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Frugivory and size variation of animal prey in Black Redstart *Phoenicurus ochruros* during summer and autumn in south-western Poland

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Analyses of faeces of the Black Redstart *Phoenicurus ochruros* from the countryside of south-western Poland revealed a significant increase in the proportion of plant items (mainly berries of *Sambucus nigra*/*racemosa*) between July and October; for animal prey items an inverse trend was found. During summer-autumn, no significant trends in the mass of all animal prey were found. The most numerous animal prey were three genera of ants (*Lasius*, *Formica* and *Myrmica*; 44.1% by number of all animal prey). Large numbers of undamaged seeds of several species of shrubs in the analyzed faeces, including non-native species, indicate that the Black Redstart is a potential disperser of woody plants in rural landscapes of Europe.

1. Introduction

The Black Redstart *Phoenicurus ochruros* inhabits built-up areas within human dominated landscapes and is broadly distributed across Europe, including Scandinavia. The species belongs to the group of birds recognized as facultative frugivores, whose diet switches from animal to plant, mainly fruits, during the post-breeding period (Menzel 1983, Herrera 1984a, Cramp 1998, Stiebel & Bairlain 2008). On the other hand, some data from the Mediterranean region reveal the lack of plant material in the autumn-winter diet of the Black Redstart, which indicates a general foraging strategy based on the diet consisting of available food resources (Herrera 1978, Hodar 1998, Nicolai 1998). Until now most papers on the diet of the Black Redstart have concerned mainly nestlings (Flinks & Pfeifer 1990, Sedlacek *et al.* 2007) and adult birds on wintering grounds in the Mediterranean region (Herrera 1978, Zamora 1992, Hodar 1998, Nicolai 1998, 2001), including data on frugivory (Crocq 2002, Fuentes *et al.* 2001, Guitan *et al.* 2001). However, detailed studies on the diet of Black Redstarts during summer and autumn in central and northern Europe are lacking. Similarly, the importance of fruits in the diet of passerines in central and northern Europe did not appear to have been established quantitatively, except for some studies in Britain (Sorensen 1981, Snow & Snow 1988, Boddy 1991) and recently in Germany (Eggers 2000, Stiebel & Bairlein 2008).

This study therefore aimed to characterise the diet composition of the Black Redstart during the post-breeding period in the countryside of south-western Poland. We determined the mass and proportion of animal prey and plant (fruit) fraction in the food during four months of summer and autumn. Finally, we explored the connection between the mass of animal prey and their taxonomic, habitat and temporal characteristics.

2. Material and methods

The diet of the Black Redstart was determined on the basis of faecal analysis. Droppings were collected at three countryside areas (villages) of south-western Poland: (1) Turew (geographical location: 52°03’37”N, 16°49’39”E), (2) Rąbiń (52°03’13”N, 16°54’18”E) and (3) Stolec (51°21’38”N, 18°39’52”E).

Droppings were collected from the roosting sites of Black Redstarts (up to a few individuals) located in buildings and in their proximity, such as in barns, stacks of stones and bricks, agricultural machines and other artificial structures linked with human activity; in Stolec, droppings were collected from two localities ca. 200 m apart, near or inside buildings and from a nest after the departure of fledglings on 7 Aug 2009. Woody vegetation within 100 m of all sites was comprised mainly of fruit tree species: apple *Malus domestica*, pear *Pyrus communis*, plum *Prunus* spp., sweet cherry *Prunus avium*, Scots pine *Pinus sylvestris*, and a few species of shrubs, including both native and exotic ornamental species, such as black elder *Sambucus nigra*, European bird cherry *Prunus padus*, blackthorn *Prunus spinosa*, hawthorn *Crataegus* spp. and bramble *Rubus* spp. In Stolec, also the red elder *Sambucus racemosa*, whose fruiting period extend between July and beginning of August, was abundant.

The fruiting period of the black elder began at the first middle of August, however during the first half of this month, drupes of both species of elders was available as a potential food source. Droppings were collected during 19 different days (dates) in the summer-autumn seasons between 5 July 2008 and 30 October 2009. Altogether 25 faecal samples with 279 droppings were collected. The number of droppings collected during consecutive months at the three areas amounted to 44 in July (28, 16 and 0 for Turev, Rąbiń and Stolec, respectively), to 164 in August (4, 18 and 142), to 34 in September (34, 0 and 0) and to 37 in October (0, 0 and 37). The collected droppings were preserved dry. The identification of food items was conducted using a binocular microscope.

