The Studies of Archaeological Bird Remains from Medieval Staraya Ladoga

New Results and Interpretations

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Abstract

This article presents the results of studies of bird remains from medieval Staraya Ladoga, one of the most important medieval cities in the north-western part of Russia. The identification of bird bones from the collection acquired during three years of excavations (2004, 2008, and 2009) at Zemlyanoe gorodishche in Staraya Ladoga revealed the presence of 48 species of birds with a diverse range of wild species (46) in general and the dominance of capercaillie (*Tetrao urogallus*) in particular. The domestic birds in the collection studied are represented by domestic chicken (*Gallus gallus f. domestica*) and domestic goose (*Anser anser f. domestica*). The results of the study reveal another point of great interest, namely the discovery of bones of the razorbill (*Alca torda)*, great cormorant (*Phalacrocorax carbo*), and common eider (*Somateria mollissima*), which are valuable for the study of ornithogeography and the history of Fennoscandian avifauna. According to the analysis of the ratio of the number of vertebrate animal remains, birds were very important in the diet of the medieval population of Staraya Ladoga. The composition of identified bird species could indicate the high social and economic status of this medieval proto-city and contribute to the understanding of the interaction between different ethnic groups in the region within the context of human-nature interaction.

Keywords: bird bones, Middle Ages, Staraya Ladoga, Zemlyanoe gorodishche

Introduction

The medieval archaeological site of Staraya Ladoga is located in the Leningrad region, Russia, 125 km east of St Petersburg and 12 km south of the estuary of the Volkhov River, one of the tributaries of Lake Ladoga (Figure 1). Modern Staraya Ladoga consists of a small village and an open-air museum where archaeological and historical research projects are currently conducted. In the Middle Ages, Staraya Ladoga was one of the most important cities in the north-western part of modern Russia. The material culture of Staraya Ladoga revealed significant issues for further studies related to the emergence and development of the medieval population of the region, which resulted in the interaction of Slavic, Scandinavian, and Finnish groups (Rjabinin 1997; Kirpichnikov & Saksa 2002; Uino 2006).

The core part of the archaeological site of Staraya Ladoga, named Zemlyanoe gorodishche, has a cultural layer that dates from the 8th to the 17th century AD (Ravdonikas 1949: 11–2). The archaeological studies of Zemlyanoe gorodishche, which started in the early 20th century, have revealed the existence of a cultural layer of 4–5 meters with various archaeological finds, including remains of vertebrate animals: domestic and wild mammals, birds, and fish.

Figure 1. Map of the Eastern Baltic area showing the location of Staraya Ladoga (adapted from Brisbane et al., 2012).

Recently conducted multidisciplinary studies of Zemlyanoe gorodishche in Staraya Ladoga established the appearance of early Slavs in the Lower Volkhov River area as early as in the middle of the first millennium AD. The beginning of the development of the Ladoga settlement was synchronous with the establishment of sea trade communications in the western Baltic area in the 6th and 7th centuries AD. In general, settlement activity in the territory of Staraya Ladoga and the surrounding region, including the territory of Zemlyanoe gorodishche, falls into a period from the 5th century to the first half of the 6th century AD (Kirpichnikov & Kurbatov 2014: 129–130). According to the latest studies, the beginning of the formation of the cultural layer and the burial of the soil of Zemlyanoe gorodishche can be dated to the 8th to 9th centuries AD (Aleksandrovskii et al. 2013: 96–7).

This article presents the results of a new study of bird remains found during the excavations of Zemlyanoe gorodishche in 2004, 2008, and 2009.

Previous studies of bird remains from Zemlyanoe gorodishche

A large number of vertebrate remains, including bird bones, were recovered in the medieval layers of Staraya Ladoga. Data on their species and quantitative composition was first published by Vladislav Ravdonikas, who supervised the excavations in Staraya Ladoga from 1938 to 1947 (Ravdonikas 1949). The archaeological bird remains found during the excavations conducted at the site in 1938–1939 and 1957 were further identified by the specialists of the Institute of Zoology of the USSR Academy of Sciences. According to the results of these studies, the bird remains were found in the layers of the 9th–10th centuries AD and included 665 bird bones attributed to 23 species (Ravdonikas 1949: 51–3) (Table 1). As regards the species composition, the majority of the identified bones belonged to the Galliformes: capercaillie, black grouse, and domestic chicken (with a predominance of wild species). Among the waterfowl species present in this sample, mallard and eider (*Somateria sp.*) were dominant, and the remains of whooper swans, birds of prey, and common ravens were identified as well. Ravdonikas (1949: 50) pointed out the abundance and high level of diversity of wild bird remains in the studied collection of archaeological remains of wild fauna. On the other hand, he neither conducted any further analysis of the dimensional characteristics and anatomical structure of the remains nor discussed the possible significance of birds for the medieval population of Staraya Ladoga.

The partial data on the species composition of birds from the excavation of Staraya Ladoga in 1957 can be found in the tremendous work of Nikolai Vereshchagin and Oleg Rusakov on the Ungulates of the North-Western USSR (1979). The authors admit that the identified 125 bird bones from the excavation are attributed to domestic chicken, black grouse, capercaillie, and ducks without further species identification (Vereshchagin & Rusakov 1979: 29).

The archaeozoological collections of animal remains obtained during the excavations of Staraya Ladoga in 1988–1991 were studied by Aleksei Kasparov (Kasparov 1997). He diagnosed the mammal bone remains and provided data on the total number of fish and bird remains. The materials originate from the 9th and 10th centuries AD. Most of the remains belonged to domestic

Table 1. The results of identifications of bird bones from Zemlyanoe gorodishche of Staraya Ladoga in 1938–1939 (Ravdonikas, 1949: 51–53). NISP - number of identified specimens.

Taxa	NISP 1938	NISP 1939	NISP Total
Greylag goose (*Anser anser*)	-	1	1
Whooper swan (*Cygnus cygnus*)	-	6	6
Anser sp.	1	-	1
Mallard (*Anas platyrhynchos*)	14	46	60
Common teal (*Anas crecca*)	1	1	2
Gadwall (*Anas strepera*)	-	1	1
Eurasian wigeon (*Anas penelope*)	-	4	4
Northern shoveler (*Anas clypeata*)	2	2	4
Anatinae not identified to species	25	2	27
Aythya sp.	2	-	2
Common goldeneye (*Bucephala clangula*)	-	16	16
Somateria sp.	-	34	34
Goosander (*Mergus merganser*)	-	3	3
Aythynae not identified to species	-	6	6
Northern goshawk (*Accipiter gentilis*)	-	3	3
Rough-legged buzzard (*Buteo lagopus*)	-	2	2
Buteo sp.	1	-	1
Golden eagle (*Aquila chrysaetos*)	1	1	2
Falconiformes not identified to species	-	2	2
Black grouse (*Tetrao tetrix*)	28	66	94
Capercaillie (*Tetrao urogallus*)	105	150	255
Hazel grouse (*Bonasa bonasia*)	-	2	2
Domestic chicken (*Gallus gallus f. domestica*)	26	65	91
Galliformes not identified to species	-	31	31
Ruff (*Philomachus pugnax*)	-	1	1
Eurasian woodcock (*Scolopax rusticola*)	-	1	1
Common raven (*Corvus corax*)	1	1	2
Not identified	11	-	11
Total	218	447	665
Number of species	11	20	

mammals. The total number of bird bones with no further identification of the species was 117, which significantly exceeded the total number of wild mammal bones (see Kasparov 1997: 27, Table 1). Kasparov notes that the presence of a large number of bird remains of different sizes indicates active hunting and the widespread practice of breeding domestic chickens, the remains of which are present in the collections (Kasparov 1997: 30).

