific family names in order to ensure quick access. Within each family, also an alphabetical order based on the scientific species names was chosen. Taxa that were identifiable only to genus level are set behind. Specified is the currently valid scientific species name, synonyms that were used in the primary literature are indicated in brackets. Superscripted behind the taxa are abbreviation codes for the respective sites for which the taxon was recorded. The allocation of the codes to the sites is found in the list below. Especially with regard to the fish no claim to completeness shall be raised, as some sites yielded such enormous amounts of taxa, that they can not be listed here in detail.

Allocation of the abbreviations:

AMA Amarna (Egypt, Nile)
AMO Amorium (Asia minor)
BAW Bawit (Egypt, Nile)
BEC Berenice/Benghazi (North Africa)
BEK Berenike (Egypt, Red Sea)
BEL Belmonte (Italy)
BES Be^{o}ik Tepe (Asia minor)
BEV Bela Voda (Lower Danube Area)
BUT Butrint (Dalmatian Coast, Greece)
CAE Caesarea (Syria, Palestine)
CAN Canosa (Italy)
CAP Capidava (Lower Danube Area)
CAR Carsium (Lower Danube Area)
CHE Cherson (Krim)
DIC Dichin (Lower Danube Area)
ELE El?therna (Dalmatian Coast, Greece)
ENB En Boqeq (Syria, Palestine)
EPH Ephesos Vediusgym. (Asia minor)
FAR Faragola (Italy)
GIO San Giorgio (Italy)
GIU San Giusto (Italy)
GOR Gortyn (Dalmatian Coast, Greece)
HER Herdonia (Italy)
HES Tell Hesban (Syria, Palestine)
IAT Iatrus-Krivina (Lower Danube Area)
ITA Itanos (Dalmatian Coast, Greece)
KAR Carthage (North Africa)
LEM Leptis Magna (North Africa)
LEP Leptiminus (North Africa)
LIB Libyan Valleys Survey (North Africa)
LIM Limyra (Asia minor)
NAI Nicopolis ad Istrum (Lower Danube Area)
NAP Naples (Italy)
NIC Nichoria (Dalmatian Coast, Greece)
NOD Noviodunum (Lower Danube Area)
NOV Novae (Lower Danube Area)
OLT Oltina (Lower Danube Area)
OTR Otranto (Italy)
PEA Pessinus, Acropolis (Asia minor)
PEK Pessinus, Trench K (Asia minor)
PON Pontes (Lower Danube Area)
PYR Pyrgouthi (Dalmatian Coast, Greece)
RAQ Horbat Raqit (Syria, Palestine)
RIM Horbat Rimmon (Syria, Palestine)
SAG Sagalassos (Asia minor)
SAI Sara?ane (Istanbul/Constantinople)
SAR Sardis (Asia minor)
SHL Shallale (Syria, Palestine)
SHN Shanh? (Egypt, Nil)
STA Stari Bar (Dalmatian Coast, Greece)
SUM Sumaqa (Syria, Palestine)
TAM Tamara (Syria, Palestine)
TAS Ta?as (Syria, Palestine)
UPP Upper Zohar (Syria, Palestine)
YEN Yenikap? (Istanbul/Constantinople)
ZEU Zeugma (Syria, Palestine)

