

THE CHARACTER OF ANIMAL EXPLOITATION AND THE ENVIRONMENT AT THE POLISH/PRUSSIAN FRONTIER IN THE MEDIEVAL PERIOD: A CASE STUDY

DANIEL MAKOWIECKI, MARZENA MAKOWIECKA

Abstract

This paper presents a comparative, diachronic study of the faunal assemblages recovered from two key political, cultural and commercial centres in the medieval Polish-Prussian borderlands: Kaldus in the Kulmerland, and Gdańsk in Pomerania. Both centres were situated in a region which was incorporated into the Teutonic Order's state following the Crusades against the Prussian tribes in the 13th century. Although comparative trends are noticeable between the two centres which can be linked to the development of the Polish (Piast) state, the variation reflects specific local ecological and cultural contexts. Due to the constraints of space, this study focuses on the relative representation of different species of mammals, birds and fish, demonstrating how diachronic trends can be linked to the marked historical phases associated with the cultural and environmental transformation of this frontier, from one dominated by the Piast state to the later Teutonic Order's polity.

Key words: zooarchaeology, Kaldus, Gdańsk, Polish state, Teutonic Order, environment, mammals, birds, fish.

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The region, its history, and the zooarchaeological background

If the term 'Polish/Prussian frontier' is coined with respect to the Middle Ages, it must be expressed with at least some basic impression of the delineated area which is related to it. Regarding present-day historical knowledge of the tribes settling the area around the south Baltic coast, it is sensible to say that the River Vistula broadly delineates a natural border between Slavs on its left bank and Prussian tribes on the right (Fig. 1).

In the previous century, archaeological research carried out along the Vistula documented many settlements related to the early medieval period. At the same time, numerous assemblages of animal remains were collected and investigated. The results were published in many reports relating to mammals (e.g. Sobociński 1968; 1978; 1979; 1980; 1988; 1991a; 1992a, b; Sobociński, Makowiecki 1992), birds (Nogalski 1991; 1992a, b, c; Nogalski *et al.* 1992; Waluszewska-Bubień 1976; 1980) and fish (Iwaszkiewicz 1991).

The most numerous zooarchaeological collections were recovered from two localities, which in the medieval period were very important centres. The first, Kaldus (a small village close to Chełmno, reported in historical records as Culm), is on a tributary of the Vistula (the Nogat), and the second, Gdańsk, is about 150 kilometres north of the first one.

In Kaldus, the first zooarchaeological research was carried out in the 1970s, when a small assemblage of mammal remains and birds was investigated (Sobociński 1980; Waluszewska-Bubień 1980). Beginning from 1996, new studies combined with the interdisciplinary project concerning historic *in Culmine* were undertaken (Chudziak 2003). The effects of the first zooarchaeological analyses were short articles reporting animal taxons, the most important animal subsistence strategies, and some features of the natural environment. In 2010, a decade of research was concluded (1996 to 2005) with a voluminous zooarchaeological monograph presenting the spectrum of data, debates on animal subsistence strategies, hunting, fishing, social differentiation, and the natural environment (Makowiecki 2010). Data and the aforementioned topics were considered in the well-elaborated archaeological temporal and spatial context (Chudziak 2003).

Remains from Gdańsk, recovered in the 1950s and 1960s, mainly from the early medieval stronghold adjacent to its port and settlements, were analysed by different researchers. They reported their results in numerous publications, mainly related to mammals (Jaworski 1952; Krysiak 1955; 1956; 1967; Kubasiewicz 1977) and fish (Dąbczewski 1952; Susłowska 1966, 1967, 1968; Susłowska, Urbanowicz 1967; Urbanowicz 1965; 1967), and some scarce data was related to birds (Nogalski 1984).

Starting from the 1990s, a number of excavations were taken up in places that are historically linked to the de-

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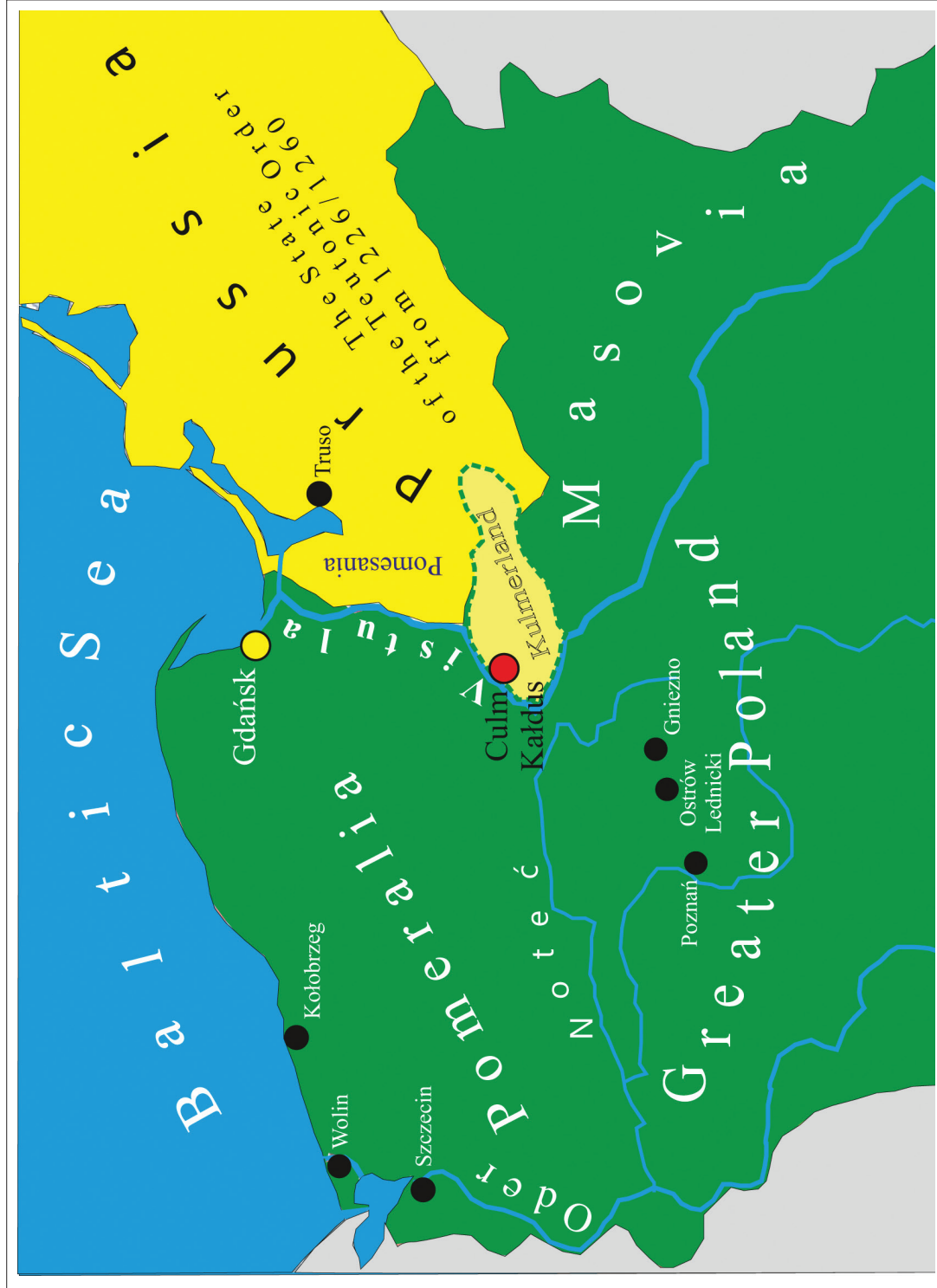


Fig. 1. A map of the region, with the locations of the two centres mentioned in the paper (prepared by authors).

velopment of the city, from the time of the Crusaders until Prussian times. In the study, a number of remains were recovered belonging to mammals, birds and fish. Their analyses were conducted by the authors in a variety of projects and collaborations with the Archaeological Museum in Gdańsk and some private companies. The growing number of material was so significant that the main effort was focused on current analysis, with results presented in unpublished reports stored in the archives of the Archaeological Museum (Paner 2006). From these early stages of research, some preliminary data and reflections on mammals were published in one article (Makowiecka *et al.* 1998), and in two other papers on bird remains (Makowiecki, Gotfredsen 2002; 2003). Records relating to fish were included in a separate analytical-synthetic study devoted to the history of fish and fishing (Makowiecki 2003a), and the remains of cod were examined in isotopic projects on cod fishing and trade in medieval northern Europe (see Barrett *et al.* 2008; Orton *et al.* 2011).

The main events associated with the historical context

Animal subsistence on the Polish/Prussian frontier should be considered in at least three stages. This is sensible, because of political and cultural events reported in historical records. The first will be called the 'pre-Crusades stage', and started in 966 with the introduction of Christianity into Slavic territory between the rivers Vistula and Oder by Mieszko I, a duke of the Piast dynasty. He started by creating a stable political, cultural and economic structure, which can be described as European. It was based on central places consisting of prominent fortified wooden strongholds and unfortified adjacent villages with cemeteries (Fig. 2). In the most important of them, called *sedes regni principalis*, a stone basilica constituted the characteristic architectural form. The dynastic successors of Mieszko I continued the development of the state, and extended it to regions in all possible directions. Only one region close to the state, located on the right bank of the Lower Vistula, belonged to the pagan Prussians, who posed a serious military threat to the young Christian Polish state.

In 1226, we may point to the second stage related to the period of crusading (the 'Crusaders stage'), when Konrad I, a local duke of Masovia from the Piast dynasty, intending to solve the Prussian problem, invited the Teutonic Knights and granted them the Kulmerland (Chełmno land), located just beside the frontier with the Prussian territories. In return for this, their duty was to propagate Christianity among the pagans, and to simultaneously put an end to the duke's difficulties.

In a very short time, the Crusaders took advantage of the unstable political situation among the Piast dukes, and built their own powerful state in the region of Prussia. Subsequently, at the beginning of the 14th century, they incorporated into their state the eastern part of Pomerania, which had earlier belonged to the Piasts. In fact, the crusading state was created, and started to grow into a political and economic power through a very well-organised administrative system with a network of castles. Therefore, it is expected that the exploitation of natural resources and a visible impact on the environment occurred at this time.

Finally, in 1466, after three centuries of dynamic development and conflict, the Teutonic Knights lost a vast part of the area on the left bank of the Vistula, and some on the right bank of the river as well. Therefore, from that date, it is sensible to indicate the third stage, with Gdańsk being part of the Kingdom of Poland. This would be called the 'post-Crusaders stage'. In 1525, the state of the Teutonic Knights was forced to become the fief of the Polish king, and it was secularised and transformed into the Duchy of Prussia, the first Protestant state. From the year 1793, a new stage in the city's history is bound up with the Kingdom of Prussia, which incorporated Gdańsk into its structure.

It is worth mentioning that the Crusaders stage is one of the characteristic periods in the history of the Polish/Prussian frontier, and not only because of the Teutonic Knights, but at the same time because of changes in the structure of the system of human settlements, which consisted of castles, towns and villages. This must have created different strategies in agriculture and the exploitation of the environment, such as forests, fields, rivers and lakes.

In the historical context presented above, Kaldus is regarded as the most important cultural, economic and political centre in the Kulmerland, and it existed from the turn of the seventh century to the turn of the 12th century. All reported zooarchaeological material corresponds with the pre-Crusaders stage. Gdańsk started its history from the tenth/11th century, and it has continued to be occupied until today. When excavations were carried out in different parts of the city, a huge amount of zooarchaeological data was collected and analysed, and it can be arranged in relation to all the historical stages described above.

Taking into account the present state of knowledge concerning the historic development of both centres, common and various features can be indicated. Common characteristics include their important roles in the cultural development of the discussed Slavic frontier zone. They were both within the Teutonic Knights' sphere of influence. Gdańsk undoubtedly differed from



Fig. 2. The settlement complex in Culmine (11th-12th/13th century) belonging to the type of *sedes regni principalis*, now Kałdus, Kujavian-Pomeranian voivodeship. Contour plan with the location of the excavated area researched by the Institute of Archaeology of Nicolaus Copernicus University in Toruń in the years 1996 to 2005 (after Makowiecki 2010).