Unfortunately, no other information on the bird remains found during the archaeological studies of Staraya Ladoga is currently available.

Materials and methods

The majority of the bird bones used for this study were found at excavations # 3 (in 2004) and # 4 (in 2008 and 2009) at Zemlyanoe gorodishche by an excavation team supervised by Dr Anatoly Kirpichnikov. As regards the methodology of the research, it should be highlighted that all bone remains, including bird bones, were collected by hand and had a common archaeological context and dating. The descriptions of the archaeozoological collection from the excavations at Zemlyanoe gorodishche in 2008 and 2009 were prepared by N.E. Bobkovskaya (Institute of Plant and Animal Ecology, Russian Academy of Sciences). She identified the mammal bones and estimated the total number of the fish and bird remains (Bobkovskaya 2008; 2009). After this, we conducted the species identification and detailed research of fish (see Galimova et al. 2015) and bird bones at the Biomonitoring Laboratory (Institute for Problems in Ecology and Mineral Wealth, Tatarstan Academy of Sciences).

The following radiocarbon datings were obtained from wood samples from the 4-m-thick cultural layer, including the studied remains: 1360 ± 50 BP (LY-5462, radiocarbon laboratory of the Research Institute of Geography of St Petersburg University) and 1300 ± 25 BP (Le-7317, radiocarbon laboratory of the IIMK RAS), that is, 660–780 cal AD (Aleksandrovskii et al. 2009: 277). The AMS dating of two bone fragments of Ladoga ringed seal *(Pusa hispida ladogensis)* provides the following dates: 1428 ± 25 BP (Hela-3825), that, is, 585–656 cal AD, and 1545 ± 24 BP (Hela-2824), that is, 427–570 cal AD (Oinonen 2016). The data was calibrated in the program OxCal v. 4.3.2, using the IntCal13 calibration curve.

The further identification of bird remains was based on recommendations and methods developed by D. Serjeantson (2009) and supplemented with a comparative analysis with the skeletal collection of the Biomonitoring Laboratory. All measurements were taken according to the standards by A. von den Driesch (1976: 103–129). The systematic list of the scientific names of birds in Table 1 and Table 2 were taken from the Checklist of the Birds of the Russian Federation (Koblik et al. 2006).

The reconstruction of the wing length of subfossil capercaillie and common eider was based on the linear regression equation y = a*x +/- b (Figure 2 and Figure 3) constructed separately for male and female individuals according to data on the humerus and wing length of modern capercaillie (inhabiting the woodlands of the European part of modern Russia) and the modern common eider (inhabiting the White Sea and Baltic Sea regions). The further comparison of the wing bones of modern and subfossil capercaillie was

Table 2. The list of species of birds from excavations of Zemlyanoe gorodishche in 2004, 2008 and 2009. NISP - number of identified specimens.

Taxa	NISP				NISP percentages
	2004	2008	2009	Total	%
Black-necked grebe/Horned grebe (*Podiceps nigricollis/Podiceps auritus*)	-	1	-	1	0.1
Great Cormorant (*Phalacrocorax carbo*)	-	1	-	1	0.1
Black stork (*Ciconia nigra*)	6	-	-	6	0.4
Barnacle goose (*Branta leucopsis*)	-	2	-	2	0.1
Greylag goose (*Anser anser*)	-	6	-	6	0.4
Domestic goose (*Anser anser f. domestica*)	-	25	9	34	2.5
Greylag/ Domestic goose (*Anser anser/A. anser f. domestica*)	-	1	2	3	0.2
Greater white-fronted goose (*Anser albifrons*)	4	3	2	9	0.7
Lesser white-fronted goose (*Anser erythropus*)	-	7	-	7	0.5
Bean goose (*Anser fabalis*)	1	11	4	16	1.2
Whooper swan (*Cygnus cygnus*)	-	4	-	4	0.3
Bewick's swan (*Cygnus bewickii*)	-	3	-	3	0.2
Anser sp.	1	8	1	10	0.7
Mallard (*Anas platyrhynchos*)	1	210	6	217	15.8
Mallard/Northern pintail (*Anas platyrhynchos/A. acuta)*	-	2	1	3	0.2
Mallard/Northern pintail/ Gadwall (*Anas platyrhynchos/A. acuta/A. strepera*)	-	10	-	10	0.7
Common teal (Anas crecca)	-	20	-	20	1.5
Gadwall (*Anas strepera*)	-	9	1	10	0.7
Eurasian wigeon (*Anas penelope*)	1	38	2	41	3.0
Northern pintail (*Anas acuta*)	-	50	2	52	3.8
Northern pintail/Gadwall (*Anas acuta/A. strepera*)	-	1	-	1	0.1
Garganey (*Anas querquedula*)	-	8	-	8	0.6
Northern shoveler (*Anas clypeata*)	-	37	4	41	3.0
Anas sp.	-	4	1	5	0.4
Common pochard (*Aythya ferina*)	-	6	-	6	0.4
Tufted duck (*Aythya fuligula*)	-	4	1	5	0.4
Greater scaup (*Aythya marila*)	-	1	1	2	0.1
Greater scaup/Tufted duck (*Aythya marila/ A. fuligula*)	-	-	1	1	0.1
Long-tailed duck (*Clangula hyemalis*)	-	5	-	5	0.4
Common goldeneye (*Bucephala clangula*)	-	-	3	3	0.2
Common eider (*Somateria mollissima*)	-	5	-	5	0.4
Smew (*Mergus albellus*)	-	6	-	6	0.4
Red-breasted merganser (*Mergus serrator*)	-	7	-	7	0.5
Goosander (*Mergus merganser*)	1	70	-	71	5.2
Merganser sp.	1	-	-	1	0.1
Northern goshawk (*Accipiter gentilis*)	5	1	-	6	0.4
Eurasian sparrowhawk (*Accipiter nisus*)	1	1	-	2	0.1
Common buzzard (*Buteo buteo*)	-	1	1	2	0.1
White-tailed eagle (*Haliaeetus albicilla*)	1	34	1	36	2.6
Merlin (*Falco columbarius*)	-	-	1	1	0.1
Willow grouse (*Lagopus lagopus*)	-	1	5	6	0.4
Black grouse (*Tetrao tetrix*)	7	92	7	106	7.7
Capercaillie (*Tetrao urogallus*)	5	275	32	312	22.7
Hazel grouse (*Bonasa bonasia*)	-	-	1	1	0.1
Domestic chicken (*Gallus gallus f. domestica*)	7	191	27	225	16.4
Galliformes not identified to species	-	1	-	1	0.1
Lesser black-backed gull (*Larus fuscus*)	-	2	-	2	0.1
Common gull (*Larus canus*)	-	1	-	1	0.1
Common tern (*Sterna hirundo*)	1	-	-	1	0.1
Razorbill (*Alca torda*)	-	2	-	2	0.1
Ural owl (*Strix uralensis*)	-	-	1	1	0.1
Common magpie (*Pica pica*)	1	4	-	5	0.4
Spotted nutcracker (*Nucifraga caryocatactes*)	-	-	1	1	0.1
Eurasian jackdaw (*Corvus monedula*)	-	2	-	2	0.1
Hooded crow (*Corvus cornix*)	15	4	9	28	2.0
Common raven (*Corvus corax*)	-	5	5	10	0.7
Total identified to species	57	1155	126	1338	97.4
Total bird bones	59	1182	132	1373	100
Number of species	15	40	24	47	

