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Spectrum of animal and plant in the diet of Woodcock (*Scolopax rusticola* L.) based on literature data

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Abstract Based on the results of dietary surveys of the Woodcock (*Scolopax rusticola* L.) in 11 countries (Great Britain, Scotland, France, Italy, Croatia, Germany, Hungary, Poland, Ukraine, Russia, and Romania), 63 taxa (42 animal and 21 plant) were detected in Woodcock gizzard contents, of which the predominant dietary components were of animal origin. The composition of the dietary components varies only within a narrow spectrum, adapting to seasonal changes in the insect fauna and the supply of the area. Earthworms (*Lumbricus* spp.) represent the dominant proportion, also with larvae of Dermaptera, Myriapoda, Coleoptera taxa, and Diplopoda and Araneidae species being present in significant numbers. The mass fraction of plant components (mainly weed seeds) is low, with occasional occurrence of vegetative plant parts. The narrow species range of animal taxa recorded and the low proportion of plant dietary components clearly indicate that the Woodcock is a specialist species, and the availability of a few major dietary component taxa groups are a limiting factor in case of the Woodcock. Therefore, it is a major determinant of the diurnal, seasonal and annual movement patterns.

Keywords: Woodcock, *Scolopax rusticola* L., nutritional spectrum, percentage of prey

Összefoglalás Az erdei szalonka (*Scolopax rusticola* L.) elterjedési területén 11 országban (Nagy-Britannia, Skócia, Franciaország, Olaszország, Horvátország, Németország, Lengyelország, Ukrajna, Oroszország, Románia, Magyarország) végzett táplálék vizsgálatok eredményei alapján 63 taxont (42 állati és 21 növényi) mutattak ki szalonka begytartalmakban, amiből a meghatározó hányadot az állati eredetű táplálékalkotók képezték. A táplálékkomponensek összetétele csak szűk spektrumban változik, igazodva a rovarvilág évszakos változásához és az adott terület kínálatához. A meghatározó hányadot a földigiliszták (*Lumbricus* spp.) képviselik, mellettük a Dermaptera, Myriapoda, Coleoptera taxonok lárvái és a Diplopoda valamint az Araneida fajok mennyisége volt számottevő. A növényi komponensek tömegaránya (főként gyommagvak) alacsony, a vegetatív növényi részek előfordulása eseti. A felvett állati eredetű taxonok szűk fajspektruma, valamint a növényi eredetű táplálékkomponensek alacsony aránya alapján az erdei szalonka egyértelműen specialista fajnak tekinthető, tehát a meghatározó néhány fő táplálékalkotó taxoncsoport rendelkezésre állása limitáló tényező a szalonka esetében, ezen keresztül pedig a napszakos, a szezonális és az éves mozgásmintázat egyik meghatározó befolyásoló tényezője.

Kulcsszavak: erdei szalonka, *Scolopax rusticola* L., táplálkozási spektrum, zsákmányállat-taxonok

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Introduction

The Woodcock is a game species in many European countries. However, probably due to the difficulty of detecting its dietary components, few dietary biology studies have been published in the ornithological literature in relation to its importance for hunting and the annual size of the bags. A few major monographs (e.g. Gyementyev & Gladkov 1951, Glutz *et al*. 1973, Cramp & Simons 1983) and a few authors (Ferrand *et al*. 1979, Hirons 1982, Kiss 1973, Koubek 1986, Kiss *et al*. 1990, Fadat 1995, etc.) provide data on the unique features of dietary biology, but in many cases only the major taxon groups are given, and precise data on the mass ratios are rarely available. Based on the results of recent bromatological studies (Hoodless & Hiorons 2007, Aradis *et al*. 2019), our knowledge has been expanded over the last decades. Based on them and previous literature, we would like to provide a comprehensive picture of the dietary spectrum of the Woodcock.

Results and Discussion

Based on the results of dietary biological studies carried out in eleven countries of the Woodcock's range (Great Britain: Seebohm 1885, Borrer 1891, Campbell 1936, Gordon 1915, Sperry 1940, Hirons 1978, Hoodless & Hirons, 2007, France: Garavini 1962, Shorten 1974, Fadat *et al*. 1979, Ferrand *et al*. 1979, Lebeurier 1982, Granval 1987, Fadat 1995, Italy: Lo Valvo 1988, Spanò & Borgo 1993, Aradis *et al*. 2019, Croatia: Cvitanić & Novak 1968, Germany: Bettmann 1975, Glutz von Blotzheim 1986, Poland: Steinfatt 1938, Ukraine: Kistyakivski 1957, Grekov *et al*. 1973, Russia: Buturlin 1902, Aradis *et al*. 2019, Romania: Kiss & Sterbetz 1973, Kiss *et al*. 1990, 1999, Hungary: Bod 1901), 21 plant and 42 animal taxa (63 in total) were detected in the gizzard content. The dominant part is made up of dietary components of animal origin, which are summarised in *Table 1* included in the study.

