Slovak Raptor Journal 2016, 10: 51–64. DOI: 10.1515/srj-2016-0005.
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DE GRUYTER OPEN

The Eurasian eagle-owl (*Bubo bubo*) diet in the Trøndelag region (Central Norway)

Potrava výra skalného (*Bubo bubo*) v regióne Trøndelag (stredné Nórsko)

Ján OBUCH & Georg BANGJORD

Abstract: Between 2008 and 2015 we collected pellets of the Eurasian eagle-owl (*Bubo bubo*) in the Trøndelag region of central Norway and identified the food remains in these samples. We collected material at 45 sites with samples from a total of 76 nests. Some of the samples were from older and already abandoned nests, but at several sites we also found and collected fresh *B. bubo* pellets. In total 40,766 items of prey were identified from the osteological material. The most dominant food components were mammals (Mammalia, 25 species, 63.5%). The species representation of birds was very diverse (Aves, more than 150 species, 19.4%). Of amphibians (Amphibia, 16.8%), the well-represented species were *Rana temporaria*. Fish (Pisces, 0.3%) were represented rarely, while invertebrates were represented only sporadically (Invertebrata, 0.05%). A special composition was found in the diet spectra of the mammals and birds in the mountainous areas at altitudes between 220–780 m above sea level. The highest proportion of frogs was found in areas in the proximity of the mainland shore. On the northern islands located near the coast a significant proportion of the *B. bubo* diet consisted of rodents (Rodentia). On the more isolated southern islands of Frøya, Hitra and Storfosna the main prey was sea birds, and of the mammals there were also hedgehogs and rats.

Abstrakt: V rokoch 2008 až 2015 sme uskutočňovali zber a determináciu potravných zvyškov výra skalného (*Bubo bubo*) v kraji Trøndelag v strednom Nórsku. Získali sme zbery zo 45 lokalít, na ktorých boli odobraté vzorky zo 76 hniezd. Niektoré vzorky pochádzajú zo starších opustených hniezd, na niektorých lokalitách boli zbierané tiež čerstvé vývržky *B. bubo*. Z osteologického materiálu sme determinovali 40 766 kusov potravy. Najpočetnejšou zložkou boli cicavce (Mammalia, 25 druhov, 63,5 %). Veľmi pestré je druhové zloženie vtáčej koristi (Aves, viac ako 150 druhov, 19,4 %). Z obojživelníkov (Amphibia, 16,8 %) bol početne zastúpený druh *Rana temporaria*. Ryby (Pisces, 0,3 %) boli zriedkavou súčasťou potravy a sporadicky sa vyskytovali zvyšky bezstavovcov (Invertebrata, 0,05 %). Osobitné zloženie malo potravné spektrum cicavcov a vtákov v horských oblastiach 220 – 750 m nad morom. Najvyšší podiel žiab bol zistený na územiach v blízkosti pevninského pobrežia. Na severnejšie položených ostrovoch v blízkosti pobrežia tvorili významnú časť potravy *B. bubo* hlodavce (Rodentia). Na viac izolovaných južných ostrovoch Frøya, Hitra a Storfosna boli hlavnou korisťou morské druhy vtákov, z cicavcov ježe a potkany.

Key words: Eurasian eagle-owl, *Bubo bubo*, diet, Norway

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Acknowledgement: We are very grateful to Ingar J. Øien of the Norwegian Ornithological Society, who has been our contact in this organisation and has contributed to our applications for project funding. We also wish to thank the following institutions which have been funding the project: Norwegian Environment Agency, County Governor of Sør-Trøndelag, Nord-Trøndelag and Nordland. Furthermore, we are greatly indebted to the persons who have contributed in different ways to the project, especially Lorentz Noteng, Martin Person, Sigurd Bangjord, Venke Ivarrud, Asgeir Østvik, Eva Tilseth, Morten Venås, Per Inge Værnesbranden, Marit Hegseth Rønning and Livar Ramvik. They have given information regarding nesting sites and have participated in searching for nests and resting sites, and in the collection of pellets and bones from the nest areas.

Introduction

The Eurasian eagle-owl is an extremely efficient and versatile raptorial bird (Willgohs 1974). This top predator also hunts smaller species of owls and birds of prey and beasts of prey up to the size of a fox. In this way it plays an important role in various ecosystems in which animals are reflected in the relative representation of its prey. Comparison of the various food compositions enable us to render changes over long periods and between years and types of living area. The first compilation of *B. bubo* diet studies in Norway was published by Hagen (1952). In total, the material consisted of 780 individual

items of prey, mostly found in the inner parts of the country. A more extensive study of the *B. bubo* food remains from 82 sites (28 nesting places) collected between 1957–1972 was presented (n = 4456) by Willgohs (1974). Most of the sites were located on the west coast, and approximately 85% of the material was from the Hordaland and Sogn og Fjordane counties. In neighbouring Sweden the diet of *B. bubo* has been researched by Regnell (1957), Höglund (1966), Schaefer (1970), Emmet et al. (1972) and Olsson (1979).

The main goal of our research was to determine the differences in the composition of the *B. bubo* diet between the islands, near the mainland shore and in the mountainous areas of the Trøndelag region of Central Norway.

Materials and methods

In this article we evaluate the differences in the representation of species in the prey of *B. bubo* between the municipalities of Sør-Trondelag and Nord-Trøndelag counties. In order to protect the nesting sites we will not specify names of specific locations. Their locations are shown in the attached map (Fig. 1). Descriptions of the natural conditions in the municipalities are mentioned in the Tab. 1. Additional and more extensive data from this study will be presented in a later report by the same authors in a journal published by the Norwegian Ornithological Society.

While locating the nesting sites we consulted some ornithologists as well as historical records. In some localities one *B. bubo* breeding pair used several sites for

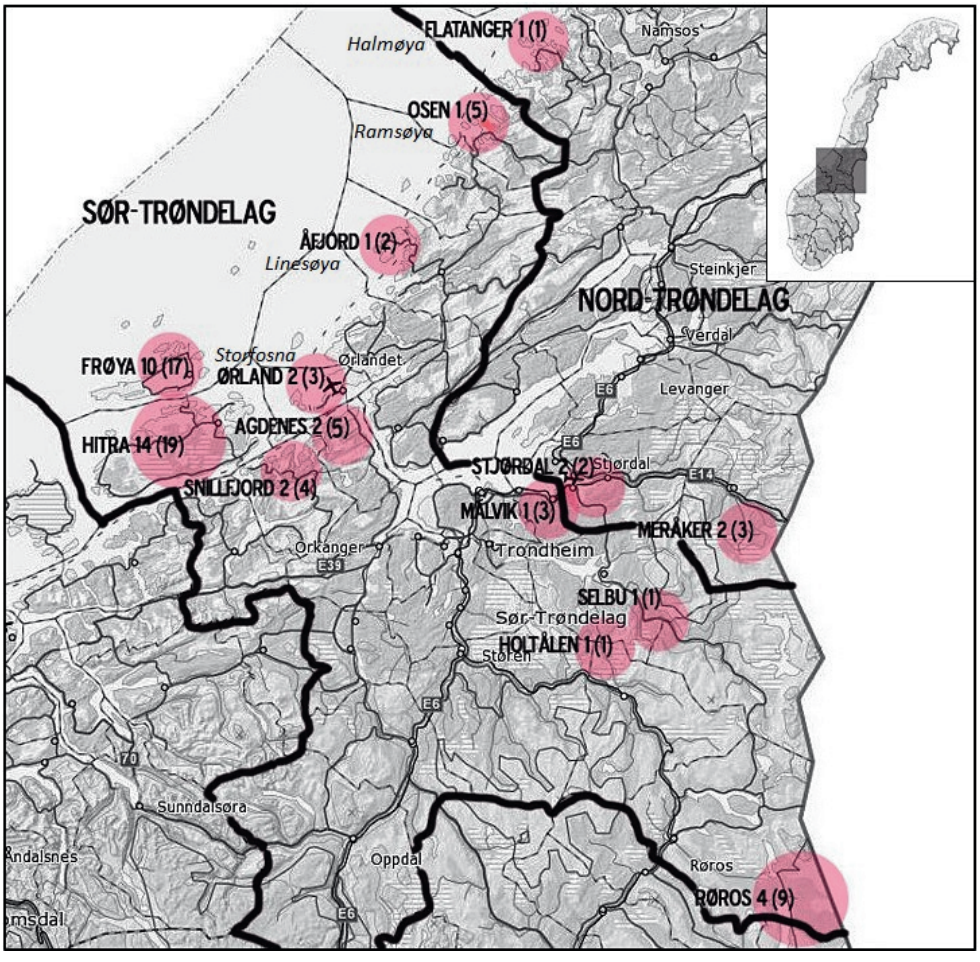


Fig. 1. Map of the study area. Next to the name of each municipality is the number of territories and in parentheses is the number of nests.
Obr. 1. Mapa študovaného územia. Vedľa názvu samosprávy je uvedený počet teritórií a v zátvorkách počet hniezd.