Kaldus, in the long distance away, and in the fact that, despite its tempestuous history, it has never lost its significance as an important centre; while Kaldus, as early as the 13th century, after the arrival of the Teutonic Order, lost its original purpose in favour of nearby Chelmno, a town set up by the Order in 1233.

Undoubtedly, an important feature of both centres is their situation as far as the natural environment is concerned, especially aquatic zones. Although both are located on the biggest river in the zone, Gdańsk also had access to the Baltic Sea. Hence, their access to fauna and the development of animal-based subsistence varied.

It can be assumed that the most important properties of both centres' locations had an impact on both common and different features in economic strategies (animal subsistence) and processes occurring in the natural environment.

Methods

The goal indicated in the title of this paper was fulfilled by quantifying animal taxons and the abundance of animal bone fragments (NISP), analysed by percentage. An analysis of raw material of animal origin obtained was based on percentage relations between vertebrates, i.e. domesticated mammals, wild mammals, birds, fish, and between particular species of listed groups. In this case, the data concerning domestic mammals for consumption, that is, cattle, pigs, sheep/goats and horses, were particularly meaningful.¹ Features of the natural environment were estimated on the grounds of contemporary biotopes of particular species of wild mammals, birds and fish. Within these groups, sub-groups of faunal representatives inhabiting similar biotopes or creating separate animal groups associated with nutrition were distinguished. Relating to categorisations of medieval wild mammals, taxons of this group were divided into big game, *Animalia superiora*, and small game, *Animalia minuta*. The first of them includes species such as bear, boar, red deer, elk, roe deer, aurochs and European bison; while the other group consists of hare, squirrel, beaver, fox, wolf, European badger, beech marten and weasel. Of all the listed species, two provided the basis for indicating changes occurring in the natural environment. They were: a) hare, preferring open landscapes; and b) roe deer, which easily adapts to identical landscape conditions (Makowiecki 2001; 2010).

¹ Studies on the remains of this species from medieval, but also prehistoric, deposits indicate that its meat was consumed, although this had not been the main purpose of breeding it (Makowiecki 2001; 2004; 2010).

Zooarchaeological data were analysed in chronological contexts, based on archaeological dating criteria. They provided the basis for searching trends, marked out by percentage indicators. Their significance was explained by cultural and natural processes occurring in the Prussian/Slavic boundary zone (in the early Middle Ages, before the arrival of the Teutonic Knights, on the basis of the data from Kaldus and Gdańsk), and subsequently the Polish/Teutonic one (beginning with the 13th century, only on the basis of the material from Gdańsk).

In the case of Kaldus, the results of the studies on remains, animal subsistence, sociotopography and the environment, included in the voluminous monograph mentioned above, were used (Makowiecki 2010). Based on archaeological and historical data (Chudziak 2003; 2006), bone collections were combined into four phases: first, referring to the tribal period (mid-seventh to eighth centuries); second, encompassing the times of the centre functioning within the territory of the early Piast state (tenth/11th century to the first half of the 11th century); third, relating to the tribal separatism of the Kulmerland (second half of the 11th century to the 11th/12th century); and fourth, identified with the centre functioning as a Piast castellany (mid-12th to first quarter of the 13th century).

As far as Gdańsk is concerned, data taken mainly from publications and the results of many years of analysis by both authors were taken into consideration. Others are accessible only in the form unpublished reports kept in the archives of the Archaeological Museum in Gdańsk, and a list of them can be found in publications on archaeological explorations in the city (Paner 2006). Zooarchaeological materials, despite complications connected with their dating, were arranged in order referring to crucial historic events in the city's development, i.e. until Slavic times or rather the pre-Crusaders stage (about the end of the tenth century until 1308), the Crusaders stage, and the post-Crusaders stage, when the town returned to the rule of the Polish kings (from 1466), and was subsequently incorporated into the Kingdom of Prussia (from 1793).

Kaldus, Culm

Of nearly 100,000 bone fragments excavated in the area of the Kaldus settlement complex, over 75,000 were examined (Table 1). They originate from domesticated and wild mammals, birds and fish. Moreover, single fragments of invertebrates, such as freshwater molluscs and crayfish, were also identified.

Fauna of that settlement complex made up a varied composition of groups referring to different economic,

Table 1. Kałdus, Kujavian-Pomeranian voivodeship: animal taxa and their NISP in the chronological context and pottery phases (Makowiecki 2010)

Animal	Fazy I-IV	Fazy V-VI	Fazy VI-VIII	Fazy VIII-IX	Total
Cattle <i>Bos primigenius</i> f. <i>taurus</i>	940	875	6883	6733	15431
Pig <i>Sus scrofa</i> f. <i>domestica</i>	845	972	6006	7559	15382
Sheep/Goat <i>Ovis ammon</i> f. <i>aries</i> / <i>Capra aegagrus</i> f. <i>hircus</i>	427	390	2127	2759	5703
Sheep <i>Ovis ammon</i> f. <i>aries</i>	46	26	211	154	437
Goat <i>Capra aegagrus</i> f. <i>hircus</i>	17	20	67	91	195
Horse <i>Equus ferus</i> f. <i>caballus</i>	122	119	719	676	1636
Dog <i>Canis lupus</i> f. <i>familiaris</i>	23	17	98	92	230
Cat <i>Felis silvestris</i> f. <i>catus</i>		1	8	25	34
Hare <i>Lepus europaeus</i>	7	5	79	82	173
Red squirrel <i>Sciurus vulgaris</i>	1		2	12	15
European beaver <i>Castor fiber</i>	1	3	15	7	26
Grey wolf <i>Canis lupus</i>			1		1
Grey wolf/Dog <i>Canis lupus/Canis lupus</i> f. <i>familiaris</i>				1	1
Red fox <i>Vulpes vulpes</i>	2	1	8	16	27
Brown bear <i>Ursus arctos</i>	41		42	23	106
Marten <i>Martes</i> spec.					
Badger <i>Meles meles</i>			4	1	5
<i>Mustelids</i> mustelidae			1		1
Least weasel <i>Mustela nivalis</i>				1	1
European otter <i>Lutra lutra</i>	1			2	3
Wild cat <i>Felis silvestris</i>			1	1	2
Wild/Domestic cat <i>Felis silvestris/Felis silvestris</i> f. <i>catus</i>			1		1
Eurasian lynx <i>Felis lynx</i>				1	1
Wild boar <i>Sus scrofa</i>	265	42	1000	578	1885
<i>Sus scrofa</i> L./ <i>Sus scrofa</i> f. <i>domestica</i>	2		1		3
Red deer <i>Cervus elaphus</i>	123	23	719	425	1290
Elk <i>Alces alces</i>	25		37	45	107
Roe deer <i>Capreolus capreolus</i>	44	18	299	252	613
Aurochs <i>Bos primigenius</i>	13	2	31	24	70
Aurochs/Cattle <i>Bos primigenius/Bos primigenius</i> f. <i>taurus</i>		1		1	2
Aurochs/European bison <i>Bos primigenius/Bison bonasus</i>		1	1	2	4
European bison <i>Bison bonasus</i>			3		3
Birds Aves	44	151	664	1533	2392
European pond turtle <i>Emys orbicularis</i>				1	1
Fish Pisces	25	193	674	1763	2655
<i>Bivalvia</i>	5	4	9	8	26
Crayfish <i>Astacus</i> sp.				2	2
Identified	3019	2864	19711	22870	48464
Not identified	1225	899	5452	7969	15545
Total	4244	3958	25163	30839	64204

zoocenotic factors and body sizes. Domestic mammals included cattle, pigs, sheep, goats, horses, dogs and cats. Representatives of *Animalia superiora* included the following taxa: brown bear, wild boar, red deer, elk, roe deer, aurochs, aurochs/bison and bison. Animals from the *Animalia minuta* group were: European brown hare, squirrel, beaver, wolf, fox, beech marten, badger, mustelids, weasel, otter, wildcat and lynx. The list of avifauna is quite long, and consists mainly of wild species (Table 2), although the most numerous were remnants of chicken (domestic fowl). Domestic birds can also be represented by *Anser* and *Columba*. The list of fish contains mostly freshwater species, but also migratory fish (diadromous: catadromous and anadromous), and marine ones (Table 3).

Taking into account the study's results presented in the individual diagrams, the following characteristic features can be distinguished. The basis of exploitation was on domestic animals, and domestic fowl. The relevance of hunting and fishing, documented in zooarchaeological materials by numerous assemblages of wild mammals, birds and fish, cannot be ignored either. They were particularly important in seasons when a clear deficiency of agricultural products and meat from farm animals was observed. The best example in this case is fishing, which could deliver a substantial quantity of proteins in the spring, when fish gathered to spawn and were easy prey for humans (Makowiecki 2003a).

It should be noted that the percentage of domestic mammals in comparison with other animal groups is variable from a diachronic point of view (Fig. 3).

The reported trends can be correlated with the historic stages of the centre's development. The high representation of wild mammals refers to the period when the centre was not under the political influence of Piast state structures, that is, in the times of tribal development, and in times of 'tribal separatism', being the effect of the historically documented crisis. In contrast, the relatively high domestic mammal representation is characteristic of assemblages relating to the presence of the Piast administration in the centre, for the first time from the turn of the tenth/11th century to the first half of the 11th century, and for the second time in the 12th and the first quarter of the 13th century.

Identical tendencies are observable in the percentage representation of bone remains within the group of domestic mammals, and concern mainly cattle and pigs (Fig. 4). Although in all stages of the centre's development, cattle, pigs, sheep, goats and horses were bred, the proportions of their consumed meat underwent changes. During the tribal period in the times of tribal separatism, cattle were of greater significance, while during the times of the centre functioning as a crucial element of the Piast state, pigs were of greater importance. It can be supposed that this species' meaning is an effect of the economic strategy introduced by the Piasts, well evidenced, amongst others, in Greater Poland (the core territory of the Piast state), where the basis of the meat diet was pork (Makowiecki 2001; 2007; 2009).

Hare was the main component of hunted animals of *Animalia minuta* (Fig. 5). Its representation in both the collection from the stronghold and the settlement is

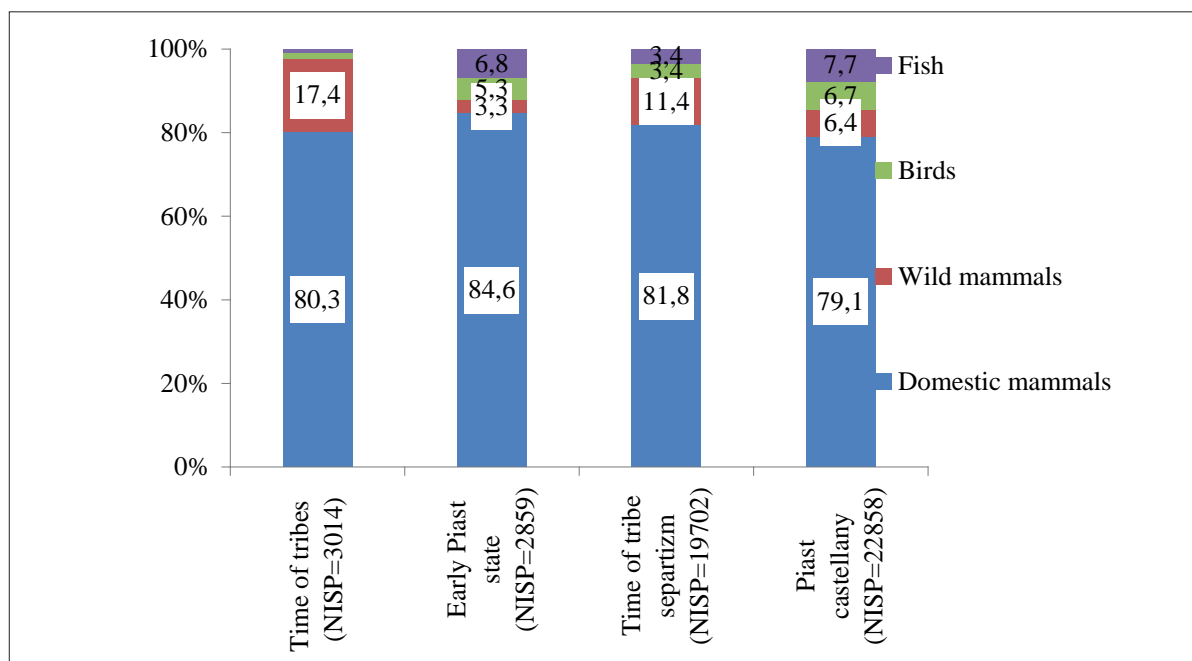


Fig. 3. Kaldus (eighth to 13th century): the percentage of animal groups in the historical stages of the *Culmine* complex (NISP=56284) (graph by authors).

