

## **Body mass of European Robins *Erithacus rubecula* at migratory stopovers is strongly habitat-related**

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Body mass of European Robins *Erithacus rubecula* at autumn and spring migratory stopovers on the Courish Spit (Eastern Baltic) was strongly habitat-related, with body mass of birds captured in hardwood significantly higher than body mass of their conspecifics in coastal scrub. At a nearby site, European Robins mist-netted in alder forest were significantly heavier than their conspecifics captured in funnel traps on the edge of young pine plantations just several hundred metres away. Trapping method (standardised ‘passive’ trapping vs. active flushing of birds into the nets) did not consistently bias the mean body mass towards either higher or lower values. Body mass variation between the habitats reached 10%, i.e. it was comparable with Europe-wide variation in the mean body mass in e.g. Eurasian Reed Warbler *Acrocephalus scirpaceus* or Sedge Warbler *A. schoenobaenus* known from the literature. Our results caution against making broad regional scale comparisons of mean body mass and condition of songbird migrants at stopover without taking habitat into account. Condition of migrants may vary broadly on the landscape scale and thus distort the geographic patterns.

*Key words:* European robin, body mass, stopover, habitat

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### **1. Introduction**

During migration, energy is one of the main assets, together with time and safety (Alerstam & Lindström 1990; Hedenström & Alerstam 1997; Newton 2008). Birds can adopt the migratory strategy of short flights, frequent fuelling and low fuel loads wherever possible, or they can accumulate heavy fuel loads during long but infrequent stopovers and make long flights. These two possibilities are not alternatives but rather the ends of a continuum. Therefore, fuel loads at stopovers and their geographic patterns are believed to be an important characteristic of migratory strategy of a given species or population (Schaub & Jenni 2000, 2001; Schaub et al. 2008). However, fuel loads may vary not only of the regional level showing characteristic geographic patterns (e.g. higher loads before barrier crossing, Odum et al. 1961; Schaub & Jenni 2000; Rguibi-Idrissi et al. 2003; Chernetsov et al. 2007), but also be habitat-related (Ktitorov et al. 2008), which would obscure these geographic patterns.

We captured European Robins *Erithacus rubecula* in different habitats on the Courish Spit in the Eastern Baltic during spring and autumn migration to see whether habitat-related variation in their condition was significant and on the scale comparable to geographic variation.

## 2. Material and methods

European Robins were captured in several habitats on the Courish Spit on the Russian Baltic coast in 1996–2000. In autumns 1996 and 1997, we captured birds (1) in coastal willow scrub and reed habitat in 73 standard mist-nets at the permanent trapping site (Rybachy field site of the Biological Station Rybachy, 55°09'N, 20°46'E) by 'passive' trapping, i.e. when the birds flew into the nets during their spontaneous movements within the habitat; (2) in very similar habitat just several hundred metres from the permanent trapping site, but when the birds were actively flushed into the nets by several persons walking 50–100 m towards the nets across the habitat ('active' trapping); (3) at a woodland plot not immediately near the coast (some 2–3 km from the Rybachy field site), by 'active' trapping. In autumn 1998, trapping was conducted at Fringilla field station (55°05'N, 20°42'E, 10–11 km from the Rybachy field site) in parallel (4) in large stationary funnel traps (Rybachy-type traps) located on the edge of a pine plantation and open sand dunes, and (5) in mist-nets set up in black alder forest just 200 m from the funnel traps.

In springs 1997 and 2000, passive trapping was performed in habitat (1) and active trapping in habitat (2). In spring 1998, active trapping was performed in the reedbed on the coast of Lake Chaika (Möwenbruch) which is an inner lake situated on the Courish Spit 1–1.5 km from Rybachy (dataset 6) in parallel to the standardised trapping.

Active trapping [datasets (2), (3) and (6)] invariably occurred in the afternoon, between 1400 and 1800 local time (GMT+3). Because of that, we compared body masses of birds captured by this method with body masses of European Robins captured in the standardised project ('passive' trapping, dataset 1) in the same time and on the same days when active trapping was conducted. Standardised trapping occurred uninterrupted between 30 June and 6 November, with captures of European Robins occurring since the end of August until the end of October. Active trapping sessions were performed between the beginning of September and the middle of October, i.e. during the mass passage of European Robins in our study area (Tsvey 2008). In Fringilla, trapping by both methods (datasets 4 and 5) was performed since dawn till dusk, therefore all captures between 25 August and 1 November at all times of day were included. In spring, standardised trapping was performed between 27 March and 10 June, with European Robins trapped in considerable numbers until 10 May. Active trapping in habitats (2) and (6) was performed in the same season.