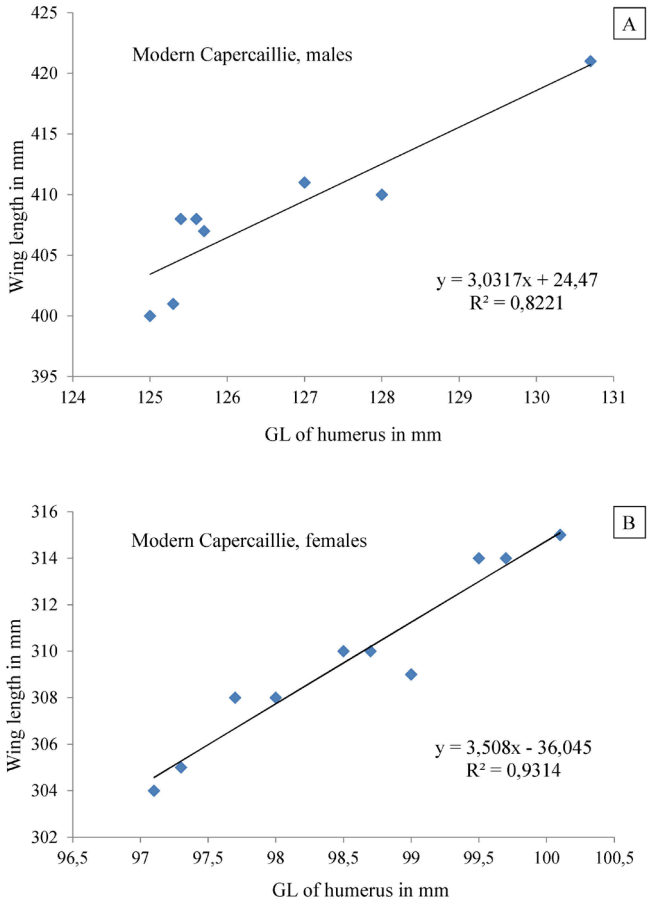

Figure 2. The linear regression according to data on the greatest length (GL) of humerus and wing length of modern capercaillie separately for males, n=8 (A) and females, n=10 (B).

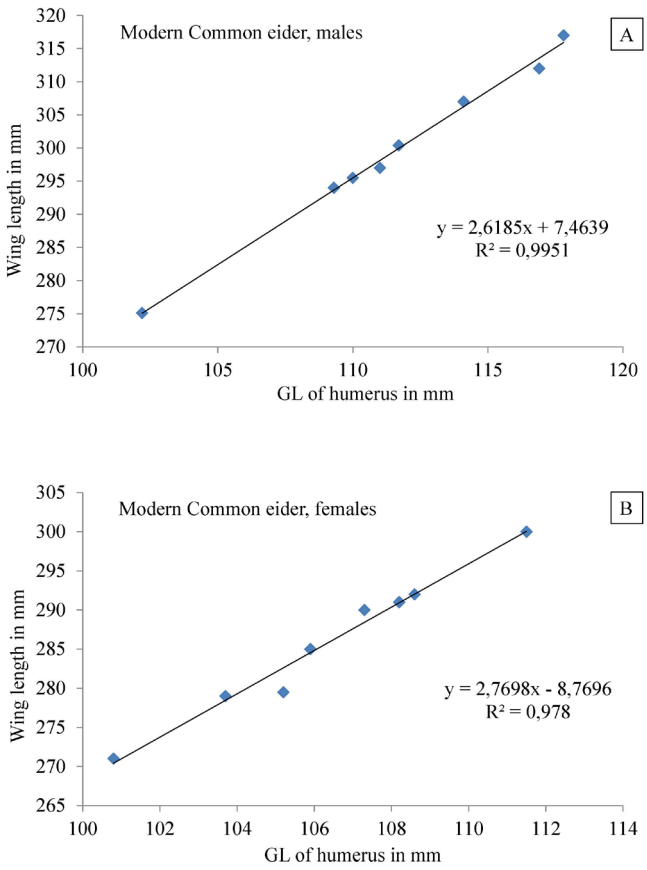

Figure 3. The linear regression according to data on the greatest length (GL) of humerus and wing length of modern common eider separately for males, n=8 (A) and females, n=8 (B).

conducted based on the nonparametric Mann–Whitney U test with an accepted critical level of significance of 0.05 (Zar 2010).

The size comparison of the coracoid of a subfossil razorbill from Staraya Ladoga with that of a modern razorbill was based on the measurements of a modern razorbill from the White Sea population (the collection of the Biomonitoring Laboratory) and the zoological collections of the Natural History Museum of Helsinki (the required data was kindly provided by Dr Henry Pihlström). The reconstruction of the wing length of the subfossil razorbill was also conducted according to the linear regression equation y = a*x + b (Figure 4) constructed on the ratio of the wing lengths and coracoid lengths of modern adult razorbills.

Results

The total number of bird bones (NISP) from all three years of excavations (2004, 2008, and 2009) was 1373. Of these, 1,338 were identified as belonging to 48 species, 46 of which were wild and two domestic (Table 2). It is interesting that the wild species constitute 80.6% of all bird bones studied. Due to the good state of preservation of the bones, all bird bones are identified. The following species dominate the assemblage: capercaillie (22.7%), domestic chicken (16.6%),