Table 2. Kałdus, Kujavian-Pomeranian voivodeship, settlement and cemetery (site 2) and stronghold (site 3): bird taxa and their NISP (see Makowiecki *et al.* 2007; Makowiecki 2010)

Birds	Kałdus 2	Kałdus 3	Total
Red-necked grebe <i>Podiceps grisegena</i>		1	1
Cormorant <i>Phalacrocorax carbo</i>	1	1	2
Bittern <i>Botaurus stellaris</i>	1		1
Grey heron <i>Ardea cinerea</i>		4	4
White stork <i>Ciconia ciconia</i>		1	1
Stork <i>Ciconia</i> sp.		1	1
Mute swan <i>Cygnus olor</i>	1		1
Goose <i>Anser</i> sp.	143	94	237
Wigeon <i>Anas penelope</i>		1	1
Gadwall <i>Anas strepera</i>		2	2
Teal <i>Anas crecca</i>	1	1	2
Mallard <i>Anas platyrhynchos</i>	1		1
Duck <i>Anas</i> sp.	30	23	53
Ferruginous duck <i>Aythya nyroca</i>		1	1
Common goldeneye <i>Bucephala clangula</i>	3		3
Sparrowhawk <i>Accipiter nisus</i>	3		3
Goshawk <i>Accipiter gentilis</i>	1	18	19
Kestrel <i>Falco tinnunculus</i>		1	1
Lesser spotted eagle/Osprey <i>Aquila pomarina/Pandion haliaetus</i>		1	1
Black grouse <i>Tetrao tetrix</i>	24	26	50
Capercaillie <i>Tetrao urogallus</i>	21	49	70
Black grouse/Capercaillie <i>Tetrao</i> sp.	1		1
Partridge <i>Perdix perdix</i>	2		2
Domestic chicken <i>Gallus gallus</i> f. <i>domestica</i>	788	389	1177
Crane <i>Grus grus</i>	9	31	40
Moorhen <i>Gallinula chloropus</i>		1	1
Coot <i>Fulica atra</i> L., 1758	1		1
Woodcock <i>Scolopax rusticola</i>		1	1
Stock dove <i>Columba oenas</i>	2	4	6
Dove <i>Columba livia</i> f. <i>domestica</i>		1	1
Stock dove/Dove <i>Columba oenas/Columba domestica</i>		1	1
Dove <i>Columba</i> sp.		1	1
Short-eared owl/Long-eared owl <i>Asio flammeus/Asio otus</i>		1	1
Starling <i>Sturnus</i> sp.		1	1
Jay <i>Garrulus glandarius</i>		3	3
Raven <i>Corvus corax</i>	3	3	6
Carrion crow <i>Corvus corone</i>	1	6	7
Jackdaw <i>Corvus monedula</i>		3	3
Corvus sp. <i>Corvus</i> sp.		8	8
Total	1036	679	1715

identical (Makowiecki 2010). The group of *Animalia superiora* is represented by a high level of participation of bones belonging to wild boar, red deer and roe deer (Fig. 5). The remaining species, elk, aurochs and European bison, are represented by a small percentage, while the latter was reported only in the stronghold.

Observing the percentage data of hare in comparison with the remaining species of the *Animalia minuta*

group, and roe deer in relation to the species of *Animalia superior*, it can be noted that both of them clearly increased their representation in the younger stages (Fig. 6). This corresponds to the stage when the centre *in Culmine* became bigger, and a more important centre for culture and trading (Chudziak 2003).

The list of birds was estimated on the grounds of studies of only a portion of bones recovered from sites 2

Table 3. Kaldus, Kujavian-Pomeranian voivodeship: fish taxa and their NISP, preliminary identification (see Makowiecki 2010)

Fish group	Biotope	Fish	Kaldus 1	Kaldus 2	Kaldus 3	Kaldus 4	Total	
Fresh water	Rivers/lakes	<i>Cyprinids Cyprinidae</i>	2	698	132	283	1115	
		Roach <i>Rutilus rutilus</i>		4		3	7	
		Rudd <i>Scardinius erythrophthalmus</i>		1			1	
		Bream <i>Abramis brama</i>		47	9	4	60	
	Lakes/rivers	Catfish <i>Silurus glanis</i>			23	56	31	110
		Pike <i>Esox lucius</i>			180	55	27	262
		Perches Percidae			6			6
		Perch <i>Perca fluviatilis</i>			31	2	13	46
		Pike-perch <i>Sander lucioperca</i>			21	17		38
	Lakes	Tench <i>Tinca tinca</i>			24	14	5	43
		Crucian carp <i>Carassius carassius</i>			3	2	3	8
	Rivers	Ide <i>Leuciscus idus</i>			5	1		6
		Asp <i>Aspius aspius</i>	2		19	7		28
		Burbot <i>Lota lota</i>			1			1
Migratory	Rivers/Seas	Salmon/Sea trout <i>Salmo spec.</i>		2	3		5	
		Atlantic sturgeon <i>Acipenser oxyrinchus</i>	3	114	195	5	317	
		Eel <i>Anguilla anguilla</i>			1		1	
Marine	Seas	Herring <i>Clupea harengus</i>		10	14		24	
		Identified	7	1190	507	374	2078	
		Not identified	1	536	95	107	739	
		Total	8	1726	602	481	2817	

and 3 (Table 2). They represent a few orders relating to distinguishing methods discussed in the introduction, and they belong to several ornithological groups. Chicken remains are predominant in both collections; the other bird groups are represented by a lower percentage, in which goose and wild galliformes are particularly prominent. An analysis of the graphic picture of the data obtained indicates that both sites are different as far as the percentage of the distinguished groups and taxons are concerned. There is clearly a smaller representation of chicken (57.3%) in the stronghold than in the assemblage from the settlement (76.1%), while the representation of other birds is lower in the assemblages from the settlement (Makowiecki 2010).

The only common feature of both sites is the identical representation of geese (13.8%). These proportions are a reflection of the different social and economic functions of both settlements. Site 2 was a settlement of a residential-household character, while site 3 served ritual-religious purposes in tribal periods, and later in Christian periods as well (Chudziak 2003; Makowiecki 2010).

Preliminary studies of 2,803 fishbones were the basis for distinguishing 18 taxa (Table 3). Considering the types of waters inhabited by them, they belong to three ecological groups, freshwater fish, diadromous (migratory) fish, and marine fish. The first is evidently the most numerous, consisting of species typical of river

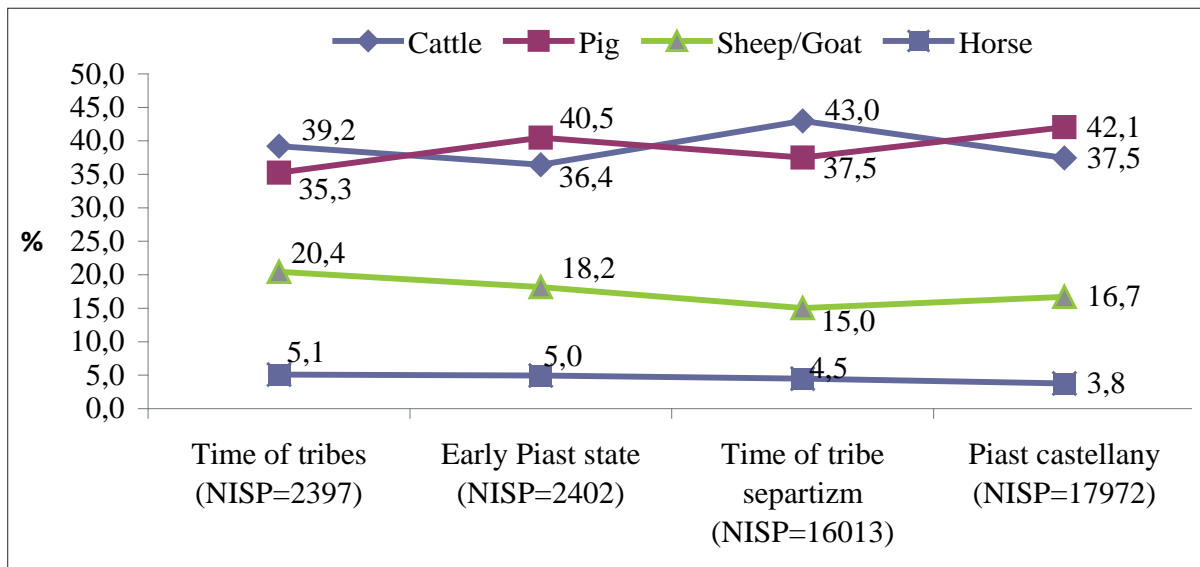


Fig. 4. Kałdus: the percentage of domestic species in the historical context of the *Culmine* complex (graph by authors).

waters (asp, ide and burbot), and characteristic of a high degree of lake eutrophication (tench and crucian carp). The most numerous are those existing in both types of water body, including Cyprinidae and predatory fish, such as pike, catfish, perch and pike-perch. Among diadromous species are sturgeon, salmon/trout, and eel. The only sea fish is herring.

The percentage representation of the described taxa is varied. Cyprinidae are the main component (26% to 56%), with the most numerous recognised remains of common bream, tench and asp. Other families are represented by quite a high representation of species, such as sturgeon (9% to 38%), pike (7% to 15%) and catfish (2% to 11%). The percentage of other fish is definitely lower. The explored sites differ with the frequency of identified taxa. Cyprinidae constitute the most numerous component of sites 2 and 4, with a clear decline in site 3 (26%). The last, in turn, has a prevalence of sturgeon remains (38%). Differences between percentage indicators of the remaining fish in particular sites are slight. They concern species such as tench, pike-perch and herring;² the quantity of their bones is a little larger in the stronghold, and pike, bream and asp are more often identified in site 2.

The data above suggest that the centre *in Culmine* implemented a strategy consisting of several elements fulfilling their economic needs. This included the husbandry of domestic mammals and birds, hunting mammals and wild birds, and fishing. In the case of the latter, the trade in herring can be indicated as the effect of contacts with coastal centres and the introduction of

Christianity to the Kulmerland by the Piast state. The recorded faunal components point to the exploration of various landscape zones, such as forests, open spaces, swampy areas and waters (definitely the Vistula, but also lakes situated in the uplands).

Palynological data obtained from cores indicate that, although the valley of the River Vistula had been nearly completely deforested in the early Middle Ages, the spectra included the pollen of, among others, birchwood, oak, hard beam and elm, being components of forest concentrations (Noryskiewicz 2004). Because of this fact, it can be assumed that in the valley itself, forests were still the primary landscape element, and in the area of the uplands there was even much denser woodland. It consisted first and foremost of sub-continental *tilio carpinetum corydaletosum* (Cyzman, Kamiński 2004), which at present consists of oak-bass-hard-beam forests (Matuszkiewicz 2008). The interiors of the listed complexes must have created favourable habitats for numerous species of forest mammals, whose remains were identified during analyses of zooarchaeological material.