Slovak Raptor Journal 2016, 10: 51–64. DOI: 10.1515/srj-2016-0005.
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Tab. 1. Description of the study areas.
Tab. 1. Opis študovaných území.

municipality / okres	habitats / habitaty	elevation (m a.s.l.) / nadmorská výška (m)
Røros	sparse pine forest[1], bogs and wetlands[2], flat terrain without cliffs or mountains[3]	680–750
Holtålen	mountain forest[4], bogs and wetlands	630–660
Meråker	mountain forest and bogs[5]	450–500
Selbu	valley with forest and felled areas[6], bogs and cultivated pastures[7]	220–350
Stjørdal	cultivated areas[8], bogs and wetlands	30–350
Malvik	forest[9], river[10], bogs[11], cultivated pastures and farmland[12]	0–250
Agdenes	coastal heath[13], marsh[14], wetlands[15], beach[16], cultivated pastures and farmland	0–160
Snillfjord	coastal heath, marsh, wetlands, beach, cultivated pastures and farmland	0–300
Flatanger	island in saline[17]; coastal heath, marsh, wetlands, beach, cultivated pastures and farmland	0–170
Osen	island in saline; coastal heath, marsh, wetlands, beach, cultivated pastures and farmland	0–160
Åfjord	island in saline; coastal heath, marsh, wetlands, beach, cultivated pastures and farmland	0–140
Ørland	island in saline and mainland; coastal heath, marsh, wetlands, beach, cultivated pastures and farmland	0–200
Hitra	marsh, wetlands, coastal heath, sparse pine forest, farmland[18], archipelago[19]	0–150
Frøya	island in saline; coastal heath, marsh, wetlands, archipelago, farmland	0–60

Habitaty: [1]riedke borovicové lesy, [2]rašeliniská a mokrade, [3]rovinatý terén bez útesov alebo hôr, [4]horské lesy, [5]horské lesy a rašeliniská, [6]lesnaté údolie s vyťaženými plochami, [7]rašeliniská a kultivované pasienky, [8]kultivované územia, [9]les, [10]rieka, [11]rašeliniská, [12]kultivované pasienky a poľnohospodárske plochy, [13]pobrežné vresoviská, [14]pobrežné mokrade, [15]mokrade, [16]pláž, [17]morský ostrov, [18]poľnohospodárske plochy, [19]polostrov.

nesting; some nests were also abandoned from the past. In some nest surroundings we also found resting sites with a higher concentration of pellets where we collected pellets as well as bones from the remains of old pellets. In the nests we collected the loose recent bone layer. In cases where bones were located deeper in the hard soil layer we processed this material individually and a bone sample was sent for C^{14} dating analysis to the Research Laboratory for Archaeology and the History of Art, University of Oxford. The age of the oldest layers is included in the results. Osteological material from nests was separated by washing in a container with water. Organic remains were removed with a 5% solution of NaOH and washed under running water. After drying the samples for identification purposes, the jaws of mammals were sorted. Among the Arvicolinae, we included the jaws where the first upper molar M_1 had fallen out and among the Leporidae, we included the heel bone *calcaneus*. Among the birds, we identified the bones of bills: *premaxilla* and *mandibula*, wings: *humerus* and *metacarpus* and feet: *tarsometatarsus*. Among the amphibians we focused on the *os ilium*, among the fish it was their jawbones, the insects their heads and the crabs their claws. The number of individual species, or taxa, in the samples was determined by the most abundant of their body parts found. The identification of bones was undertaken using the collection of vertebrate skeletons at the Botanical Garden of Comenius University in Blatnica.

In the study we analyse the sums of all samples in individual municipalities without differentiating them by age and location. In the modified tables the samples are sorted by similarities of the species spectra. The order of the species is specified in such a way that the plus values of marked differences from the mean values, calculated using the Chi-quadrate test (+ MDFM, Obuch 2001), are arranged into blocks that are marked in the tables with a bold line. Under the dotted line in the table there are stated more numerous species without a marked difference from the mean arranged by decreasing values of total abundance. In the last line of each table the diversity indices H' are specified, calculated according to Shannon & Weaver (1949). The least abundant species are given beneath the tables. The MDFM computations and modified tables were generated by the program Zber (Šipöcz 2004).

Results

The main goal of our research was to acquire comparative material of *B. bubo* food from three parts of Trøndelag: from the mountains (including sparse forest and peatland in highland areas), lower areas close to the sea shore and from islands along the coast. In eight years we collected food remains from 45 sites in 14

municipalities where we found 76 nests of *B. bubo* with prey remains from various dates.

Diet of *Bubo bubo* in the mountains

The basic food components of *B. bubo* in mountainous areas of Trøndelag were mammals (Mammalia, 64.8%), in particular rodents of the subfamily Arvicolinae: species of *Microtus agrestis* (27.6%), *Lemmus lemmus* (11.6%), *Arvicola amphibius* (8.7%) and *Clethrionomys rufocanus* (7.0%) (Appendix 1). Among birds (Aves, 18.4%) the most important food components were the family Phasianidae: *Lagopus lagopus* (5.9%) and *Lagopus muta* (1.1%), Anatidae: species *Anas crecca* (2.9%) and Scolopacidae. Another significant food component was frogs, species *Rana temporaria* (16.6%).

The highest located nests were found in the municipality of Røros (780 meters above sea level), close to the lakes, rivers and peatlands. Here *B. bubo* often hunts for birds, i.e. ducks (9 species) and shorebirds (12 species). Of rodents, in addition to prevailing species *M. agrestis* and *L. lemmus*, also species of *Clethrionomys glareolus*, *Myopus schisticolor* and *Sciurus vulgaris* were well represented.

In the oldest part of the nesting area (650 meters above sea level in highland forest and peatland) in the municipality of Holtålen (up to 150 years old) a rare occurrence of ptarmigan *L. muta* was found. Unlike the other mountainous areas, here frogs *R. temporaria* and grey-sided vole, *C. rufocanus* were represented more often.

In the valley of Dalåa and Tevla in Meråker municipality, one nest of *B. bubo* contained bones older than 60 years. In another place we found one recent and one subfossil nest, where lower layers were dated back 3960 years. The oldest layers contained mainly water voles *A. amphibius* and lemmings *L. lemmus*.

In the valley of Neadalen in Selbu municipality, we found an abandoned nest of *B. bubo* with few breeding (small samples) attempts in recent times, the food remains of which were clearly dominated by *M. agrestis*.

Diet of *Bubo bubo* close to the continental coast

In 13 samples from 5 municipalities close to the seashore of Trondheimsfjorden, Kråkvågfjorden and Åstfjorden almost half of the prey was mammals (Mammalia, 48.9%) (Appendix 2). Birds (Aves, 13.0%) were a less plentiful component of the diet of *B. bubo* here, and frogs of species *R. temporaria* were represented more significantly (37.9%).

An abandoned nest located about 2.6 km from the coast in Malvik municipality contained bones in the deepest layer up to 300 years old. In addition to the predominant species of *M. agrestis*, rodents *L. lemmus* and *A. amphibius* were also well represented. Phasianidae and Anatidae were the birds most often hunted.

Two nests in Stjørdal municipality were located further from the coast, one in a wide valley near agricultural areas and one in forest and peatland higher up. In forest and peatland the diet of *B. bubo* consists mostly of mammals, particularly species of *M. agrestis* and *L. lemmus*. Of birds, *L. lagopus* was most often hunted.

In the municipality of Agdenes, we collected food remains from two territories of *B. bubo* located close to the coast in mountain landscape with peatlands and almost no forest. They consisted mostly of frogs *R. temporaria* (50.7%) and a considerable proportion of birds.

