

Zooarchaeological and Historical Data on Wild Birds and Falconry from the 13th to 17th Centuries in Lithuania

ABSTRACT

In general, bird bones form a small part of zooarchaeological material from any given period. Although written sources indicate that the hunting of wild birds was a rather visible leisure pursuit and that domestic birds formed a significant part of the nobles' diet in the 13th to 17th centuries in the territory of modern Lithuania, there are very few zooarchaeological studies supporting this. The aim of this study is to add to what we know so far about game birds and falconry in Lithuania based on bird bone material from two sites: Kernavė town and castle and Vilnius Lower Castle. A total minimum number of individuals of 1323 assigned to ten orders were examined, and at least six species of birds of prey have been identified from both sites. This paper presents new zooarchaeological data, radiocarbon dating results and bone collagen $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ stable isotope measurements and adds further archaeological and historical materials before arriving at a conclusion.

KEYWORDS

Falconry / taphonomy / avian remains / Lithuania / medieval / Early Modern Period

Bird Remains in Lithuania

Bird bones are found at every late Mesolithic to early Subneolithic site (6th–4th millennia BC) in Lithuania where faunal remains have been preserved, e.g. at Garnys, Šventoji 43, Kretuonas 1C, 1D and others (Piličiauskas et al. 2019; 2023; see also Daugnora/Girininkas 2004). The first domesticated mammals appeared in Lithuania only around 2900–2600 cal BC (Piličiauskas et al. 2017). Early evidence of predatory birds – an unspecified northern goshawk bone (*Accipiter gentilis*) and a white-tailed eagle phalanx (*Haliaeetus albicilla*) – came to light at the Šventoji Subneolithic sites (c. 3000 cal BC) in coastal Lithuania. A phalanx and a tarsometatarsus from a white-tailed eagle (*Haliaeetus albicilla*) were found at the Subneolithic/early Bronze age sites Kretuonas 1C and Žemaitiškė 2 in eastern Lithuania (Bilskienė/Daugnora 2000; Daugnora/Girininkas 2012).

The first attempt to discuss hunting with birds of prey in general in the territory of modern Lithuania was made in 2012, when elaborated zooarchaeological and historical analyses were carried out, based on zooarchaeological, archaeological and palynological data from the Middle Ages (Blaževičius et al. 2012). Bird bones and falconry equipment from the 13th to 16th centuries were analyzed within a historical context, with the result that, overall, birds of prey from the Middle Ages (13th century to second half of 15th century) and later times have so far been identified at three Lithuanian sites: Kernavė upper town and castle (Bilskienė/Daugnora 2000; Daugnora et al. 2002), Klaipėda castle (Ehrlich et al. 2020) and Vilnius Lower Castle (Blaževičius et al. 2012; Rumbutis et al. 2018; Ehrlich et al. 2022).

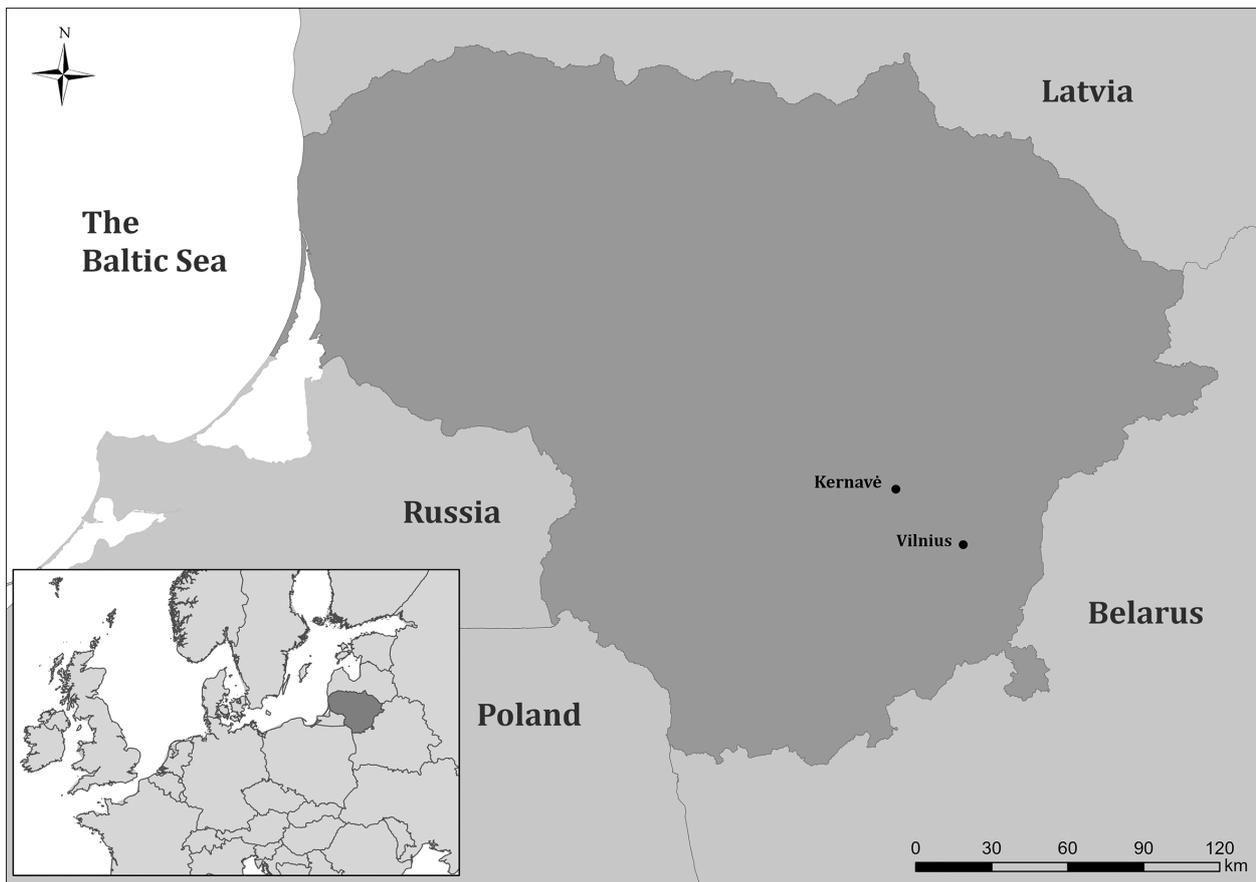


Fig. 1 Map of Lithuania with sites mentioned in the text. – (Map A. Zagurskytė).

Falconry in general can be described as the taking of quarry in its natural state and habitat by means of trained birds of prey (definition according to The International Association for Falconry and Conservation of Birds of Prey [IAF]; www.iaf.org). According to modern-day falconers (description in the following after Richter 2018), hawking utilises the natural behaviour of the bird. Sparrowhawks, goshawks and peregrines are used in central Europe, and usually the females are preferred because they are bigger than the males. Goshawks are short distance hunters, usually flown from the fist, and they hunt rabbits on the ground as well as birds in the air, such as partridges, ducks, pheasants, and crows. Falcons are mostly used in open landscape, for example in so-called waiting-on falconry. The bird is released into the air and when it is in a good, high position, it waits for the game to be flushed out by a dog and then swoops at high speed down on the birds beneath it, which are the same species as are taken by the aforementioned goshawk.

Goshawks were an important bird species in the Baltic region and were commonly used here for falconry in the past. Falcons were also used for the same purpose, but much more rarely. During the period in question (13th–17th centuries), the territory of the Grand Duchy of Lithuania was favourable for the use of goshawks due to densely forested lands (Makowiecki 2009, 438).

This paper deals with data from the 13th–17th centuries from key sites in Lithuania: Vilnius Lower Castle and Kernavė town and castle (fig. 1). New zooarchaeological data will be presented to complement previous publications from both sites. Direct AMS dating and stable isotope $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ analyses on birds of prey from Vilnius Lower Castle were also performed for this study. Previous analysis of remains from Klaipėda Castle in Lithuania will be mentioned for comparison (Ehrlich et al. 2020). The main subject of this article is falconry in Lithuania in the 13th–17th centuries and what evidence is available for its occurrence.

Material and Methods

Zooarchaeological Analysis

The bird bones from Kernavė (upper and lower) town and castle (NISP: 297, MNI: 45) were hand-collected during the excavations of 1987–2001 (tab. 1; see Vėlius 2019). The rest of the material was retrieved by sieving during the excavations conducted in 2021 (NISP: 193, MNI: 29; Vėlius 2019; 2022). This study discusses bird bones from the Middle Ages only, therefore bones from earlier periods were not taken into account here. The whole collection is well-preserved and mainly consists of complete bones or large fragments.

The bird bones from Vilnius Lower Castle were collected during the excavations of 1988–2020 (tab. 1). The paper presented here includes bird bones from the 13th–17th centuries, therefore those from earlier and later periods of this site were not included. Part of the material was gathered by hand during the 1987–2018 excavations (NISP: 1253, MNI: 446) and analysed and identified by Saulius Rumbutis (Rumbutis et al. 2018). The rest of the material from the excavations of 2019 and 2020 was retrieved by sieving (NISP: 1095, MNI: 803) and analysed and identified by Aurelija Zagurskytė with the help and supervision of Hanneke J. M. Meijer during a visit to Bergen University (Norway). The material is well-preserved and consists mainly of whole bones or

large fragments. The material from Vilnius Lower Castle discussed in this article was chronologically divided into three periods: 13th century to middle of 14th century, late 14th to early 16th century, and 16th to 17th centuries. This chronological classification continues throughout the text (with dating of two bird bones revised according to AMS results; see tab. 6).

Taxonomical identification was achieved by morphological comparison with large collections of modern bird skeletons at Kaunas Tadas Ivanauskas Museum of Zoology (Lithuania) and the University of Bergen (Norway). Manuals by von den Driesch (1976), Serjeantson (2009) and a case study by Poland 2018 (see also references therein) were also used. The recording included: bone element, side, zones present, fusion, sex when identification was possible, and bone surface modifications. All identified and unidentified bones were assigned to size classes. Size categories used for recording in this study were assigned by Aurelija Zagurskytė (tab. 2). In this way it was possible to include all bird bone fragments in the record and then to demonstrate that small birds, which could not be identified to species, as well as large birds were present (Serjeantson 2009, 81–83; Harrison/Steward 1999).

Site	Vilnius Lower Castle		Kernavė, upper town and castle		
Years of excavation and method applied	1988–2018 hand collected	2019–2020 sieved	upper town, 1986–2001, hand collected	castle, 1997–2018 hand collected	castle, 2022 sieved
Excavation area	20,000 m ²	~22 m ²	~18,000 m ²		36 m ²

Tab. 1 General information on excavation methods and areas at Vilnius Lower Castle (after Blaževičius 2018; 2022) and Kernavė (after Vėlius 2019; 2022).