Birds were captured, ringed by aluminium leg rings of Moscow Ringing Centre, their wing length was taken, moult status recorded and body mass taken. The birds were released as soon as possible, always within one hour after their capture (in

the case of active trapping, usually much sooner). In individuals that were captured more than once, only the first capture was considered. Means are given  $\pm$  SD; statistical tests are two-tailed.

### 3. Results

#### 3.1. Autumn migration

Wing length may not be the optimal indicator of body size (Labocha & Hayes 2012) but it is the only size proxy available in the dataset analysed. Wing length did not vary significantly between samples of European Robins captured and measured in Rybachy in 1996 and 1997 (datasets 1–3): one-way ANOVA,  $F_{5,588} = 0.97$ ,  $p = 0.43$ . Therefore, instead of using any kind of condition index, I opted for directly comparing body masses of the birds captured.

In autumn 1996, the mean body mass of robins captured by active trapping in the coastal scrub was significantly higher than the body mass of individuals trapped in the standardised project in the same habitat (Table 1):  $t = 2.17$ ;  $p = 0.03$ . In autumn 1997, this result could not be confirmed, the mean body mass did not differ between two different capture methods:  $t = 1.30$ ;  $p = 0.19$ . However, robins captured in the forest study plot in autumn 1997 were significantly heavier than their conspecifics ‘passively’ captured in the standardised nets in the same days and the same time of day (Table 1):  $t = 4.15$ ;  $p < 0.0001$ . Even though ‘active’ trapping in two different habitats occurred in different days, I still compare the mean body mass of European Robins in these two samples: birds stopping over in the forest were much heavier,  $t = 9.30$ ;  $p < 0.0001$ .

One-way ANOVA showed a highly significant variation in the mean body mass between the groups:  $F_{5,592} = 22.3$ ;  $p < 0.0001$ , and post-hoc Tukey’s HSD test suggested that these were the robins trapped in the forest that differed from all other samples:  $p < 0.001$  in all cases. If these birds are removed from the analysis, one-way ANOVA becomes marginally insignificant ( $F_{4,521} = 2.38$ ;  $p = 0.051$ ) and post-hoc Tukey’s HSD test is no longer significant (all  $p > 0.09$ , with the difference closest to significance between ‘active’ trapping results on the coast in 1996 and 1997).

The results of trapping in *Fringilla* cannot be directly compared to the aforementioned results, because both *Fringilla* samples cover the whole day, and not just the afternoon. Mean wing length did not differ significantly between European Robins captured in funnel traps and in mist-nets ( $t = 0.70$ ;  $p = 0.48$ ), so here again the uncorrected body masses are compared. Robins mist-netted in the alder forest were significantly heavier than birds captured in funnel traps:  $16.52 \pm 1.15$  ( $n = 1781$ ) and  $16.11 \pm 1.19$  ( $n = 982$ ), respectively;  $t = 8.85$ ;  $p < 0.0001$ . If we compare just the birds captured before noon to remove any possible bias due to different nycthemeral pattern of captures, the difference becomes smaller but remains significant:  $16.25 \pm 1.08$  ( $n = 762$ ) and  $16.09 \pm 1.17$  ( $n = 881$ ), respectively;  $t = 2.83$ ;  $p < 0.005$ .

Table 1. Mean body mass of European robins captured during autumn migration on the Courish Spit in difference habitats (coastal scrub vs. inland forest) and by different methods.

	Standardised ('passive') trapping 1996 (habitat 1)	'Active' trapping coastal site 1996 (habitat 2)	Standardised ('passive') trapping 1997 <sup>1</sup> (habitat 1)	'Active' trapping coastal site 1997 (habitat 2)	Standardised ('passive') trapping 1997 <sup>2</sup> (habitat 1)	'Active' trapping forest site 1997 (habitat 3)
Mean body mass $\pm$ SD	16.07 $\pm$ 1.25; n = 80	16.39 $\pm$ 0.98; n = 149	16.26 $\pm$ 1.23; n = 115	16.06 $\pm$ 1.24; n = 157	16.54 $\pm$ 1.08; n = 25	17.72 $\pm$ 1.28; n = 72

Notes: <sup>1</sup> Standardised trapping in autumn 1997 in the days when active trapping at the coastal site was performed. <sup>2</sup> Standardised trapping in autumn 1997 in the days when active trapping at the forest site was performed.

Table 2. Mean body mass of European robins captured during spring migration on the Courish Spit in difference habitats (coastal scrub vs. inland lake) and by different methods.