From the municipality of Snillfjord we analysed four bone samples from two territories (four nests) close to the end of the fjord and on a small island by the coast: water birds of families Laridae and Alcidae formed a significant part of the prey (Aves, 34.5%).

There are vast peatlands in the vicinity of inland nests of *B. bubo* in Ørland municipality, where *B. bubo* hunts mostly frogs and species of water birds.

Diet of *Bubo bubo* on the islands

On the northern offshore islands rodents were more represented, forming a significant part of the *B. bubo* prey. *M. agrestis* (50.5%), *A. amphibius* (8.4%) and *L. lemmus* (3.5%) were the species most often hunted (Appendix 3). On the southern islands of Hitra and Frøya water bird species of the family Laridae were an important part of the diet: *Larus argentatus* (2.6% and *Larus canus* (1.7%), Anatidae: *Anas platyrhynchos* (1.1%) and *A. crecca* (1.1%), Alcidae: *Fratercula arctica* (1.3%) and *Alle alle* (0.7%) and other species of Charadriiformes. On some islands frogs were often hunted (*R. temporaria*, 9.2%). On the islands with frogs, this species is well represented. Fish and invertebrates were sporadically represented in the diet of *B. bubo* here.

On the island of Halmøya, Flatanger municipality, we found a large number of bones, which were processed in three layers. Their age will be determined in a separate study. The main diet components of *B. bubo* at this site were mammals (Mammalia, 81.8%). Recently

the island has gradually been overgrown by woody plants and *M. agrestis* has become dominant (62.6%). The island had no forests in the past with sheep grazing there. The species of *A. amphibius* was more represented (14.2%) in the oldest cultural layer. Birds (Aves, 9.7%, 97 species) were less plentiful but more varied prey components of *B. bubo*. The most plentiful species was *F. arctica* (1.3%). Recently frogs (*R. temporaria*, 8,2%) have been more often hunted.

On the island of Ramsøya, Osen municipality, *B. bubo* used five sites for nesting in turn, and under an overhanging rock we found a resting site with pellets. The oldest bones were 60–70 years old. *M. agrestis* (61.5%) was dominant among mammals (Mammalia, 77.5%), while in samples from some of the nests *L. lemmus* was represented (11.0%). The occurrence of *L. lemmus* originates from invasions in years with a lot of *L. lemmus* on the mainland. This applies to the instance of *L. lemmus* on the other islands as well. Under such circumstances *L. lemmus* swim to the islands. In addition, a surprisingly high number of *Sorex araneus* (2.1%) was found. In pellets, frogs were frequent (*R. temporaria*, 6.8%). Of birds (Aves, 15.1%, 68 species) the species most frequently hunted was *L. argentatus* (1.1%).

On Linesøya in Åfjord municipality we collected samples from two nests in the same territory of *B. bubo*. Mammals (Mammalia, 68.6%) were less represented than in the two previous islands with prevailing species of *M. agrestis* (65.6%). Also here there was a surprisingly high number of *S. araneus* (5,1%). Frogs were most represented in pellets from 2013 (*R. temporaria*, 14.0%). Of birds (Aves, 17.1%, 58 species) *L. argentatus* (1.8%) and *Gallinago gallinago* (1.8) were the species most frequently hunted.

On Storfosna in Ørland municipality we collected food remains of *B. bubo* from two nests in the same territory on the cliffs. Rodents of subfamily Arvicolinae were not found there, and therefore mammals (Mammalia, 28.4%) were most often represented by mouse (*Mus musculus*, 10.3%), hare (*Lepus timidus*, 9.6%) and hedgehog (*Erinaceus europaeus*, 7.5%). Frogs were also missing, so the dominant part of the prey of *B. bubo* was birds (Aves, 70.4%, 59 species), in particular species *L. canus* (12.1%), *L. argentatus* (6.5%), *Vanellus vanellus* (11.1%) and *A. platyrhynchos* (5.7%).

On Hitra the material represented 14 territories and 19 nests of *B. bubo*. Of mammals (Mammalia, 34.0%) the most frequent prey species were *Clethrionomys glareolus* (12.5%), *L. timidus* (8.1%), *Rattus norvegicus* (6.1%) and *E. europaeus* (3.5%). The main prey were birds (Aves, 65.6%, 81 species), and of these the most frequently represented species were *L. argentatus* (10.3%), *L. canus* (4.8%), *F. arctica* (4.3%), *A. alle* (3.9%), *G. gallinago* (5.4%), *Scolopax rusticola* (3.2%), *A. crecca* (3.2%) and *A. platyrhynchos* (2.6%). Auks were presented in the owls' diet mainly during periods outside the breeding season. Among gulls the young ones were prevalent, as *B. bubo* hunts them in their nesting colonies.

On Frøya *B. bubo* used 17 nesting sites in ten territories. In its diet mammals (Mammalia, 10.8%) were mostly represented by species *R. norvegicus* (3.8%), *L. timidus* (2.5%), *E. europaeus* (1.6%) and *Neomys fodiens* (1.6%).

The common frog *R. temporaria* (24.3%) was introduced to the island of Frøya repeatedly after 1960 (Dolmen & Seland 2016). Over the past ten years, this frog has become common in several places on this island. In some territories *B. bubo* has started using it as an attractive diet component. *L. lagopus* (3.2%) was an attractive prey in this area. The pheasant *Phasianus colchicus* (0.3%) was introduced earlier, but has probably not expanded enough on the island. The representation of bird species in the diet of *B. bubo* (Aves, 63.4%, 81 species) is similar to the situation on Hitra.

Types of *Bubo bubo* diet in Trøndelag

From our present findings from 39 sites in Sør-Trøndelag county and six sites in Nord-Trøndelag county, it is possible to differentiate the proportional representation of types of prey in the mountains and in the proximity of the coast (Tab. 2). However, the findings from the islands are so varied that we have separated the biggest collections made over a long period on Halmøya, Nord-Trøndelag, from more recent samples acquired on Ramsøya and Linesøya. Here the dominant food components of *B. bubo* are still mammals, subfamily Arvicolinae. On Storfosna, Hitra and Frøya in the southern part of Sør-Trøndelag the *B. bubo* hunts mostly for birds.

In the mountainous diet type of *B. bubo* in Trøndelag the diagnostic species are rodents, *M. oeconomus*, *M. schisticolor* and *C. rufocanus*, and birds, *L. muta*, *Tetrao urogalus*, *Tringa nebularia*, *Numenius phaeopus* and *Turdus torquatus*. Bird species of *L. lagopus*, *A. crecca*, *Bucephala clangula* and *Philomachus pugnax* often appear as the prey of *B. bubo* not only in the mountains but also on the southern islands, e.g. the spe-

Tab. 2. Comparison of abundance of diagnostic species in five types of *Bubo bubo* diet in Trøndelag. Numerical values in the table are presented in absolute value; positive and negative deviations (1 +, 2+, and 1 -, 2-) are marked differences from the mean (MDFM, Obuch 2001) within a respective species, across locations. Species with plus values of MDFM (1+, 2+) are arranged into blocks marked with a bold line. Under the dotted line are more numerous species without MDFM arranged by decreasing values of total abundance. The diversity index H' is calculated according to the work of Shannon & Weaver (1949). For more details see Methods.
Tab. 2. Porovnanie početnosti diagnostických druhov v piatich typoch potravy *Bubo bubo* v regióne Trøndelag. Číselné hodnoty v tabuľke sú uvedené v absolútnych hodnodnotách, kladné a záporné odchýlky (1 +, 2+ a 1 -, 2-) sú významné odchýlky od priemeru (MDFM, Obuch 2001) v rámci toho istého druhu, naprieč lokalitami. Druhy s pozitívnymi hodnotami MDFM (1+, 2+) sú zoradené do blokov vyznačených plnou čiarou. Pod bodkovanou čiarou sú početnejšie zastúpené druhy bez hodnôt MDFM zoradené zostupne podľa ich početnosti. Index diverzity H' je vypočítaný podľa práce Shannon & Weaver (1949). Pre viac informácii pozri Metodiku.