The items found in the droppings were divided into animal and plant material. The diet composition was expressed by the number and weight of both kinds of items. The number of prey (hereafter number of items, i.e., the number of individuals) belonging to a particular species of invertebrates (mainly insects) was established on the basis of fragments of chitin parts found, mainly elytra (Coleoptera and Heteroptera), wings (Diptera, Hymenoptera), mouth parts (most orders and larvae) and other preserved parts (e.g., limbs, petiolus, clypeus or mandible).

During the determination of the number of prey belonging to a particular species a rule of summation of different chitin parts was applied to the level of one individual, i.e., two or more different fragments of chitin parts (e.g., head, mandibles, six legs, and other parts in the case of ants) from one dropping was treated as belonging to the same individual of a given species. This protocol produces the minimum estimate for the total number of invertebrates and plant items consumed. The weight of animal prey and plants (mainly fruits) was expressed by dry mass (mg d.w.). For animal prey these values were obtained by detailed measures of insect weights (Karg 1989).

The data given by Herrera (1987) and Ercisli and Orhan (2007) were used for the calculation of dry weight of consumed whole fruit (i.e., seed with pulp) of black elder, white mulberry *Morus alba*, guelder rose *Viburnum lantana* and bramble *Rubus* sp. In the case of multi-seeded fruits, when the number of seeds recorded in droppings was greater than their number in one fruit, the determination of the number of consumed fruits was done by dividing the total number of recorded seeds by the average number of seeds per fruit based on literature; hence, for black elder the total number of recorded seeds (n = 197; Appendix) was divided by 2.6 (Herrera 1987). Due to difficulties with identification of seeds of elder species, which occurred sympatrically in Stolec, these two items were treated as *Sambucus racemosa/nigra*.

A general linear model (GLM; Hosmer & Lemeshow 1989) was applied to test the effects of four predictor variables on the mass of prey of the Black Redstart during the four months. In this

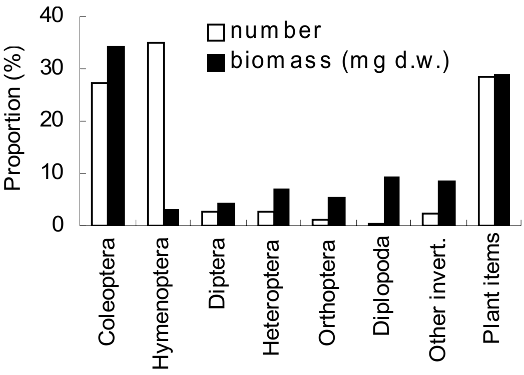

Fig. 1. Percentage distribution of the number (*n* = 1049) and biomass (*n* = 6370.405 mg d.w.) of different taxonomical groups of invertebrates and plant items (calculated for whole dry fruits) in the diet of the Black Redstart. The number of items is calculated for all items and the biomass for 942 items with known weight (see Table 1).

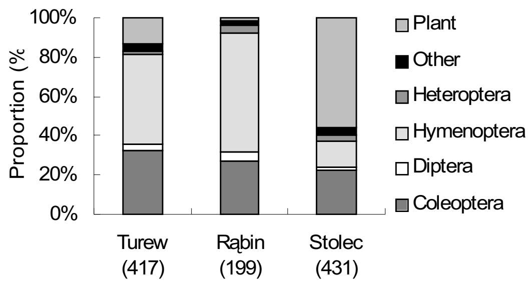

Fig. 2. Proportion of the number of items in the droppings of the Black Redstart at three areas (names of areas on the x-axis) during July-October in south-western Poland. The category 'Other' includes Araneae, Diplopoda, Lepidoptera, Lumbricidae, Mollusca, Odonata, Orthoptera and unidentified insects. The total number of items is given in parentheses.

multivariate analysis, data for 721 prey items with known mass were used (Appendix); individual prey was treated as a separate data point. Four categorical predictor variables were used: Order = five classes (Coleoptera, Hymenoptera, Diptera, Heteroptera and others, including Araneae, Diplopoda, Lepidoptera, Lumbricidae, Mollusca, Odonata, Orthoptera; Appendix); Village (Turew, Rąbin or Stolec), Month (July, August, September or October) and the variable "Control" (continuous variable consisting of 19 different dates of gathering faecal samples, expressed as whole numbers between 1 and 19). To identify the model, the Akaike Information Criterion (AIC) was used to optimise the number and combination of predictive variables included (Burnham & Anderson 2002). Wald (χ^2) statistic was applied for GLM results, including interactions between the above-listed four variables.