	Standardised ('passive') trapping 1997	'Active' trapping coastal site 1997	Standardised ('passive') trapping 1998	'Active' trapping Lake Chaika 1998	Standardised ('passive') trapping 2000	'Active' trapping coastal site 2000
Body mass $\pm$ SD	16.88 $\pm$ 1.25; n = 370	16.64 $\pm$ 1.13; n = 387	16.58 $\pm$ 1.02; n = 9	16.56 $\pm$ 0.98; n = 18	16.95 $\pm$ 1.04; n = 319	16.63 $\pm$ 1.04; n = 265

### 3.2. Spring migration

In spring, the mean wing length significantly differed between the samples ( $F_{5,1368} = 22.0$ ;  $p < 0.0001$ ). Therefore, to ensure more rigorous testing, I used size-corrected body mass (body mass divided by wing length) for comparisons of condition in different habitats and in captures by different methods (passive vs. active trapping). However, raw body mass is given in Table 2 to ensure comparisons with the autumn data.

Size-corrected body mass varied significantly between the samples ( $F_{5,1352} = 8.84$ ;  $p < 0.0001$ ). Pairwise comparisons of active and passive trapping samples collected at the same part of the season and time of the day showed a significant difference only between European Robins captured in coastal habitats in spring 2000: the birds captured in the standardised trapping project were actually heavier after correcting for size than their conspecifics captured by 'active' trapping ( $t = 6.21$ ;  $p < 0.0001$ ). Captures at the same sites in spring 1997 did not result in a significant difference ( $t = 1.27$ ;  $p = 0.20$ ); neither did captures on the shores of Lake Chaika (Möwenbruch) inside the Courish Spit in spring 1998 ( $t = 0.61$ ;  $p = 0.55$ ).

## 4. Discussion

The results of this study reveal that migrating songbirds captured at stopover in different habitats at sites just hundred metres or a few kilometres apart may have significantly different mean body masses. Birds captured in some habitats (mature hardwood forest) were on average in better condition than their conspecifics in other habitats (willow scrub, edge of pine plantations). The mean body mass of European Robins flushed into the mist-nets in the hardwood (sample 5) was 7% higher than the mean body mass in standardised captures in coastal scrub (sample 1) and 10% higher than in active captures in coastal scrub (sample 2) in the same period. The distance between capture sites was measured by few kilometres. For comparison, in the European-African Songbird Migration Network the greatest difference in the mean body mass between north and central European sites, where songbirds are believed to migrate with continuous stopover opportunity, and south European sites, where long-distance migrants fuel up for crossing the Mediterranean and the Sahara, was 11% for the Eurasian Reed Warbler *Acrocephalus scirpaceus*, 17% for the Sedge Warbler *A. schoenobaenus*, 26% for the Garden Warbler *Sylvia borin*, 41% for the Whitethroat *S. communis*, 31% for the Pied Flycatcher *Ficedula hypoleuca* and 30% for the Spotted Flycatcher *Muscicapa striata* [calculated from Table 4 in Schaub & Jenni (2000)]. Thus, habitat-scale variation in the body mass of European Robins on the Courish Spit within a few kilometres was comparable to Europe-wide variation in mean body masses in such long-distance migrants as Eurasian Reed and Sedge Warblers.

It should be emphasized that our data do not allow us to distinguish between the two possibilities: (1) migrants in better habitats forage and gain mass more successfully and thus are in better condition than their conspecifics in poorer habitats;

(2) migrants in better condition are able to settle in better habitats and exclude birds in poorer condition into suboptimal areas. Furthermore, these two possibilities are not mutually excluding. It should also be kept in mind that better foraging habitat is not necessarily the one where birds in better condition occur: lean birds may choose habitats rich in food but with higher predation pressure, while fat individuals may prioritise their safety over foraging opportunities (Johnson 2007). The point I am trying to make is that landscape-scale variation in fuel stores of migrants may be well comparable to continent-scale variation in body mass (Schaub & Jenni 2000, 2001).

Another point is that using active trapping, i.e. flushing the birds into the nets, does not result in estimates of the mean body mass consistently biased towards either higher or lower values as compared with passive mist-netting in standardised trapping projects. It could be argued that as daytime movements of migrants at stopover are condition-related (e.g. Titov 1999; Ktitorov et al. 2010; Cohen et al. 2012), captures in standardised nets may be biased towards birds in poorer condition. Flushing the birds into the nets, that works comparatively well with species that, like European Robins, preferably remain near the ground and usually do not escape to the canopy, could theoretically result in a more representative mixture of birds in different body condition. Our data, however, generally do not support this claim, as there was no tendency by birds captured by different methods to be consistently lighter or heavier.

In conclusion, the results of our study caution against making broad regional scale comparisons of mean body mass and condition of songbird migrants at stopover without taking habitat into account. Condition of migrants may vary broadly on the landscape scale and distort the geographic patterns (cf. e.g. Chernetsov 1998).

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