region / územie	**mountains / hory**		**coast / pobrežie**		**Halmøya**		**Linesoya Ramsoya**		**Frøya Hitra Storfosna**			
taxa / taxón											**∑**	**%**
Microtus oeconomus	3+	241	3-	5	5-	0	4-	0	3-	0	246	0.60
Myopus schisticolor	2+	25	1-	0	2-	0					25	0.06
Clethrionomys rufocanus	2+	477		190	4-	19	2-	35	5-	0	721	1.77
Lagopus muta	2+	75	2-	5	2-	10	1-	6	2-	0	96	0.24
Numenius phaeopus	2+	35		9	1-	12	1-	1		9	66	0.16
Surnia ulula	2+	25		3	2-	0				1	29	0.07
Tringa nebularia	2+	18		3	1-	0		1			22	0.05
Aythya fuligula	2+	19		2	1-	2				1	24	0.06
Mustela erminea	1+	32		22		39	1-	6	1-	3	102	0.25
Tetrao urogallus	1+	16		11	2-	0		1		1	29	0.07
Asio flammeus	1+	36		34	1-	35		27		18	150	0.37
Turdus torquatus	1+	8		1	1-	0		2		3	14	0.03
Lagopus lagopus	2+	397	1-	86	2-	83	1-	43	1+	132	741	1.82
Anas crecca	1+	196	1-	78	1-	80	2-	25	1+	157	536	1.31
Philomachus pugnax	1+	27		17	1-	12	1-	4	1+	32	92	0.23
Bucephala clangula	1+	28	1-	9	2-	3	1-	2	2+	33	75	0.18
Clethrionomys glareolus	1+	245	1+	287	2-	86	4-	7	1+	256	881	2.16
Lemmus lemmus	1+	784	1+	827	1-	513		365	6-	1	2490	6.11
Mustela nivalis	1+	26	1+	22	1-	12	1-	2		6	68	0.17
Aegolius funereus	1+	14	1+	19	1-	3	1-	0	1-	0	36	0.09
Sciurus vulgaris		21	2+	80	3-	1	2-	0	2-	0	102	0.25
Tetrastes bonasia		7	2+	25	2-	0	1-	0			32	0.08
Lyrurus tetrix		31	1+	76	1-	47		36		22	212	0.52
Vulpes vulpes		1	1+	6							7	0.02
Rana temporaria		1127	1+	3410	1-	1183	1-	552	1-	555	6827	16.75
Columba palumbus	1-	1	1+	15	2-	2	1+	13		8	39	0.10
Arvicola amphibius	1+	587	2-	223	1+	2059	6-	7	3-	38	2914	7.15
Aythya marila					1+	12					12	0.03
Somateria mollissima	2-	0	1-	2	1+	25		4	1+	18	49	0.12
Mergus merganser	2-	0	2-	2	1+	38		6	1+	13	59	0.14
Uria aalge	-	0	1-	1	1+	29		4	1+	12	46	0.11
Fratercula arctica	4-	0	2-	18	1+	189	1-	16	2+	112	335	0.82
Calidris maritima	2-	0	2-	1	1+	38	1+	21	1-	1	61	0.15
Microtus agrestis	1-	1871	1-	2468	1+	9073	1+	3546	8-	8	16,966	41.62
Sorex araneus	2-	8	2-	9	1-	37	2+	125	3-	0	179	0.44
Calidris alpina		5	2-	0		10	2+	22		1	38	0.09
Tringa totanus		7	1-	0	2-	0	1+	10		7	24	0.06
Cepphus grylle	1-	0	1-	0		14	1+	12		7	33	0.08
Asio otus		6		8	2-	1	1+	15		3	33	0.08
Turdus iliacus		9		14	1-	11	1+	26		12	72	0.18
Turdus pilaris		25		48	2-	16	1+	38	1+	54	181	0.44
Alle alle	4-	0	1-	27	2-	13	1+	47	2+	113	200	0.49
Charadrius hiaticula	1-	0	1-	3	1-	5	1+	13	2+	20	41	0.10
Erinaceus europaeus	3-	0	1-	20	4-	0	3-	0	3+	152	172	0.42
Rattus norvegicus	2-	7		76	5-	0	4-	0	3+	209	292	0.72
Larus argentatus	5-	0	2-	36	4-	19		77	3+	552	684	1.68

Slovak Raptor Journal 2016, 10: 51–64. DOI: 10.1515/srj-2016-0005.
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Tab. 2. Continuation.
Tab. 2. Pokračovanie.

region / územie	mountains / hory		coast / pobrežie		Halmøya		Linesoya Ramsoya		Frøya Hitra Storfosna		∑	%
taxa / taxón												
Larus canus	3-	10	2-	39	2-	64	1-	29	3+	332	474	1.16
Larus marinus	2-	0	3-	1	3-	3		13	3+	78	95	0.23
Lepus timidus		68		127	5-	2	1-	37	2+	277	511	1.25
Neomys fodiens	1-	0	1-	1	2-	0	1-	0	2+	39	40	0.10
Mus musculus	2-	1		30	3-	2	2-	21	2+	82	116	0.28
Neovison vison		1		1	1-	0		1	2+	18	21	0.05
Ardea cinerea				1	1-	0		5	2+	16	22	0.05
Anas platyrhynchos		55		72	3-	21	1-	34	2+	218	400	0.98
Anas penelope		11	2-	2	1-	13	1-	5	2+	45	76	0.19
Mergus serrator	1-	6	2-	1	1-	19	1-	5	2+	51	82	0.20
Haematopus ostralegus	3-	0	1-	18		61		17	2+	54	150	0.37
Pluvialis apricaria	1-	20		31	1-	31		19	2+	77	178	0.44
Vanellus vanellus	2-	5		36	2-	20	1-	11	2+	110	182	0.45
Numenius arquata	2-	0	2-	2	2-	6		13	2+	50	71	0.17
Scolopax rusticola	2-	5	1-	23	2-	13		25	2+	85	151	0.37
Gallinago gallinago	2-	26	1-	74	2-	59		67	2+	205	431	1.60
Turdus merula	1-	2		14	1-	10		14	2+	33	73	0.18
Carduelis flavirostris	1-	0	1-	2	2-	1		5	2+	22	30	0.07
Corvus cornix	2-	15		75	1-	84	1-	32	2+	112	318	0.78
Corvus corax	1-	3		11	1-	11		12	1+	23	60	0.15
Pica pica		1		8	1-	2		3	1+	10	24	0.06
Garrulus glandarius		1		6	1-	1		1	1+	9	18	0.04
Sturnus vulgaris	1-	1		6		14		5	1+	21	47	0.12
Turdus philomelos		9		16	1-	13		16	1+	29	83	0.20
Melanitta fusca		1		2		8			1+	13	24	0.06
Anas acuta		5		4	1-	1		1	1+	11	22	0.05
Phasianus colchicus				2					1+	6	8	0.02
Limosa limosa		1			1-	0		1	1+	10	12	0.03
Limosa lapponica	1-	0	1-	2		17	1-	0	1+	13	32	0.08
Larus fuscus				4	1-	0			1+	8	12	0.03
Rissa tridactyla	1-	0		5		9		8	1+	10	32	0.08
Sterna hirundo						1		2	1+	11	14	0.03
Sterna paradisaea		1	1-	1		7		7	1+	13	29	0.07
Bubo bubo		6		5		18	1-	1	1+	11	41	0.10
Sorex minutus				1		2		2	1+	8	13	0.03
Pisces	1-	5	2-	6		44		20	1+	35	110	0.27
Uria lomvia			1-	0		12		2		7	21	0.05
Lymnocryptes minimus				6	1-	0		2		4	12	0.03
Actitis hypoleucos		1		6	1-	0		3		5	15	0.04
Falco tinnunculus		4		2		7		5		3	21	0.05
Mammalia		**4397**	**1-**	**4397**	**1+**	**11,846**		**4135**	**2-**	**1102**	**25,877**	**63.48**
Aves		**1250**	**1-**	**1165**	**1-**	**1411**	**1-**	**897**	**2+**	**3192**	**7915**	**19.42**
Amphibia, Pisces		**1136**	**1+**	**3423**	**1-**	**1227**	**1-**	**572**	**1-**	**597**	**6955**	**17.60**
Invertebrata		**1**		**2**	**1-**	**1**		**6**	**1+**	**9**	**19**	**0.05**
∑		**6784**		**8987**		**14,485**		**5610**		**4900**	**40,766**	**100.00**
H'		**2.55**		**2.22**		**1.58**		**1.80**		**3.57**	**2.50**	

cies *C. glareolus* on Hitra. The species *A. amphibius* was represented in old samples from Meråker municipality and from the island of Halmøya. In the mountains and along the coast the species of *L. lemmus*, *Mustela nivalis* and *Aegolius funereus* were more often represented.