Taking into consideration the taxa of wild fauna representing independent proxies of their paleoenvironment and preferred biotopes, we can draw conclusions concerning not only the forestation of the Culm area, but also concerning the existence of landscapes characterised by a mosaic of various open spaces and shrubs and deciduous woods. The group of animals preferring forest biotopes consists firstly of predatory species, such as lynx (Buchalczyk 1984; Okarma 2000), wildcat (Buchalczyk 1984), badger (Buchalczyk 1984; Sumiński 1989), brown bear (Buchalczyk 1984), and wolf (Okarma 1992). Herbivorous mammals are represented here by bison (Pucek, Sych 1984; Krasieńska,

² The site also contained four pieces of herring, found in a heap the 12 th trench on the basilica area, by its southern walls. Due to their ambiguous stratigraphic position, they were omitted in the present collation of results.

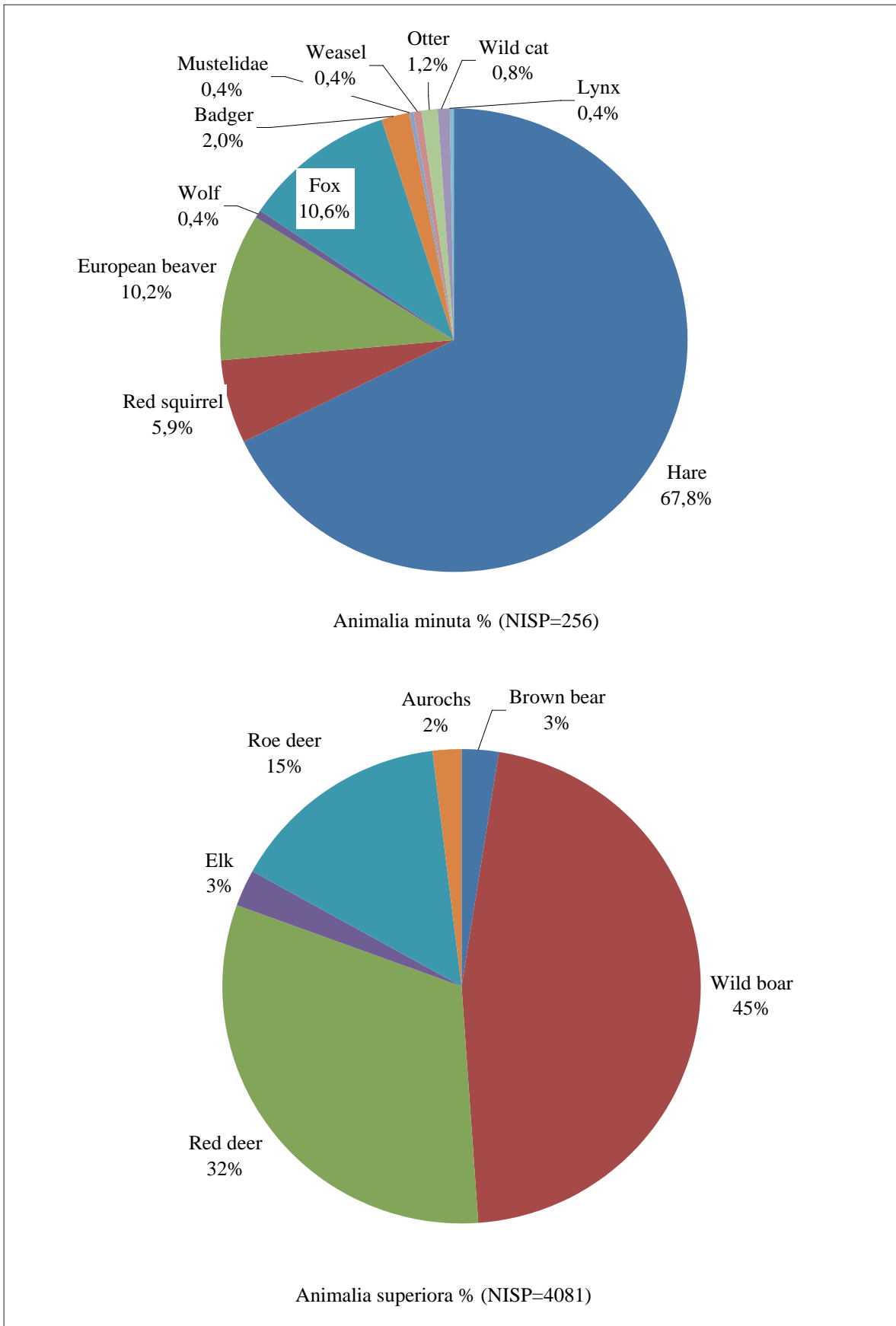


Fig. 5. Kaldus: the percentage of *Animalia minuta* and *Animalia superiora* species in the historical context of the *Culmine* complex (graph by authors).

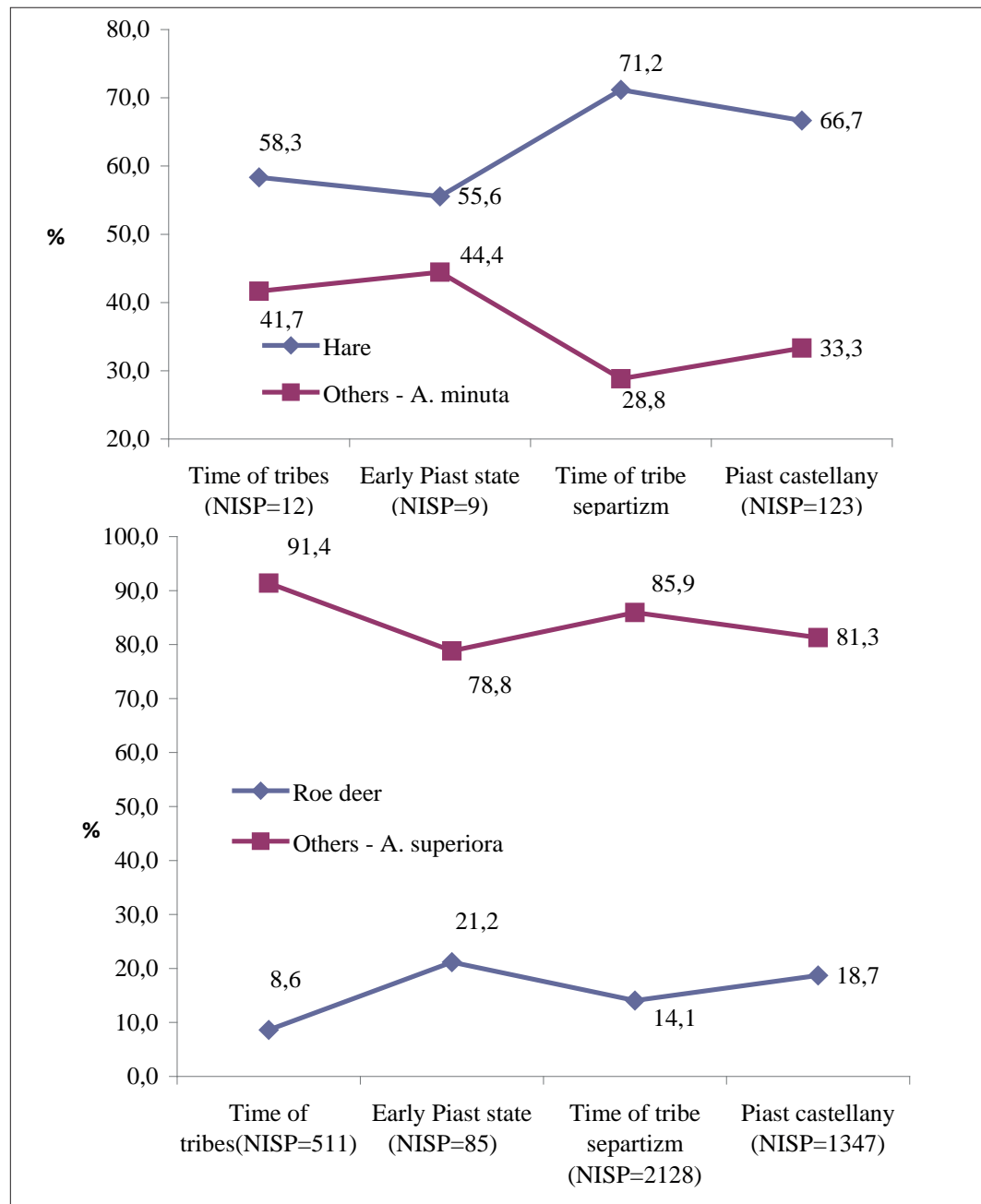


Fig. 6. Kałdus: the percentage remains of two groups of wild mammals in the historical stages: a) hare versus *Animalia minuta*; b) roe deer versus *Animalia superiora* (graph by authors).

Kraśński 2007), aurochs (Głowaciński 1992), red deer (Dzięgielewski 1973), elk (Pucek, Sych 1984), and wild boar (Fruziński 1993). Forest biotopes are also preferred by various birds, e.g. capercaillie and black grouse (Matuszewski, Morow 1994). The species living mainly in open spaces diversified by fields, meadows and small inter-field shrub concentrations include, in the first place, hare (Pielowski 1966). Moreover, fauna representing adjustments to life in the forests and open spaces include roe deer (Pielowski 1999) and fox (Goszczyński 1995). It should be pointed out that the species listed also include elk, which prefers not only woodland habitats but also humid and swampy areas. Water bodies surrounded by forests create adequate

biocenoses for beaver (Dzięciołowski 1996) and otter (Buchalczyk 1984).

The list of bird species and the characteristics of their preferred habitats can also indicate diversified landscapes around the early medieval settlement complex in *Culmine*. Some of them are species connected with water areas, which were found in the vast valley of the River Vistula, covered with numerous overflowing tributaries. They were inhabited by ducks and geese, grebes, cormorants, great bitterns, Eurasian woodcocks, common moorhen and common coots. Heron and crane preferred fenlands and swampy areas. Game Galliformes species, capercaillie and black grouse,

provide evidence of the existence of widespread woodland zones. The substantial occurrence of these wild species can be considered an additional factor indicating the existence of suitable living conditions for them in the surrounding areas. The northern goshawk is also such a proxy. Another bird of prey, the Eurasian sparrowhawk, prefers forest areas and field afforestations; whereas the raven prefers forests, as well as fields. The latter is a favourite habitat for stork and partridge as well.

The analysis presented above, as in the case of mammals, confirms the occurrence of diverse landscape zones, including agricultural and forest terrains. Wetlands and water areas were also clear elements of the local landscape. In the case of these last examples, it is worth adding that they were rich not only in wild fowl, but also in ichthyofauna, among which the Cyprinidae family, so numerous in sub-fossil materials, were the most common component.

Zooarchaeological analysis does not provide grounds for conclusions determining the specific localisation, extent or dimensions of individual landscape zones. It can only be inferred, on the basis of the ecological data quoted, that the least forested zones, with extensive open areas (fields, meadows, grazing), were situated in the immediate vicinity of the settlement. The further from it, the more diversified the landscape became, until dense forests and wild woodland complexes appear. However, when including the presence of other settlement centres in the region, a subsequent hypothesis can be proposed, according to which the greatest forest areas occurred on the border of anthropogenic penetrations of neighbouring population concentrations, identified by settlement studies (Chudziak 1996). The demographic, economic and cultural development of the centre *in Culmine*, together with the process of its incorporation into the Piast state, were factors affecting both animal husbandry strategies and exploitation of the natural environment. Changes observed can be connected with the intensification of food production, for which open areas were necessary. These were acquired at the expense of woodland, which effectively led to creating living conditions favourable for hare and roe deer. It can be presumed that the diminution of forest areas, and simultaneously the populations of game living within them, red deer, wild boar, aurochs, European bison and bear, were another effect of changes associated with advances in agriculture. Nevertheless, the surroundings of *in Culmine*, just before the arrival of the Teutonic Knights, can still be characterised as a mosaic landscape, but with an evidently smaller forest component than it had when the centre formed in the middle of the seventh century. Fields were presumably the predominant element in the close vicinity of the

centre. Despite this fact, the generally high occurrence of remains of wild mammals in the examined faunal collections allows us to infer that hunting in those times did not result in the disturbance of zoocenotic structure, that is, the abilities of self-reproduction of the vertebrate fauna population living in the times of the settlement's development. However, such unsettling must have taken place in subsequent centuries, because the present number of wild fauna within the Kulmerland, compared with that of the period of the functioning Slavic centre, is intensely reduced (Makowiecki 2004). These changes in the structure of the zoo-environment, or more broadly, the whole biocenosis, could have been caused by the economic activity of the Teutonic Order's state.