Domestic Mammals

Family Bovidae
Cattle *Bos primigenius f. taurus*[Everywhere except ITA, TAM, AMA, BAW, SHN.]
Goat *Capra aegagrus f. hircus*[Everywhere except (CAN, NIC), ITA, TAM, AMA, BAW, SHN.]
Sheep *Ovis ammon f. aries*[Everywhere except ITA, TAM, AMA, BAW, SHN.]
Family Camelidae[IAT, NOV, NAI, AMO, ZEU?, SHL, HES, UPP, BEC, LEM, LEP, KAR]
Dromedary *Camelus dromedarius*[YEN, SAG, TAS, SUM, CAE, HES?, BEK, KAR?]
Bactrian Camel *Camelus ferus f. bactriana*[YEN]
Family Canidae
Dog *Canis lupus f. familiaris*[Everywhere except BEL, CAN, FAR, GIO, GIU, PYR, ITA, CHE, SHL, RIM, ENB, TAM, AMA, BAW, SHN, LEM, LIB.]
Family Equidae[BEL, OTR, BUT, PYR, GOR, NOD, BES, LIM, SAG, AMO, PEK, ZEU, TAS, HES, UPP, BEK, LEM, KAR]
Donkey *Equus africanus f. asinus*[NAP, HER, CAN, NIC, PYR?, ELE, GOR, IAT, NOV, NAI, BEV, CAP, OLT, YEN, LIM, SAG, AMO, PEK, PEA, ZEU?, TAS, SHL, SUM, CAE, RIM, HES, UPP?, BEK, BEC, KAR?]
Horse *Equus equus f. caballus*[NAP, HER, CAN, FAR, NIC, ELE, GOR, IAT, NOV, NAI, DIC, BEV, CAP, OLT, CAR, PON, YEN, SAR, LIM, SAG, AMO, PEK, PEA, ZEU?, TAS, CAE, HES, BEC, LEP, KAR]
Mule/Hinny *Equus equus f. caballus x Equus africanus f. asinus*[ELE, YEN, SAG, ZEU?, KAR?]
Family Felidae
Cat *Felis silvestris f. catus*[NAP, HER, OTR, BUT, GOR, IAT, NOV, NAI, DIC, BEV, NOD, PON, YEN, EPH, SAG, PEA, ZEU, SUM?, CAE, HES, BEK, KAR]
Family Leporidae
(kept in captivity) Rabbit *Oryctolagus cuniculus*[GOR, DIC, KAR]
Family Suidae
Pig *Sus scrofa f. domestica*[Everywhere except ITA, RAQ, TAM, AMA, BAW, SHN.]

(*Potentially) Domestic Poultry*

Family Anatidae
(probably only kept in captivity) Domestic duck/Mallard *Anas platyrhynchos (f. domestica*)[NAP, HER, BUT, NAI, BEV, CHE, BES?, LIM, SAG, SUM?, CAE, KAR]
Domestic goose/Greylag goose *Anser anser (f. domestica)*[NAP, BUT, IAT, NAI, CAP, CAR, BES?, ENB, KAR]
Family Columbidae
Domestic pigeon/Rock pigeon *Columba livia (f. domestica)*[NAP, IAT?, NAI, TAS, RIM, HES, ENB, UPP, BEK, LEM, KAR]
Family Phasianidae
Chicken *Gallus gallus f. domestica*[Everywhere except AMA, BAW, BEL, DIC, ITA, LIB, NIC, NOV, PYR, GIO, GIU, SAI, SHN, TAM.]
(kept in captivity) Peafowl *Pavo cristatus*[NAP, NAI, KAR]

Game

Family Bovidae
Hartebeest *Alcelaphus buselaphus*[LIB?]
Barbary Sheep *Ammotragus lervia*[BEK, LIB?]
Aurochs *Bos primigenius*[PON, CHE, AMO?, HES]

Wild Goat *Capra aegagrus*[HES]
Kri-kri *Capra aegagrus cretica*[ELE]
Ibex *Capra ibex*[HES, YEN]
Dama Gazelle *Nanger dama* (Syn.: *Gazella dama*)[KAR]
Dorcas Gazelle *Gazella dorcas*[HES, BEK, LIB, LEM?]
Mountain Gazelle *Gazella gazella*[CAE, RIM, HES]
Gazelles *Gazella*[TAS, RAQ, HES, UPP, BEC, LEM, LEP]
Oryx *Oryx leucoryx*[HES, LIB?]
Wild sheep *Ovis orientalis*[HES]
Saiga *Saiga tatarica*[CHE]

Family Canidae
Wolf *Canis lupus*[AMO, HES]
Red Fox *Vulpes vulpes*[BEK, TAS, HES, CAE, OTR, GOR, IAT, NOV, NAI, DIC, BEV, OLT, CAR, CHE, YEN, BES, EPH, SAG, AMO, PEK]