The diet type of *B. bubo* at lower altitudes close to the coast includes a great proportion of frogs *R. temporaria*, and a higher comparative representation of forest species of *Sciurus vulgaris*, *Tetrastes bonasia* and *Lyrurus tetrix* is characteristic.

The collection of samples from the *B. bubo* nest on Halmøya is distinguished by significant dominance of species *M. agrestis* and *A. amphibius*. Similarly, as on the southern islands, also here we found higher abundance of water bird species: *F. arctica*, *Uria aalge*, *Somateria molissima* and *Mergus merganser*.

On Ramsøya and Linesøya, in addition to dominant representation of the species *M. agrestis* in food samples of *B. bubo*, we found a higher abundance of the shrew *Sorex araneus* and birds: *Calidris alpina*, *Tringa totanus*, *Cepphus grylle*, *Asio otus* and *Turdus iliacus*. The birds *Turdus pilaris*, *A. alle* and *Charadrius hiaticula* are more often represented also on the southern islands.

On the southern islands of Frøya, Hitra and Storfosna mammals are a less significant part of the diet of *B. bubo* (Mammalia, 22.5%), while more often represented are species of *E. europaeus*, *R. norvegicus*, *L. timidus*, *M. musculus*, *Neovison vison* and *Neomys fodiens*. The most frequently hunted are birds (Aves, 65.1%), of which the highest represented are species from the orders of Charadriiformes and Anseriformes.

Discussion

According to the Norway Bird Distribution Atlas (Solem 1994) and population estimates for Norwegian breeding birds, most of the confirmed occurrences of *B. bubo* are located along the sea coast. The results from the years 2008 to 2012 (Øien et al. 2014) estimate the population in Norway from 451 (minimum) to 681 (maximum) pairs, the highest number of pairs being on the western coast of Rogaland and Hordaland counties. A numerous population is also present on the islands in the north, in the county of Nordland. Half of the 30 to 50 sites of *B. bubo* in Sør-Trøndelag county are on islands, where the significant food components are species of water birds. Similarly, a high proportion of birds (Aves, 63.2%) in the diet of *B. bubo* was presented by Willgohs (1974), who acquired most of the material from the western coast of Norway. Hagen (1952) studied the diet of *B. bubo* mainly in the south-east of Norway, in Hedmark county, and in his results mammals are prevalent (Mammalia, 63.3%) as they are in our results from the mountainous areas. Both authors present lower representation of frog *R. temporaria* (2.8%, or 9.3%) than we do in our study (16.8%). A high proportion of frogs has been found at some sites in Malvik and Agdenes municipalities. The species *R. temporaria* was intensively hunted after its introduction to the island of Frøya. This shows its attractiveness as food for *B. bubo*. Frogs in the diet of *B. bubo* are equally plentiful in the mountainous areas of Slovakia (Obuch & Karaska 2010).

In their study of the diet of *B. bubo* in southern Kirghizia, the authors Obuch & Rybin (1993) concluded that its natural environments are in the steppe zone. In the conditions of Central Europe it hunts in cultivated landscapes, which means that forest species of mammals and birds are rare in its diet. Norwegian offshore islands have been deforested by people and grazed by sheep, so the potential prey of *B. bubo* has been enriched also with introduced mammal species: *R. temporaria*, *M. musculus*, *R. norvegicus*, *N. vison* and birds: *Columba livia domestica*, *Gallus gallus domesticus*, *Phasianus colchicus*. Nevertheless, a substantial portion of its diet still consists of original species of birds and mammals despite human activities. After grazing stopped and the areas became overgrown with deciduous forest, as for instance on Halmøya, *B. bubo* did not necessarily leave the areas; it only changed its diet composition. Similar decrease in agricultural activities can be seen in the highland areas of Trøndelag where deforested areas are being overgrown with thin woods. Here *B. bubo* has adapted to hunting various forest species of mammals, *S. vulgaris*, *M. schisticolor* and birds of the family Phasianidae: *T. bonasia*, *T. urogalus* and Strigidae: *S. ulula*, *A. funereus*. *B. bubo* has in the long period lived in such regions with boreal steppe, even without humans, which is documented by the age of bones from the deep layer of the nest in Meråker municipality They date back to almost 4000 years ago (radiocarbon analysis at the University of Oxford, Oct. 2015).

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Appendix 1.

Diet of *Bubo bubo* in the mountains. Numerical values in the table are presented in absolute value; positive and negative deviations (1 +, 2+, and 1 -, 2-) are marked differences from the mean (MDFM, Obuch 2001) within a respective species, across locations. Species with plus values of MDFM (1+, 2+) are arranged into blocks marked with a bold line. Under the dotted line are more numerous species without MDFM arranged by decreasing values of total abundance. The least abundant prey species are given beneath the table. The diversity index H' is calculated according to the work of Shannon & Weaver (1949). For more details see Methods.

Vzorky potravy *Bubo bubo* z hôr. Číselné hodnoty v tabuľke sú uvedené v absolútnych hodnodnotách, kladné a záporné odchýlky (1 +, 2+ a 1 -, 2-) sú významné odchýlky od priemeru (MDFM, Obuch 2001) v rámci toho istého druhu, naprieč lokalitami. Druhy s pozitívnymi hodnotami MDFM (1+, 2+) sú zoradené do blokov vyznačených plnou čiarou. Pod bodkovanou čiarou sú početnejšie zastúpené druhy bez hodnôt MDFM zoradené zostupne podľa ich početnosti. Najmenej početné druhy koristi sú pod tabuľkou. Index diverzity H' je vypočítaný podľa práce Shannon & Weaver (1949). Pre viac informácii pozri Metodiku.

municipality / okres	**Røros**		**Holtålen**		**Meråker**		**Selbu**		**∑**	**%**
taxa / taxón										
Anas crecca	2+	134	2-	22	1-	38	1-	2	196	2.89
Anas platyrhynchos	2+	37	1-	6	1-	11		1	55	0.81
Myopus schisticolor	2+	25	2-	0	2-	0			25	0.37
Clethrionomys glareolus	1+	136	1-	51	1-	53	1-	5	245	3.61
Sciurus vulgaris	1+	14	1-	2		5			21	0.31
Anas penelope	1+	8				3			11	0.16
Aythya fuligula	1+	14		3	1-	1		1	19	0.28
Mergus serrator	1+	6							6	0.09
Tringa nebularia	1+	15	1-	0		3			18	0.27
Numenius phaeopus	1+	26	1-	4	1-	5			35	0.52
Gallinago gallinago	1+	14		5	1-	5		2	26	0.38
Larus canus	1+	9		1	1-	0			10	0.15
Corvus cornix	1+	10		2		3			15	0.22
Lagopus lagopus	1+	135		143	1-	118	2-	1	397	5.85
Lagopus muta	1+	26	1+	41	2-	6		2	75	1.11
Clethrionomys rufocanus		105	1+	210	1-	146		16	477	7.30
Lemmus lemmus		149	1+	321		291	1-	23	784	11.56
Rana temporaria	1-	135	1+	512		462	1-	18	1127	16.61
Turdus pilaris		6	1+	15	1-	3		1	25	0.37
Turdus torquatus			1+	8					8	0.12
Arvicola amphibius	1-	67	2-	38	1+	482	3-	0	587	8.65
Mustela erminea		6	1-	3	1+	22		1	32	0.47
Microtus agrestis	1-	203		654		813	1+	201	1871	27.58
Lepus timidus		20	1-	15		28		5	68	1.00
Bucephala clangula		8	1-	4		14		2	28	0.41
Lyrurus tetrix		7	1-	5		18		1	31	0.46
Tetrao urogallus		6		8	1-	2			16	0.24
Microtus oeconomus		58		99		80	1-	4	241	3.55
Asio flammeus		11		7		17		1	36	0.53
Philomachus pugnax		3		12		10		2	27	0.40
Mustela nivalis		8		6		12			26	0.38
Surnia ulula		5		7		13			25	0.37
Pluvialis apricaria		3		11		5		1	20	0.29
Aegolius funereus		2		1		9		2	14	0.21
Turdus iliacus		1		6		2			9	0.13
Turdus philomelos		2		2		5			9	0.13
Sorex araneus		3		3		2			8	0.12
Rattus norvegicus				2		5			7	0.10
Tetrastes bonasia		1				6			7	0.10
Tringa totanus		2		2		3			7	0.10
Tringa glareola		3		3					6	0.09
Bubo bubo		3		1		1		1	6	0.09
Asio otus		2		2		2			6	0.09
Mammalia	**1-**	**794**		**1404**		**1944**	**1+**	**255**	**4397**	**64.81**
Aves	**1+**	**546**		**349**	**1-**	**333**	**1-**	**22**	**1250**	**18.43**
Amphibia, Pisces	**1-**	**140**	**1+**	**515**		**462**	**1-**	**19**	**1136**	**16.75**
Invertebrata		**1**		**0**		**0**		**0**	**1**	**0.01**
∑		**1481**		**2268**		**2739**		**296**	**6784**	**100.00**
H'		**3.3**		**2.26**		**2.28**		**1.42**	**2.55**	