In order to record similar values of the number and weight of plant material (28.4% and 28.9%, respectively; Fig. 1), the proportion of animal and plant food in the diet in half-month periods was expressed and analysed using only the quantitative approach. As for the different dates of gathering faecal samples at particular areas (see above), differences in the proportion of food items between areas were not tested. The proportion of plant and animal food items and the weight of animal prey were predicted to change in the course of the summer-autumn period. Hence, the data on diet composition were divided into seven half-month periods (between July and October) and differences in the proportions of six main types of items, including the main taxonomical groups of invertebrates, were tested between these periods with a chi-square test. The percentage data were arcsine-transformed ($Y' = \arcsin (Y)^{-1}$) prior to analysis (Zar 1984).

Also possible differences and trends were examined for the mass of all prey, including two most numerous taxonomical groups of prey (Hymenoptera and Coleoptera), during four months and 19 different dropping-collecting dates using non-parametric Kruskall-Wallis, median and Spearman rank correlation tests. Post hoc comparisons were applied to assess differences in the mass of prey between pairs of months. Results with $P \leq 0.05$ were treated as statistically significant. All analyses were conducted with Statistica 7.0 (StatSoft 2006).

3. Results

A total of 1,048 items were found in the droppings, including 751 (71.7%) animal and 296 (28.3%) plant items (Appendix). Animal food was represented by 73 different groups (taxa) of invertebrates; the most diverse group of prey was Coleoptera. Differences in the percentage distribution of the number and biomass of seven groups of inver-

Table 1. Comparison of animal prey (mg dry weight) of the Black Redstart *Phoenicurus ochruros* during summer and autumn in south-western Poland. Test results show similarity comparisons between months (see text for details). For post hoc test results, only significant results are shown, and asterisks denote the significance level: * $p \leq 0.05$, ** $p < 0.01$, *** $p < 0.001$; n.d. – not determined.

Prey item	Statistic	All months	July	August	September	October	Comparison	Post hoc test result
All items	Avg. (95%CI)	6.00 (4.71–7.30)	6.62 (4.67–8.58)	6.92 (3.98–9.86)	3.54 (2.14–4.94)	6.46 (3.55–9.38)	$H_{3,720}$ = 33.5***	Jul vs Sep*** Jul vs Oct* Sep vs Oct** Aug vs Sep***
	Median	1.17	0.84	1.18	0.62	2.74	χ^2 = 50.9***	–
	n	720	253	252	166	49		
Coleoptera	Avg. (95%CI)	7.67 (5.95–9.39)	8.30 (4.71–11.90)	8.20 (5.98–10.42)	7.67 (3.92–11.42)	3.99 (2.95–5.03)	$H_{3,284}$ = 22.0***	Jul vs Aug*** Jul vs Sep**
	Median	3.12	1.30	3.40	4.66	5.20	χ^2 = 32.2***	–
	n	284	114	87	51	32		
Hymenoptera	Avg. (95%CI)	0.93 (0.85–1.01)	0.94 (0.83–1.05)	1.00 (0.90–1.10)	0.76 (0.61–0.92)	0.71 (0.90–1.10)	$H_{3,369}$ = 27.1*** Aug vs Sep**	Jul vs Sep*
	Median	0.62	0.62	0.62	0.62	0.62	χ^2 = 44.7***	–
	n	369	111	137	111	10		
Diptera	Avg. (95%CI)	13.04 (11.75–14..33)	12.90 (10.97–14.83)	11.72 (7.89–15.55)	14.14 (n.d.)	n.d.	–	–
	Median	14.14	14.14	14.14	14.14	n.d.	–	–
	n	20	11	7	2	1		
Heteroptera	Avg. (95%CI)	16.19 (9.78–22.61)	21.07 (6.79–35.35)	10.20 (2.97–17.42)	n.d.	24.60 (25.58–74.77)	–	–
	Median	14.28	26.16	1.27	n.d.	36.26	–	–
	n	27	8	15	1	3		
Other	Avg. (95%CI)	55.19 (2.74–250.0)	31.98 (14.19–49.76)	109.91 (5.45–225.3)	n.d.	27.99 (26.32–82.30)	–	–
	Median	40.61	40.61	53.71	n.d.	40.61	–	–
	n	20	10	6	1	3		