Plant dietary components are considered insignificant by some authors (Steinfatt 1938, Kiss & Sterbetz 1979, Hoodless & Hirons 2007), but in other studies they represent a significant proportion up to 21% (Shorten 1974, Koubek 1986, Fadat 1995).

The plant parts in the gizzard content were mainly made up of weed seeds and a small number of other seeds (buttercups *Ranunculus* spp., orache *Atriplex* spp., knotweed *Polygonum* spp., sorrel *Rumex* spp., spurge *Euphorbia* spp., sedge *Carex* spp., cottongrass *Eriophorum* sp., rush *Juncus* sp., bur-reed *Sparganium* sp.). In addition, seeds of cultivated plants (pea *Pisum* sp., oat *Avena* sp., maize *Zea mays*), as well as fruits (blueberry *Vaccinium* spp., elderberry *Sambucus* sp., whitebeam *Sorbus* spp., berry *Rubus* spp.) and juniper pine nuts *Juniperus* sp. were found in the tested gizzard contents. Among the vegetative plant parts, Norway spruce *Picea abies* needles and in several cases root fragments were found. In addition to these, inorganic components (pebble, sand) were also present in small quantities in the gizzard content.

The results of most dietary biology studies (Seebohm 1885, Sperry 1940, Buturlin 1902, Hirons 1982, Granval 1987, Kiss *et al*. 1990, 1999, Duriez *et al*. 2005, Hoodless & Hirons 2007) are in agreement with Hoffmann's observations (1867), who found that earthworms

Table 1. Nutritional spectrum of the Woodcock (*Scolopax rusticola* L.) from animal sources based on gizzard content analyses from 1885 to 2019

1. táblázat Az erdei szalonka (*Scolopax rusticola* L.) állati eredetű táplálékspektruma 1885–2019-es évek között végzett begytartalom-vizsgálatok alapján

Taxonomy					
Phylum	**Class/Subclass**	**Order/Suborder**	**Family**	**Genus**	**Species**
Nemertea	–	–	–	–	–
Annelida	Clitellata / Oligochaeta	Opisthopora / Lumbricina	Lumbricidae	Lumbricus	***Lumbricus* spp.**
	Clitellata / **Hirudinea**	–	–	–	–
Mollusca	Gastropoda / Orthogastro-poda	**Pulmonata / Stylommatophora, Basommatophora**	–	–	–
	Bivalvia	Mytiloida	**Mytilidae**		
Arthropoda	Chilopoda	Scolopendromorpha	**Scolopendridae**	–	–
		Lithobiomorpha	**Lithobius**		
	Diplopoda	Glomerida	**Glomeridae**	–	–
		Julida	**Julidae**		
	Malacostraca / Eumalacostraca	Isopoda / Oniscidea	Oniscidae	Oniscus	***Oniscus* spp.**
	Branchiopoda	Laevicaudata / Cladocera	Leptodoridae	Leptodora	***Leptodora kindtii***
	Araneae	Araneae / Labidognatha	**Araneidae**	–	
	Insecta / Pterygota	Dermaptera / Forficulina	Forficulidae	**Forficula**	–
	Insecta	Hemiptera / Heteroptera	Nabidae, Pentatomidae	**Eurydema Notonecta**	–
		Orthoptera	**Gryllidae**	–	
		Hymenoptera	Formicidae	**Forficula**	–
		Diptera / Nematocera	**Tipulidae Limoniidae Chironomidae Bibionidae**	–	–
		Diptera / Brachycera	**Tabanidae Asilidae Therevidae Calliphoridae Tephritidae**	–	–
		Coleoptera / Adephaga	**Cicindelinae Carabidae Dytiscidae Histeridae**	–	–
		Coleoptera / Polyphaga	**Silphidae Staphylinidae Elateridae Tenebrionidae Curculionidae Hydrophilidae Geotrupidae Scarabaeidae Heteroceridae**	–	–

The taxa in bold were described during gizzard content analysis.