Slovak Raptor Journal 2016, 10: 51–64. DOI: 10.1515/srj-2016-0005.
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Appendix 1.
Continuation.
Pokračovanie.

Other species (municipality–number) / ostatné druhy (okres–počet): *Mus musculus* (3–1), *Castor fiber* (3–1), *Vulpes vulpes* (3–1), *Alopex lagopus* (3–1), *Neovison vison* (3–1), *Podiceps auritus* (3–1), *Anas querquedula* (1–3; 3–1), *Anas acuta* (1–5), *Melanitta fusca* (1–1), Anatidae (1–5; 2–1), *Accipiter gentilis* (1–1; 3–1), *Buteo lagopus* (1–1; 2–2; 3–1), *Pandion haliaetus* (1–1), *Falco tinnunculus* (1–1; 2–1; 3–2), *Falco columbarius* (1–2; 2–2; 3–1), *Gallus gallus dom.* (3–1), *Vanellus vanellus* (1–3; 2–2), *Calidris alpina* (1–1; 2–3; 4–1), *Calidris temminckii* (2–1), *Calidris canutus* (2–1), *Actitis hypoleucos* (1–1), *Limosa limosa* (3–1), *Scolopax rusticola* (1–1; 2–3; 3–1), *Gallinago media* (1–2; 3–1), *Larus ridibundus* (1–1), *Sterna paradisaea* (1–1), *Columba palumbus* (3–1), *Cuculus canorus* (2–1; 3–2), *Anthus pratensis* (2–1), *Lanius excubitor* (1–1), *Sylvia curruca* (1–1), *Oenanthe oenanthe* (1–1), *Turdus merula* (2–1; 3–1), *Turdus viscivorus* (2–2), *Plectrophenax nivalis* (2–1), *Fringilla montifringilla* (1–1; 3–1), *Fringilla coelebs* (1–1; 3–3), *Carduelis flammea* (3–1), *Pinicola enucleator* (3–1), *Loxia curvirostra* (3–1), *Sturnus vulgaris* (3–1), *Garrulus glandarius* (4–1), *Perisoreus infaustus* (1–3; 3–1), *Pica pica* (1–1), *Corvus corax* (1–1; 2–1; 3–1), Passeriformes (3–2), Aves juv. (1–7; 2–5; 3–3), Salmonidae (2–3), *Esox lucius* (1–1), Pisces (1–4; 4–1), Coleoptera (1–1)

Appendix 2.
Diet of *Bubo bubo* close to the continental sea coast. See Appendix 1 for more details.
Vzorky potravy *Bubo bubo* z blízkosti pevninského pobrežia. Pre viac inforácií viď Appendix 1.

municipality / okres	**Malvik**		**Stjordal**		**Agdenes**		**Snillfjord**		**Ørland**		**Σ**	**%**
taxa / taxón												
Arvicola amphibius	1+	201	2-	10	4-	0	2-	2		10	223	2.48
Rattus norvegicus	1+	72	2-	2	3-	0	1-	0		2	76	0.85
Mus cf. *musculus*	1+	24	1-	0	1-	1				5	30	0.33
Sciurus vulgaris	1+	72	1-	6	2-	2	1-	0			80	0.89
Tetrastes bonasia	1+	21	1-	0		2		1		1	25	0.28
Asio flammeus	1+	24	1-	2		3		2		3	34	0.38
Aegolius funereus	1+	16		1		1		1			19	0.21
Lemmus lemmus	1+	560	1+	262	6-	1	4-	3	3-	1	827	9.20
Microtus agrestis		1093	1+	748	1-	438	1-	155	1-	34	2468	27.46
Lagopus lagopus	1-	16	1+	27	1+	28	1+	14		1	86	0.96
Rana temporaria		1534		596	1+	997	1-	179		104	3410	37.94
Lepus timidus		47	1-	8	1+	55		12		5	127	1.41
Vulpes vulpes					1+	6					6	0.07
Vanellus vanellus		11		3	1+	14		4		4	36	0.40
Columba palumbus	1-	1		2	1+	9		2		1	15	0.17
Turdus pilaris	1-	9		5	1+	26		5		3	48	0.53
Anas crecca	1-	19	1-	6	1+	39		5	1+	9	78	0.87
Gallinago gallinago	2-	11	1-	4	1+	43	1+	11		5	74	0.82
Clethrionomys rufocanus	2-	19	1-	26	1+	65	2+	78		2	190	2.11
Haematopus ostralegus	1-	2		2		5	1+	7		2	18	0.20
Larus argentatus	3-	0	1-	0		4	3+	31		1	36	0.40
Larus canus	2-	3	1-	2		11	2+	22		1	39	0.43
Fratercula arctica	2-	0				1	2+	17			18	0.20
Alle alle	2-	0	1-	0	1-	1	2+	26			27	0.30
Corvus cornix		37	1-	6	1-	9	1+	20		3	75	0.83
Erinaceus europaeus		5		3	1-	0		1	2+	11	20	0.22
Pluvialis apricaria	1-	4		5		12		4	1+	6	31	0.34
Philomachus pugnax	1-	2		2		4		1	1+	8	17	0.19
Anas platyrhynchos		36	1-	7		17		8		4	72	0.80
Lyrurus tetrix		42	1-	4		22		4		4	76	0.85
Turdus iliacus	1-	2		7		4		1			14	0.16
Clethrionomys glareolus		131		69		62		17		8	287	3.19
Scolopax rusticola		12		2		4		4		1	23	0.26
Mustela erminea		10		6		1		4		1	22	0.24
Mustela nivalis		11		8		1		1		1	22	0.24
Turdus philomelos		7		3		5				1	16	0.18
Turdus merula		3		3		5		3			14	0.16
Tetrao urogallus		8						2		1	11	0.12
Corvus corax		3				3		4		1	11	0.12

Appendix 2.
Continuation.
Pokračovanie.

municipality / samospráva	Malvik	Stjordal	Agdenes	Snillfjord	Ørland	∑	%
taxa / taxón							
Sorex araneus	2	1	4	1	1	9	0.10
Bucephala clangula	6	1	1	1		9	0.10
Numenius phaeopus	1	3	5			9	0.10
Asio otus	7	1				8	0.09
Pica pica	4	1		1	2	8	0.09
Accipiter gentilis	7					7	0.08
Falco columbarius	3	1		2		6	0.07
Actitis hypoleucos	4		1	1		6	0.07
Lymnocryptes minimus			4	1	1	6	0.07
Anthus pratensis	1		5			6	0.07
Sturnus vulgaris			1	4	1	6	0.07
Garrulus glandarius	4		1	1		6	0.07
Mammalia	**2249**	**1+ 1152**	**1- 641**	**1- 274**	**1- 81**	**4397**	**48.93**
Aves	**1- 400**	**1- 114**	**1+ 323**	**2+ 241**	**1+ 87**	**1165**	**12.96**
Amphibia, Pisces	**1535**	**597**	**1+ 1001**	**1- 182**	**108**	**3423**	**38.09**
Invertebrata	**0**	**0**	**1**	**0**	**1**	**2**	**0.02**
∑	**4184**	**1863**	**1966**	**697**	**277**	**8987**	**100.00**
H'	**2.10**	**1.69**	**1.91**	**2.71**	**2.78**	**2.22**	