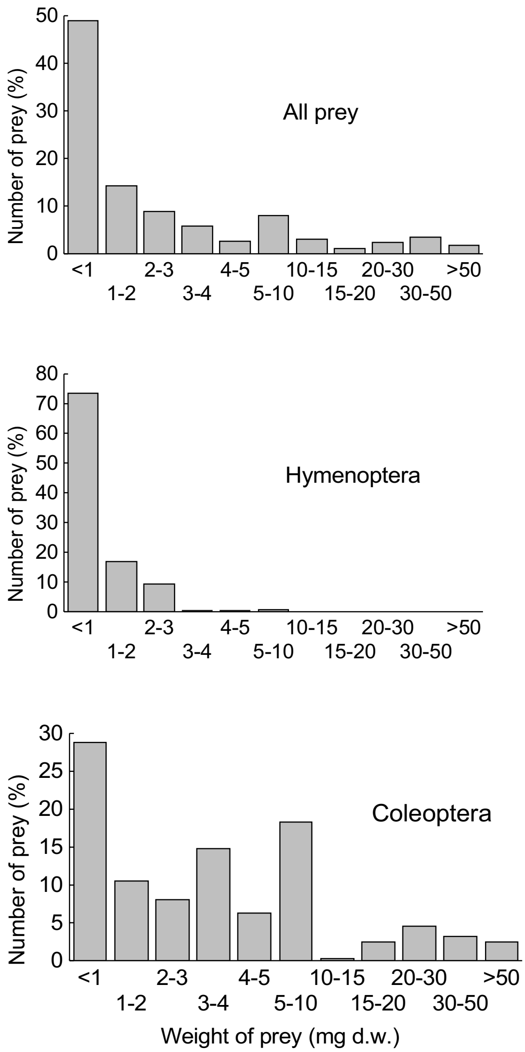

Fig. 3. Comparison of the size distribution of all animal prey items (*n* = 720), and the two most numerous groups of prey, i.e., Hymenoptera (*n* = 369) and Coleoptera (*n* = 285) found in the droppings of the Black Redstart in south-western Poland.

tebrates and plant items were highly significant ($\chi^2 = 44.7$, df = 7, $p < 0.001$; Fig. 1).

The most numerous group of animal prey by numbers was Hymenoptera (44.1% of all animal prey items), and this group was dominated by three taxa of ants (*Lasius*, *Formica* and *Myrmica*; *n* = 331). However, the total biomass of Hymenoptera was disproportionately small (Fig. 1). At the three areas the proportion Hymenoptera varied between 13.7% and 60.3% (Fig. 2). The Hymenopterans were the smallest prey items: 99.45% of them (*n* = 367) did not exceed 4 mg (Fig. 3). Small prey items (<1 mg) dominated in the pooled data and in the two most numerous groups of prey, i.e., Hymenoptera and Coleoptera, constituting 49%, 73.4% and 28.9%, respectively (Fig. 3).

GLM analyses revealed that the mass of prey was significantly affected by three predictors: Order, Village and Month (Table 1). Moreover, significant interactions were found for Order vs. Control, Order vs. Month and Control vs. Month. Significant differences among the four months were obtained for the average and median mass of all prey, and for Coleoptera and Hymenoptera (Table 1). The mass of all prey peaked in August, and was lowest in September: the values for September were significantly different from those for the other months. The average mass of Coleoptera was highest in July, and that of Hymenoptera peaked in August (Table 1). The 19 dates for collecting droppings did not show statistically significant trends for the mass of prey or the two most numerous groups of insects, i.e., Hymenoptera and Coleoptera ($r_s = -0.205$, -0.056 and -0.047, $p \geq 0.324$, respectively).