Size classes	Species defining the class	Body length (cm)	Weight (kg)
Extra small/XS	Passerines	<30	<0.23
Small/S	<i>Columba livia</i> ; <i>Perdix perdix</i>	29–37	0.24–0.5
Medium/M	<i>Tetrao tetrix</i> ; <i>Anas platyrhynchos</i>	38–73	1.1–1.25
Large/L	<i>Tetrao urogallus</i> ; <i>Anser anser</i>	74–125	3.6–6.7
Huge/H	<i>Grus grus</i> ; <i>Cygnus cygnus</i> ; <i>Meleagris gallopavo</i>	126–275	5.1–14

Tab. 2 Size categories for recording bird bones, established by A. Zagurskytė.

$\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ Analyses and AMS Dating

Radiocarbon dating and stable isotope $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ measurements were carried out at the Centre for Physical Sciences and Technology, Vilnius (Lithuania). An accelerator mass spectrometer (SSAMS, NEC, USA) and automated graphitization system AGE 3 (IonPlus AG) were used for analysis. Collagen extraction from bones was applied with the acid-alkaline-acid (AAA) procedure, followed by collagen extraction (Szidat et al. 2017). Base materials IAEA C3, OXII, IAEA C9 were used. Conventional ^{14}C dates were calibrated with the OxCal 4.4.4 software, the

IntCal20 curve (Reimer et al. 2020). All the ^{14}C dates are reported within the 95.4 % (2σ) confidence interval. Bone collagen extraction for stable isotope $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ measurements was successfully performed on seven raptor bones (five from northern goshawks, two from golden eagles) and one chicken bone from Vilnius Lower Castle (see **tab. 6**). All samples had sufficient collagen yields ($\geq 1\%$), and atomic C:N ratios were between 3.20 and 3.35, indicating good preservation according to the empirical study by DeNiro (1985). All samples had elemental concentrations above the range of $\geq 30\%$ for C and $\geq 11\%$ for N, as defined by G. J. van Klinken (1999).

Description of Sites

Kernavė Town

The town of Kernavė is situated in the eastern part of modern Lithuania (**fig. 1**). In the second half of the 13th century, a castle – Aukuras hillfort – existed, together with a town surrounding it, with characteristic defensive installations and street layout. Zooarchaeological and other findings dating from the end of the 13th and the first half of the 14th century reflect the prosperity of Kernavė lower town and castle (Vėlius 2005, 10). However, the year 1390 turned out to be baneful for city and castle when a large army of the Teutonic Order and its allies approached. City defenders set fire to the castle and the forts and withdrew. After that, the castle was never rebuilt, and even though the city itself did not burn down, it was abandoned by its residents in the 14th century (Vėlius 2005; Vitkūnas 2006; Kuncevičius et al. 2019). Over time, the area was covered with sediments and layers of soil. Under the peat, at high groundwater levels, organic material was very well preserved. The entire complex of archaeological monuments in Kernavė remained almost undamaged in later times. Kernavė town and castle (**fig. 2**) were excavated between 1986 and 2022 (Vaičiūnienė 2000; 2001; 2002; Vėlius 2019; 2022).

Vilnius Lower Castle

In Vilnius, the existence of a castle and town in the territory of the Vilnius Lower Castle complex can be confirmed from the second half of the 13th century. Three different stages can be distinguished in the history of the castle complex: the first period starts

at the beginning of the 13th century and lasts until the middle of the 14th century, indicating a brick-walled castle surrounded by wooden constructions. The second phase starts at the end of the 14th century and lasts until the beginning of the 16th century, reflecting the use of the site as the residence of the Grand Dukes in a period of prosperity, when constant constructions and reconstructions of the castle led to the rapid formation of large cultural layers. The third period lasted from the second part of the 16th century until the 17th century, when the complex functioned as a royal residence. The castle was transformed into a palace and its defensive function disappeared. Wooden buildings used by craftsmen, merchants and courtiers were replaced by new brick buildings, and log-built streets and roads were paved with stones. This period is also characterized by dramatic changes in the middle of the 17th century, after the city had been plundered, pillaged and burned down by the Muscovite army. In the year 1655 and onwards, most of the buildings were destroyed and abandoned, and they were not rebuilt. After this war (Russo-Polish War of 1654–1667), the castle complex was no longer repaired and used as a residence, and from the 18th century just townspeople and poor nobles settled here. The complex was finally destroyed at the turn from the 18th to the 19th century. The humid environment, uneven terrain and constant reconstructions of the castle and surrounding city led to the formation of rich cultural layers of up to eight meters (Blaževičius et al. 2012). Vilnius Lower Castle territory was excavated over more than three decades (**fig. 3**), between 1987 and 2020 (Rackevičius 2009, 165–167; Blaževičius 2018, 10–17).

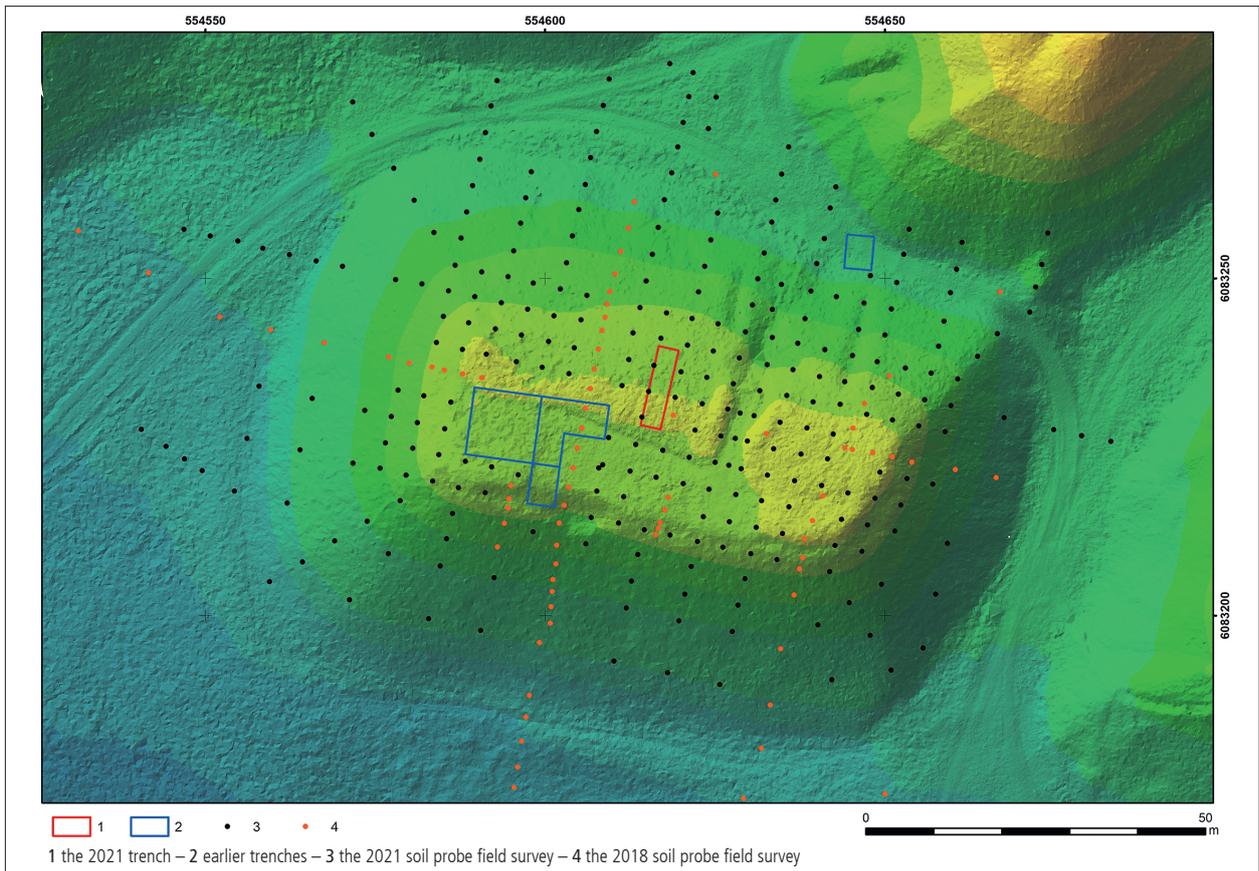


Fig. 2 Excavation areas at Kernavė town and hillfort. – (After Vėlius et al. 2021).

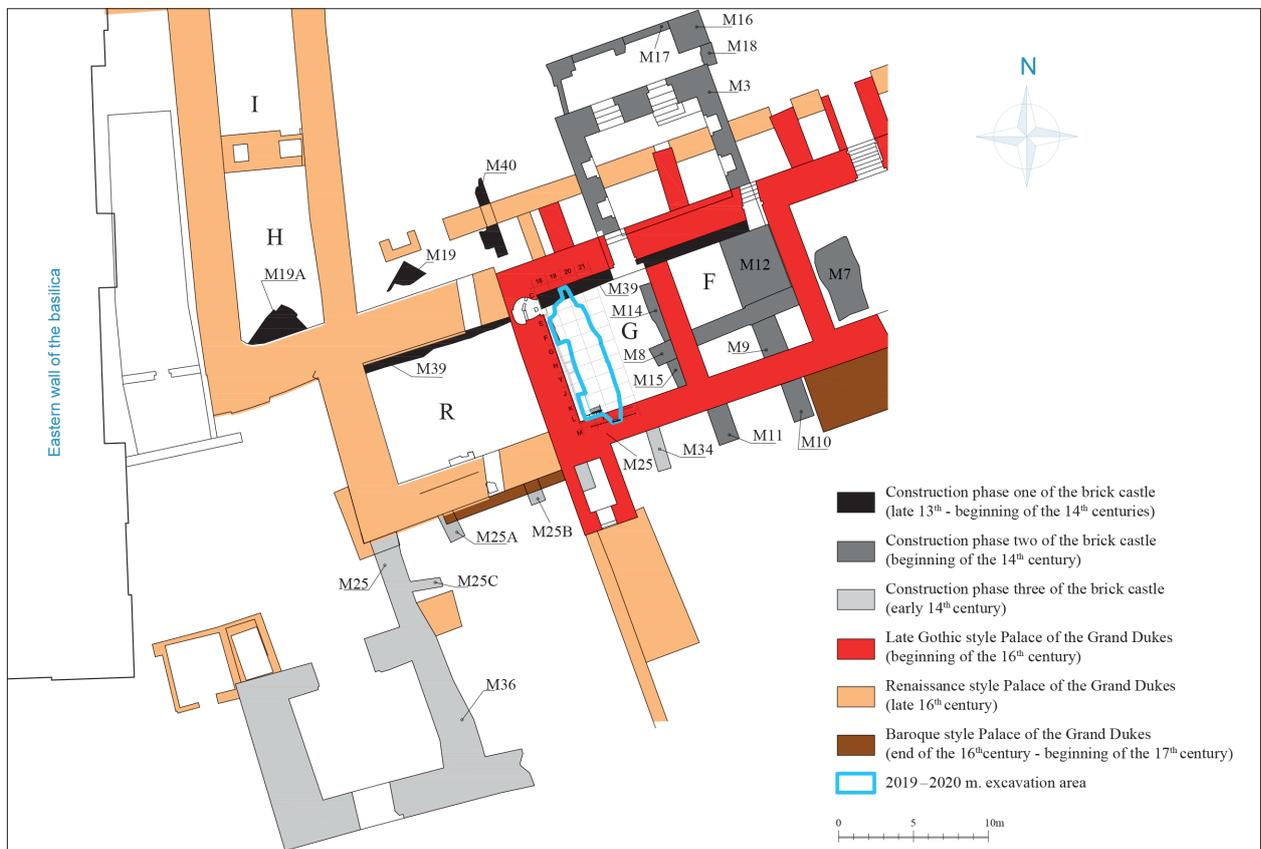


Fig. 3 Excavation area at Vilnius Lower Castle. – (Map R. Račinskas, after Blaževičius 2022).