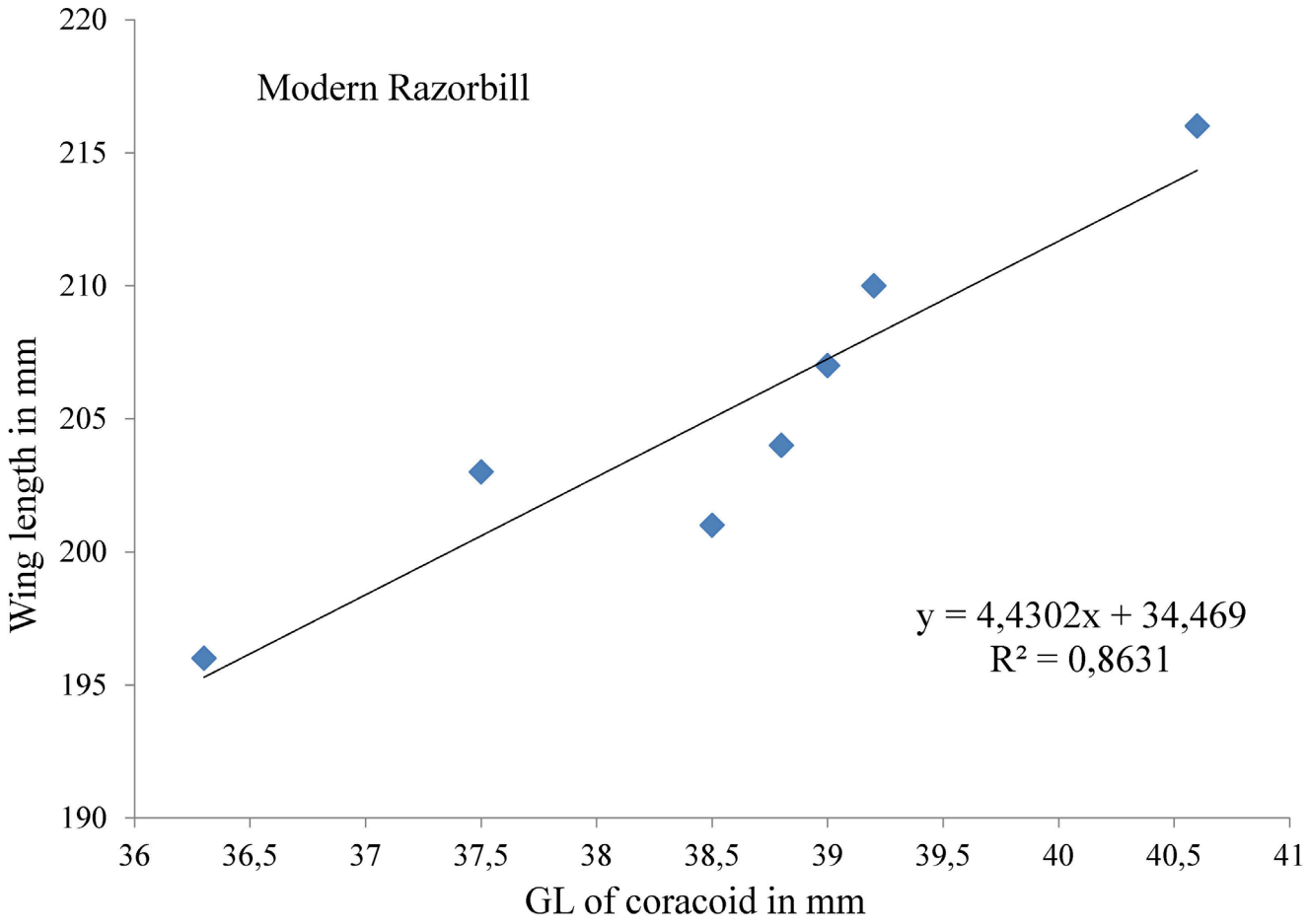

Figure 4. The linear regression according to data on the greatest length (GL) of coracoid and wing length of modern razorbill (without separation by sex), n=7.

Table 3. The number of bird bones (NISP) and the number of species according to order.

Taxon	NISP	Number of species	% species
Podicipediformes	1	1	2.1
Pelecaniformes	1	1	2.1
Ciconiiformes	6	1	2.1
Anseriformes	580	24	51.1
Falconiformes	47	5	10.6
Galliformes	650	5	10.6
Charadriiformes	6	4	8.5
Strigiformes	1	1	2.1
Passeriformes	46	5	10.6
Total	1338	47	100

mallard (16.4%), black grouse (7.7%), and goosander (5.2%). As regards the number of species, the Anseriformes are dominant with 24 species represented (Table 3).

The ratio of the numbers of bird, fish, and mammal bones from Zemlyanoe gorodishche in 2008 and 2009 was as follows: the total number of vertebrate animal bones found during these two years was 36,215 (19,127 bones in 2008 and 17,088 bones in 2009). The remains of mammals (56.5%) prevailed, dominated by domestic species. In second place, fish remains made up 39.3% of the bone finds (Bobkovskaya 2008; 2009). According to our data, bird remains made up 3.6% of all vertebrate animals (1314 bones). It should be noted that the number of bird remains was greater than that of wild mammal bones, the proportion of which was 0.9% of all vertebrate animal remains.

Domestic birds

The domestic birds in the collection studied are represented by domestic chicken and domestic goose.

As regards domestic chicken, 225 bones belonging to this species were found. The collection included all age groups with a predominance of adults (80.8%). However, the amount of bones of immature individuals was relatively high (11.6%). It should be mentioned that among the bones suited for determining the sex, the majority is attributed to male individuals. The main skeletal elements are present, including wing (ulna, humerus) and limb (femur, tibiotarsus), with limb elements dominating (Table 4; Appendix 1). Seven bones of adult chickens (humerus, femur, tibiotarsus) contain medullary bone.

Moreover, an almost complete skeleton of one adult cock was identified (Figure 5), with the bones of the head, carpometacarpus, vertebrae, and phalanges apparently lost during the process of excavation and material collection. Its other bones are in a good state of preservation in complete anatomical order with no traces of cutting identified.

The comparison of minimum, medium, and maximum values of the greatest lengths (GL) of the humerus, femur, and tibiotarsus of adult chicken bones (without separation by sex) found in Staraya Ladoga revealed similarities with the limb size of chicken bones found in the medieval city of Bilyar (dating from the 10th century to the first part of the 13th century AD and located in the Middle Volga region, Russia) (Biomonitoring laboratory data) and medieval Novgorod the Great (dating to the 11th–13th centuries AD, north-western Russia) (see Gorobets & Kovalchuk 2016: 13, Table 18) (Figure 6 B and C). At the same time, the humerus length of chickens from Staraya Ladoga was less than that of chickens from Novgorod the Great (Figure 6 A).

Compared to domestic chicken, the bones of domestic goose are present in smaller numbers. A total of 34 bones were found, making up 13.1% of the poultry remains found during excavations in 2004, 2008, and 2009. This distribution is considered to be typical for the majority of archaeological sites of the 8th to 11th centuries AD (Hamilton-Dyer 2002: 103, Table 1; Askeyev et al. 2013: 121–2, Figure 2; Gorobets & Kovalchuk 2016: 5, Table 3, 4, 6). The bones of domestic geese from Staraya Ladoga belong mainly to adult individuals. However, subadult and juvenile geese are also infrequently present. As regards skeletal elements, the humerus, pelvis, and