The proportion of plant items significantly increased between July and October (Fig. 4), whereas the inverse relation was found for animal prey items (Spearman rank correlation coefficient, $r_s = +0.543$ and -0.543, $p = 0.005$, for plant and animal items, respectively). The proportion of plant food items was the lowest in July; in the first half of this month we found 18 seeds of white mulberry *Morus alba* (Fig. 5). For pooled monthly data of four months (not depicted) the proportion of animal and plant food items was significantly different (for arcsin-tranformed data, chi-square test, $\chi^2 = 98.74$, df = 3, p < 0.001); significant differences were found also between each pair of neighbouring months, i.e. July vs. August ($\chi^2 = 35.96$, df = 1, p < 0.001), August vs. September ($\chi^2 = 45.15$, df = 1, p < 0.001) and September vs. October ($\chi^2 = 47.56$, df = 3, p < 0.001).

4. Discussion

We documented a large proportion of plant food fractions, mainly fruits, and a significant increase of these items in the diet of the Black Redstart, in

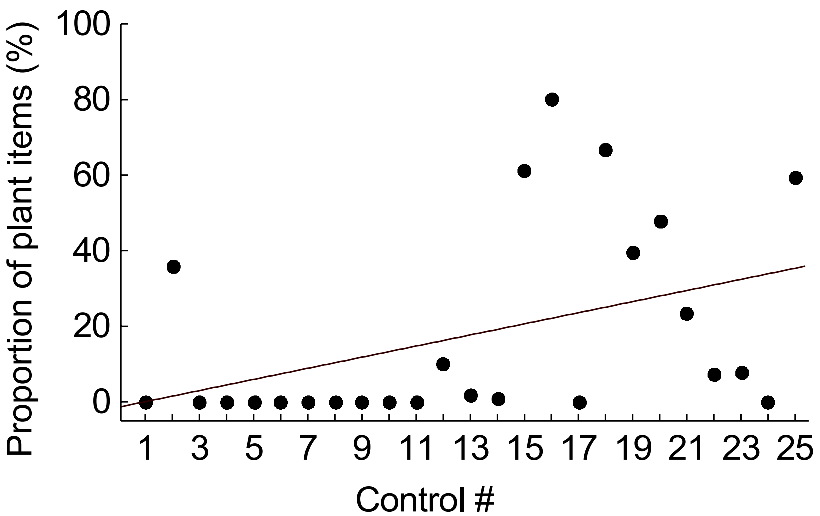

Fig. 4. Proportion of plant items in the droppings of the Black Redstart on consecutive dates of collecting faecal samples during summer and autumn; control number, 1–13 = Jul, 14–19 = Aug, 20–24 = Sep, 25 = Oct.

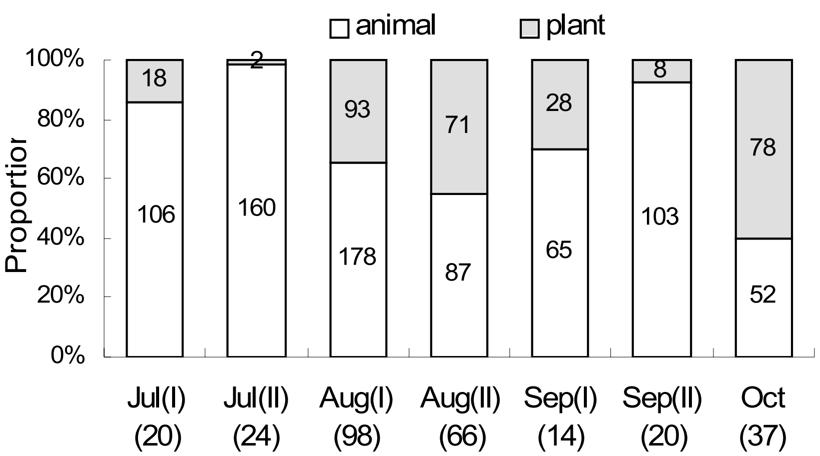

Fig. 5. Proportion of animal and plant items in the droppings of the Black Redstart in half-month periods during summer and autumn in south-western Poland. The numbers on the bars denote the number of recorded items; the numbers of analyzed droppings are given in parentheses.

the course of summer and autumn in south-western Poland. The significance of fruit food of the Black Redstart has earlier been described in the Mediterranean region (Herrera 1978, Nicolai 1998, 2001). However, until now research has not produced detailed quantitative characteristics of the diet composition and the importance of fruit food for this species in central and northern Europe over periods of multiple months.