Gdańsk

Faunal collections containing nearly 250,000 pieces and originating from various chronological and location contexts (Table 4) became the basis of consideration in the case of this centre. They come from domestic mammals, wild mammals, marine mammals, birds and fish. Moreover, a fragment of pond turtle, the species of reptile, was also identified.

Cattle, pig, sheep, goat, horse, dog and cat belong to the list of domestic mammals. Brown bear, wild boar, red deer, elk, roe deer, aurochs, aurochs/bison and bison are classified as *Animalia superiora*. The European hare, squirrel, Eurasian beaver, wolf, fox, marten, European badger, Mustelidae, weasel, otter, European wildcat and lynx belong to *Animalia minuta*. The black rat is a species representing synanthrope mammals. The remains of seal and porpoise were the most numerous from among the marine mammals.

The list of birds, although based on a relatively small number of specimens, is quite long and diverse with regard to such groups as domestic fowl, waterfowl (excluding geese and ducks), geese (wild, wild/domestic), ducks, forest birds, birds of prey and synanthropes (Table 5). The domestic chicken is the most numerous species among the group of domestic birds. Moreover, in this group, some bones of goose, duck, peacock, and, in collections dated from modern times, turkey, were recognised. The presence of synanthrope species, barn owl and carrion crow/rook, was observed. Dove can be added to the last group, and to the domestic birds. Forest species are represented by black grouse, capercaillie and raven. Mainly white-tailed eagles and goshawks were identified among the birds of prey. Water birds are represented in the greatest number, with a prevalence of mallard and greylag goose.

I

LIFE AT THE FRONTIER: THE ECOLOGICAL SIGNATURES OF HUMAN COLONISATION IN THE NORTH

Fish remains originating from freshwater, saltwater and migratory (diadromous) species were reported (Table 6). Cod, flatfish (including flounder) and herring were the most numerous of the identified marine fish. Single remains belonged to garfish and turbot. Sturgeon belonged to the main recognised migratory species, and only a few specimens belonged to the others.

Several clear trends were noticed in analysing the percentages of vertebral remains in the town's historic contexts. Firstly, domestic mammals dominate in all the assemblages, although birds and fish make up a significant proportion (Fig. 7). Wild mammals are more numerous than the second and third group mentioned above only in the Slavic (pre-Teutonic) phase, while in the younger phases they occur as a distinct minority. The presence of marine mammals, whose participation in successive stages is almost unnoticeable, is a particular feature of this collection. These observations provide sufficient grounds for us to state that the percentages of animal group proportions in the Slavic collection differ radically in comparison with assemblages from the period of the Teutonic Order and later times, which is the result of various economic strategies adopted in successive historic periods.

In almost all periods, the remains of cattle prevail distinctly over other species, that is, pig and sheep/goat (Fig. 8), beginning with the phase of the Teutonic Order, whereas completely different proportions were

noticed in the Slavic collection. The number of cattle and pig fragments in the last is identical. Therefore, a separate feature in this collection in comparison with those later ones is evident, as in the case of the (wild) animal groups.

Much clearer trends were evident during the comparison of domestic species, horse, dog and cat, whose role in consumption is commonly recognised as being of little importance (Fig. 9). In this respect, relations between these species are clearly different in the Slavic phase, when the horse predominates, with clearly fewer dog remains, and least of all cat. A very large decrease in the proportion of horse remains and an increase in the percentage of dog remains are visible in the Teutonic Order phase. The relative representation of these animals is equalised somewhat, and in the youngest stage (the end of Royal Prussia and the beginning of the Kingdom of Prussia), dog remains are at their highest proportion and horse remains are at their lowest. In the case of cat, there is a clear percentage increase, from about 11% in the Slavic material up to 40% in the last phase.

More species were registered in collections of wild mammals from the Slavic phase than from later phases. This is especially clearly visible in the presence of specific predatory fauna (Fig. 10). The other vertebrates (except bear) represent there the group *Animalia minuta*. Only bear was noticed in assemblages corre-

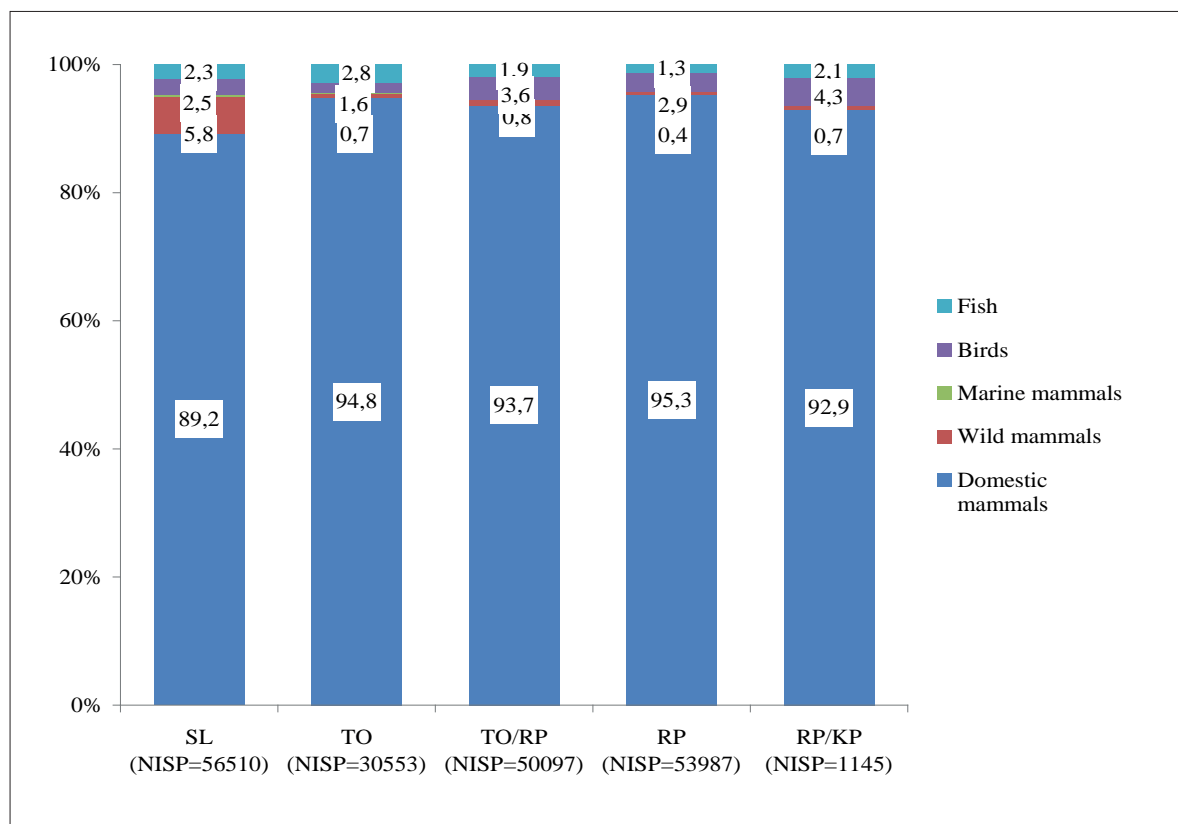


Fig. 7. Gdańsk: the percentage of animal groups in the historical stages (graph by authors).

Table 4. Gdańsk, Pomeranian voivodeship: animal taxa and their NISP in the chronological context phases, by different authors and unpublished reports of Makowiecka, Makowiecki

Animal	SL	SL/TO	TO	TO/RP	TO-RP	RP	SL-TO-RP	RP/KP	KP	13th/14th-20th c.	Total
Cattle <i>Bos primigenius</i> f. <i>taurus</i>	20537	1665	21099	29018	9740	33532	11179	225	544	1624	129163
Pig <i>Sus scrofa</i> f. <i>domestica</i>	20213	406	4167	9547	2817	7679	1472	36	82	438	46857
Sheep/Goat <i>Ovis ammon</i> f. <i>aries</i> / <i>Capra aegagrus</i> f. <i>hircus</i>	7936	452	2527	7235	3089	7607	1880	38	97	186	31047
Sheep <i>Ovis ammon</i> f. <i>aries</i>	41	0	693	405		1445	632	7	8	69	3300
Goat <i>Capra aegagrus</i> f. <i>hircus</i>	18	0	186	118		352	56	2	2	22	756
Horse <i>Equus ferus</i> f. <i>caballus</i>	1173	21	111	231	86	293	16		2	36	1969
Dog <i>Canis lupus</i> f. <i>familiaris</i>	336	16	125	229	52	281	29		12	12	1092
Cat <i>Felis silvestris</i> f. <i>catus</i>	181		44	141	96	257	21	7	2	7	756
Hare <i>Lepus europaeus</i>	95	5	11	19	3	21	3		2	3	162
European rabbit <i>Oryctolagus cuniculus</i>						1					1
Red squirrel <i>Sciurus vulgaris</i>	3		1	2							6
European water vole <i>Arvicola terrestris</i>	1										1
Black rat <i>Rattus rattus</i>	3			3							6
European beaver <i>Castor fiber</i>	236		7	2		1				2	248
Grey wolf <i>Canis lupus</i>	16										16
Grey wolf/Dog <i>Canis lupus/Canis lupus</i> f. <i>familiaris</i>			1			1					2
Red fox <i>Vulpes vulpes</i>	31			2		2					35
Bear <i>Ursus arctos</i>	22		2								24
European polecat <i>Mustela putorius</i>	5									1	6
Badger <i>Meles meles</i>	12										12
Least weasel <i>Mustela nivalis</i>	1										1
European otter <i>Lutra lutra</i>	47			1							48
Wild cat <i>Felis silvestris</i>	15										15
Eurasian lynx <i>Felis lynx</i>	3										3
Wild boar <i>Sus scrofa</i>	685	4	28	21	3	16	2		1	4	764
Red deer <i>Cervus elaphus</i>	433	4	89	164	24	38	12	1		16	781
Elk <i>Alces alces</i>	1033		4	3	2	4	1				1047
Roe deer <i>Capreolus capreolus</i>	374		81	198	30	155	37	2	2	7	886
Aurochs <i>Bos primigenius</i>	222		1	6		1				1	231
European bison <i>Bison bonasus</i>	50										50
Seals <i>Phocidae</i>	28	1	7	2							38
Grey seal <i>Halichoerus gryphus</i>	77										77
Common porpoise <i>Phocaena phocaena</i>	1		7	4	5	5	1				23
Birds <i>Aves</i>	1387	31	499	1796	253	1586	441	23	26	57	6099
Pond tortoise <i>Emys orbicularis</i>						1					1
Fish <i>Pisces</i>	1290	41	864	950	162	714	212		24	30	4287
Identified	56505	2646	30554	50097	16362	53992	15994	341	804	2515	229810
Not identified	1543	245	2259	2350	2141	3565	4948	10	81	125	17267
Total	58048	2891	32813	52447	18503	57557	20942	351	885	2640	247077