Family Castoridae
Beaver *Castor fiber*[IAT, NOV, NAI, DIC, CAP, OLT, CAR, CHE]

Family Cervidae[GIU, BUT, DIC, SAG, AMO]
Roe Deer *Capreolus capreolus*[NAP, HER, FAR, GIO, OTR, BUT, NIC, ELE, STA, IAT, NOV, NAI, DIC, CAP, OLT, CAR, NOD, PON, CHE, YEN, SAG, ZEU?]
Red Deer *Cervus elaphus*[NAP, HER, CAN, FAR, GIO, OTR, BUT, NIC, STA, IAT, NOV, NAI, DIC, BEV, CAP, OLT, CAR, NOD, PON, CHE, YEN, SAG, AMO, ZEU?]
Barbary Stag *Cervus elaphus barbarus*[KAR]
Fallow Deer *Dama dama* (Syn.: *Cervus dama*)[NAP, ELE, GOR, DIC, NOD, YEN, BES, SAG, AMO, UPP, KAR]

Family Delphinidae[CHE, YEN]
Family Elephantidae[YEN, BEK]
Family Felidae
Wildcat *Felis*[BUT, IAT, CHE, HES]
Lion *Panthera leo*[BEK]
Leopard *Panthera pardus*[BEK]

Family Hippopotamidae
Hippopotamus *Hippopotamus amphibius*[BEK]

Family Hystricidae
Common Porcupine *Hystrix cristata*[LIB]

Family Leporidae[NAP, GIU, OTR, BUT, NIC, PYR, GOR, IAT, NOV, CHE, BES, SAR, EPH, AMO, ZEU?, SUM, UPP, LEP, KAR]
Cape Hare *Lepus capensis*[SAG, PEK, PEA, TAS, CAE, RIM, HES, BEK]
European Hare *Lepus europaeus*[HER, ELE, STA, IAT, NAI, DIC, BEV, CAP, OLT]
Savanna Hare *Lepus victoriae*[KAR]

Family Mustelidae[NAI, CHE, SAG, KAR]
European Otter *Lutra lutra*[IAT]
Beech Marten *Martes foina*[RAQ]
Marten *Martes*[CAR]
European Pine Marten *Martes martes*[SAG]
Badger *Meles meles*[IAT, NOV, DIC, CAP, PON]
Least Weasel *Mustela nivalis*[KAR]
Weasel *Mustela*[DIC, HES]
Polecat *Putorius*[BEV]
Marbled Polecat *Vormela peregusna*[CAE, HES]

Family Phocidae
Mediterranean Monk Seal *Monachus monachus*[CAE]

Family Phocoenidae[CHE]

Family Procaviidae
Rock Hyrax *Procavia capensis*[SUM, HES]

Family Ursidae
Brown bear *Ursus arctos*[IAT, NAI, PON, YEN, SAG]

Family Suidae
Wild boar *Sus scrofa scrofa*[FAR, GIU, BUT, ELE, IAT, NOV, NAI, DIC, BEV, CAP, OLT, CAR, PON, CHE, AMO, PEA, ZEU?, SHL, HES, KAR]

Water Fowl

Family Accipitridae
White-tailed Eagle *Haliaeetus albicilla*[IAT]
Black Kite *Milvus migrans migrans*[HES]

Family Anatidae
Northern Shoveler *Anas clypeata*[BES?, KAR]
Eurasian Teal *Anas crecca*[NAP, NAI, BES?]
Eurasian Wigeon *Anas penelope*[NAP, NAI]
Mallard *Anas platyrhynchos*[(see Domestic species)]
Garganey *Anas querquedula*[NAP, BES?]
Greater White-fronted Goose *Anser albifrons*[NAI, BES?, ENB]
Greylag Goose *Anser anser*[(see Domestic species)]
Lesser White-fronted Goose *Anser erythropus*[BES?]
Bean Goose *Anser fabalis*[NAP, NAI]
Common Pochard *Aythya ferina*[NAI, SAG]
Tufted Duck *Aythya fuligula*[NAP]
Tundra Swan *Cygnus columbianus*[KAR]
Mute swan *Cygnus olor*[IAT]
Swan *Cygnus*[IAT, CAR, SAG]
Red-crested Pochard *Netta rufina*[KAR]
White-headed Duck *Oxyura leucocephala*[SAG]
Ruddy Shelduck *Tadorna ferruginea*[TAS]
Ducks Anatinae[OTR, STA, IAT, NAI, NOD, YEN, EPH, SAG, TAS, BEK, KAR]
Geese Anserinae[OTR, NAI, NOD, YEN, EPH, SAG, PEK, ZEU?]