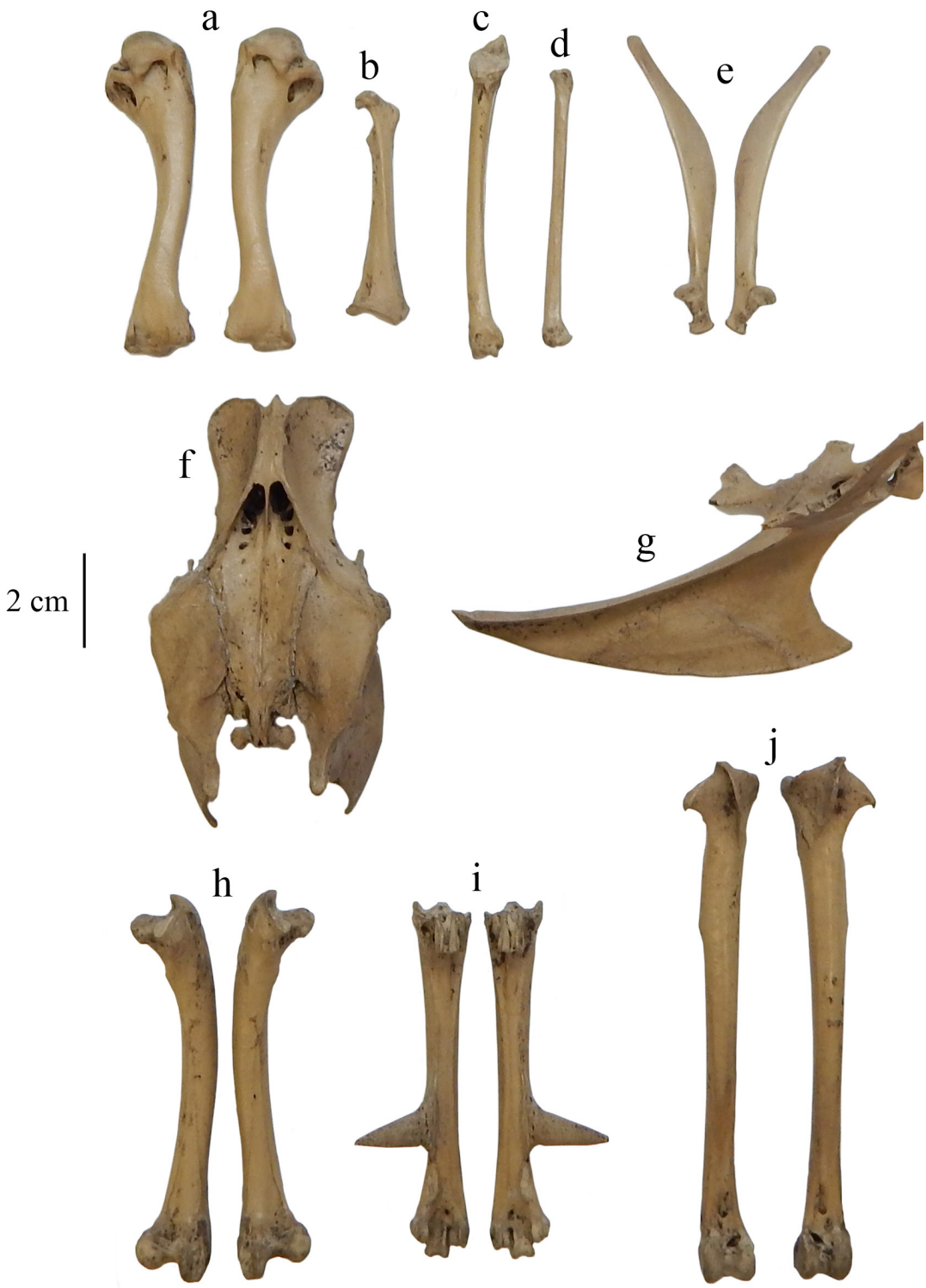

Figure 5. The skeleton of an adult cock from Staraya Ladoga (excavation # 4 of Zemlyanoe gorodishche): a – humerus (right and left), b – coracoid (left), c – ulna (left), d – radius (left), e – scapula (left and right), f – pelvis, g – sternum, h – femur (right and left) , i – tarsometatarsus (right and left) , j – tibiotarsus (left and right). Photo: Dilyara Shaymuratova (Galimova)

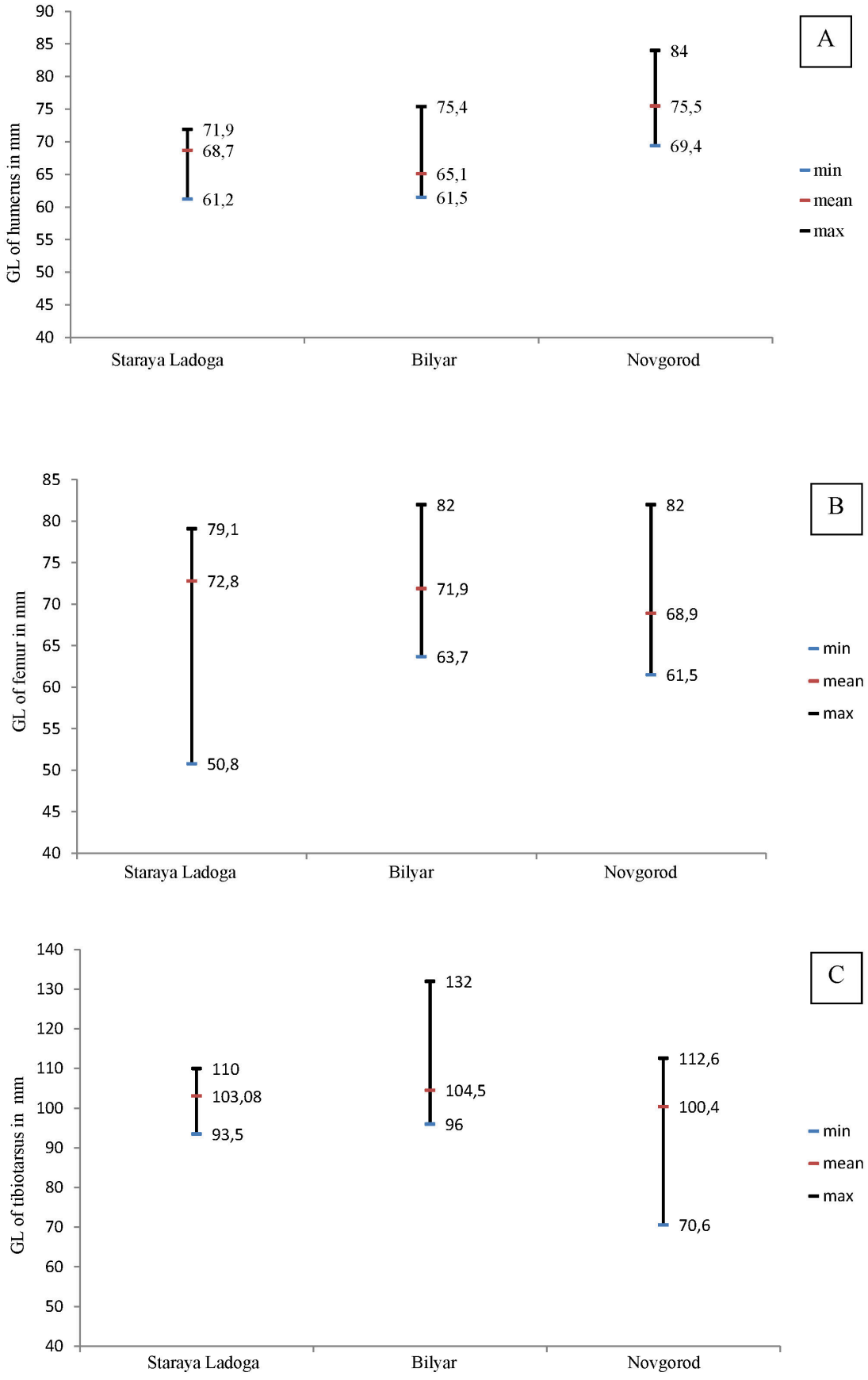

Figure 6. The minimum, medium, and maximum values of the greatest length (GL) measurements of the humerus (A), femur (B), and tibiotarsus (C) of adult domestic chickens (without separation by sex) from the archaeological sites of Staraya Ladoga (humerus n=8; femur n=9; tibiotarsus n=10), Bilyar (humerus n=14; femur n=11; tibiotarsus n=8), and Novgorod the Great (humerus n=12; femur n=17; tibiotarsus n=18).

Table 4. The number of identified specimens (NISP), minimum number of individuals (MNI) with sex distribution, age distribution and prevailing elements of the skeleton of capercaillie and domestic chicken from Zemlyanoe gorodishche (in 2004, 2008, 2009).

Taxa	NISP of taxa	MNI of taxa	Age (NISP; % total NISP)	The dominant elements of the skeleton (NISP; % total NISP)
Capercaillie	312	Male – 81 Female – 24 Sex n.d. – 1 Total – 106	Adult – 305; 98.1% Subadult – 4; 1.3% Subadult-adult – 2; 0.6%	Coracoid – 34; 10.9% Humerus – 39; 12.5% Ulna – 23; 7.4% Femur – 34; 10.9% Tibiotarsus – 23; 7.4%
Domestic chicken	225	Male – 23 Female – 19 Sex n.d. – 61 Total – 103	Adult – 181; 80.8% Subadult – 12; 5.4% Immature – 26; 11.6% Age unknown – 5; 2.2%	Humerus – 31; 13.8% Ulna – 27; 12.1% Femur – 24; 10.7% Tibiotarsus – 46; 20.5%

tibiotarsus dominate the assemblage (Appendix 1). Among the domestic goose bones, one femur has medullary bone.