Other species (municipality–number) / ostatné druhy (okres–počet): *Sorex minutus* (3–1), *Neomys fodiens* (3–1), *Microtus oeconomus* (2–2; 1–3), *Martes martes* (3–1), *Neovison vison* (3–1), *Artiodactyla* sp. (3–1), *Gavia* sp. (2–2), *Ardea cinerea* (4–1), *Anas penelope* (3–1; 4–1), *Anas querquedula* (4–1), *Anas acuta* (3–3; 5–1), *Aythya fuligula* (2–2), *Melanitta fusca* (4–1; 5–1), *Somateria mollissima* (2–1; 4–1), *Mergus serrator* (4–1), *Mergus merganser* (4–2), Anatidae (2–5), *Accipiter nisus* (2–2), *Buteo lagopus* (2–4), *Pandion haliaetus* (2–1), *Falco peregrinus* (2–1), *Falco tinnunculus* (2–2), *Lagopus muta* (2–1; 3–4), *Phasianus colchicus* (4–1; 5–1), *Gallus gallus dom.* (4–1), *Rallus aquaticus* (5–1), *Crex crex* (2–1), *Gallinula chloropus* (3–1), *Fulica atra* (3–1), *Charadrius dubius* (4–1), *Charadrius hiaticula* (5–3), *Charadrius morinellus* (4–2), *Calidris maritima* (4–1), *Calidris* sp. (2–1), *Tringa nebularia* (2–3), *Tringa glareola* (2–1), *Tringa ochropus* (2–3), *Tringa* sp. (5–1), *Numenius arquata* (3–1; 5–1), *Limosa lapponica* (3–2), *Gallinago media* (2–1), Limicolae (2–1; 3–1; 4–1), *Larus ridibundus* (2–2; 5–3), *Larus fuscus* (2–1; 4–2; 5–1), *Larus marinus* (4–1), *Rissa tridactyla* (4–3; 5–2), *Sterna paradisaea* (5–1), *Alca torda* (1–1; 4–2), *Uria aalge* (4–1), Charadriiformes (2–5; 5–1), *Columba livia dom.* (2–2; 4–1), *Cuculus canorus* (5–1), *Bubo bubo* (2–4; 3–1), *Surnia ulula* (2–3), *Strix aluco* (2–1), *Picus canus* (2–2; 4–1), *Dendrocopos major* (3–1), *Dendrocopos leucotos* (3–1), *Alauda arvensis* (5–1), *Delichon urbica* (2–1), *Anthus petrosus* (3–2), *Prunella modularis* (3–1), *Phylloscopus trochilus* (3–1), *Oenanthe oenanthe* (2–1), *Phoenicurus phoenicurus* (2–1), *Erithacus rubecula* (1–2), *Turdus torquatus* (3–1), *Turdus viscivorus* (2–1), *Turdus* sp. (2–1), *Periparus ater* (3–1), *Cyanistes caeruleus* (2–1), *Troglodytes troglodytes* (3–1), *Emberiza citrinella* (2–1; 3–1), *Emberiza schoeniclus* (3–2; 4–1), *Plectrophenax nivalis* (1–1), *Calcarius lapponicus* (1–1), *Fringilla montifringilla* (2–1; 1–3), *Carduelis spinus* (2–1), *Carduelis flavirostris* (1–1; 4–1), *Carduelis hornemanni* (3–1), *Loxia curvirostra* (2–1), *Loxia pytyopsittacus* (3–1), *Perisoreus infaustus* (2–3; 1–1), *Nucifraga caryocatactes* (1–1), *Coloeus monedula* (2–4), Passeriformes (2–1), Aves (2–1; 1–1), Aves sp. juv. (2–3; 1–2; 3–4; 4–3; 5–4), *Bufo bufo* (5–2), Salmonidae (2–1; 1–1; 4–1; 5–2), Pisces (3–4; 4–2), Coleoptera (3–1), Decapoda (5–1)

Slovak Raptor Journal 2016, 0: 0–0. DOI: 10.1515/srj-2016-0005.
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Appendix 3.
Diet of *Bubo bubo* on the islands. See Appendix 1 for more details.
Vzorky potravy *Bubo bubo* z ostrovov. Pre viac inforácií viď Appendix 1.

island / ostrov	Halmøya		Ramsøya		Linesøya		Storfosna		Hitra		Frøya		Σ	%
taxa / taxón														
Arvicola amphibius	1+	2059	5-	6	6-	1	4-	1	2-	36	6-	1	2104	8.42
Mustela erminea	1+	39		6	1-	0		1		2	1-	0	48	0.19
Microtus agrestis	1+	9073	1+	1989	1+	1557	6-	2	7-	4	8-	2	12,627	50.52
Lemmus lemmus		513	2+	356	3-	9	3-	0	4-	1	5-	0	879	3.52
Clethrionomys rufocanus	1-	19	2+	35	1-	0			1-	0	1-	0	54	0.22
Cepphus grylle		14	1+	10		2		1		4		2	33	0.13
Tringa totanus	2-	0	1+	7		3				3		4	17	0.07
Sorex araneus	1-	37	2+	68	2+	57			2-	0	2-	0	162	0.65
Turdus iliacus	1-	11	1+	14	1+	12		1	1+	9		2	49	0.20
Turdus merula	2-	10	1+	14	1-	0		4	1+	13	1+	16	57	0.23
Turdus pilaris	2-	16	1+	22		16	1+	9	1+	27	1+	18	108	0.43
Calidris alpina	1-	10		2	2+	20				1			33	0.13
Asio otus	2-	1		2	2+	13				2		1	19	0.08
Asio flammeus	1-	35		12	1+	15			1+	14		4	80	0.32
Lyrurus tetrix	1-	47		18	1+	18		1	1+	18	1-	3	105	0.42
Charadrius hiaticula	2-	5		3	1+	10	1+	9	1+	9		2	38	0.15
Melanitta fusca		8					1+	8		2		3	21	0.08
Carduelis flavirostris	2-	1		1		4	2+	19		1		2	28	0.11
Philomachus pugnax	1-	12		3		1	2+	13		5	1+	14	48	0.19
Mus cf. *musculus*	3-	2	2-	0	1-	1	4+	62		3	1+	17	85	0.34
Erinaceus europaeus	5-	0	3-	0	2-	0	3+	45	2+	71	1+	36	152	0.61
Lepus timidus	5-	2		37	3-	0	3+	58	3+	162	1+	57	316	1.26
Anas platyrhynchos	3-	21	1-	16	1-	18	2+	34	1+	52	2+	132	273	1.90
Haematopus ostralegus		61		11	1-	6	2+	16	1+	17	1+	21	132	0.53
Numenius arquata	2-	6	1-	3		10	1+	9	1+	11	2+	30	69	0.28
Larus canus	2-	64	2-	19	2-	10	3+	73	2+	97	2+	162	425	1.70
Larus argentatus	4-	19	1-	34	1-	43	1+	39	2+	206	3+	307	648	2.59
Larus marinus	3-	3		7		6		4	2+	34	2+	40	94	0.38
Alle alle	3-	13	1+	31		16	1+	10	2+	78	1+	25	173	0.69
Corvus cornix	1-	84	1-	20	1-	12	1+	14	1+	41	1+	57	228	0.91
Corvus corax	1-	11		10		2	1+	6	1+	10		7	46	0.18
Sturnus vulgaris	1-	14		4		1	1+	8	1+	9		4	40	0.16
Pica pica	1-	2		3				1	1+	7		2	15	0.06
Garrulus glandarius	1-	1		1					1+	7		2	11	0.04
Larus fuscus	1-	0						2	1+	6			8	0.03
Fratercula arctica		189	2-	10	2-	6		5	2+	87	1-	20	317	1.27
Clethrionomys glareolus	1-	86	3-	4	3-	3	1-	2	3+	252	3-	2	349	1.40
Sorex minutus	1-	2		2					1+	7		1	12	0.05
Mustela nivalis		12		2					1+	6			20	0.08
Anas acuta	1-	1				1			1+	7		4	13	0.05
Anas crecca	1-	80	1-	12	1-	13		2	2+	64	2+	91	262	1.50
Anas penelope	1-	13	1-	2		3		1	1+	20	2+	24	63	0.25
Mergus serrator	1-	19	1-	3	1-	2		1	2+	30	1+	20	75	0.30
Bucephala clangula	2-	3		1		1		1	1+	12	2+	20	38	0.15
Scolopax rusticola	2-	13		17		8		1	3+	64	1+	20	123	0.49
Gallinago gallinago	2-	59	1-	25	1+	42		10	2+	108	2+	87	331	1.32
Rattus norvegicus	5-	0	3-	0	3-	0	1-	0	3+	123	2+	86	209	0.84
Neovison vison	2-	0		1					1+	11	1+	7	19	0.08
Lagopus lagopus	1-	83		30	1-	13		2	1+	57	2+	73	258	1.30
Pluvialis apricaria	1-	31	1-	9		10		5	1+	27	2+	45	127	0.51
Vanellus vanellus	2-	20	1-	9	2-	2	4+	67	1+	18	1+	25	141	0.56
Turdus philomelos	1-	13		12		4		5	1+	11	1+	13	58	0.23
Neomys fodiens	3-	0	1-	0						2	3+	37	39	0.16
Rana temporaria		1183	1-	219	1+	333	4-	0	6-	0	2+	555	2290	9.16