Family Ardeidae
Grey Heron *Ardea cinerea*[IAT]
Purple Heron *Ardea purpurea*[NAP]
Eurasian Bittern *Botaurus botaurus*[NAP]
Little Bittern *Ixobrychus minutus*[BES?]
Black-crowned Night Heron *Nycticorax nycticorax*[IAT]

Family Charadriidae[BEV, BEK]

Family Gruidae
Common Crane *Grus grus*[IAT, YEN, KAR]

Family Laridae[NAI, BEK]
Common Gull *Larus canus*[BEK]

Family Pelecanidae[IAT, NAI, YEN]
Dalmatian Pelican *Pelecanus crispus*[BES?, LIM]
Great White Pelican *Pelecanus onocrotalus*[IAT]

Family Phalacrocoracidae
Great Cormorant *Phalacrocorax carbo*[IAT, CAE, KAR]

Family Podicipedidae[SAG]
Great Crested Grebe *Podiceps cristatus*[IAT, NAI]

Family Procellariidae
Manx Shearwater *Puffinus puffinus*[CHE]

Family Rallidae
Eurasian Coot *Fulica atra*[BUT, IAT, BES?, SAG, ENB, KAR]
Purple Swamphen *Porphyrio porphyrio*[KAR]
Water Rail *Rallus aquaticus*[ENB]

Family Scolopacidae
Snipes *Gallinago*[BEK]
Eurasian Curlew *Numenius arquata*[BES?]

Birds of cultural landscapes

Family Accipitridae
Rough-legged Buzzard *Buteo lagopus*[NAP?, IAT]

Family Caprimulgidae
European Nightjar *Caprimulgus europaeus*[NAI]
Family Ciconiidae[IAT, EPH, SAG, BEK]
White Stork *Ciconia ciconia*[IAT, BEK]
Family Columbidae[OTR, EPH, SAG, ZEU?]
European Turtle Dove *Streptopelia turtur*[NAP, NAI, BES?, UPP, KAR]
Family Corvidae[EPH, PEA, BEK]
Common Raven *Corvus corax*[TAS, UPP, LEM]
Carrion Crow *Corvus corone*[NAP?, IAT, NAI]
Rook *Corvus frugilegus*[NAP?, IAT, NAI, PEA]
Jackdaw *Corvus monedula*[OTR?, NAI, RIM, HES]
European Magpie *Pica pica*[IAT, NAI]
Family Falconidae
Merlin *Falco columbarius*[UPP]
Family Otididae[BEK]
Great Bustard *Otis tarda*[NAI, CHE, BES?]
Family Passeridae
House Sparrow *Passer domesticus*[NAI]
Family Phasianidae[ZEU?]
Barbary Partridge *Alectoris barbara*[KAR]
Chukar Partridge *Alectoris chukar*[BES?, SAG, PEK, RIM, HES, ENB, UPP]
Rock Partridge *Alectoris graeca*[NAP, NAI, LIM]
Red-legged Partridge *Alectoris rufa*[KAR]
Common Quail *Coturnix coturnix*[NAP, OTR, STA, NAI, CHE, UPP, BEK, LEP, KAR]
Black Francolin *Francolinus francolinus*[UPP]
Grey Partridge *Perdix perdix*[IAT, NAI, BEV, BES?, SAG]
Pheasant *Phasianus colchicus*[NAP, NAI]
Family Rallidae
Corn Crake *Crex crex*[RIM, HES, ENB, UPP]
Family Strigidae
Little Owl *Athene noctua*[NAI]
Family Sturnidae
Common Starling *Sturnus vulgaris*[NAI, KAR]
Family Turdidae[ZEU?]
Common Blackbird *Turdus merula*[NAP, PEA?]
Song Thrush *Turdus philomelos*[NAP, ENB]
Family Tytonidae
Barn Owl *Tyto alba*[HES]