Results and Discussion

Overview of Birds in Kernavė Town and Castle

In total, 490 specimens were collected in the territory of Kernavė town (upper and lower) and castle. Identified bones (80.6 %, NISP: 395, MNI: 74) were assigned to eight families from eight orders (fig. 4) and at least 24 species of birds (tab. 3). The most abundant ones are the domestic and wild species of the Phasianidae bird family (70.61 %, NISP: 346). In comparison, the second-largest family present is that of the Anatinae (4.29 %, NISP: 21), while the remaining six avian families consist of only a few specimens each in this material. It is worth mentioning that the Corvidae family (2.86 %, NISP: 14) is also fairly well-represented.

Remains of birds of prey (six wing bones, two leg bones) from the territory of Kernavė town and castle were assigned to at least three species of the Accipitridae family (2.0 %, NISP: 8). Even though only disarticulated bones were present, neither of them had visible marks that could indicate the extraction of feathers. However, plucking feathers from birds does not necessarily leave marks on bones. Feathers are attached to the skin, and when plucked, they usually come off with the skin and follicle intact. In some circumstances, especially if plucking is done carelessly or aggressively, the skin can be damaged, potentially leading to abrasion or injury to the underlying tissue (Serjeantson 2009). The distal part of a tarsometatarsus belonged to a juvenile golden/white-tailed eagle (tab. 5).

In terms of bird sizes, medium ones prevailed (89.37 %, NISP: 353), while the amount of large (6.08 %, NISP: 24), small (3.29 %, NISP: 13), and extra small (1.01 %, NISP: 4) birds was limited. Only one fragment (0.25 %) of mute swan was assigned to the »huge bird« category (fig. 5). Concerning game birds, 18 species of all sizes of birds were present at the site (tab. 3), with medium-sized ones dominating. Only a few of the bones had marks of human activity: a pintail/mallard clavicle and a goose sternum had cut marks, whereas one black grouse humerus was split transversely, which might suggest the disarticulation of the birds for meat (Serjeantson 2009).

Kernavė Castle (13th/14th centuries)

At least 15 species of birds were identified in the territory of the castle (tab. 3). Only three species were waterfowl: goose (3.8 %, NISP: 15), ducks (1.4 %, NISP: 5) and mute swan (0.3 %, NISP 1). The largest

part of the collection, at least twelve species, were land fowl. Most of these were domestic (NISP: 195) and wild (NISP: 24) species of the Phasianidae family (86.9 %). It is worth mentioning that the second-largest family collected in the territory of the castle, the Corvidae (4.0 %, NISP: 10), consists of five different species (western jackdaw, common raven, hooded crow, spotted nutcracker, Eurasian magpie), while the rest of the land birds (2.8 %, NISP: 7) belonged to five different families. Three specimens of predatory birds were collected: one northern goshawk carpometacarpus, one (juvenile) golden/white-tailed eagle tarsometatarsus and one (male) white-tailed eagle humerus (tab. 5).

Kernavė Town (13th/14th centuries)

At least 16 species of birds were identified in the territory of the town (tab. 3). Four species belonged to waterfowl: goose (1.4 %, NISP: 2), duck (1.4 %, NISP: 2), mute swan (0.7 %, NISP: 1) and ruddy turnstone (0.7 %, NISP: 1). However, as expected, the largest part, at least eleven species, were land fowl. Most of them, as in the castle territory, were domestic (NISP: 103) and wild (NISP: 24) species of the Phasianidae family (88.8 %), while at least two species of birds of prey were present: three (female) white-tailed eagle bones and two merlin/kestrel bones.

Overview of Birds at Vilnius Lower Castle

In total, 2348 specimens were collected in the area of Vilnius Lower Castle. Identified bones (79.6 %, NISP: 1869, MNI: 1249) were assigned to 18 families from ten orders (tab. 4) and at least 46 species. The largest number of identified bones belong to the domestic and wild birds of the Phasianidae family (72.5 %, NISP: 1355). The Anatinae (20.97 %, NISP: 392) are the second-largest family on-site. In comparison, the remaining 16 families together represent just over 6 % of all identified bird specimens (tab. 4; fig. 6).

At least 42 species of game birds have been identified at Vilnius Lower Castle (tab. 4). The majority of the bones are from waterfowl (17.5 %, NISP: 412), while land fowl represent less than half of the game birds (9.2 %, NISP: 216). Waterfowl game birds belong to at least 14 species, with the most abundant ones being geese (12.9 %, NISP: 304) and ducks (2.7 %, NISP: 64). As for land game birds, most of them belong to the Phasianidae family (5.9 %, NISP: 139). It is worth noting that birds of the Corvidae family were

Taxon	Castle			Town			Total		
	NISP	%	MNI	NISP	%	MNI	NISP	%	MNI
Mute swan (<i>Cygnus cygnus</i>)	-	-	-	1	0.7	1	1	0.3	1
Greylag/bean goose (<i>Anser anser/fabalis</i>)	12	4.8	1	2	1.4	1	14	3.5	2
Barnacle goose (<i>Branta leucopsis</i>)	1	0.4	1	-	-	-	1	0.3	1
Mallard (<i>Anas platyrhynchos</i>)	-	-	-	1	0.7	1	1	0.3	1
Long-tailed duck (<i>Clangula hyemalis</i>)	1	0.4	1	-	-	-	1	0.3	1
Ducks (Anatinae)	2	0.8	1	-	-	-	2	0.5	1
Diving ducks (<i>Aythya</i>)	-	-	-	1	0.7	1	1	0.3	1
Golden/white-tailed eagle (<i>Aquila chrysaetos/Haliaeetus albicilla</i>)	-	-	-	1	0.7	1	1	0.3	1
Northern goshawk (<i>Accipiter gentilis</i>)	-	-	-	1	0.7	1	1	0.3	1
White-tailed eagle (<i>Haliaeetus albicilla</i>)	3	1.2	1	1	0.7	1	4	1.0	2
Merlin/kestrel (<i>Falco columbarius/tinnunculus</i>)	2	0.8	2	-	-	-	2	0.5	2
Tawny owl (<i>Strix aluco</i>)	-	-	-	1	0.7	1	1	0.3	1
Western jackdaw (<i>Coloeus monedula</i>)	1	0.4	1	1	0.7	1	2	0.5	2
Common raven (<i>Corvus corax</i>)	7	2.8	-	1	0.7	1	8	2.0	1
Hooded crow (<i>Corvus cornix</i>)	1	0.4	1	-	-	-	1	0.3	1
Domestic chicken (<i>Gallus gallus var domesticus</i>)	195	77.4	27	103	72.0	11	298	75.4	38
Phasianidae	16	6.3	4	15	10.5	1	31	7.8	5
Grouse (Tetraonidae)	-	-	-	2	1.4	1	2	0.5	1
Black grouse (<i>Tetrao tetrix</i>)	-	-	-	4	2.8	1	4	1.0	1
Western capercaillie (<i>Tetrao urogallus</i>)	2	0.8	1	3	2.1	1	5	1.3	2
Hazel grouse (<i>Bonasa bonasia</i>)	3	1.2	2	-	-	-	3	0.8	2
Willow ptarmigan (<i>Lagopus lagopus</i>)	1	0.4	1	-	-	-	1	0.3	1
Rock ptarmigan (<i>Lagopus mutus</i>)	2	0.8	2	-	-	-	2	0.5	2
Ruddy turnstone (<i>Arenaria interpres</i>)	-	-	-	1	0.7	1	1	0.3	1
Spotted nutcracker (<i>Nucifraga caryocatactes</i>)	-	-	-	1	0.7	1	1	0.3	1
Eurasian magpie (<i>Pica pica</i>)	1	0.4	1	1	0.7	1	2	0.5	2
Rock dove (<i>Columba livia</i>)	1	0.4	1	-	-	-	1	0.3	1
Rock/stock dove (<i>Columba livia/oenas</i>)	1	0.4	1	-	-	-	1	0.3	1
Water rail/corn crake (<i>Rallus aquaticus/crex crex</i>)	-	-	-	2	1.4	1	2	0.5	1
Total NISP/MNI	252	84.8	45	143	74.1	29	395	80.6	74
Indetermined	45	15.2	-	50	25.9	-	95	19.4	-
Total	297	100	45	193	100	29	490	100	74

Tab. 3 Distribution of bird taxa from Kernavė town and castle dated to the 13th/14th centuries. – NISP = number of identified specimens; MNI = minimum number of individuals. – (Table A. Zagurskytė).