Wild birds

The most numerous wild bird species in the collection studied is capercaillie, which is also typical of the collection acquired from the excavations in 1938–1939. Most of the bones of this species belong to large adult males. Only two age groups of capercaillies were identified, with adult birds predominating (Table 4). It is therefore suggested that the predominance of large male capercaillies indicates intentional hunting for these birds on leks.

Most key elements of the capercaillie skeleton are present, with wing and leg elements dominating (Table 4). The Mann-Whitney U test showed that capercaillie from Staraya Ladoga had a similar humerus length and wing length as modern capercaillie from the woodlands of the European part of modern Russia (humerus length: p=1 for females, p=0.11 for males; wing length: p=0.9324 for females, p=0.05186 for males). The ratio of the greatest humerus length (GL) of to the smallest diaphysis width (SC) of capercaillie from Staraya Ladoga (Table 5) shows no difference compared to measurements taken from modern capercaillie (Figure 7 A), which allows us to conclude that the size of capercaillie in medieval Staraya Ladoga was similar to the size of modern birds.

Birds of prey

There are six species of birds of prey in the studied collection: white-tailed eagle, northern goshawk, Eurasian sparrowhawk, common buzzard, merlin, and Ural owl.

Another interesting find in this category is an almost complete skeleton of an adult female white-tailed eagle (25 bones) (Appendix 1). The statement that all 25 bones originate from one specimen is based on the fact that they were found in one location in anatomically correct order and had a similar colour and structure of bone tissue. No cut marks were found on the bones. Thus, we assume that the bird died a natural death. The wing bones (carpometacarpus) and leg bones (tibiotarsus) of this individual have pathological changes. Both carpometacarpi have a pathological proliferation of bone tissue in the proximal part of the bone (Figure 8 C), which made it difficult

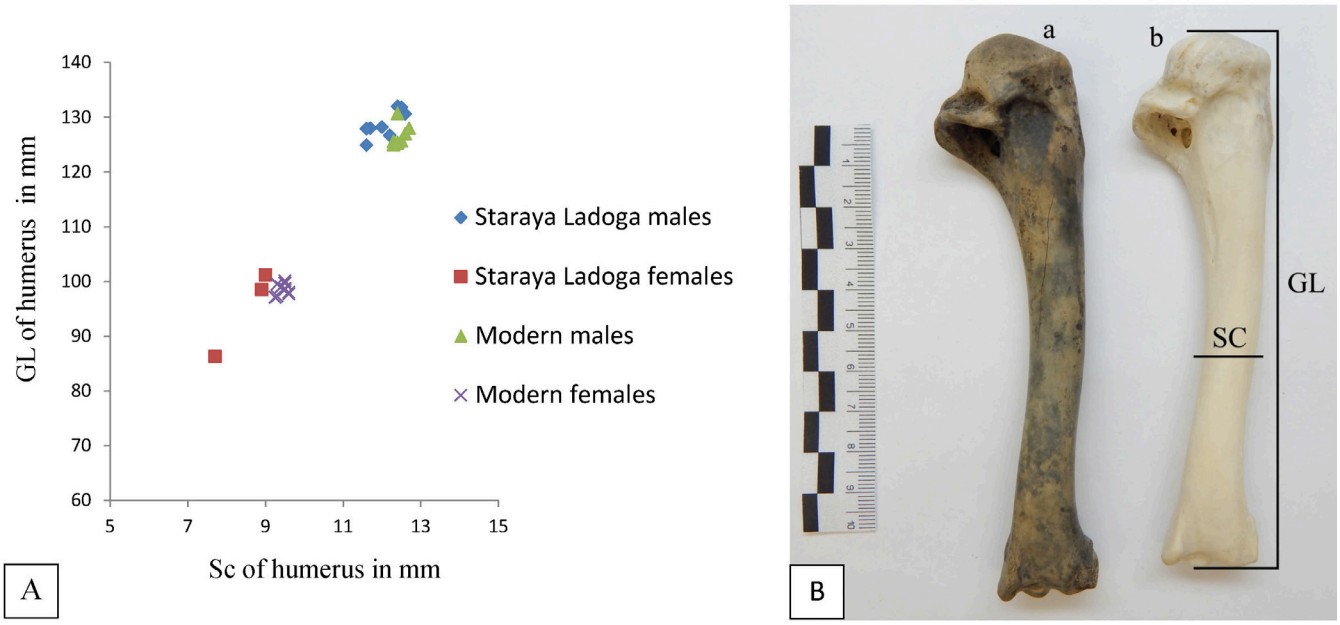

Figure 7. A: The ratio of the greatest length (GL) of humerus (Y axis) to the smallest width (SC) of diaphysis (X axis) of capercaillie from Staraya Ladoga and modern capercaillie from the European part of modern Russia. B: The humerus (right) of subfossil capercaillie (a) and modern capercaillie with measurements (b). Photo: Dilyara Shaymuratova (Galimova)

Figure 8. The tibiotarsus (A, B - from different sides, left tibiotarsus with pathology) and carpometacarpus (C) of white-tailed eagle with pathological changes indicated by arrows. > Figure 8. The tibiotarsus (A, B - from different sides, left tibiotarsus with pathology) and carpometacarpus (C) of white-tailed eagle with pathological changes indicated by arrows. Photo: Dilyara Shaymuratova (Galimova)

Table 5. Bone measurements and reconstruction of wing length of capercaillie, razorbill and common eider from Zemlyanoe gorodishche of Staraya Ladoga.

Greatest length (GL), mm	Smallest breadth of the diaphysis (SC), mm	The reconstruction of wing length, mm
Humerus of Capercaillie (males)		
124.9	11.6	403.1
130.6	12.6	420.4
126.7	12.2	408.6
132	12.4	424.7
128	11.7	412.5
128.2	12	413.1
127.9	11.6	412.2
131.8	12.5	424.0
Humerus of Capercaillie (females)		
98.5	8.9	309.5
101.2	9	319.0
86.3	7.7	266.7
Coracoid of Razorbill (males/females)		
36.3	4.2	195.3
Humerus of Common eider (male)		
113.4	7.4	304.4

to move the wing. This growth is typical for old birds and leads to a significant change affecting the flight abilities of the bird. On the lower part of the diaphysis of the left tibiotarsus (Figure 8 A and B), an overgrown fracture with subsequent formation of a large bone callus was identified. Due to this trauma, the entire leg became shorter and, apparently, had lost its functional activity. The movement of the bird was hindered. Based on these pathological changes in the skeleton, we assume that this individual lived in a settlement: perhaps it was kept captive in an enclosure for some purpose or was a scavenger in local garbage dumps. The traumas would not allow it to survive in nature.

The collection studied includes the remains of other white-tailed eagle individuals as well: 11 bones from 7 individuals. The northern goshawk and Eurasian sparrowhawk bones identified belong to adult individuals, which may indicate hawking or cult birds (Prummel 1997: 335–8; Serjeantson 2009: 321–3; Bochenski et al. 2016: 661–9).

The predominance of white-tailed eagle, northern goshawk, and Eurasian sparrowhawk bones among the total number of birds of prey found at Staraya Ladoga is a feature common to European medieval settlements with a high social status in the modern United Kingdom (Yalden & Albarella 2009: 134–49), Poland (Bochenski et al 2016: 661–9), Ukraine (Gorobets & Kovalchuk 2016: 6–14), north-western Russia (Hamilton-Dyer 2002: 104; Zinoviev 2011: 280, Table 1; Gorobets & Kovalchuk 2016: 4, Table 2; Hamilton-Dyer et al. 2016: 6–7, Table 6), and the Middle Volga region of Russia (Askeyev et al. 2013: 119–120, Table 1, 135).