Wood dwelling birds

Family Accipitridae
Northern Goshawk *Accipiter gentilis*[NAP, NAI]
Eurasian Sparrowhawk *Accipiter nisus*[NAP, NAI]
Cinereous Vulture *Aegypius monachus*[KAR]
Common Buzzard *Buteo buteo*[NAP, NAI]
Family Ciconiidae
Black Stork *Ciconia nigra*[UPP]
Family Columbidae
Stock Dove *Columba oenas*[IAT?, NAI, TAS, KAR?]
Common Wood Pigeon *Columba palumbus*[NAP, NIA, SAG]
Family Fringillidae
Linnet *Carduelis cf. cannabina*[NAI]
Chaffinch *Fringilla coelebs*[NAI]
Family Scolopacidae
Eurasian Woodcock *Scolopax rusticola*[NAP]
Family Strigidae
Tawny Owl *Strix aluco*[NAI]

Birds of semiarid and arid habitats

Family Accipitridae
Long-legged Buzzard *Buteo rufinus*[NAP?]
Griffon Vulture *Gyps fulvus*[KAR]
Egyptian Vulture *Neophron percnopterus*[HES, BEK]
Vulture Aegypiinae[YEN, SAG, BEK]
Family Columbidae
Rock pigeon *Columba livia*[(see Domestic species)]
Laughing Dove *Streptopelia senegalensis*[KAR]
Family Corvidae[BEK]
Fan-tailed Raven *Corvus rhipidurus*[UPP?]
Brown-necked Raven *Corvus ruficollis*[UPP?, BEK]
Family Phasianidae
Sand Partridge *Ammoperdix heyi*[HES, ENB, UPP, BEK]
Family Pteroclididae[BEK]
Family Struthionidae
Ostrich *Struthio camelus*[YEN, ENB, LEP, KAR]

Wandering Fish

Family Acipenseridae[IAT, NOV, OLT, NOD, PON, CHE, PEA, SAG]
Russian Sturgeon *Acipenser gueldenstaedtii*[CHE]
Sterlet *Acipenser ruthenus*[NAI]
Starry Sturgeon *Acipenser stellatus*[CHE]
Beluga Sturgeon *Huso huso*[NOD]
Family Anguillidae
European Eel *Anguilla anguilla*[NAI]
Family Salmonidae[STA]
Brown Trout *Salmo trutta*[NAI]

Eurasian freshwater Fish

Family Esocidae
Pike *Esox lucius*[IAT, NOV, NAI, CAP, OLT, CAR, NOD, CHE, SAG, PEA]
Family Siluridae
Wels Catfish *Silurus glanis*[IAT, NOV, NAI, DIC, BEV, CAP, OLT, CAR, NOD, CHE, SAG, PEK, PEA]
Family Percidae
European Perch *Perca fluviatilis*[NAI, CAP, OLT, NOD]
Zander *Sander lucioperca* (Syn.: *Stizostedion lucioperca*)[IAT, NAI, OLT, CAR, NOD, CHE]

Ubiquitous freshwater Fish

Family Cyprinidae[STA, IAT, NOV, NAI, DIC, CAP, OLT, CAR, NOD, CHE, EPH, SAG, PEK, PEA, AMO, UPP, AMA, BAW, SHN]
Common Bream *Abramis brama*[IAT, NOV, CAP, OLT, NOD, SAG]
Common Bleak *Alburnus alburnus*[NAI]
Asp *Aspius aspius*[NAI, CAP, OLT]
Common Barbel *Barbus barbus*[NAI, NOD]
Barbel *Barbus*[EPH, CAE, BAW]
Crucian Carp *Carassius carassius*[NOV, NAI, CAP]
Common Nase *Chondrostoma nasus*[STA?, NAI]
Common Carp *Cyprinus carpio*[STA, IAT, NOV, NAI, BEV, CAP, OLT, CAR, NOD, PON, EPH, SAG, PEK, PEA]
Cyprinid *Labeo*[BAW]
Ide *Leuciscus idus*[NAI, NOD]
Ziege *Pelecus cultratus*[OLT]
Common Minnow *Phoxinus phoxinus*[NAI]
Common Roach *Rutilus rutilus*[IAT, NAI, OLT]
European Chub *Squalius cephalus* (Syn.: *Leuciscus cephalus*)[STA, NAI]