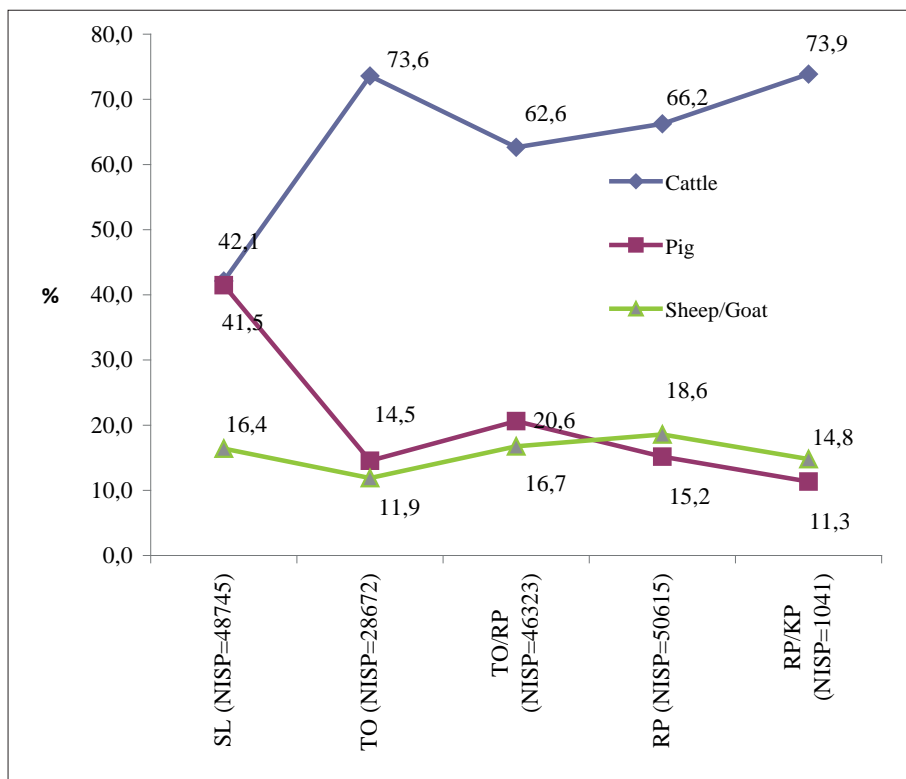


Fig. 8. Gdańsk: the remains of pigs, cattle and sheep/goats in the historical stages (graph by authors).

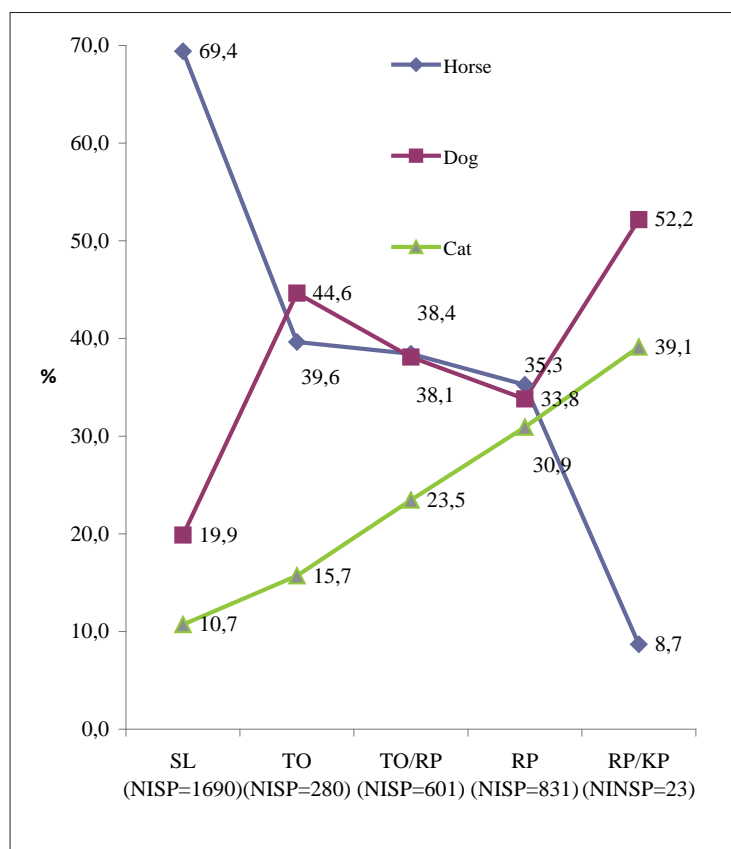


Fig. 9. Gdańsk: the remains of horses, dogs and cats in the historical periods (graph by authors).

responding to the period of the Teutonic Order's rule, and only red fox in the subsequent period.

It became evident again that the Slavic period was radically different to that of the Teutonic Order phase and the subsequent ones in the case of species from the *Animalia superiora* group (Fig. 11). A relatively little-differentiated representation of particular species was, first of all, characteristic of this period. However, elk was markedly the dominating mammal; wild boar, red deer, roe deer and aurochs were successively the next represented. The percentage of the first came down to almost zero as early as the Teutonic Order phase, and likewise in the case of aurochs. Wild boar is the next species indicating a downward tendency in its representation. In contrast, the number of red deer and roe deer remains increases. The proportion of red deer remains in the youngest phase, corresponding to the Kingdom of Prussia period, decreases; while the representation of roe deer reaches its highest percentage.

Almost equally explicit increasing or decreasing trends were noticed among the remains of quantified spe-

Table 5. Gdańsk, Pomeranian voivodeship: birds according to chronological context (by Nogalski 1984; Makowiecki, Gotfredsen 2002; 2003)

Bird	SL	TO	TO/RP	RP	Total
Domestic chicken <i>Gallus gallus</i> f. <i>domestica</i>	470	88	22	190	770
Turkey <i>Meleagris gallopavo</i>				26	26
Peacock <i>Pavo cristatus</i> f. <i>domestica</i>			1		1
Stock dove/Dove <i>Columba oenas</i> / <i>Columba domestica</i>				1	1
Dove <i>Columba</i> sp.				3	3
Barn owl <i>Tyto alba</i>	1				1
Carrion crow/Rook <i>Corvus corone</i> / <i>Corvus frugilegus</i>		1	1	1	3
Domestic goose <i>Anser anser</i> f. <i>domestica</i>		1	3	61	65
Greylag goose/Domestic <i>Anser anser</i> / <i>Anser anser</i> f. <i>domestica</i>	34	1	4	61	100
Goose <i>Anser</i> sp.	16	7	3	23	49
Mallard <i>Anas platyrhynchos</i>	4	4	4	14	26
Mallard/Domestic duck <i>Anas platyrhynchos</i> / <i>Anas platyrhynchos</i> f. <i>domestica</i>	8		1	6	15
Domestic duck <i>Anas platyrhynchos</i> f. <i>domestica</i>				2	2
Duck <i>Anas</i> sp.	2	2	1	2	7
Red-throated diver <i>Gavia stellata</i>				1	1
Cormorant <i>Phalacrocorax carbo</i>	3			1	4
Grey heron <i>Ardea cinerea</i>			1		1
Mute swan <i>Cygnus olor</i>	1				1
Greylag goose <i>Anser anser</i>		4	4	14	22
Barnacle/Brent goose <i>Branta leucopsis</i> / <i>Branta bernicla</i>				3	3
Wigeon/Pintail <i>Anas penelope</i> / <i>Anas acuta</i>				1	1
Velvet scoter <i>Melanitta fusca</i>		1			1
Smew <i>Mergus albellus</i>				1	1
Crane <i>Grus grus</i>			2	1	3
Coot <i>Fulica atra</i>	3				3
Herring gull/Lesser black-backed gull <i>Larus argentatus</i> / <i>Larus fuscus</i>		1			1
White-tailed eagle <i>Haliaeetus albicilla</i>	12		3	6	21
Red kite/Black kite <i>Milvus milvus</i> / <i>Milvus migrans</i>				1	1
Goshawk <i>Acipiter gentilis</i>	7				7
Black grouse <i>Tetrao tetrix</i>	9				9
Capercaillie <i>Tetrao urogallus</i>	9		1	1	11
Raven <i>Corvus corax</i>	1				1
Partridge <i>Perdix perdix</i>	2				2
Total	582	110	51	420	1163

Table 6. Gdańsk, Pomeranian voivodeship: fish according to chronological context (Makowiecki 2003a)

Fish	SL	TO	TO/RP	RP	Total
Pike <i>Esox lucius</i>	340	14	17	93	464
Carp <i>Cyprinidae</i>	1625	36	103	20	1784
Roach <i>Rutilus rutilus</i>	174	2	5		181
<i>Leuciscus</i> sp.	83				83
Chub <i>Leuciscus cephalus</i>	5				5
Ide <i>Leuciscus idus</i>	16	1	1		18
Rudd <i>Scardinius erythrophthalmus</i>	14				14
Asp <i>Aspius aspius</i>	147	2		3	152
Tench <i>Tinca tinca</i>	303	5		3	311
Barbel <i>Barbus barbus</i>	1				1
White bream <i>Blicca bjoerkna</i>	42		1		43
Bream <i>Abramis brama</i>	1470	9	2	16	1497
Zarthe <i>Vimba vimba</i>	92				92
Sichel <i>Pelecus cultratus</i>	12				12
Crucian carp <i>Carassius carassius</i>	13				13
Carp <i>Cyprinus carpio</i> f. <i>domestica</i>	1			4	5
Catfish <i>Silurus glanis</i>	121	7	3	12	143
Perches Percidae		3	32	5	40
Perch <i>Perca fluviatilis</i>	237	3	32	1	273
Pike-perch <i>Sander lucioperca</i>	3005	33	12	35	3085
Burbot <i>Lota lota</i>	3				3
<i>Salmo</i> sp.	3			1	4
Pollan <i>Coregonus lavaretus</i>	1				1
Sturgeon <i>Acipenser</i> sp.	5853	311	42	164	6370
Eel <i>Anguilla anguilla</i>	5		26		31
Garfish <i>Belone belone</i>				1	1
Houting <i>Coregonus</i> sp.			1		1
Herrings Clupeidae	361				361
Herring <i>Clupea harengus</i>	1	1	60	10	72
<i>Alosa</i> sp.			3		3
Allis <i>Alosa alosa</i>	1				1
Cod <i>Gadus morhua</i>	15	46	101	198	360
Flatfish Pleuronectidae	42	3	34	32	111
Flounder <i>Platichthys flesus</i>			3		3
Turbot <i>Psetta maxima</i>			1	2	3
Total	13986	476	479	600	15541

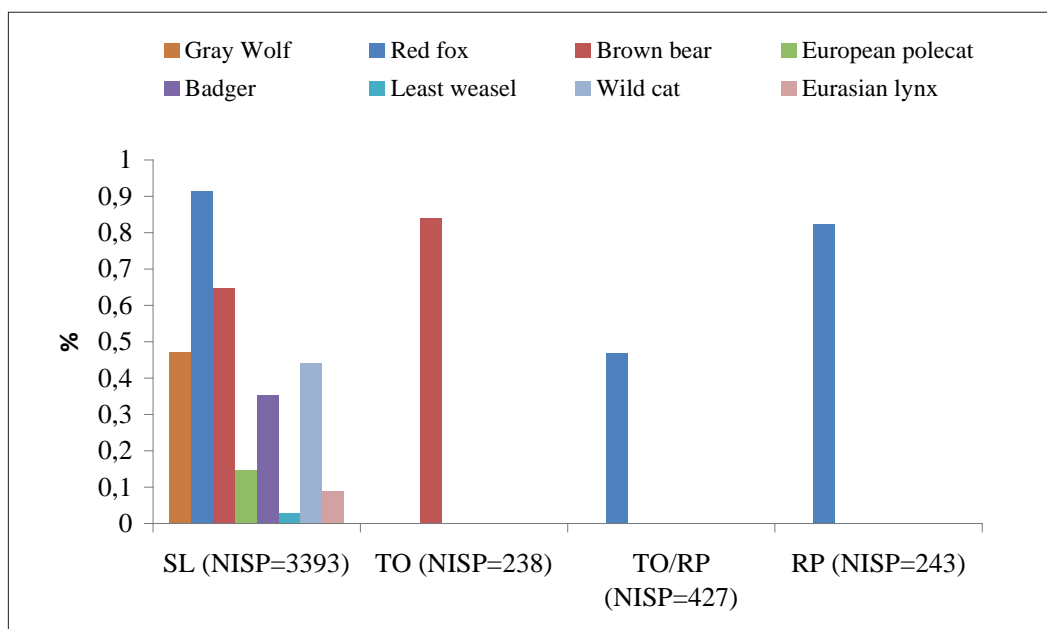


Fig. 10. Gdańsk: the remains of predatory mammals in the historical stages (graph by authors).