Corvids

The presence of bones of representatives of the Corvidae family should be noted: the bones of the common magpie, spotted nutcracker, Eurasian jackdaw, hooded crow, and common raven were found, with a relatively large number of hooded crow and common raven bones among them (Table 2; Appendix 1). It is significant that the crow and raven bones do not have any cut marks. As regards the quantity and species composition of corvids from Staraya Ladoga, there are several similarities with the bird remains found at Viking settlements in Denmark (Gotfredsen 2014: 369, Table 2).

Bones of rare bird species: the most interesting findings

The greatest finding of this study is the discovery of razorbill, great cormorant, and common eider bones (Table 2; Appendix 1). The coracoid (Figure 9) and scapula fragment of one adult razorbill female were identified. A cleavage of the coracoid has medullary bone, indicating that the bird was hunted during its nesting period. There is also a cut mark fixed on the diaphysis of the coracoid. As regards the measurements of the razorbill coracoid from Staraya Ladoga (Table 5), they are similar to the measurements of modern razorbills inhabiting the White Sea region and to the measurements of individuals from the Natural History Museum in Helsinki. According to the reconstruction conducted using the methodology mentioned above, the length of the wings of the subfossil razorbill is 195.3 mm. One humerus (fragment) from the collection from Staraya Ladoga belongs to a great cormorant. Although only one bone of

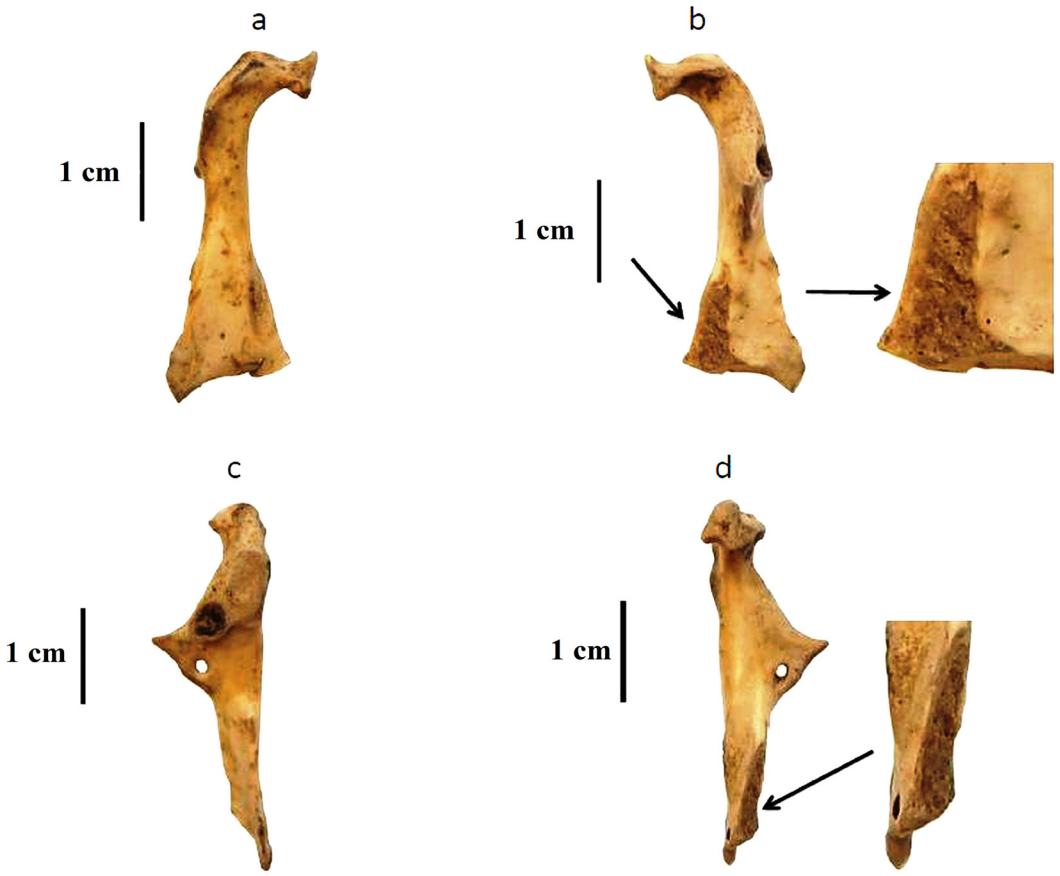

Figure 9. The razorbill coracoid (right) from Staraya Ladoga (excavation # 4 of Zemlyanoe gorodishche) from different sides: a – external, b – internal, c - outer side, d - inner side. The medullary bone is indicated with arrows. Photo: Dilyara Shaymuratova (Galimova)

Figure 10. The common eider humerus (left) from Staraya Ladoga (excavation # 4 of Zemlyanoe gorodishche). A and B - different sides of the bone. Photo: Dilyara Shaymuratova (Galimova)

this species was found, it could indicate that the cormorant was not uncommon in the area around the southern shore of Lake Ladoga.

Five bones of the common eider were also identified in the collection (Appendix 1; Figure 10). The reconstructed wing length of the subfossil common eider is 304.4 mm (Table 5). The reconstructed length is similar to the wing length of a modern common eider from the Baltic Sea and White Sea populations.

Discussion

One of the features revealed by the analysis of species diversity and quantity of archaeological bird remains from Zemlyanoe gorodishche is the similarity of these finds to characteristics obtained from similar studies conducted at the following medieval settlements: Idnakar (9th–13th centuries AD, the Republic of Udmurtia, Russia) (Bogatkina & Kalyakin 2005: 281–6; Ivanova & Zhurbin 2006: 74) Krutik (9th–10th centuries AD, Vologda region, Russia) (Andreeva 1991: 186), and Rodanovo (9th–11th centuries AD, Perm region, Russia) (Panteleev 2012: 728). Such similarities in the composition, in our opinion, may be caused by several reasons. Firstly, all of the above-mentioned settlements were located in a boreal area characterized by a similar composition of eastern European taiga avifauna (Sazonov 2004: 73–148).

Secondly, the dominance of capercaillie and black grouse among the archaeological bird remains found at the above-mentioned medieval

settlements could reflect the substantial use of these species by the medieval population as a food resource available all year round. According to calculations of the total biomass of vertebrate animals in the boreal area of the European part of Russia, the biomass of tetraonids amounts to 26–42 kg per square kilometer. This is approximately equal to the biomass of wild ungulates, namely Eurasian elk (*Alces alces*) and reindeer (*Rangifer tarandus*) (Semenov-Tian-Shansky 1960: 189, Table 54; 302–3).

Thirdly, the diversity of wetland and aquatic species identified was due to the location of these settlements in the vicinity of bird habitats and migration routes, namely in the valleys of major rivers and lakes. It is possible that the hunting of these birds increased seasonally during mass migration periods.

All of the medieval settlements mentioned above had a predominantly Finno-Ugric population that probably had common traditions and ways of human-nature interaction, as well as common beliefs and food preferences. In this context, the absence of the remains of some species of birds or their small amount in the collections may be attributed to the fact that the killing of such species was prohibited. For instance, this has a parallel in the traditions of the Finnish medieval population, among which it was prohibited to kill cranes and swans, whereas the hunting of grouse birds was permitted (Vinokurova 2007: 20–3).