Tench *Tinca tinca*[IAT, OLT, CAR]
Vimba Bream *Vimba vimba*[SAG]

Levantine/African freshwater Fish

Family Cichlidae[SUM, HES, ENB, UPP, TAM, SHN]
Blue Tilapia *Oreochromis aureus*[ENB?]
Mango Tilapia *Sarotherodon galilaeus*[ENB?]
Zille's Tilapia *Tilapia zillii*[CAE, ENB?]
Tilapia *Tilapia*[AMA, BAW, SHN]
Family Clariidae[YEN, HES]
African Sharptooth Catfish *Clarias gariepinus*[CAE, ENB, UPP, TAM]
Catfish *Clarias*[SAG, AMA, BAW]

African freshwater Fish

Family Alestidae (formerly Characidae)[AMA, SHN]
African Characidae *Alestes*[BAW?]
African Characidae *Brycinus*[BAW?]
Family Bagridae
Bagrid Catfish *Bagrus*[BEK, AMA, BAW, SHN]
Family Latidae (formerly Centropomidae)
Nile Perch *Lates niloticus*[CAE, UPP, AMA]
Family Mochokidae
Wahrindi *Synodontis schall*[AMA, BEK]
Squeaker *Synodontis*[BAW, SHN]
Family Mormyridae[AMA, BAW, SHN]
Family Schilbeidae[AMA]