Taxon	13 th to middle of 14 th century			Late 14 th to early 16 th century			Middle of 16 th to 17 th century			Total		
	NISP	%	MNI	NISP	%	MNI	NISP	%	MNI	NISP	%	MNI
White/black stork (<i>Ciconia ciconia/nigra</i>)	1	0.1	1	2	0.4	2	6	1.2	1	9	0.5	4
Mute/whooper swan (<i>Cygnus olor/cygnus</i>)	1	0.1	1	8	1.4	7	2	0.4	2	11	0.6	10
Geese (<i>Anser</i> sp.)	4	0.5	4	142	25.7	63	136	26.5	50	282	15.1	117
Greylag/bean goose (<i>Anser anser/fabalis</i>)	22	2.7	22	-	-	-	-	-	-	22	1.2	22
Ducks (Anatinae)	18	2.2	18	23	4.2	13	4	0.8	4	45	2.4	35
Northern pintail (<i>Anas ac-cuta</i>)	2	0.2	2	-	-	-	-	-	-	2	0.1	2
Mallard (<i>Anas platyrhynchos</i>)	9	1.1	9	-	-	-	-	-	-	9	0.5	9
Common shelduck (<i>Tadorna tadorna</i>)	2	0.2	2	-	-	-	-	-	-	2	0.1	2
Eurasian teal/garganey (<i>Anas crecca/querquedula</i>)	4	0.5	4	-	-	-	-	-	-	4	0.2	4
Diving ducks (<i>Aythya</i> sp.)	2	0.2	2	-	-	-	-	-	-	2	0.1	2
Common goldeneye (<i>Buce-phala clangula</i>)	4	0.5	4	5	0.9	4	2	0.4	2	11	0.6	10
Common scoter (<i>Melanitta nigra</i>)	1	0.1	1	-	-	-	-	-	-	1	0.1	1
Red-breasted merganser (<i>Mergus serrator</i>)	1	0.1	1	-	-	-	-	-	-	1	0.1	1
Razorbill (<i>Alca torda</i>)	1	0.1	1	-	-	-	-	-	-	1	0.1	1
Northern goshawk (<i>Accipiter gentilis</i>)	-	-	-	7	1.3	5	-	-	-	7	0.4	5
Eurasian sparrowhawk (<i>Acci-piter nisus</i>)	3	0.4	3	-	-	-	2	0.4	1	5	0.3	4
Golden eagle (<i>Aquila chry-saetos</i>)	-	-	-	1	0.2	1	1	0.2	1	2	0.1	2
Peregrine falcon (<i>Falco pe-regrinus</i>)	-	-	-	1	0.2	1	-	-	-	1	0.1	1
Kestrel (<i>Falco tinnunculus</i>)	5	0.6	5	-	-	-	-	-	-	5	0.3	5
Merlin/kestrel (<i>Falco colum-barius/tinnunculus</i>)	1	0.1	1	-	-	-	-	-	-	1	0.1	1
Hazel grouse (<i>Bonasa bona-sia</i>)	11	1.4	11	1	0.2	1	1	0.2	1	13	0.7	13
Grey partridge (<i>Perdix perdix</i>)	2	0.2	2	1	0.2	1	3	0.6	2	6	0.3	5
Willow ptarmigan (<i>Lagopus lagopus</i>)	4	0.5	4	1	0.2	1	-	-	-	5	0.3	5
Black grouse (<i>Tetrao tetrix</i>)	33	4.1	33	10	1.8	7	11	2.1	6	54	2.9	46
Western capercaillie (<i>Tetrao urogallus</i>)	16	2.0	16	3	0.5	3	5	1.0	4	24	1.3	23
Chicken (<i>Gallus gallus var domesticus</i>)	502	62.5	55	326	59.0	145	314	61.2	90	662	35.4	257
Common pheasant (<i>Phasia-nus colchicus</i>)	2	0.2	2	6	1.1	5	1	0.2	1	9	0.5	8
Phasianidae	74	9.2	8	-	-	-	-	-	-	554	29.6	53
Indian peafowl (<i>Pavo crista-tus</i>)	-	-	-	5	0.9	3	-	-	-	5	0.3	3

Taxon	13 th to middle of 14 th century			Late 14 th to early 16 th century			Middle of 16 th to 17 th century			Total		
	NISP	%	MNI	NISP	%	MNI	NISP	%	MNI	NISP	%	MNI
Turkey (<i>Meleagris gallopavo</i>)	-	-	-	5	0.9	3	16	3.1	4	21	1.1	7
Turkey/peafowl (<i>Meleagris gallopavo/Pavo cristatus</i>)	-	-	-	1	0.2	1	1	0.2	1	2	0.1	2
Common crane (<i>Grus grus</i>)	1	0.1	1	1	0.2	1	1	0.2	1	3	0.2	3
Corn crane (<i>Crex crex</i>)	4	0.5	4	-	-	-	-	-	-	4	0.2	4
Water rail (<i>Rallus aquaticus</i>)	5	0.6	5	-	-	-	-	-	-	5	0.3	5
Rail (Rallidae)	3	0.4	3	-	-	-	-	-	-	3	0.2	3
Sandpiper (Scolopacidae)	2	0.2	2	-	-	-	1	0.2	1	3	0.2	3
Northern lapwing (<i>Vanellus vanellus</i>)	3	0.4	3	2	0.4	1	-	-	-	5	0.3	4
Charadriiformes	2	0.2	2	-	-	-	-	-	-	2	0.1	2
Motacillidae	4	0.5	4	-	-	-	-	-	-	4	0.2	4
Rock dove (<i>Columba livia</i>)	5	0.6	5	-	-	-	-	-	-	5	0.3	5
Stock dove (<i>Columba oenas</i>)	1	0.1	1	-	-	-	-	-	-	1	0.1	1
Stock/rock dove (<i>Columba oenas/livia</i>)	-	-	-	1	0.2	1	-	-	-	1	0.1	1
Common wood pigeon (<i>Columba palumbus</i>)	1	0.1	1	-	-	-	-	-	-	1	0.1	1
Fieldfare (<i>Turdus pilaris</i>)	-	-	-	-	-	-	1	0.2	1	1	0.1	1
True thrushes (<i>Turdus</i> sp.)	5	0.6	5	-	-	-	-	-	-	5	0.3	5
Bunting (Emberizidae)	1	0.1	1	-	-	-	-	-	-	1	0.1	1
Eurasian golden oriole (<i>Oriolus oriolus</i>)	1	0.1	1	-	-	-	-	-	-	1	0.1	1
Passeriformes	1	0.1	1	-	-	-	-	-	-	1	0.1	1
Western jackdaw (<i>Coloeus monedula</i>)	1	0.1	1	-	-	-	4	0.8	2	1	0.1	3
Common raven (<i>Corvus corax</i>)	16	2.0	16	1	0.2	1	-	-	-	17	0.9	17
Hooded crow (<i>Corvus cornix</i>)	2	0.2	2	-	-	-	-	-	-	2	0.1	2
Rook (<i>Corvus frugilegus</i>)	1	0.1	1	-	-	-	-	-	-	1	0.1	1
Crow (<i>Corvus</i> sp.)	2	0.2	2	-	-	-	-	-	-	2	0.1	2
Spotted nutcracker (<i>Nucifraga caryocatactes</i>)	1	0.1	1	-	-	-	-	-	-	1	0.1	1
Eurasian magpie (<i>Pica pica</i>)	7	0.9	7	-	-	-	1	0.2	1	8	0.4	8
True owls (Strigidae)	9	1.1	9	-	-	-	-	-	-	9	0.5	9
Total NISP/MNI	803	73.3	803	553	83.5	270	513	86.8	176	1869	79.6	1249
Indetermined	292	26.7	-	109	16.5	-	78	13.2	-	479	20.4	-
Total	1095	100.0	803	662	100.0	270	591	100.0	176	2348	100.0	1249

Tab. 4 Distribution of bird bone taxa from Vilnius Lower Castle dated to the 13th to 17th centuries. – NISP = number of identified specimens; MNI = minimum number of individuals. – (Table A. Zagurskytė).

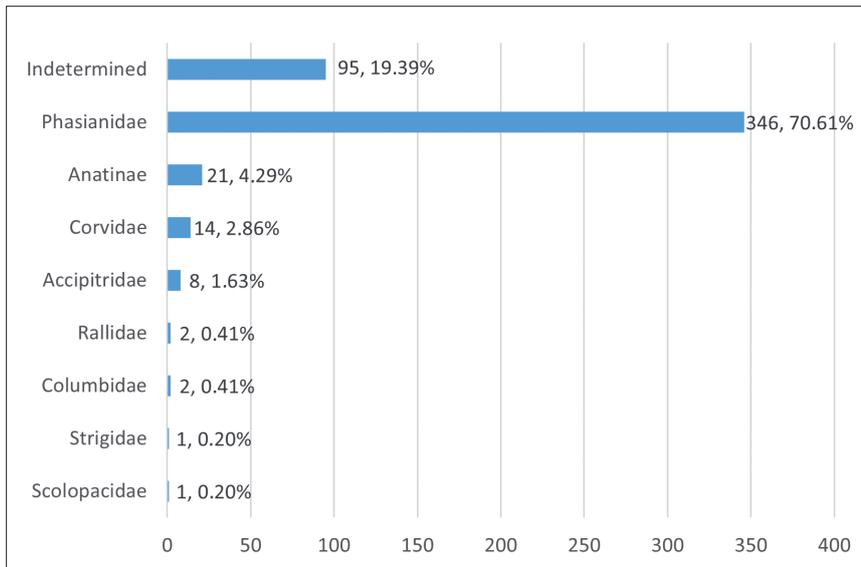


Fig. 4 Families of birds identified in Kernavė town dated from the 13th/14th centuries. Numbers behind bars indicate NISP = number of identified specimens.

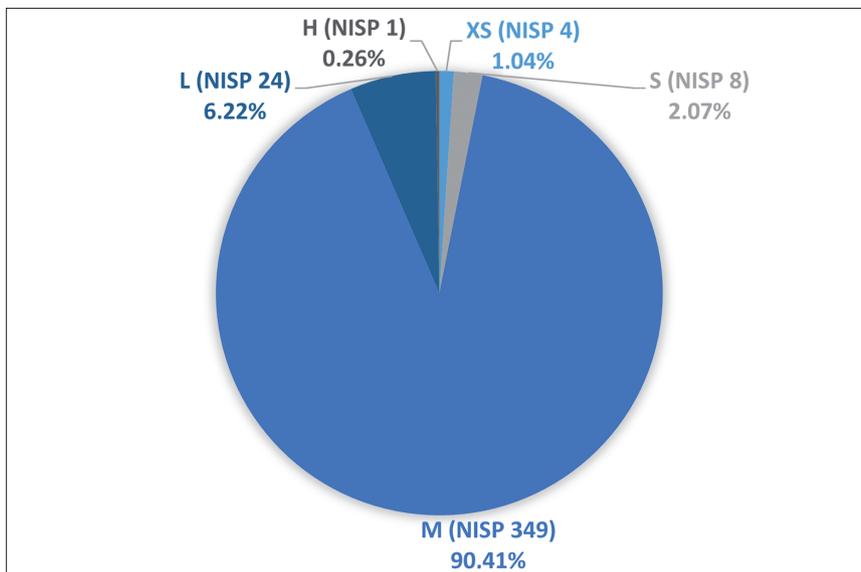


Fig. 5 Distribution of bird sizes from Kernavė town, 13th/14th centuries. XS: extra small; S: small; M: medium; L: large; H: huge. - NISP = number of identified specimens.