The species composition of birds found during the excavations of Staraya Ladoga may indicate the multi-ethnic composition of the medieval human population of this settlement and its neighbourhood. Namely, the broad diversity of aquatic bird species (ducks) and the large number of domestic chicken bones is considered to be a feature of medieval East Slavic cities (Maltby 2013: 239–40, 243, Appendix 1; Gorobets & Kovalchuk 2016: 11, Table 15; Hamilton-Dyer et al. 2016: 6–7, Table 6). At the same time, the relatively large amount of corvid bones may indicate the presence of Scandinavian ethnic groups in Staraya Ladoga, as it is known that these birds had a sacred meaning for the medieval population of Scandinavia (Gotfredsen 2014: 371–2). Moreover, the large number of bones of forest game birds, such as capercaillie, allows us to assume that the Finnish population might have played the role of supply agents of these species to Staraya Ladoga and to consider that the Finnish ethnic group was present as residents in this settlement. It is necessary to emphasize that the abundance of capercaillie bones is a feature of medieval and post-medieval settlements in Finland (Puputti 2006: 19, Table 1; Tourunen 2008: 269, Table 30; Nurminen 2013a: 3–4; Nurminen, 2013b: 3-4; Salmi et al, 2014: 494, Table 1; Kivikero, 2015: 20, Table 24). On the contrary, the remains of capercaillie are rarely found at Slavic medieval settlements (Gorobets & Kovalchuk, 2016; Hamilton-Dyer et al. 2016).

The identification of the bones of birds of prey and corvids in the collection may indicate an urbanized area with a high accumulative capacity. A large medieval settlement like Staraya Ladoga, surrounded by a variety of natural landscapes, could naturally accumulate a number of faunal remains, including various species of wild birds. The early urbanization of a certain territory leads to the formation of a large amount of human food waste. This attracts various bird species that could be fed by these dumps, whereas predatory species also use these places for hunting corvids and other birds (Mulkeen & O'Conner 1997: 446).

The presence of the bones of wild birds that were neither eaten nor hunted may therefore reflect the accumulation effect caused by direct or indirect human activities.

Although the amount of poultry bird bones in the studied collection is 3.5 times smaller than the amount of bones of wild species, their presence, as well as the presence of juvenile domestic chicken bones, may indicate that the medieval population could breed chickens locally in Staraya Ladoga. A similar trend has already been noted at medieval urban settlements in western Europe (Clavel 2001: 108–10; Serjeantson 2006: 131–44; Thys & Van Neer 2010: 81). At the same time, the presence of domestic goose bones in the collection could be sufficient evidence of the successful breeding of this species in the period studied. However, the small amount of goose remains may indicate the minor significance of this species in the diet and economy of the medieval population of Staraya Ladoga.

The discovery of razorbill and common eider bones in the collection of Staraya Ladoga is quite interesting from the point of view of zoogeography. Ilmari Hilden collected data on the breeding of razorbills in the north-western part of Lake Ladoga (Hilden 1921a: 56; Hilden 1921a b: 61–2, 218–9). This data is then used to complete the verification of a number of review articles and monographs devoted to the avifauna of the USSR, Finland, Karelia, and north-western Russia (Dementev, 1951: 176; Merikallio 1958; Neufeldt 1958: 246; Malczewski & Pukinsky 1983: 228–9). Based on this data, Irena Neufeldt believed that auk birds formed a relict bird fauna in Lake Ladoga in the late Neolithic (Neufeldt 1958: 246). Starting from the 1960s, scientific articles began to question the accuracy of the information obtained by Ilmari Hilden in 1920 on the presence of razorbills and other auks on Lake Ladoga (see review Pihlström 2015: 14–6). The recent publications show a lack of data on razorbill breeding on the islands of Lake Ladoga, and no data is provided on migrant and vagrant individuals in this region (Cherenkov et al. 2016: 208). We discuss the existence and possibility of breeding razorbills on Lake Ladoga. According to recent scientific understanding, there are no biological or ecological obstacles to the breeding of auk birds, including razorbill, in freshwater and brackish-water ecosystems. The absence of these birds in the modern ecosystem of Lake Ladoga is likely due to human activity (Pihlström 2012: 332).

As regards common eider, it is necessary to note that until the end of the 20th century, it was commonly thought that this species rarely migrated to Lake Ladoga. However, during the last decade, there has been an increase in the number of migrating and nesting birds of this species in the region (Waltho & Coulson 2015: 66). The common eider bones identified in the collection suggest that this species was quite common on the southern shore of Lake Ladoga, as well as on the lower reaches of the Volkhov River.

Conclusions

An analysis of the ratio of the numbers of vertebrate animal remains allows us to conclude that the residents of Staraya Ladoga in the 9th–10th centuries AD practiced the breeding of domestic mammals and domestic chickens, as well as fishing and wild bird hunting. Birds were of great importance in the diet of the medieval population of Staraya Ladoga. The presence of several hunting grounds, including vast forests and wetlands, around this

medieval proto-city gave rise to the high diversity of wild species found in the collection.

The discovery of the bones of razorbill, great cormorant, common eider, black stork, and barnacle goose is quite important for ornithogeography and the study of the history of Fennoscandian avifauna, allowing us to track several changes in the ranges of these species over the last 1500 years.

The convenient location of Staraya Ladoga on the flyways of migratory birds, its favourable landscape, its environment, the nearby huge forest areas, and Lake Ladoga and the Volkhov River allowed the population to actively use its natural resources, namely birds, fish, and wild mammals. The diversity of bird species, as well as the various ways of using them, indicates the high social and economic status of this medieval settlement.

The results of this study show the importance of further studies of the animal remains from archaeological sites not only from a biological and economic viewpoint, but also for improving our understanding of the emergence and development of various peoples who inhabited particular areas in the past in general. In particular, the outcomes of this research project on archaeological bird remains from Zemlyanoe gorodishche could contribute to the understanding of the interaction between different ethnic groups in the region within the context of human-nature interaction.

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Appendix 1. The skeleton elements composition of discussed birds from Zemlyanoe gorodishche of Staraya Ladoga (2004, 2008, 2009). NISP – number of identified specimens. MNI – minimum number of individuals.

Taxa	NISP	MNI	Cranium	Qudratum	Maxilla	Mandibula	Coracoid	Furcula	Sternum	Scapula	Humerus	Radius	Ulna	Carpometacarpus	Synsacrum	Pelvis	Femur	Tibiotarsus	Fibula	Tarsometatrsus	Vertebrae	Costae	Phalanx
Phalacrocorax carbo	1	1									1												
Ciconia nigra	6	1									1	1										4	
Anser anser f. domestica	34	19			1	1	2		3	1	8	1	2	1		5	3	4	1	1			
Branta leucopsis	2	1						1			1												
Somateria mollissima	5	4					1		1		3												
Accipiter gentilis	6	2									2	1	1	1						1			
Accipiter nisus	2	2									1		1										
Buteo buteo	2	2											1	1									
Haliaeetus albicilla	11	7					1					1		2			1			1	1		4
Haliaeetus albicilla*	25	1	1				1		1	2	2	1	2	2		1	1	2		1	4	1	3
Falco columbarius	1	1											1										
Tetrao urogallus	312	106	7	1	1	6	34	8	21	15	39	18	23	12	8	17	34	23	2	12	20	8	3
Gallus gallus f. domestica	225	103	2				11	3	22	11	31	13	27	1	1	16	24	46	1	15			
Alca torda	2	1					1			1													
Strix uralensis	1	1												1									
Pica pica	5	5					1				1		1					2					
Nucifraga caryocatactes	1	1									1												
Corvus monedula	2	2				1											1						
Corvus cornix	28	12					1		2	1	5	1	5	1		2	1	5		2	2		
Corvus corax	10	8									1		1	2			1	3		1			1

*** one individual with pathologies**