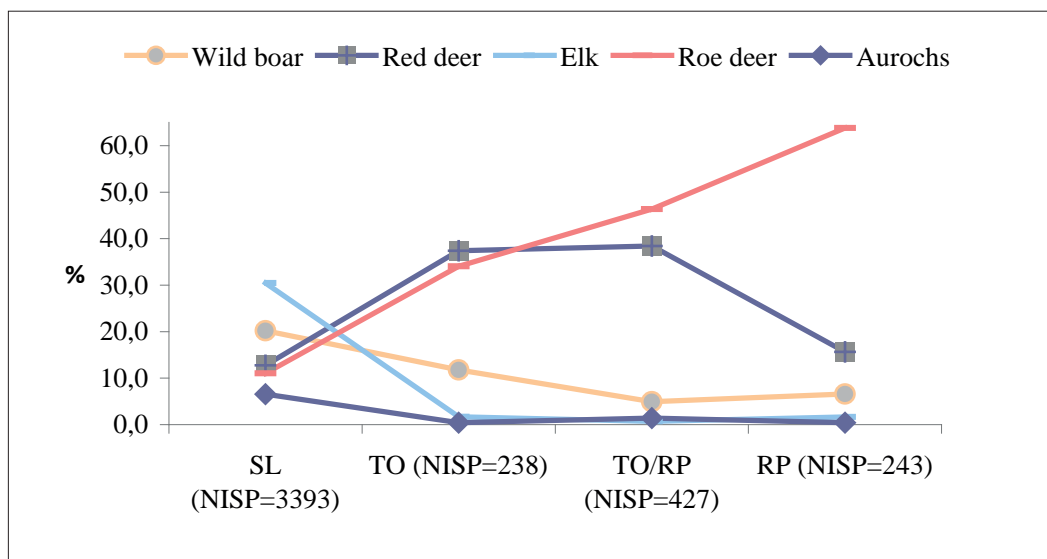


Fig. 11. Gdańsk: the remains of wild mammal (*Animalia superiora*) species in the historical stages (graph by authors).

cies within ecosystem groups, that is, animals of: a) the forest biotope (badger, wolf, bear, wildcat, lynx, wild boar, red deer, aurochs and European bison); b) open/forest (fox, roe deer); c) open (hare); d) aquatic (wetland: beaver, otter) and e) wetland/forest (elk) (Fig. 12). Remains of forest animals were dominant in the Slavic phase, and their share was also the biggest in the phase of the Teutonic Order. An evident decrease in them was noticed as late as the phase associated with Royal Prussia and the Kingdom of Prussia. The opposite trend was noticed for mammals of open and open/forest biotopes, with a decreasing tendency registered in both cases already in the period of the Teutonic Order. A similarly considerable decrease was noted for species of water and wet/forest biotopes. The high rep-

resentation of seal and the low number of porpoise in the Slavic phase are characteristic in the case of marine mammals, whereas a high representation of porpoise remains was observed in collections from the Teutonic Order phase and later times (Fig. 13).

The relative representation of birds is characterised by a rather clear decrease in domestic chicken, which in 'Slavic' and 'Teutonic' collections comprises over 80%, and in subsequent times by half of that (Fig. 14). On the other hand, the noticeably small numbers of geese and birds of the aquatic biotope in the youngest phase increases threefold. Other groups from particular phases constitute a small percentage. However, it is worth noting that typically forest species, such as black grouse and capercaillie, and likewise goshawk

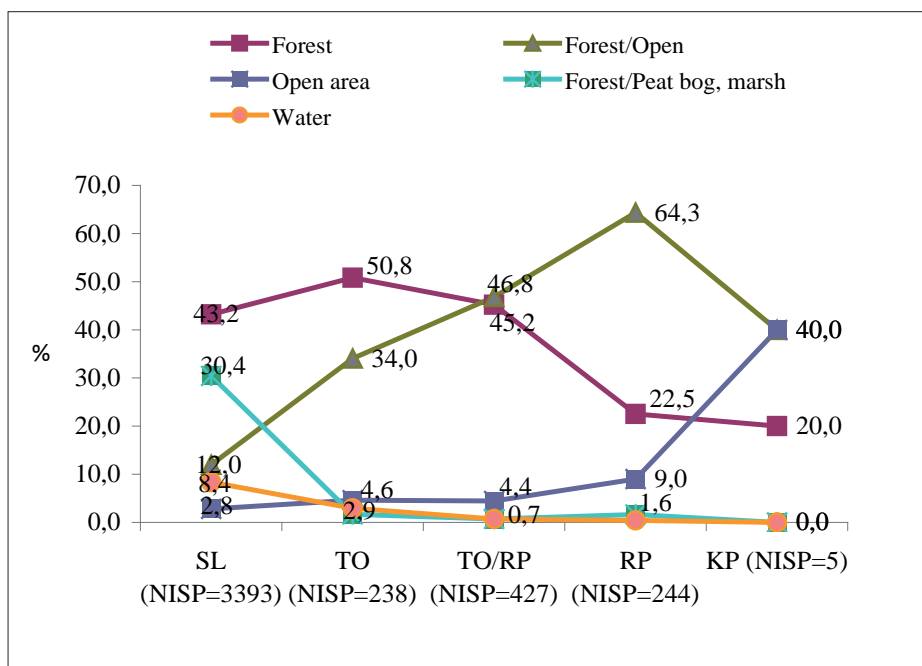


Fig. 12. Gdańsk: the remains of wild mammals according to ecological groups in the historical stages (graph by authors).

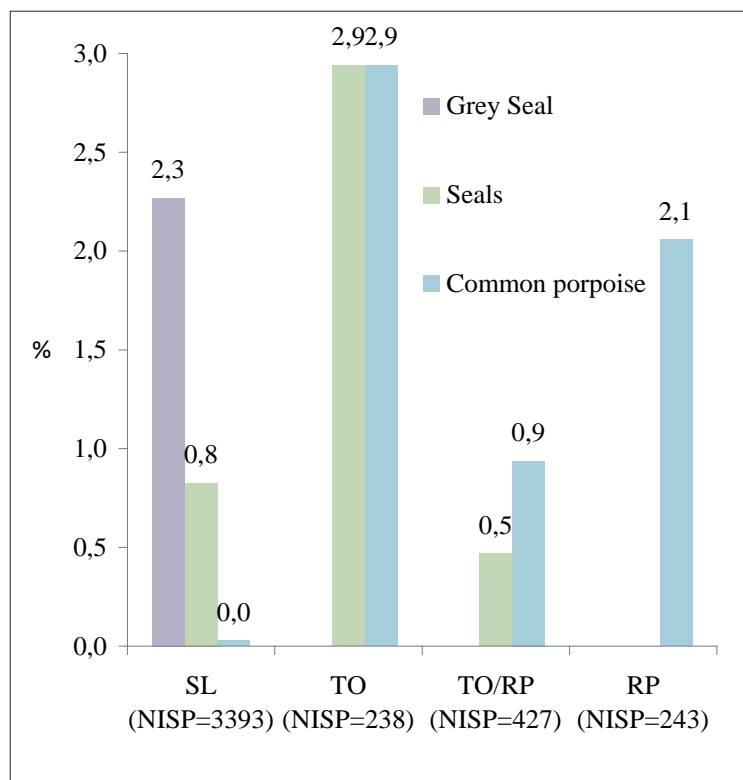


Fig. 13. Gdańsk: the remains of marine mammals in the historical stages (graph by authors).

from the birds of prey group, were registered mainly in materials from the Slavic period.

Fish remains display a great dynamism of changes (Fig. 15). Sturgeon dominate in Slavic and Teutonic times. Its occurrence in later collections is distinctly lower. In comparison, an explicit increase is noted for cod, which has minimal representation in Slavic times, while in Teutonic collections it amounts to about 10%, increasing to over 20% in the youngest phase. Reverse tendencies were observed for two predatory fish spe-

cies, pike and pike-perch. The representation of pike bones in the first three phases was at the same level, but in the youngest phase it evidently increased. The other fish represent the third major component of the assemblage in the Slavic period, but already in the Teutonic Order phase the number of its remains is very low, and does not increase in successive younger phases. The number of Cyprinidae remains stable in comparison with the species described above, and represents a considerable component. A similar proportion is noted in the case of catfish, whose remains were noted in as-

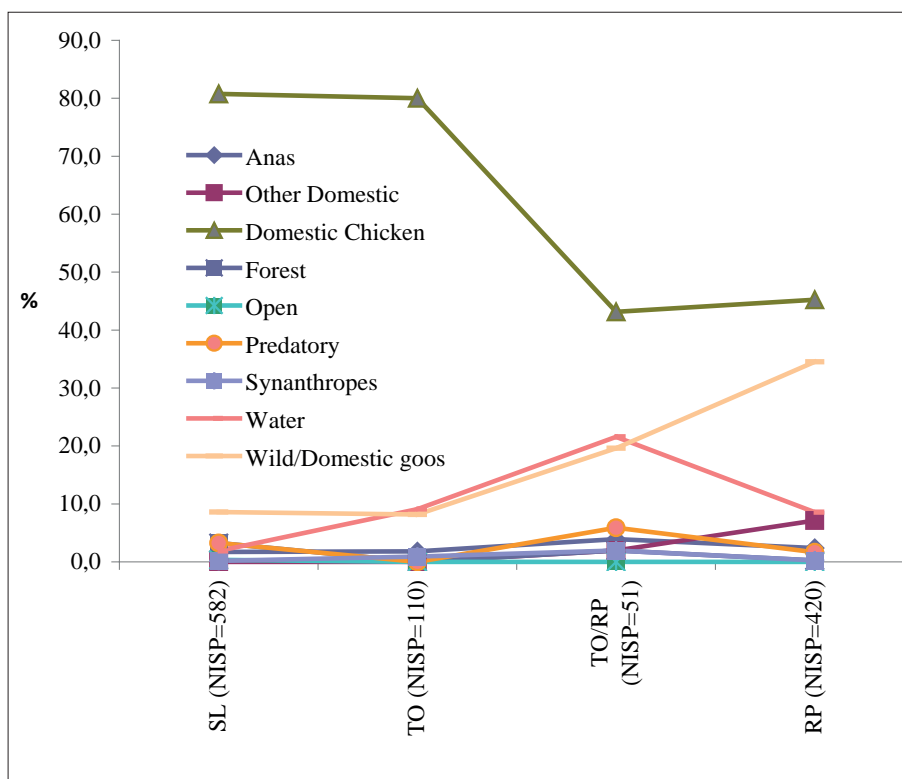


Fig. 14. Gdańsk: the remains of birds according to ecological groups in the historical stages (graph by authors).

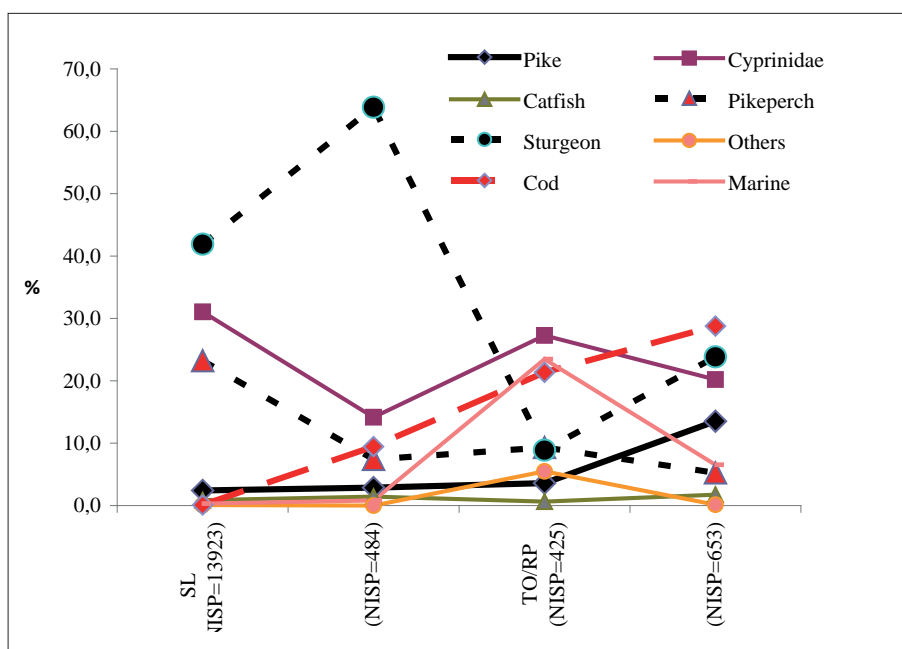


Fig. 15. Gdańsk: the remains of fish in the historical stages (graph by authors).

semblages from all phases, although in small percentages.