Mediterranean Fish

Family Atherinidae
Old World Silverside *Atherina*[ITA]
Family Balistidae[UPP, BEK]
Grey Triggerfish *Balistes carolinensis*[CAE]
Family Belonidae[BEK]
Garfish *Belone belone*[OTR]
Family Carangidae[STA, CHE, CAE, UPP, BEK]
Orangespotted Trevally *Carangoides bajad*[BEK]
Longnose Trevally *Carangoides chrysophrys*[BEK]
Golden Trevally *Gnathanodon speciosus*[BEK]
Leerfish *Lichia amia*[STA?]
White Trevally *Pseudocaranx dentex*[STA?]
Greater Amberjack *Seriola dumerili*[KAR]
Atlantic Horse Mackerel *Trachurus trachurus*UPP
Family CentracanthidaeITA
Family Congridae
European Conger *Conger conger*[NAP, ITA, KAR]
Family Clupeidae[CHE]
Shads *Alosa*[CHE]
Family Engraulidae
European Anchovy *Engraulis encrasicolus*[CHE]
Family Gadidae[NAP, ITA]
Whiting *Merlangius merlangus*[NOV]
Family Gobiidae[CHE]
Family Labridae[OTR, ITA, CHE, EPH, TAM, BEK, KAR]
East Atlantic Peacock Wrasse *Symphodus tinca* (Syn.: *Crenilabrus tinca*)[CHE, KAR]
Family Merlucciidae[UPP]
Family Moronidae[YEN, EPH, KAR]
European Seabass *Dicentrarchus labrax* (Syn.: *Morone labrax/M. labratus*)[NAP, OTR, UPP, KAR]
Family Mugilidae[STA?, CHE, EPH, CAE, UPP, TAM, BEK, KAR]
Thicklip Grey Mullet *Chelon labrosus*[CAE?, KAR]
Thinlip Grey Mullet *Liza ramada*[UPP?]
Grey Mullet *Liza*[CHE, CAE?]
Flathead Mullet *Mugil cephalus*[SUM, UPP, CAE?, KAR]
Family Mullidae[STA?, CHE]
Red Mullet *Mullus barbatus*[KAR]
Goatfishes *Mullus*[ITA]
Family Muraenidae
Mediterranean Moray *Muraena helena*[OTR]
Family Pleuronectidae[NAI]
European Flounder *Platichthys flesus*[NAI]
Family Polyprionidae
Atlantic Wreckfish *Polyprion americanus*[NAP]
Family Pomacentridae[BEK]
Damselfish *Chromis chromis*[ITA]
Family Scaridae
Mediterranean Parrotfish *Sparisoma cretense*[ITA, EPH]
Family Sciaenidae[OTR, ITA, CAE, HES, BEK, KAR]
Meagre *Argyrosomus regius* (Syn.: *Johnius hololepidotus*)[ENB, UPP, TAM, KAR]
Brown Meagre *Sciaena umbra* (Syn.: *Johnius umbra*)[BES?]
Family Scombridae[ITA, YEN, EPH, SAG, HES, TAM, BEK, KAR]
Bullet Tuna *Auxis rochei*[SAG]
Little Tunny *Euthynnus alletteratus*[KAR]
Skipjack Tuna *Katsuwonus pelamis* (Syn.: *Euthynnus pelamis*)[TAM]
Atlantic Bonito *Sarda sarda*[CHE, SAG, TAM, KAR]
Atlantic Mackerel *Scomber scombrus*[NAI]
Atlantic Bluefin Tuna *Thunnus thynnus*[NAP, ELE?, BES?, KAR]
Family Scophthalmidae
Brill *Scophthalmus rhombus*[CHE]
Family Scorpaenidae[UPP, TAM]
Scorpionfish *Scorpaena*[CHE, EPH]
Family Serranidae[OTR, STA?, PYR, ITA, YEN, EPH, CAE, UPP, TAM, BEK, KAR]
White Grouper *Epinephelus aeneus*[UPP, TAM, KAR]
Dusky Grouper *Epinephelus marginatus* (Syn.: *Epinephelus guaza*)[NAP, ELE?, UPP, KAR]
Grouper *Epinephelus*[BUT, ITA, EPH, SAG, KAR]
Sandfish *Serranus*[ITA]
Family Sparidae[OTR, ITA, CHE, YEN, EPH, CAE, HES, UPP, ENB, TAM, BEK, KAR]
Bogue *Boops boops*[ITA]
Common Dentex *Dentex dentex*[ELE?, ITA, BEC]
Sand Steenbras *Lithognathus mormyrus*[CAE?]
Common Pandora *Pagellus erythrinus*[ITA]
Porgy *Pagellus*[KAR]
Red Porgy *Pagrus pagrus* (Syn.: *Sparus pagrus*)[ITA, CAE?, KAR]
Sea Bream *Rhabdosargus*[BEK]
Gilt-head Sea Bream *Sparus aurata*[NAP, BUT, BES?, EPH, SUM, CAE?, UPP, TAM, KAR]
Family Xiphiidae[YEN]

Red Sea Fish

Family Acanthuridae[BEK]
Family Ariidae[BEK]
Family Chanidae[BEK]
Family Chirocentridae[BEK]
Family Diodontidae[BEK]

Family Ephippidae[BEK]
Family Haemulidae[BEK]
Family Holocentridae[BEK]
Family Lethrinidae[BEK, UPP]
Emperors *Lethrinus*[ENB, TAM]
Family Lutjanidae[BEK]
Family Ostraciidae[BEK]
Family Scaridae[HES, UPP, ENB, BEK]
Candelamoa Parrotfish *Hipposcarus harid* (Syn.: *Scarus harid*)[ENB?]
Parrotfish *Pseudoscarus*[HES]
Parrotfish *Scarus*[UPP, TAM]
Family Siganidae[BEK]
Family Sphyraenidae[BEK]
Family Tetraodontidae[BEK]
Family Terapontidae[BEK]

Cartilaginous Fish (selection)

Family Rajidae
Thornback Ray *Raja clavata*[CAN, CHE]
Family Sphyrnidae[KAR]
Family Squalidae
Dogfish Shark *Squalus*[KAR]

Small Mammals (selection)