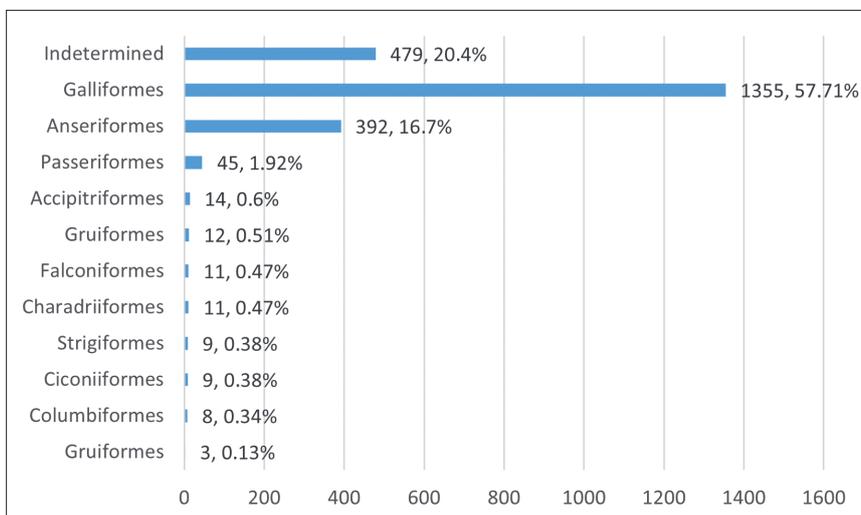


Fig. 6 Orders of birds identified at Vilnius Lower Castle, 13th to 17th centuries. Numbers behind bars indicate NISP = number of identified specimens.

a relatively large proportion of all identified game birds (1.3 %, NISP: 32). Many of the game bird bones have chopping, cutting and gnawing marks. Cases of splitting also present on long leg and wing bones are indicative of the birds being used for meat (Serjeantson 2009). In terms of size, medium-sized birds completely dominate (74.05 %, NISP: 1384), whereas large birds (18.41 %, NISP: 344) represent the second-largest group. All remaining sizes of birds are fairly evenly distributed (**tab. 4**).

At least five different species of birds of prey were identified (1.34 %, NISP: 25) from different Vilnius Lower Castle periods: northern goshawk, Eurasian sparrowhawk, golden eagle, peregrine falcon and kestrel/merlin. A total of 21 northern goshawk bones from all parts of the body and one almost entire skeleton have been identified. The northern goshawk was most common in the material, but sparrowhawk and kestrel bones were also frequent (**tab. 5**).

Vilnius Lower Castle before Christianization (13th Century - Middle of 14th Century)

The bird bone collection from this period is the most abundant one (46.6 %, NISP: 1095) from this site, because sieving was applied during the excavations. The majority of the identified specimens were assigned to the category of chicken (62.5 %, NISP: 502) and wild species of the Phasianidae family (in total 80.1 %): hazel grouse, grey partridge, willow ptarmigan, black grouse and western capercaillie, while ducks (5.4 %, NISP: 43) and geese (3.2 %, NISP: 26) were much less common. It is worth mentioning that birds of the Corvidae family (western jackdaw, common raven, hooded crow, rook, spotted nutcracker) were also high in number (2.7 %, NISP: 23) in this phase, which is not noticeable in later periods. This is, most likely, due to sieving being implemented during the excavations of the layers of this period. The amount of small (6.1 %, NISP: 49) and extra small (3.5 %, NISP: 28) birds in this period is also substantial. Large (6.4 %, NISP: 51) and huge (0.3 %, NISP: 3) ones from this period are less common, while medium-sized birds are the most abundant ones (83.7 %, NISP: 672; **fig. 7**).

Residence of the Grand Duke (Late 14th Century to early 16th Century)

Bird bones from this period account for 28.2 % of all specimens (NISP: 662), and all material was collected by hand. The largest family of birds recorded for this period is that of the Phasianidae (64.9 %, NISP: 359), with the most abundant species being the chicken (59 %, NISP: 326). Additionally, a few Indian pea-

fowl and turkey bones appear in this period. Wild Phasianidae species, namely hazel grouse, willow ptarmigan, black grouse, western capercaillie, grey partridge and common pheasant, are less abundant (4.0 %, NISP: 22) than in the earlier period. A considerably larger number of geese (25.7 %, NISP: 142) have been identified, while ducks (5.1 %, NISP: 28) are less abundant. In terms of size, hazel grouse (NISP: 1), grey partridge (NISP: 1) and northern lapwing (NISP: 2) are the only small birds from this period, whereas none of the identified bones were classified as extra small, which is most likely due to the hand-collection method applied.

Royal Palace (Mid-16th Century to 17th Century)

The last period accounts for 25.2 % of all specimens (NISP: 591), with the material being collected by hand. Chickens (61.2 %, NISP: 314) and other species of the Phasianidae family form the largest part of the identified bones (in total 68.6 %, NISP: 353). Overall, the distribution of chickens and the wild species of the Phasianidae family is similar to that of the earlier period, with a significantly higher amount of turkey bones (3.1 %, NISP: 16) present (**tab. 4**). A large number of geese (26.5 %, NISP: 136) and only few ducks (1.2 %, NISP: 6) were identified. In terms of size, small (2.1 %, NISP: 11) and extra small (0.2 %, NISP: 1) birds are present. However, the largest groups are medium (64.7 %, NISP: 332) large (27.7 %, NISP: 142) and huge (5.1 %, NISP: 26) birds.

$\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ Analysis and AMS dating of Birds from Vilnius Lower Castle

Results of isotopic analyses (**tab. 6**; **fig. 8**) show that northern goshawk from this site had a mean $\delta^{13}\text{C}$ value of -20.72 ‰, ranging from -21.44 ‰ to -19.95 ‰, and golden eagle had a mean $\delta^{13}\text{C}$ value of -20.73 ‰, ranging from -20.53 ‰ to -20.93 ‰. The mean $\delta^{15}\text{N}$ value for northern goshawk was 8.98 ‰, ranging from 7.74 ‰ to 10.23 ‰, and golden eagle had a mean $\delta^{15}\text{N}$ value of 8.63 ‰, ranging from 7.22 ‰ to 10.05 ‰.

The lowest nitrogen values for predators are 7.22–7.74 ‰, which are even lower than those for chickens, and are close to values for herbivores and omnivores, but not for predators with a meat-based diet, or at least dogs with an omnivorous diet in general (**figs 8–9**). Moreover, the difference between the highest and lowest nitrogen values for both species of analysed birds of prey is quite large, reaching 2.83 ‰. If the two specimens with the lowest $\delta^{15}\text{N}$ values are excluded, the mean $\delta^{15}\text{N}$ values of the

remaining individuals are very similar, averaging 9.4 ‰ and differing by only 1.41 ‰. Without a more extensive and detailed study of raptor diets, it will be difficult to provide a reasonable explanation for such differences. It may be assumed that the unexpectedly low nitrogen values of a few individuals are related to an error in species identification or by a very different diet of these birds, related to exceptional living conditions. However, a more detailed study is needed to support this hypothesis. Perhaps such low values are indeed the norm in the diet of birds of prey.

All in all, five specimens of predatory birds and a rooster were taken for C/N carbon stable isotope analysis to reveal the diet of these birds. All carbon isotope values of birds lie between 19.95 ‰ to 27.10 ‰ and the nitrogen values between 5 ‰ to 10.80 ‰.

Two birds of prey – a specimen from a northern goshawk skeleton and a fragment from a golden eagle's sternum – were also sampled for radiocarbon AMS ¹⁴C dating. These (tab. 6) had previously been assigned to the late 14th to early 16th centuries; however, the goshawk according to AMS ¹⁴C dating can be dated more precisely to cal AD 1265–1384 and the golden eagle to cal AD 1300–1401.

Further Archaeological and Historical Information

Northern goshawk bones were the most abundant bird of prey bones found at Vilnius Lower Castle (tab. 5). All seven goshawk bones were collected from the layer previously dated to the late 14th to the early 16th century (0.4 %, NISP: 7), three of which belonged to female goshawks, two to male, while two could not be identified to sex. The finds of Eurasian sparrowhawk (0.3 %, NISP: 5) date to between the

13th and the middle of the 14th century in the earliest phase of the castle (tab. 5). Regarding the sex of the identified birds, only one bone was identified as being that of a female, while the others could not be determined. Two specimens of golden eagle (0.1 %, NISP: 2) were previously dated to two different periods: the late 14th to the early 16th, and the middle of the 16th to the 17th century. Both of them are from

Taxon	NISP		MNI	Sex	Juveniles
	NISP total	NISP %			
Kernavė town (13th-14th century)					
Northern goshawk (<i>Accipiter gentilis</i>)	1	0.7	1		
Golden/white-tailed eagle (<i>Aquila chrysaetos/Haliaeetus albicilla</i>)	1	0.7	1		1
White-tailed eagle (<i>Haliaeetus albicilla</i>)	1	0.7	1	1 ♂	
Kernavė castle (13th-14th century)					
White-tailed eagle (<i>Haliaeetus albicilla</i>)	3	1.2	1	3 ♀	
Merlin/kestrel (<i>Falco columbarius/tinnunculus</i>)	2	0.8	1		
Vilnius Lower Castle (13th to middle of 14th century)					
Eurasian sparrowhawk (<i>Accipiter nisus</i>)	3	0.4	3	1 ♂, 1 ♀	1
Kestrel (<i>Falco tinnunculus</i>)	5	0.6	5	1 ♀	1
Merlin/kestrel (<i>Falco columbarius/tinnunculus</i>)	1	0.1	1		
Vilnius Lower Castle (late 14th to early 16th century)					
Northern goshawk (<i>Accipiter gentilis</i>)	7	1.3	5	2 ♂, 3 ♀	
Golden eagle (<i>Aquila chrysaetos</i>)	1	0.2	1	1 ♂	
Peregrine falcon (<i>Falco peregrinus</i>)	1	0.2	1	1 ♂	
Vilnius Lower Castle (middle of 16th to 17th century)					
Eurasian sparrowhawk (<i>Accipiter nisus</i>)	2	0.4	1	1 ♂	
Golden eagle (<i>Aquila chrysaetos</i>)	1	0.2	1	1 ♂	

Tab. 5 Bird of prey bones from Kernavė town and Vilnius Lower Castle, dated to the 13th to 17th centuries. – (Table A. Zagurskytė).

Bone ID #	Common name (Species)	Dating	Element	$\delta^{13}\text{C}$	$\delta^{15}\text{C}$	N, %	C, %	C/N atomic ratio	Yield, %
106, 310	Northern goshawk (<i>Accipiter gentilis</i>)	1265-1306 calAD, (FTMC-ZZ98-2; 710 ± 28 BP)	Skeleton	-20.88	8.98	16.69	46.28	3.24	14.65
202	Northern goshawk (<i>Accipiter gentilis</i>)	Late 14 th to early 16 th century	Femur	-19.95	7.74	16.81	45.02	3.12	11.31
222	Northern goshawk (<i>Accipiter gentilis</i>)	Late 14 th to early 16 th century	Tibiotarsus	-20.75	8.82	42.00	14.96	2.81	3.28
259	Golden eagle (<i>Aquila chrysaetos</i>)	Late 14 th to early 16 th century	Carpometacarpus	-20.53	7.22	48.12	16.77	2.87	3.35
1245	Northern goshawk (<i>Accipiter gentilis</i>)	Late 14 th to early 16 th century	Tibiotarsus	-21.44	9.13	45.33	16.07	2.82	3.29
1329	Northern goshawk (<i>Accipiter gentilis</i>)	Late 14 th to early 16 th century	Tibiotarsus	-20.59	10.23	44.92	15.89	2.83	3.30
1334	Chicken (<i>Gallus gallus</i> var domesticus)	Late 14 th to early 16 th century	Tibiotarsus	-21.33	7.96	46.21	16.34	2.83	3.30
1395	Golden eagle (<i>Aquila chrysaetos</i>)	1300-1401 calAD, (FTMC-ZZ98-3; 613 ± 26 BP)	Sternum	-20.93	10.05	44.55	15.73	2.83	3.30

Tab. 6 Isotopic data of birds from Vilnius Lower Castle. – (Table A. Zagurskytė).