Based on the above analyses, it can be stated that the rules for providing the centre with animal resources changed together with political, social and cultural transformations. The taking of the town by the Teutonic Order was undoubtedly a primary caesura in this case. However, before that, the inhabitants of the large and active centre of Gdańsk had relied on domestic animal husbandry, hunting wild mammals, marine mam-

imals and fishing. Changes noted in the proportions of domestic mammals are clear enough to enable conclusions to be drawn concerning substantial changes in the natural environment, which were the result of the functioning of the state of the Teutonic Order. Its economic structure also modified the strategies of animal exploitation and social divisions in the distribution of natural resources. It is worth adding, though, that the archaeological premises that are the grounds for this thesis can be considered only to a small extent with reference to the social changes which could have ac-

companied the transformation of the stronghold centre into the urban structure of the late medieval town. To explain this line of reasoning, the following perspective in thinking was accepted. Due to natural reasons, the burghers, being traders and craftsmen by profession, were a group deprived of hunting possibilities, hence hunted species rarely found their way to the tables of Gdańsk. In this situation, however, trends concerning wild mammals and birds would not have indicated increasing and declining tendencies, but they would have stayed at a constant level in subsequent younger historical contexts; but because the situation is different, these trends suggest that they can rather be treated as the result of changes occurring in the natural environment.

In the Slavic stage, Gdańsk, as a rule, practised the same divisions of animal exploitation which had been implemented by the inhabitants of Culm, and more broadly the population of the Kulmerland (Makowiecki, Makowiecka 1999; Makowiecki 2003b). With reference to hunting and fishing, the centre differed from other stronghold centres situated in the interior zone of the Slavic/Prussian frontier by two important features, which resulted from clear local environmental conditions. In the first case, they were characteristics favourable for the presence of elk, which is otherwise poorly represented in other medieval centres (Makowiecki, Stach 2007). Taking into account the biotope characteristic of this species, we can assume the presence of wetland and marshy areas overgrown with forests in the vicinity. This statement is concurrent with the palaeogeographical characteristics of that area established by Kasprzycka (1999). According to her, in the years 800 to 1200 AD, the total annual precipitation increased, and this period is referred to as the Medieval Climate Optimum. The uplands were covered in forest, with the predominance of ash, oak, cottonwood and alder. All things considered, the dramatic drop in the representation of elk in the faunal assemblages during the next stages of the centre's functioning (likewise other 'aquatic' species) is striking, which can lead us to the supposition that the environment in the discussed region was subjected to substantial transformations. Extensive deforestation could have been one of the changes, the other being transformations in the inland water network. This changing phase can be associated with the economic activity of the local population under the influence of the Teutonic Order's management strategy.

This important transformation in the natural environment during the period of the Teutonic Order's rule is also evidenced by changes reported in relation to other wild mammals, as is reflected by the very small rep-

resentation of their remains during the period of the Teutonic Order, with a clear increase in species preferring biotopes with small wooded areas (hare), or ones adapting easily to it (roe deer).

The next example of environmental conditioning and the shaping of a varied picture of natural resource exploitation is the fact that Gdańsk was situated on the mouth of a river estuary. This factor enabled mass fishing by the inhabitants, who caught species not known in the interior (such as herring, flatfish, cod), or species appearing only in small numbers (sturgeon, pike-perch). At that time, Gdańsk was one of the centres with the highest rates of sturgeon fishing. Overfishing was so intense that in the next few centuries a significant population reduction was observed (Makowiecki 2008), and although in the Teutonic Order phase it was still caught frequently, the entire process was under the strict control of the Order, for which it constituted an important dietary component. It was consumed fresh (including caviar), and smoked (Makowiecki 2008). It is possible that the decrease in sturgeon fishing was an impulse for the gradual introduction of cod into the diet of not only the Teutonic Knights, but also the burghers of Gdańsk, which is reflected in an increase of the species' representation in ichthyological material, not only in Gdańsk, but also in other Teutonic castles, such as Mała Nieszawka (Makowiecki 2003a). In the preliminary stage it was a stockfish, and later locally caught Baltic cod (Orton *et al.* 2011).

In the case of fish, it should be noted that contexts dating from the period of the Teutonic Order include among their ichthyological material the presence of carp, a fish not belonging to the natural component of this zone's ichthyofauna (Makowiecki 2003a). Its breeding was documented in historical records, along with the use of ponds (Filuk 1968; Chęć 2009). On this basis, we can conclude that the Teutonic Knights contributed to introducing and popularising carp breeding in this zone (Makowiecki 2003a).

The coastal situation of Gdańsk made possible the exploitation of marine mammals, although during the period of the Teutonic Order's rule, the proportions of seal to porpoise changed in favour of the latter. It may also have been caused by changes occurring in the aquatic environment of the Baltic Sea.

Comparing changes observed in Teutonic times as far as animal exploitation is concerned in the Slavic period, it can be stated that they related to almost all elements. The proportions of pig to cattle changed. Cattle became the dominant species, which on one hand could have resulted from expanding meadow areas, the diminishing forest lands, and additionally the gradual

process of the drainage of Żuławy Wiślane. The more urban character of the centre compared to the state from the Slavic period caused important changes in animal exploitation. Cat keeping became more common, which could have been related in the first place to creating favourable conditions for synanthropes, such as the rat. The next changes concerned the drop in the significance of the horse among burghers. Studies performed concerning dogs bred in towns have shown that in that period the big dog form was in a minority, and small and medium-size dogs were preferred, mostly as pets for company (Makowiecki 2006).

To sum up, it is worth emphasising that the increased importance of goose, including domestic goose, and the decline in the occurrence of chicken, would have been an effect of the changes initiated in Gdańsk during the rule of the Teutonic Order, at the end of the functioning of their state rather than earlier. This tendency is known from other towns in Poland in later medieval and post-medieval times (Makowiecka, Makowiecki 2005).

Concluding remarks

The changes of animal exploitation strategies and environmental features based on only two centres situated a significant distance from each other cannot be representative of the entire sphere of the Polish/Prussian frontier. Therefore, it should be treated first as the initial stage of broader analytical-synthetic studies, and second as grounds for the verification of the results presented here. Their value is significant, because they were the result of studies on very large (almost unique in their scale) faunal collections, originating (this should be emphasised here) from a centre with very well-documented archaeological and historic contexts. Thanks to these, it was easy to make the assumption at the very beginning that changes in the exploitation of animals were the reflection of social-cultural systems and structures at particular stages of the centre's functioning. Furthermore, the demographic factor in such large human agglomerations for these periods, and their economic activities, could not have been indifferent towards biocenotic structures, including vegetation cover, and, more generally, the natural landscape surrounding these settlements. In this respect, the analyses of fauna in the contexts and with the assumptions presented above gave significant and coherent enough results to make conclusions of a synthetic nature.

The thesis can be put forward that the arrival of the Teutonic Order coincided with a period when the frontier region had already seen active human agglomerations, functioning on the basis of rather stable

economic structures. They had been based, to a large extent, on domesticated mammal and bird husbandry (mostly chicken and goose). Traditional occupations included the exploitation of natural faunal resources of neighbouring natural environments (land and water), that is, hunting and fishing. In the case of Culm, although animal husbandry was the basis of its economy, the occupations mentioned above were also important animal subsistence strategies, implemented well before the arrival of the Teutonic Order in the Kulmerland. However, even in Slavic times, the system of animal exploitation was subject to various fluctuations, reflecting the effects of political and cultural changes. During the period of the development of the centre, we can observe at least two anthropogenic impulses leading to transformations in the natural environment, which, in the light of zooarchaeological findings, reflect the diminishing areas of woodland and the expanding open spaces.

Hunting and fishing were also of great importance in the case of Gdańsk in the Slavic period. Both centres were similar in this respect, although the results reflect different environmental conditions. This is most clearly visible in the occurrence of elk. It is worth pointing out that the high numbers of this species distinguish Gdańsk when compared with other centres in Poland in the early Middle Ages (Makowiecki, Stach 2007). Gradual changes in animal exploitation coincide with the seizure of the town by the Teutonic Knights in 1308/1309. The importance of hunting dropped significantly, which was the result of the introduction of new rules in managing the animal-based economy, and transformations occurring in the natural environment. On this basis, we can conclude that in the Kulmerland also the development of the Teutonic Order's state and its economic base resulted in an even more pronounced impact on the natural environment than had been observed during the existence of the earlier Slavic centre *in Culmine*.

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Daniel Makowiecki
Laboratory for Natural Environment Reconstruction
Institute of Archaeology
Nicolaus Copernicus University
Szosa Bydgoska 44/48
PL 87-100 Torun, Poland
E-mail: makdan@umk.pl

Marzena Makowiecka
Zakątek 3
PL 62-090 Rokietnica, Poland
E-mail: marzenamakowiecka@wp.pl

GYVŪNŲ NAUDOJIMAS IR APLINKOS POVEIKIS LENKIJOS–PRŪSIJOS PASIENYJE VIDURAMŽIAIS: ATVEJO STUDIJA

**DANIEL MAKOWIECKI,
MARZENA MAKOWIECKA**

Santrauka

Šiame straipsnyje pristatoma santykinė gyvūnų analizė, kuriai duomenys buvo gauti tiriant XIII a. buvusiame Lenkijos–Prūsijos pasienyje du kultūrinius ir komercinius centrus: Kaldus – Kulmo žemėje ir Gdanske – Rytų Pomeranijoje. Abu centrai yra tolokai vienas nuo kito, todėl jie neatskleidžia visos ūkinės situacijos palei buvusį Lenkijos–Prūsijos pasienį. Minėtose vietovėse atlikus archeologinius ir istorinius tyrimus, nustatyta, kad Kaldus ir Gdanskas buvo XIII a. Ordino užkariautose žemėse. Per juos tarp Ordino ir Lenkijos žemių buvo palaikomi glaudūs ekonominiai ryšiai. Tyrimų metu nustatyta, kad dar iki Ordino pasirodymo šiose vietovėse tarp Lenkijos ir Prūsijos gyventojų Gdansko teritorijoje funkcionavo stabilūs ekonominiai ryšiai, kurių pagrindą sudarė žemdirbystė, gyvulininkystė ir paukštininkystė. Kaldus ūkiniame

centre, be žemdirbystės, to meto ūkiui didelę reikšmę turėjo ir medžioklė bei žvejyba. Aptariamuoju laikotarpiu abiejose vietovėse miškingų vietovių buvo nedaug, tai atskleidžia zooarcheologinė medžiaga. Zooarcheologinė medžiaga rodo, kad Lenkijos (Piaštų dinastijos metu) – Ordino pasienyje šiuose dviejuose tyrinėtuose centruose vyravo gyvulininkystė.

Straipsnyje aptariamos žinduolių, paukščių ir žuvų rūšys, parodoma, kaip diachroniniai tyrimų metodai gali būti taikomi istoriniams procesams atskleisti, aptariant kultūrinius ir aplinkos pokyčius, prasidėjusius šiose pasienio regiono vietose, kai minėtas teritorijas pradėjo valdyti Ordinas.

Vertė Linas Daugnora