(*Lumbricus* spp.) represent the dominant part of the diet – in terms of abundance and dry weight (up to 85%) (Granval 1987, Duriez *et al*. 2005). According to Gordon (1915), *"...it consumes an extraordinary number of worms, almost equal to its own weight in a single day."* In the samples (n = 42) collected in Ukraine during the migration and reported by Kistyakivski (1957), the proportion of earthworms was 2% in total, with spiders (34%), Diplopoda species (34%), and Julidae and other Myriapoda (29%) taxa predominating. This matches well with the results of samples collected in Italy and Sicily during the winter period by Aradis *et al*. (2019). All this points to the fact that insects and centipedes may be the main dietary source in different zones and in the absence of earthworms in the autumn-winter period.

Little is known in the literature about the diet spectrum of chicks, but the available studies suggest that there is no significant variation in the diet spectrum, at best only during the first few days (Hoodless & Hirons 2007). Birds hatched in captivity will pick up small earthworms independently after a few hours, provided they are moving. Woodcock broods are not able to search in the topsoil during the first days, so during this period they feed with the help of the hen. The mother bird turns over the soil and uses her beak to "offer" her chicks food of animal origin; the broods typically eat small insects found on the soil surface or in the forest litter cover (Bettmann 1975).

The composition of the dietary components varies over a narrow spectrum, adapting to seasonal changes in insect life and supply of the area (Aradis *et al*. 2019). The number of larvae of Dermaptera, Myriapoda, Coleoptera taxa and of Diplopoda and Araneida species in the diet increases with the activation of soil life, as indicated by the gizzard content collected in spring. During this period, the proportion of earthworms (Lumbricidae) is still low because the soil is still too cold for them and their activity is therefore low (Kistyakivski 1957, Glutz von Blotzheim 1986, Aradis *et al*. 2019). However, from late spring to autumn *Lumbricus* species become dominant in the consumed diet (Glutz von Blotzheim 1986). During wintering, the diet spectrum varies from area to area (Aradis *et al*. 2019). Fadat (1995) found no statistically significant difference in the dietary composition of hens and cocks in his studies.

The number of taxa recognized as diet is high, but due to the dominant *Lumbriscus*, Coleoptera and Diplopoda mass ratios, the Woodcock is considered a specialist species, so it only finds the required quantity and quality of diet in periods and areas with optimal conditions for the main dietary component taxa.

Through the special dietary strategy of the Woodcock, the daily, seasonal and annual variation in the abundance of the main dietary component taxa – mainly Lumbricidae – has a profound influence on the occurrence and habitat use of this bird species in a given area. The abundance and activity of Lumbricidae species – typically *Lumbricus terrestris* – is influenced mainly by the physical properties of the soil, its chemistry, compactness, temperature and moisture content, and last but not least, its dietary content (Lee 1985, Binet *et al*. 1987, Edwards & Bohlen 1996, Curry 2004). Earthworms typically come to feed near the soil surface only under optimal moisture and temperature conditions – usually at night – and during the day they typically stay in the safety of their burrows, which extend down to depths of several metres (Binet *et al*. 1987, Binet 1993). This, therefore, is the

most optimal time for the Woodcock to feed, but it is known that Woodcock feeding is not exclusively restricted to the night. The choice of night feeding sites is dominated by open areas, especially low-grassed cattle pastures (Burton 1974, Niçaise 1996, Aradis *et al*. 2019), where the main food sources, *Lumbricus* species and insect larvae developing in dung, are abundant. Agricultural fields are far inferior to the dietary supply of pastures, with studies by Binet *et al*. (1997) showing that earthworm abundance was only one-tenth in maize fields, compared to pastures. The population decline in the UK in the 1960s was partly explained by Lewis and Roberts (1993) as a result of pasture ploughing. Numerous studies have shown that the Woodcock may cease to change habitat diurnally during periods of excessive drought as the dietary supply becomes more limited (Hirons & Jonhson 1987, Duriez *et al*. 2005, Hoodless & Hirons 2007, Braña *et al*. 2010), so changes in the abundance and availability of dietary components determine daily and seasonal movement patterns as well as habitat selection.

The dietary spectrum compiled based on literature data – given the species' specialist dietary strategy – is likely to include the taxa groups to be regarded as food for the Woodcocks migrating through our country or nesting in small numbers in Hungary. However, the literature reviewed in this study shows that soil condition, through the availability of food of animal origins, has a fundamental influence on the choice of wintering sites, migration intensity, and reproductive success of the Woodcock.

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