The most numerous plant items recorded in the faecal samples were most probably seeds of two species of red and black elder. The red elder ripened earlier than black elder, from July up to the beginning of August (authors' unpublished data). Black elder ripens asynchronously from August to November (Sorensen 1981, authors' unpublished data). However, considering phenology of ripening of these species, fruits consumed in second half of August (Fig. 5) might concern rather *S. nigra*. The presence of elder fruits in the food of fledglings (found in the faeces gathered from the nest), supports earlier studies on nestling and adult food during the breeding period in the Black Redstart (Niethammer 1937, Meitz in Cramp 1998, Glutz & Bauer 1988, Fuentes *et al.* 2001, Guitan *et al.* 2001). Similar findings have been reported for other fruit-eating bird species, such as Blackcap *Sylvia atricapilla* and Blackbird *Turdus merula* (Hernandez 2005). Black elder fruits are also eaten by the Rook *Corvus frugilegus* during

Table 2. GLM results based on Akaike Information Criterion (AIC), testing the effects of Order (Coleoptera, Hymenoptera, Diptera, Heteroptera or other), Area (three areas), Control (19 sampling dates) and Month (Jul, Aug, Sep or Oct) on the mass of animal prey (n = 721) in the Black Redstart *Phoenicurus ochruros* in south-western Poland. See text for details.

Factor	Wald χ^2	p
Order	61.0	<0.001
Area	63.5	<0.001
Control	2.8	0.094
Month	133.5	<0.001
Order × Control	11.6	<0.001
Order × Month	24.8	<0.001
Control × Month	3.9	0.057
Order × Area	0.00	1.00
Control number × Area	2.7	0.152
Month × Area	0.00	1.00

winter, and their seeds have been found in large numbers in the Rook pellets collected from winter roosts (Czarnecka & Kitowski 2010).

The present GLM results suggest the following conclusions: (1) Large differences in the mass of prey between different orders of invertebrates reflect their taxonomical features connected with different weight of individuals (Table 1). (2) The mass of prey representing particular orders changed over the summer-autumn period, expressed in interactions between collecting date and month. (3) The observed monthly differences can be linked with the presence of prey with large body mass, mainly in the group of other invertebrates in August (Table 1; for division of prey items, see Material and methods). (4) Differences in prey mass between the three areas may not have resulted from variation in dropping-collecting dates, as the variable Control was always non-significant in the models. This finding supports the general foraging strategy based on available food, including remarkable differences in diet composition between individuals observed at the same time in similar habitats (Zamora 1992, Hodar 1998, Nicolai 1998, 2001; see also Fig. 2), and nestlings of the Black Redstart (Sedlacek *et al.* 2007).

The present study confirmed the important contribution of ants in the diet of the Black Redstart: nearly half of the prey items found were ants. In Spain, the proportion of ants in the diet of the Black Redstart has been reported to be equally high, and in Robin *Erithacus rubecula*, Stonechat *Saxicola torquata*, White Wagtail *Motacilla alba*, Pied Flycatcher *Ficedula hypoleuca* and Hoopoe *Upupa epops* it may range between 54.3% and 90.9% (Herrera 1984b). Hodar (1998) studied 14 individuals of the Black Redstart wintering in south-western Spain and found that the proportion of ants as prey items ranged between 3.7% and 88.3%. According to Herrera (1984b), widespread ant consumption by ground-feeding birds in the Mediterranean areas during autumn and winter is linked to the relative scarcity of alternative invertebrate prey. The abundance and importance of ants as food may generally be higher in the Mediterranean region than in northern Europe (Herrera 1984b). Yet, ant-eating is an important feeding strategy for many bird species in northern and central Europe, such as Green Woodpecker *Picus viridis* and Wryneck *Jynx torquilla* (Cramp 1998, Mermod *et al.* 2009), Chough *Pyrrhocorax pyrrhocorax* (Cowdy 1973, Kerribou & Juilliard 2007) and the Black Redstart (this study). These studies suggest the importance of local abundance of and access to ants rather than to geographic differences in the distribution and number of these Hymenoptera in Europe. The local availability of ants has earlier been associated with the proportion of ants in the diet of the Black Redstart in the Mediterranean region, but in these cases the proportion of ants was much smaller (15.8–23.9%; Nicolai 1998, 2001), or varied considerably (Hodar 1998).