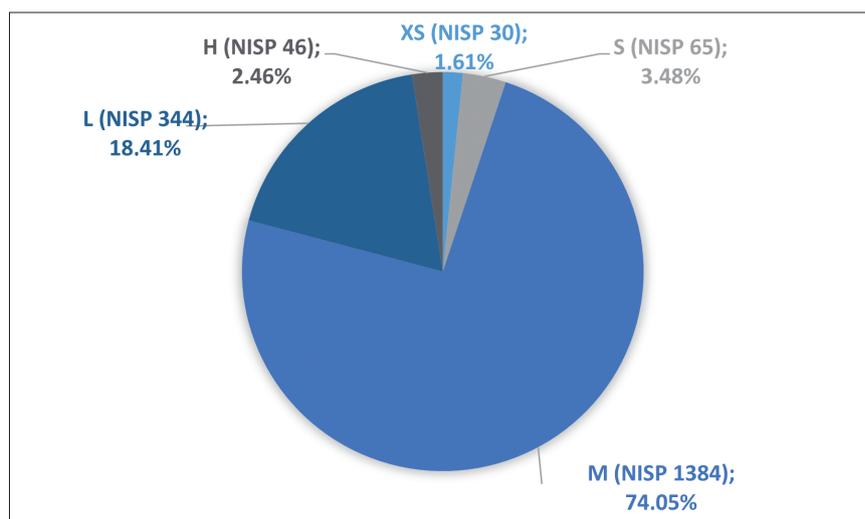


Fig. 7 Distribution of bird size from Vilnius Lower Castle, 13th to 17th centuries. XS: extra small; S: small; M: medium; L: large; H: huge. – NISP = number of identified specimens.

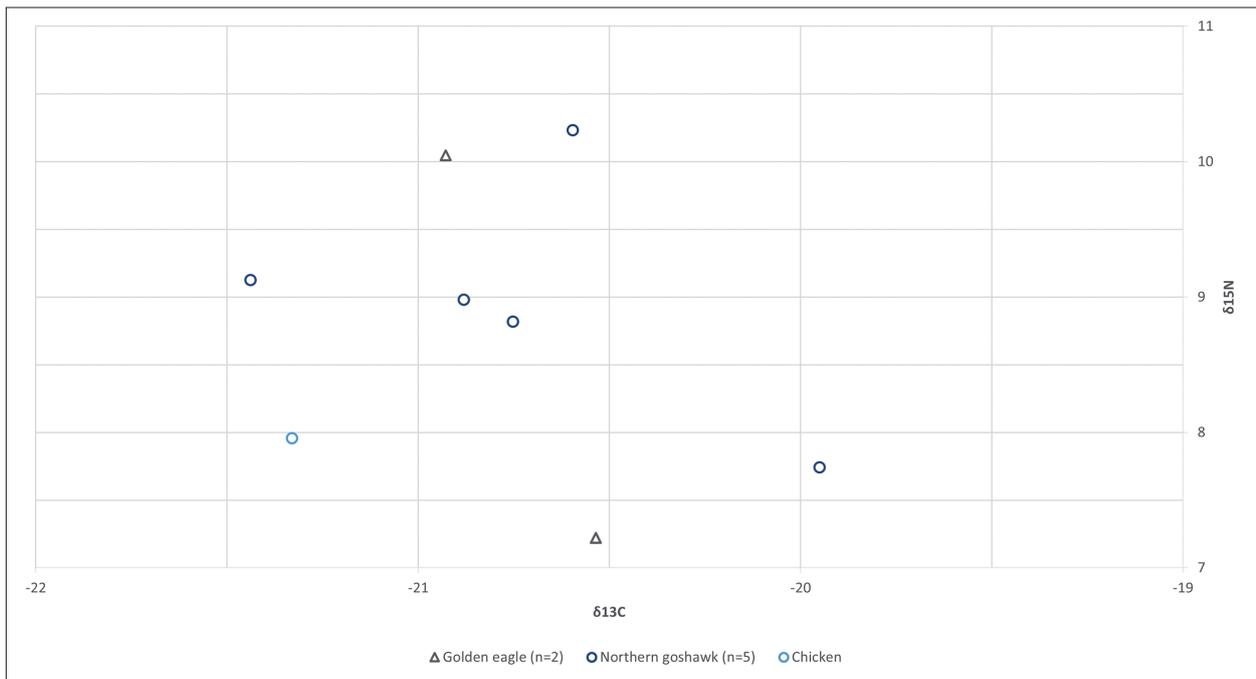


Fig. 8 Scatterplot diagram of stable carbon and nitrogen isotope ratios of golden eagle, northern goshawk and chicken from Vilnius Lower Castle.

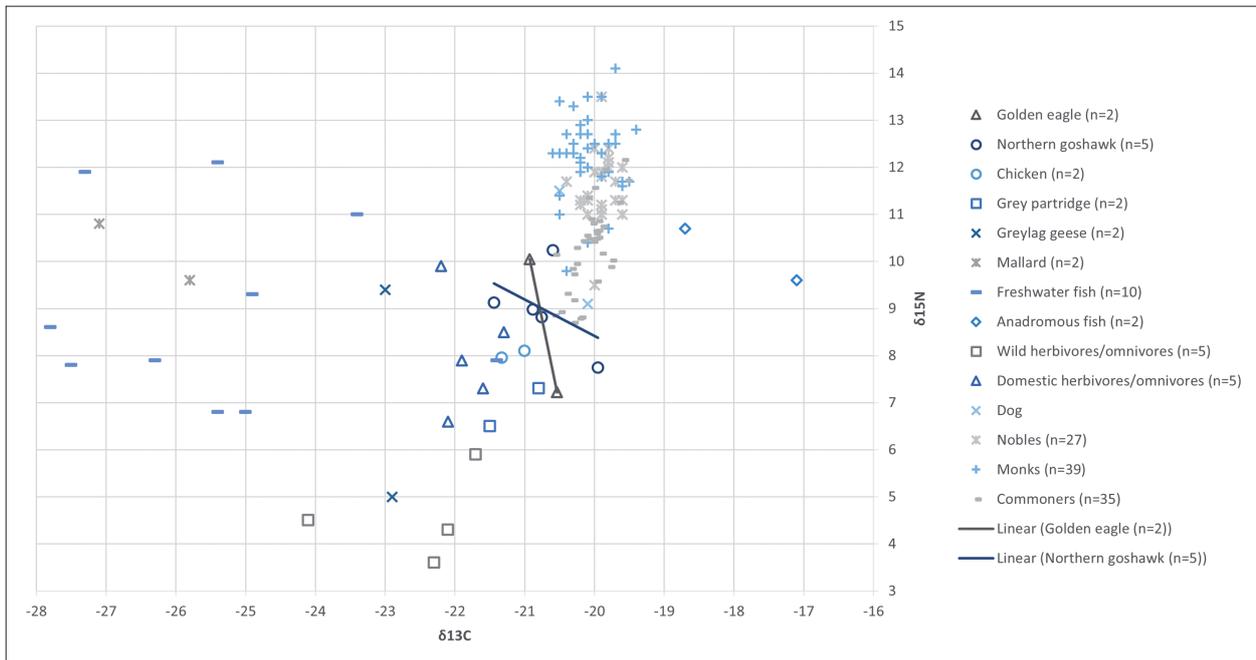


Fig. 9 Scatterplot diagram of stable carbon and nitrogen isotope ratios of medieval and early modern humans and fauna from various archaeological sites in Lithuania. – (After Simčėnka et al. 2020).

males. Only one specimen of peregrine falcon (0.1 %, NISP: 1) was identified from the late 14th to the early 16th century.

A total of 21 bones of six raptor species have been identified in Vilnius Lower Castle from all three periods, foremost northern goshawk, but also Eurasian sparrowhawk and kestrel (tab. 4). Most of them were attributed as medium-sized birds. However, if we look only at the game birds, the largest part of all game bird bone specimens were of large size. Many of the game bird bones had chopping, cutting and gnawing marks. Cases of splitting were also present on long leg and wing bones, which is an indication that the birds were used for meat, either for the human diet or as animal fodder (Serjeantson 2009).

There are also several hoods or raptor caps (14th-century layer) from Vilnius Lower Castle which have only survived due to favourable preservation conditions (figs 10-11). The largest hood would be perfectly suitable for a saker falcon (*Falco cherrug*) or northern goshawk (*Accipiter gentilis*). However, the cut line and shape itself are more suitable for a falcon. Arguably, this hood belonged to a male gyrfalcon (*Falco rusticolus*) or a female saker falcon. Another hood, a smaller one, could, judging by its shape, also be suitable for a falcon. Based on the measurements, it would suit a female merlin (*Falco columbarius*). The third one, which stands out by its simple design, would fit a saker falcon or gyrfalcon (Blaževičius et al. 2012, 312-313). Only saker falcon and northern goshawk bones were actually found in the castle area.

An exceptional case is the well-preserved skeleton of a female goshawk found together with actual falconry equipment in the form of goatskin jesses on each leg. Analysis shows multiple breakage of bones that were partly healed. The left wing forearm and several left ribs were broken, and it also had a cracked left jaw and broken shoulder blade. Taking into consideration the partial healing of the fractures it can be argued that the bird was still alive for some time before death. It is likely that, although the bird possibly received some treatment, it eventually died from blood poisoning or tissue necrosis (Blaževičius et al. 2012).

Three white-tailed eagle bones, one northern goshawk bone, one golden eagle/white-tailed eagle bone and two merlin/kestrel bones were found in Kernavė town and castle, dating from the 13th/14th centuries. Only one bone was identified as that of a male bird (white-tailed eagle), while three other ones were from females. Also one juvenile golden/white-tailed eagle bone was identified.

Another possible clue to hawking may be the remains of subadult and immature birds of prey. In

the Middle Ages, professional hawk catchers took young birds from their nests or caught adult wild birds in various nets and traps (Serjeantson 2009). Some of the freshly captured birds might have died before reaching adulthood and becoming trained hawks, and we may expect to find their remains at archaeological sites (Bochenski et al. 2015). Unfused bones of juvenile and subadult predatory birds were present at Vilnius Lower Castle, which may suggest that these birds were trained for falconry, although it cannot be excluded that they were dispatched as pests.