Family Muridae
House Mouse *Mus musculus*[NAP, PYR, NAI, EPH, RAQ, UPP, KAR]
Black Rat *Rattus rattus*[NAP, GIU, STA, NIC, PYR, GOR, IAT, NOV, NAI, DIC, BEV, SAR, EPH, SAG, CAE, UPP, BEK, BAW, KAR]

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Summary

The present study reviews the current archaeozoological state of knowledge for the Era of the Byzantine Empire. By analysing how animal husbandry, hunting, fowling, and fishery are represented in the faunal materials, new insights into the diet of this era can be gained. Most of the faunal materials examined were from the Early Byzantine Period (395-642). To isolate the factors that determine the composition of the faunal materials, the area of research was split into seven regions, which were first examined separately. Meat diet in the Byzantine Empire was based on livestock husbandry, and for the choice of which animals were to be kept their respective secondary products were crucial. The composition of the main domestic livestock in the different areas demonstrates that the transition from the Roman to the Early Byzantine Era took place without any major shifts in the animal husbandry patterns. The economic focuses were maintained with minor amendments particularly in the utilisation of the less important species. The Byzantines dealt with famine and shortages by increasing their use of natural resources, as is evident from the high percentage of game, fish or wild fowl, which were shot, trapped, or fished in the immediate vicinity of the sites.

Riassunto

Animali nell'Impero Bizantino: una panoramica delle testimonianze archeozoologiche.

Il presente lavoro offre una sintesi della ricerca sull'archeozoologia dell'Impero Bizantino. Studiando i resti dell'allevamento del bestiame, della caccia, dell'uccellatura e della pesca ritrovati nei siti archeologici, si cerca di ricostruire le abitudini alimentari di quei tempi. La maggiore concentrazione di reperti risale al periodo iniziale dell'Impero Bizantino (395-642). Per isolare i fattori determinanti la composizione dei reperti faunistici, il territorio considerato viene diviso in sette regioni geografiche che sono esaminate singolarmente. L'alimentazione nell'Impero Bizantino si basava sull'allevamento del bestiame, gli animali si allevavano non solo per la loro carne ma anche per gli altri prodotti che fornivano. I reperti animali confermano una continuità del sistema Romano nelle province con alcune modifiche marginali nell'uso delle specie meno importanti. I Bizantini affrontavano fame e carestie con un maggiore sfruttamento delle risorse naturali, come può essere sicuramente provato dalle elevate percentuali di selvaggina, di gallinacei o di pesce, che sono stati cacciati, catturati o pescati nelle immediate vicinanze di ciascun sito.

Zusammenfassung

Tiere im Byzantinischen Reich: Archäozoologische Forschungen im Überblick.

Die vorliegende Studie gibt einen Überblick über den Forschungsstand zur Archäozoologie des Byzantinischen Reiches. Indem betrachtet wird, wie Viehzucht, Jagd, Vogelfang und Fischerei ihren Niederschlag in den Faunenmaterialien finden, sollen Erkenntnisse über die Ernährungsweise dieser Zeit gewonnen werden. Die meisten Knochenensembles stammen aus frühbyzantinischer Zeit (395-642). Um die Faktoren zu isolieren, die für die jeweilige Zusammensetzung der Faunenspektren bestimmend waren, wurde das Forschungsgebiet in sieben Einzelregionen unterteilt, die zunächst einzeln untersucht wurden. Die Ernährung im Byzantinischen Reich fußte auf der Haltung von Vieh, dessen Sekundärprodukte eine große Rolle bei der Wahl der jeweiligen Tiere spielten. Die anhand des Haustierartenspektrums erkennbaren Nutzungsschwerpunkte belegen eine Weiterführung der für die Römische Zeit festgestellten Viehwirtschaftsweise in den Provinzen mit kleineren Anpassungen vor allem in der Nutzung der weniger wichtigen Arten. Nahrungsknappheiten und Hungersnöten wurde mit einer verstärkten Ausbeutung natürlicher Ressourcen begegnet, wie stellenweise hohe Anteile an Jagdwild, Fisch oder Wildvögeln anzeigen. Diese wurden stets in der Nähe der Siedlung erlegt oder gefangen.