Although the methods used were not perfect due to, e.g., variation in the digestion process of chitin parts among different prey groups (Rosenberg & Cooper 1990) we are convinced that even the present results on soft-bodied prey, such as small Diptera, are reliable. Earlier studies have successfully employed analyses of faeces to determine food composition of birds, including Black Redstart (Hodar 1998, Nicolai 1998, 2001). According to Poulsen and Aebischer (1995), analysis of faeces yields reliable results on the diet of insectivorous birds. Data collected on main orders of insects (Diptera, Hymenoptera, Coleoptera and Hemiptera) using neck-collar techniques and simultaneous faeces collecting from chicks, resulted in less than 4% difference between the two methods (Poulsen & Aebischer 1995).

Finally, we acknowledge that the present estimates of the number and biomass of large water-rich multi-seeded fruits in the diet, such as elder, white mulberry and bramble, resulted from an unknown volume of consumed pulp and estimates of the number of seeds per fruit based on literature. On the other hand, the lack of seed coats or digested seeds in the faeces (we found only one damaged seed of elder; Table 1) indicates that seeds may pass the digestive system of the Black Redstart undamaged. The presence of seeds of several species of shrubs found in the analyzed faeces, including the non-native white mulberry and guelder rose, supports the role of the Black Redstart as a potential disperser of woody plants (Herrera 1984a). These results also imply the need for further studies on internal transport of fruit seeds by birds (Deckers *et al.* 2008), especially in central and northern Europe.

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Lounais-Puolan maaseudulta kerättyjen mustaleppälinnun *Phoenicurus ochuros* ulostenäytteiden analyysi osoitti kasviravinnon (erityisesti seljan marjojen) osuuden kasvavan voimakkaasti kesästä syksyyn lajin ravinnossa. Eläinravinnolle trendi oli vastakkainen. Kesän-syksyn jaksolla ei havaittu trendiä eläinravinnon massan suhteen. Runsain eläinravintoryhmä olivat muurahaiset (*Lasius*, *Formica* ja *Myrmica*; 44,1 % kaikista löydetyistä eläinyksilöistä). Ulostenäytteissä oli suuria määriä pensaiden siemeniä, mukaan lukien tuontilajeja, mikä indikoi mustaleppälinnun olevan potentiaalinen puuvartisten kasvien levittäjä Euroopan maaseudulla.

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Appendix. Animal and plant items recorded in a faecal analysis of 274 droppings of the Black Redstart *Phoenicurus ochruros* in south-western Poland. [1]Data on the individual mass of insects after Karg (1989); [2] calculated for 25 samples; [3] the weight of seeds, the number (in parentheses) and mass of a whole dry fruit (seed with pulp) of *S. nigra/racemosa*, *M. alba*, *V. lantana* and *Rubus* sp. after Herrera (1987) and Ercisli and Orhan (2007). n.d. = not determined. For details, see Material and methods.