Appendix 3.
Continuation.
Pokračovanie.

island / ostrov	Halmøya	Ramsøya	Linesøya	Storfosna	Hitra	Frøya	∑	%
taxa / taxón								
Ardea cinerea	2- 0	4	1		5	1+ 11	21	0.08
Phasianus colchicus						1+ 6	6	0.02
Limosa lapponica	17			2	3	1+ 8	30	0.12
Rissa tridactyla	1- 9	2	6	2		1+ 8	27	0.11
Sterna hirundo	1- 1	2		1		1+ 10	14	0.06
Sterna paradisaea	1- 7	6	1	2	3	1+ 8	27	0.11
Salmonidae	1- 0					1+ 7	7	0.03
Pisces	1- 44	16	1- 4	6	8	1+ 21	99	0.40
Actitis hypoleucos	1- 0	3			4	1	8	0.03
Limosa limosa	1- 0		1		5	5	11	0.04
Columba palumbus	2- 2	7	6	2	5	1	23	0.09
Decapoda	1- 1	3	1			5	10	0.04
Calidris maritima	38	11	10		1- 0	1- 1	60	0.24
Mergus merganser	38	4	2		6	7	57	0.23
Somateria mollissima	25	3	1	4	7	7	47	0.19
Uria aalge	29	3	1	1	5	6	45	0.18
Bubo bubo	18		1	2	2	7	30	0.12
Numenius phaeopus	12		1	2	5	2	22	0.09
Uria lomvia	12	2			4	3	21	0.08
Lagopus muta	10	5	1				16	0.06
Falco tinnunculus	7	1	4		1	2	15	0.06
Anas querquedula	3	2	2		3	2	12	0.05
Aythya marila	12						12	0.05
Mammalia	**11,846**	**2507**	**1628**	**1- 171**	**1- 683**	**3- 248**	**17,083**	**68.35**
Aves	**1- 1411**	**1- 490**	**1- 407**	**2+ 424**	**2+ 1318**	**2+ 1450**	**5500**	**22.00**
Amphibia, Pisces	**1227**	**1- 235**	**1+ 337**	**3- 6**	**4- 8**	**2+ 583**	**2396**	**9.59**
Invertebrata	**1- 1**	**4**	**2**	**1**	**1**	**1+ 7**	**16**	**0.06**
∑	**14,485**	**3236**	**2374**	**602**	**2010**	**2288**	**24,995**	**100.00**
H'	**1.58**	**1.84**	**1.60**	**3.22**	**3.47**	**3.15**	**2.36**	

Other species (municipality–number) / ostatné druhy (okres–počet): *Sciurus vulgaris* (1–1), *Canis domesticus* (1–1; 6–2), *Felis catus dom.* (5–2), *Ovis ammon aries* (2–1; 5–1), *Gavia stellata* (2–1), *Podiceps auritus* (1–1; 6–1), *Tachybaptus ruficollis* (3–1), *Fulmarus glacialis* (1–1; 5–1; 6–1), *Phalacrocorax carbo* (6–1), *Phalacrocorax aristotelensis* (5–1), *Anser fabalis* (5–1; 6–1), *Anas clypeata* (6–2), *Aythya fuligula* (1–2; 4–1), *Melanitta nigra* (5–2), *Clangula hyemalis* (4–2; 5–1; 6–1), *Tadorna tadorna* (2–1), Anatidae (1–19; 2–3; 4–4; 5–6; 6–2), *Accipiter gentilis* (1–3), *Accipiter nisus* (1–3; 4–1; 5–3), *Buteo lagopus* (1–1; 4–1; 5–1), *Falco peregrinus* (5–2; 6–2), *Falco columbarius* (1–3; 2–1; 5–1), *Tetrao urogallus* (2–1; 6–1), *Coturnix coturnix* (1–1), *Gallus gallus dom.* (6–2), *Rallus aquaticus* (1–4; 2–1; 4–1; 5–1; 6–1), *Porzana porzana* (5–1), *Crex crex* (1–1; 2–1; 5–1; 6–1), *Gallinula chloropus* (5–1; 6–3), *Fulica atra* (1–1; 5–1; 6–2), *Charadrius morinellus* (4–2), *Calidris canutus* (1–1; 5–1), *Calidris ferruginea* (2–1; 3–1), *Tringa nebularia* (3–1), *Tringa glareola* (1–3; 2–1; 4–1; 6–1), *Tringa ochropus* (6–1), *Gallinago media* (2–1; 4–1; 5–2), *Lymnocryptes minimus* (2–2; 5–3; 6–1), Limicolae (1–7; 2–3; 3–1; 5–1; 6–1), *Stercorarius paraziticus* (1–3; 2–1; 6–1), *Stercorarius pomarinus* (4–1), *Stercorarius skua* (5–1), *Larus ridibundus* (1–3; 4–1), *Alca torda* (4–2; 6–1), *Columba livia dom.* (1–2; 2–2; 5–1; 6–3), *Cuculus canorus* (1–2; 3–2; 5–2), *Bubo scandiacus* (3–1; 6–1), *Surnia ulula* (5–1), *Aegolius funereus* (1–3), *Strix aluco* (2–1), *Picus canus* (5–1), *Hirundo rustica* (1–2), *Delichon urbica* (1–2), *Anthus pratensis* (1–1; 2–1; 3–1; 6–1), *Anthus petrosus* (1–3), *Anthus* sp. (4–1), *Motacilla alba* (1–4), *Bombycilla garrulus* (6–1), *Lanius excubitor* (5–2), *Prunella modularis* (1–1; 3–1), *Sylvia communis* (2–1), *Sylvia curruca* (1–1), *Saxicola rubetra* (1–1), *Oenanthe oenanthe* (1–1), *Phoenicurus phoenicurus* (6–1), *Erithacus rubecula* (1–2; 2–1; 3–1), *Turdus torquatus* (2–2; 4–1; 5–1; 6–1), *Turdus viscivorus* (6–1), *Turdus* sp. (5–1; 6–2), *Parus major* (1–1), *Sitta europaea* (1–1), *Troglodytes troglodytes* (4–1), *Cinclus cinclus* (2–1), *Emberiza citrinella* (4–1), *Plectrophenax nivalis* (1–4; 3–1; 5–1), *Fringilla coelebs* (1–4; 2–1; 5–1), *Carduelis spinus* (4–1; 5–2), *Carduelis hornemanni* (1–7; 4–1), *Carduelis* sp. (6–3), *Pinicola enucleator* (1–1; 3–2), *Loxia curvirostra* (1–1; 3–1; 5–1), *Passer domesticus* (4–1), *Nucifraga caryocatactes* (6–1), *Coloeus monedula* (5–1), Passeriformes (1–1; 2–1; 3–1; 5–1), Passeriformes sp. juv (6–2), Aves (1–14; 5–2; 6–1), Aves sp. juv. (1–62; 2–9; 3–11; 5–22; 6–8), Coleoptera (2–1; 3–1; 4–1; 5–1; 6–1), Bivalvia (6–1)