Findings of eagle remains at all three sites in Lithuania do not necessarily testify to hawking. The extensive, partly wooded wetland areas must have been the perfect habitat for white-tailed eagles, as they need large, quiet, natural areas with sufficient food (waterfowl and fish as well as carrion) and large trees to nest in (Reichstein/Pieper 1986; Brown/Amadon 1989; Serjeantson 2009, 201-202; Ehrlich et al. 2022). In some countries, there were rewards for killing eagles, and their eyries were destroyed as soon as they started nesting (Zeiler 2019). White-tailed eagles are not used in falconry as they hunt out of human sight. It is different with the golden eagle, but this bird, known from falconry in the steppe, has played a role in European falconry only recently (fig. 12; cf. Richter 2018).

Previous zooarchaeological analyses of bone remains from Klaipėda Castle, which has so far been left unconsidered in the present article, reflect bird exploitation in its western part in the 13th/14th centuries (Ehrlich et al. 2020). Only certain disarticulated bones were present, suggesting that a particular anatomical part of the birds was used. The dominance of tarsometatarsi and foot phalanges of the birds of prey further supports the idea of a specific use. Cut marks on these bones strongly indicate that the birds were used for their claws. The use of eagles for feathers or the killing of them as scavengers cannot be ruled out entirely either, but in Klaipėda their use for hawking or as meat was unlikely (Ehrlich et al. 2020). Contrary to this, eagles are said to be harmful to geese and swans, and they do great harm to the wild fauna, for which reason the wardens were allowed to shoot them (Illingworth 1969; Oggins 2004).

According to historians, the noblemen of the Grand Duchy of Lithuania were familiar with around 82 bird species, and the most treasured catch in the 14th-16th centuries was black grouse (Samsowicz 2018). This is also indicated by findings of black grouse bones in Vilnius Lower Castle. Other bird species that were rather intensively hunted were the dove, hazel-grouse, heron, crane, coot, lapwing, woodcock, snipe, thrush, swallow, woodpecker,



Fig. 10 Hard hood for gyrfalcon or Saker falcon from Vilnius Lower Castle. – (Photos V. Abramauskas).

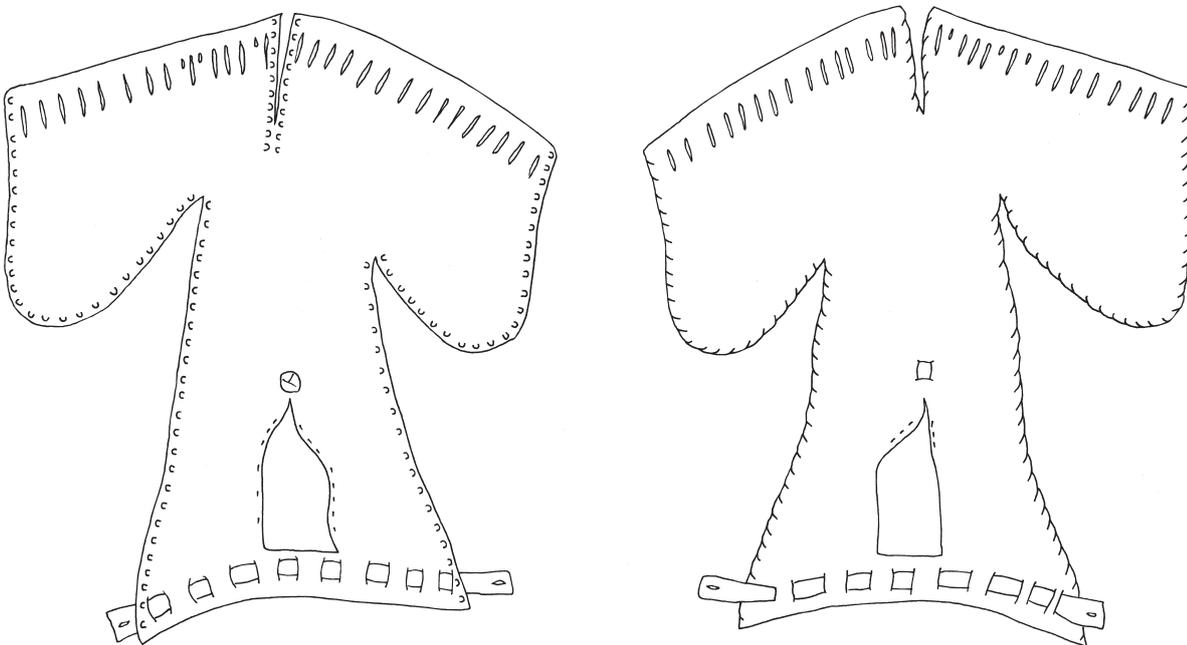


Fig. 11 Technical illustration of a hard hood for a gyrfalcon or Saker falcon. – (Drawing J. Kalėjienė).



Fig. 12 Carpometacarpus of a Golden eagle from Vilnius Lower Castle. – (Photo A. Zagurskytė).

duck, lark, wood-grouse, grey crane, partridge, swan, and grey goose (Zarankaitė-Margienė 2018). Most of these species are present in the Vilnius Lower Castle collection (tab. 4).

Written sources mention that the residents of the castle and their guests hunted with at least ten species of birds of prey (Zarankaitė-Margienė 2018). In 16th–17th-century Prussian sources it is also recorded that the most popular birds for falconry were peregrine falcons (Bezzenger 1889), although the forested landscape would not have been suitable for them. Remains of this species were found at Vilnius Lower Castle, where it was used for falconry according to written sources (Blaževičius et al. 2012, 308; Zarankaitė-Margienė 2018).

As early as the 15th century, there were already a number of peasants appointed as special hunting servants (Ivinskis 1957, 115), who provided the lord's domain with the necessary forest products, animals and poultry. Hunting sessions organised by 15th–16th-century rulers were solely of a recreational nature (Urbanavičius 2010, 329). The regularity of the hunting sessions was more a matter of etiquette than necessity, and they often occurred out of boredom and a desire for distraction (Gurnickis 2009, 34). Hunting in the Grand Duchy of Lithuania began to lose its noble status and became merely a pastime of the ruling elite, whereby animals and birds were

shot practically from the residence windows (Cynarsky 2007, 90). However, it is a common assumption in historiography that until the mid-15th century hunting was considered to be a school for the nobility to learn warfare and achieve greatness. In general, long-lasting hunts were used for learning to use weapons, develop cold-bloodedness, learn to control a horse in difficult situations, and in general become accustomed to physical exertion, hardship, and the nature of the wilderness (Blaževičius et al. 2012).

Remarkably, we know of exceptional women in the Grand Duchy of Lithuania who participated in hunting and falconry, such as the Italian princess, Bona Sforza (1494–1557), wife of Sigismund I, King of Poland and Grand Duke of Lithuania, and mother of Grand Duke of Lithuania and King of Poland, Sigismund II Augustus (1520–1572), as well as the Lithuanian noblewoman, Barbara Radziwiłł (1520–1551), second wife of Sigismund II Augustus (Kiaupa 2006; Cynarsky 2007).

Finally, the importance of birds of prey in the society of that time can also be assessed by looking at their prices and the variety of their species. For example, The First Statute of Lithuania (AD 1529) mentions a fine of 12 *groschen* for dismantling a falcon's nest, which is equivalent to the price of illegally hunting a bison (Lazutka et al. 2001).

Conclusion

Chickens and birds in general were not a significant source of protein compared to other animals (Ehrlich et al. 2022) in the period considered here. For example, the excavation at Vilnius Lower Castle in 2019–2020 revealed c. 1000 bird bones but c. 40,000 mammal bones. There is a predominance of cattle and pig, while birds with their rather small meat yield make up only 2.5 % of the material according to the NISP. Moreover, the middle and lower classes, as represented in Kernavė Upper and Lower towns, consumed even less poultry than the elite. However, a diverse number of species, especially turkey, crane, swan and others are present, though they are not that common in the Baltic region. The variety of game birds (2.5–6 % of all faunal remains) and the number of wild animals (28 % of faunal remains) in general reflects the high status of Vilnius Lower Castle, while this is not the case for Kernavė medieval town and castle with its 13th/14th-century dating. Wild animals in Kernavė account for only 1 % of the total faunal remains, with birds even less.

The material from this study adds to the discussion of medieval and early modern hunting with birds of prey. Goshawks were preferred in Lithuania, which in the given period was densely forested, and the birds were kept by professionals who took care of them on a daily basis. As historical records show, hunting with trained birds of prey was an important part of the royal and noble lifestyle during the 13th to 17th centuries. In exceptional cases, the hunters included queens and noblewomen. In addition, according to historical records, keeping and gift-giving of birds of prey were important opportunities for rulers to demonstrate their status at that time.

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Bibliography

- Bezenberger 1889:** A. Bezenberger, Die Kurische Nehrung und ihre Bewohner. Forsch. dt. Landes- u. Volkskd. 3 (Stuttgart 1889).
- Bilskienė/Daugnora 2000:** R. Bilskienė / L. Daugnora, Paukščiai akmens amžiaus gyvenvietėse. In: A. Girininkas (ed.), Archeologiniai tyrinėjimai Lietuvoje 1998 ir 1999 metais (Vilnius 2000) 567–580.
- Blaževičius 2018:** P. Blaževičius, Pratomė. In: Vilniaus pilių fauna: nuo kepsnio iki draugo (Vilnius 2018) 10–17.
- 2022:** P. Blaževičius, Arkikatedros bazilikos, Žemutinės ir Aukštutinės pilių pastatų, jų liekanų ir kitų statinių komplekso Žemutinės pilies rūmų liekanų (u.k. 24705) teritorijos (LDK Valdovų rūmų G rūsio) detaliųjų archeologinių tyrimų 2019–2020 m. ataskaita [excavation report, Lietuvos istorijos institutas, Vilnius 2022].
- Blaževičius et al. 2012:** P. Blaževičius / S. Rumbutis / T. Zarankaitė, Medžiokliniai, medžiojamieji ir naminiai paukščiai Vilniaus Žemutinėje pilyje XIV–XVI a. naujų tyrimų duomenimis. *Chr. Pal. Magn. Ducum Lithuaniae* 2, 2012, 299–319.
- Bochenski et al. 2015:** M. Z. Bochenski / T. Tomek / K. Wertz / M. Wojenka, Indirect evidence of falconry in medieval Poland as inferred from published zooarchaeological studies. *Wiley Online Library* 26(4), 2015, 661–669.
- Brown/Amadon 1989:** L. Brown / D. Amadon, Eagles, Hawks and Falcons of the World (New York 1989).
- Cynarsky 2007:** S. Cynarsky, Žygimantas Augustas (Vilnius 2007).
- Daugnora/Girininkas 2004:** L. Daugnora / A. Girininkas, Kretuono 1C gyvenvietės bendruomenės gyvensena. *Lietuvos Arch.* 25, 2004, 233–250.
- 2012:** L. Daugnora / A. Girininkas, Hunting in the territory of Lithuania from the Late Palaeolithic to the Middle Ages. In: O. Grimm / U. Schmölcke (eds), *Hunting in Northern Europe until 1500 AD. Old Traditions and Regional Developments, Continental Sources and Continental Influences.* *Schr. Arch. Landesmus. Schloss Gottorf, Ergr.* 7 (Neumünster 2012) 567–596.
- Daugnora et al. 2002:** L. Daugnora / R. Bilskienė / A. K. Hufthammer, Bird remains from Neolithic Bronze Age settlements in Lithuania. *Acta Zool. Cracoviensia* 45, 2002, 233–238.
- DeNiro 1985:** J. M. DeNiro, Postmortem preservation and alteration of in vivo bone collagen isotope ratios in relation to palaeodietary reconstruction. *Nature* 317, 1985, 806–809.
- Von den Driesch 1976:** A. von den Driesch, A Guide to the Measurement of Animal Bone from Archaeological Sites. *Peabody Mus. Bull.* 1 (Harvard 1976).
- Ehrlich et al. 2020:** F. Ehrlich / G. Piličiauskienė / M. Urbonaitė-Ubė / E. Rannamäe, The Meaning of Eagles in the Baltic Region. A Case Study from the Castle of the Teutonic Order in Klaipėda, Lithuania (13th–14th Century). *Arch. Lituana* 21, 2020, 59–78.
- 2022:** F. Ehrlich / G. Piličiauskienė / P. Blaževičius, Bird remains from Vilnius Lower Castle, Lithuania (13th–19th centuries) reveal changes in social status and unusual bird pathologies. *Internat. Journal Osteoarch.* 33(4), 2022, 731–741.
- Gurnickis 2009:** L. Gurnickis, Lenkų dvariškis (Vilnius 2009).
- Harrison/Stewart 1999:** C. J. O. Harrison / R. J. Stewart, Avifauna. In: M. B. Roberts / S. A. Parfitt, *Boxgrove: A Middle Pleistocene Hominid Site at Eartham Quarry, Boxgrove, West Sussex.* *Arch. Report* 17 (London 1999) 187–196.
- Illingworth 1969:** F. Illingworth, *Falcons and Falconry* (London 1969).
- Ivinskis 1959:** Z. Ivinskis, Medžioklė: senovės Lietuvoje. In: *Lietuvių enciklopedija* 18 (Vilnius 1959) 113.