Order	Family	Genus (species)	Mass	No. indivs	Total mass	No. samples
Invertebrates						
Coleoptera		unident. (imag.)	n.d.	3	–	1
	Carabidae	*Amara* sp.	8.49	15	127.36	11
		Bembidion sp.	1.17	15	17.56	8
		Calathus sp.	17.02	3	51.06	2
		Poecilus sp.	26.12	6	156.75	3
		unident. (imag.)	23.59	3	70.78	1
		unident. (larvae)	9.95	1	9.95	1
	Chrysomelidae	*Chaetocnema* sp.	0.86	11	9.471	2
		Lema sp.	3.12	17	53.12	10
		Lema melanopus	3.39	16	54.34	5
		unident. (imag.)	7.15	3	21.46	3
	Coccinellidae	*Propylaea* sp.	3.16	5	15.81	5
	Cryptophagidae	unident. (imag.)	0.34	9	3.11	2
	Curculionidae	*Apion* sp.	0.48	1	0.48	1
		Ceutorhynchus sp.	0.84	44	36.82	4
		Curculio sp.	37.27	2	74.54	2
		Otiorhynchus sp.	37.27	5	186.35	2
		Phyllobius sp.	3.66	3	10.98	2
		Sitona sp.	4.66	15	69.97	1
		unident. (imag.)	2.80	23	64.34	11
	Elateridae	*Agriotes* sp.	9.67	3	28.99	2
		unident. (imag.)	13.81	1	13.81	1
	Histeridae	unident. (imag.)	3.89	1	3.89	1
	Hydrophilidae	*Cryptopleurum* sp.	0.47	2	0.94	2
		unident. (imag.)	1.01	1	1.01	1
	Nitidulidae	*Glischrochilus* sp.	4.47	2	8.94	2
		Meligethes sp.	0.42	10	4.21	3
	Oedemeridae	*Oedemera* sp.	4.51	1	4.51	1
	Phalacridae	*Stilbus* sp.	0.47	3	1.42	1
	Scarabaeidae	*Amphimalon solstitialis*	40.15	1	40.15	1
		Anomala dubia	40.15	1	40.15	1
		Aphodius sp.	6.73	29	195.31	5
		Onthophagus sp.	9.69	1	9.69	1
		Phyllopertha sp.	17.35	4	69.41	2
		unident. (imag.)	84.75	7	593.26	5
	Scolytidae	unident. (imag.)	1.50	1	1.50	1
	Silphidae	*Silpha* sp.	26.00	4	104.01	4
	Staphylinidae	*Heterothops* sp.	0.29	2	0.59	1
		Philonthus sp.	1.43	2	2.87	2
		unident. (imag.)	1.79	11	19.70	5
Diptera		unident. (imag.)	n.d.	9	–	7
		unident. (larvae)	5.50	1	5.5	1
	Calliphoridae	*Lucilla* sp.	14.14	1	14.14	1
		unident. (imag.)	14.14	16	226.27	10
	Muscidae	unident. (imag.)	5.82	1	5.82	1
	Syrphidae	unident. (imag.)	9.16	1	9.16	1
Heteroptera	Pentatomidae	*Aelia* sp.	14.28	3	42.83	2
		Eurygaster sp.	36.26	4	145.03	2
		Palomena sp.	42.01	3	126.01	3

		unident. (imag.)	26.16	4	104.62	3
	Lygaeidae	unident. (imag.)	1.27	10	12.71	4
	Miridae	*Lygus* sp.	2.04	1	2.04	1
	Nabidae	*Nabis* sp.	2.01	2	4.02	1
Hymenoptera	Apidae	*Andrena* sp.	8.78	2	17.56	2
	Formicidae	*Formica* sp.	1.18	28	32.98	9
		unident. (imag.)	0.62	1	0.62	1
	Ichneumonidae	unident. (imag.)	2.45	34	83.30	15
	Myrmicidae	*Lasius* sp.	0.62	270	168.75	18
		Myrmica sp.	1.18	33	38.87	10
		unident. (imag.)	1.18	1	1.18	1
Lepidoptera		unident. (caterpillar)	n.d.	10	–	7
Odonata	Libellulidae	unident. (imag.)	15.43	1	15.43	1
Orthoptera	Acridiidae	*Chorthippus* sp.	40.61	9	365.50	4
	Orthoptera	unident. (imag.)	n.d.	2	–	2
	Tetrigidae	*Tetrix* sp.	11.40	1	11.40	1
Insects		unident.	n.d.	2	–	2
Araneae		unident.	2.74	4	10.96	4
	Pseudoscorpionidea	unident.	0.62	2	1.25	1
Lumbricidae		unident.	250.0	2	500	1
Mollusca		unident.	n.d.	3	–	3
Diplopoda		unident.	66.81	3	200.44	3
Plant material						
		Sambucus nigra/ racemosa (seed)	1.7 (8.0)	197 (76)	609	9
		Morus alba (seed)	2.1 (1,029)	19 (1)	1,029	1
		Rubus sp. (seed)	0.8 (150.4)	3 (1)	150.4	1
		Viburnum lantana (seed)	35.5 (59.0)	1 (1)	59.0	1
		Rumex acetosella (seed)	0.1	1	0.1	1
		Fallopia convolvulus (seed)	0.8	1	0.8	1
		Sambucus nigra/ racemosa (damaged)	n.d.	1	–	1
		Seeds, unident.	n.d.	1	–	1
		Cereal grain	n.d.	1	–	1
		Fragments of plants, unidentif.	n.d.	73	–	9