- Kiaupa 2006:** Z. Kiaupa, Lietuvos valstybės istorija (Vilnius 2006).
- Van Klinken 1999:** G. J. van Klinken, Bone collagen quality indicators for palaeodietary and radiocarbon measurements. *Journal Arch. Scien.* 26(6), 1999, 687–695.
- Kuncevičius et al. 2019:** A. Kuncevičius / I. Merkytė / J. Poškienė / R. Prapiestienė / R. Vengalis / G. Vėlius / J. Volungevičius, Landscape transformations in the historical capitals of Lithuania during the 13th–14th centuries. *Acta Arch.* 90(2), 2019, 181–202.
- Makowiecki 2009:** D. Makowiecki, Animals in the landscape of the medieval country side and urban agglomeration of the Baltic Sea countries. In: A. Castagnetti (ed.), *Città e campagna nei secoli altomedievali*: Spoleto, 27 marzo – 1 aprile 2008. *Settimane di studio del Centro italiano di studi sull'altomedioevo* 56, 1 (Spoleto 2009) 427–444.
- Oggins 2004:** S. R. Oggins, *The Kings and their Hawks: Falconry in medieval England* (New Haven 2004).
- Piličiauskas et al. 2017:** G. Piličiauskas / R. Jankauskas / G. Piličiauskienė / T. Dupras, Reconstructing Subneolithic and Neolithic diets of the inhabitants of the SE Baltic coast (3100–2500 cal BC) using stable isotope analysis. *Arch. Anthr. Scien.* 9(7), 2017, 1421–1437.
- Lazutka et al. 2001:** S. Lazutka / I. Valikonytė / E. Gudavičius (eds), *Pirmasis Lietuvos Statutas (1529 m.)* (Vilnius 2001).
- Piličiauskas et al. 2019:** G. Piličiauskas / D. Kisieliene / G. Piličiauskienė / L. Gaižauskas / A. Kalinauskas, Comb Ware culture in Lithuania: new evidence from Šventoji 43. *Lietuvos Arch.* 45, 2019, 67–103.
- 2023:** G. Piličiauskas / E. Pranckėnaitė / A. Matiukas / G. Osipowicz / K. Peseckas / J. Kozakaitė / A. Damušytė / E. Gal / G. Piličiauskienė / H. K. Robson, Garnys: an underwater riverine site with delayed Neolithisation in the southwestern Baltic. *Journal Arch. Scien.: Reports* 52(8), 2023. DOI: 10.1016/j.jasrep.2023.104232.
- Poland 2018:** J. G. Poland, *A Methodological Approach to the Identification of Duck and Goose Remains from Archaeological Sites with an Application to Roman Britain* [PhD thesis, Univ. Sheffield 2018].
- Rackevičius 2009:** G. Rackevičius, Vilniaus pilies teritorijos tyrimai 2002–2009 metais. In: A. Girininkas (ed.), *Archeologiniai tyrinėjimai Lietuvoje 2009 metais* (Vilnius 2009) 164–182.
- Reichstein/Pieper 1986:** H. Reichstein / H. Pieper, *Untersuchungen an Skelettresten von Vögeln aus Haithabu. Ausgrabung 1966–1969* (Neumünster 1986).
- Reimer et al. 2020:** P. J. Reimer / W. E. N. Austin / E. Bard / A. Bayliss / P. G. Blackwell / Ch. Bronk Ramsey / M. Butzin / H. Cheng / R. L. Edwards / M. Friedrich / P. M. Grootes / Th. P. Guilderson / I. Hughen / T. J. Heaton / A. G. Hogg / K. A. Hughen / B. Kromer / S. W. Manning / R. Muscheler / J. G. Palmer / Ch. Pearson / J. van der Plicht / R. W. Reimer / D. A. Richards / E. M. Scott / J. R. Southon / Ch. S. M. Turney / L. Wacker / F. Adolphi / U. Büntgen / M. Capano / S. M. Fahrni / A. Fogtmann-Schulz / R. Friedrich / P. Köhler / S. Kudsk / F. Miyake / J. Olsen / F. Reinig / M. Sakamoto / A. Sookdeo / S. Talamo, The Intcal20 Northern Hemisphere Radiocarbon Age Calibration Curve (0–55 cal kBP). *Radiocarbon* 62, 2020, 725–757.
- Richter 2018:** Th. Richter, Practicalities of falconry, as seen by a present-day falconer. In: K.-H. Gersmann / O. Grimm (eds), *Raptor and Human – Falconry and Bird Symbolism throughout the Millennia on a Global Scale*. *Advanced Stud. Arch. Hist. Hunting* 1 (Kiel, Hamburg 2018) 55–86.
- Rumbutis et al. 2018:** S. Rumbutis / P. Blaževičius / G. Piličiauskienė, Paukščiai Vilniaus pilyse. In: P. Blaževičius (ed.), *Vilniaus pilių fauna: nuo kepsnio iki draugo* (Vilnius 2018) 104–130.
- Samsonowicz 2018:** A. Samsonowicz, Falconry in the history of hunting in the Poland of the Piasts and the Jagiellons (10th–16th centuries). In: K.-H. Gersmann / O. Grimm (eds), *Raptor and Human – Falconry and Bird Symbolism throughout the Millennia on a Global Scale*. *Advanced Stud. Arch. Hist. Hunting* 1 (Kiel, Hamburg 2018) 1491–1506.
- Serjeantson 2009:** D. Serjeantson, *Birds*. *Cambridge Manuals Arch.* (Cambridge 2009).
- Simčenka et al. 2020:** E. Simčenka / M. Jakulis / J. Kozakaitė / G. Piličiauskienė / K. Lidén, Isotopic dietary patterns of monks: Results from stable isotope analyses of a seventeenth–eighteenth century Basilian monastic community in Vilnius, Lithuania. *Arch. Anthr. Scien.* 12, 2020. DOI: 10.1007/s12520-020-01063-9.
- Szidat et al. 2017:** S. Szidat / E. Vogel / R. Gubler / S. Lössch, Radiocarbon dating of bones at the LARA Laboratory in Bern, Switzerland. *Radiocarbon* 59, 2017, 831–842.
- Urbanavičius 2010:** V. Urbanavičius, *Lietuvos didžiųjų kunigaikščių rezidencija Vilniuje* (Vilnius 2010).
- Vaičiūnienė 2000:** D. Vaičiūnienė, Kernavės Viršutinio Miesto Tyrinėjimai. In: A. Girininkas (ed.), *Archeologiniai Tyrinėjimai Lietuvoje 1998 ir 1999 m.* (Vilnius 2000) 131–134.
- 2001:** D. Vaičiūnienė, Kernavės viršutinis miestas. In: A. Girininkas (ed.), *Archeologiniai Tyrinėjimai Lietuvoje 2000 m.* (Vilnius 2001) 40–41.
- 2002:** D. Vaičiūnienė, Kernavės viršutinis miestas. In: A. Girininkas (ed.), *Archeologiniai Tyrinėjimai Lietuvoje 2001 m.* (Vilnius 2002) 59–60.
- 2003:** D. Vaičiūnienė, Kernavės piliakalnio III, vadinamo lizdeikos kalnu, aplinka. In: A. Girininkas (ed.),

Archeologiniai Tyrinėjimai Lietuvoje 2002 m. (Vilnius 2003) 40–41.

Vėlius 2005: G. Vėlius, Kernavės miesto bendruomenė XI–II–XIV amžiuje (Vilnius 2005).

2019: G. Vėlius, Tyrimai Kernavės archeologinėje vietoje. In: A. Girininkas (ed.), Archeologiniai Tyrinėjimai Lietuvoje 2019 m. (Vilnius 2019) 76–79.

2022: G. Vėlius, Kernavės archeologinės vietovės (37320) 2021 detaliųjų archeologinių tyrimų ataskaita [excavation report, 2022].

Vėlius et al. 2021: G. Vėlius / R. Vengalis / M. Pilkauskas, Kernavės Aukuro kalno piliakalnio tyrimai. In: A. Girin-

inkas (eds), Archeologiniai Tyrinėjimai Lietuvoje 2021 m. (Vilnius 2021) 93–97.

Vitkūnas 2006: M. Vitkūnas, Kernavės miestas XIII–XIV amžiuje. In: Musninikai. Kernavė. Čiobiškis (Vilnius 2006) 63–124.

Zarankaitė-Margienė 2018: T. Zarankaitė-Margienė, Mėdžioklės fenomenas Lietuvos didžiojoje kunigaikštystėje XV–XVI a. (1572 m.): socioekonominis, sociopolitinis, mentalinis aspektai [PhD thesis, Vilnius Univ. 2018].

Zeiler 2019: J. Zeiler, The white-tailed eagle (*Haliaeetus albicilla*) in the Netherlands: changing landscapes, changing attitudes. Arch. Anthr. Scien. 11(4), 2019, 6371–6375.

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