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VARIATION IN THE EXTENT OF GREATER WING COVERTS MOULT IN ROBINS (*Erithacus rubecula*) MIGRATING IN AUTUMN THROUGH THE POLISH BALTIC COAST

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ABSTRACT

Ginter M., Rosińska K., Remisiewicz M. 2005. *Variation in the extent of greater coverts moult in Robins (Erithacus rubecula) migrating in autumn through the Polish Baltic coast.* Ring 27, 2: 177-187.

Intra-seasonal variation in the number of unmoulted coverts in immature Robins caught during 2001-2003 autumn migrations was studied at two ringing stations (Mierzeja Wiślana and Bukowo-Kopań) located at the Polish Baltic coast. To determine the number of unmoulted greater wing coverts we counted immature-type coverts with light spots at tips. In the analyses data on the number of spotted coverts from *ca* 11 000 migrating individuals were used. We analysed the number of spotted coverts in each season and at each ringing station separately. Based on migration dynamics we distinguished migration waves and the number of spotted coverts were compared among the waves. Trends of seasonal changes in mean values of this parameter were assessed. To explain these tendencies, percentage distributions of wing spots for each wave were presented, with distinguished three categories: 0-3 (low), 4-5 (medium) and 6-8 (high) number of spotted coverts. Next, we compared distribution of this parameter among waves by Kruskal-Wallis and *post-hoc* Dunn's tests.

Late waves generally differed in the distributions of spotted coverts' number from the earlier ones in all seasons and at all stations. Our results showed the same tendencies within a season in all cases: the mean number of unmoulted coverts fluctuated in September, but starting from the end of this month and in October the trend was clearly increasing. This was due to changes in frequencies of Robins assigned to the distinguished categories – in September birds with medium number of spotted coverts constituted over 50% of all migrants, while in late September and/or October waves individuals with high number of spotted coverts predominated. Both in 2002 and 2003, the moment of the shift in this domination from birds with medium to those with high number of unmoulted coverts was synchronised between the two stations.

These intra-seasonal differences in moult advancement can be explained by two overlapping phenomena – subsequent migration over the Baltic coast of populations with different moult characteristics and by less advanced moult of birds from later broods. Correspondence of the observed trends in moult advancement with literature data on migration timing of Robins of different breeding origin and winter quarters indicates that the populational differences play an important role in the observed variation.

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INTRODUCTION

Movements of the Robin, one of the most numerously caught passerines in Europe, are a subject of various studies on different aspects of migrations. Detailed investigations on Robin migrants regard their migration dynamics, variation in biometrics and morphology, migration routes found due to analyses of ringing recoveries and directional preferences (*e.g.* Pettersson and Lindholm 1983; Saurola 1983; Lövei *et al*. 1986; Pettersson *et al*. 1990; Ehnbom *et al.* 1993; Remisiewicz *et al*. 1997; Nowakowski and Malecka 1999; Pérez-Tris *et al*. 2000; Remisiewicz 2001, 2002; Ściborska and Busse 2004). Robins migrating through the southern Baltic coast originate from Fenno-Scandia, Baltic countries, and north-western Russia (Remisiewicz *et al.* 1997). Birds coming from different breeding grounds probably differ in timing of crossing the Polish Baltic coast and in distribution over winter-quarters. An analysis of ringing recoveries shows that Robins caught in the Baltic region at the beginning of autumn migration head to the Western winter-quarter and the passage towards this area lasts over the whole season, later migrants fly to the Apennine and Mediterranean winter-quarters and the latest – to the Balkans (Remisiewicz 2002). Robins caught on passage at ringing stations located along migration routes present intra-seasonal variation in morphology and biometry. These differences concern wing length and shape, leg colour, amount of greyness on sides and flanks and advancement of moult (Pettersson and Lindholm 1983, Karlsson *et al*. 1986, Lövei *et al.* 1986, Pettersson *et al*. 1990, Pérez-Tris *et al.* 2000). In our paper we present variation in the number of unmoulted greater wing coverts during autumn passage.

Immature Robins show a contrast between inner moulted and outer unmoulted greater coverts. Brownish unmoulted coverts usually have bright and wide spots on tips, while the moulted ones have no spots or exceptionally – very small ones. The presence of wing spots is very helpful for ageing of ringed Robins (Benvenuti and Ioalè 1983, Karlsson *et al.* 1986). Variation in the number of unmoulted coverts (further in the text - referred to as "spotted coverts") is well known in young Robins caught during spring and autumn migration in Sweden and in Russia (Karlsson *et al.* 1986, Pettersson *et al.* 1990, Rymkevich 1990 after Jenni and Winkler 1994). Pettersson *et al.* (1990) revealed differences in the number of spotted coverts also among Robins caught in various winter grounds. The aim of our study is to present intra-seasonal differences and trends in the advancement of wing coverts moult in Robins caught on autumn migration on the Polish Baltic coast.

MATERIAL AND METHODS

The data were collected at two stations of the Operation Baltic, located at the Polish Baltic coast (Fig. 1): Mierzeja Wiślana (54°21'N, 19°19'E) and Bukowo--Kopań (54°28'N, 16°25'E) during autumn migration (1 September – 1 November) in years 2001-2003. Birds were caught in mist-nets controlled every hour from dawn to dusk. Caught birds were ringed and measured using the SEEN standards (Busse 2000). Additionally, to this study the advancement of moult was assessed by counting the number of unmoulted greater wing coverts (from 1 to 10) in immature Robins. The numbers of Robins in which the unmoulted coverts were counted and periods when this parameter was recorded at different stations in subsequent years is presented in Table 1.

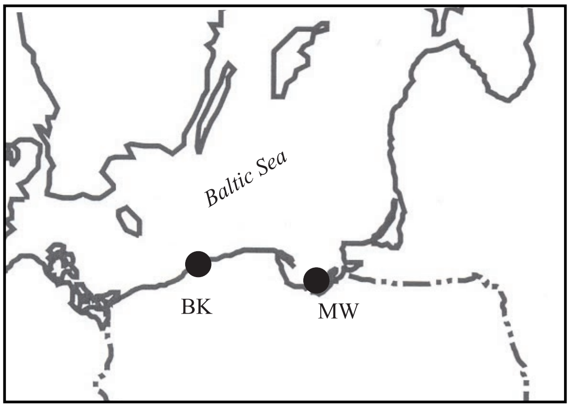

Fig. 1. Location of ringing stations where the data was collected: MW – Mierzeja Wiślana, BK – Bukowo-Kopań

Table 1
Periods of counting spotted coverts (moult study) and numbers of Robins checked for this parameter (*N*) in following years at each station

	Mierzeja Wiślana		Bukowo-Kopań	
	Moult study	*N*	Moult study	*N*
2001	1 Sep. – 31 Oct.	1460	8 Sep.-7 Oct., 13-14 Oct.	1764
2002	1-29 Sep., 5-31 Oct.	1928	10 Sep. – 5 Nov.	1817
2003	1 Sep. – 19 Oct.	1973	6 Sep. – 14 Nov.	2152

In the first step yearly percentage migration dynamics were prepared for Mierzeja Wiślana and Bukowo-Kopań. For each day the percent value was calculated in relation to the average daily number of Robins caught (immatures and adults jointly) in the analysed season at a given station and then used to draw the migration dynamics. The obtained dynamics were divided into migration waves according to modelling procedure proposed by Busse (1996). This method is based on cutting the source data for each season according to the minima of the dynamics. Next these fragments were smoothed separately, using the normal distribution coefficients, according to the formula:

$$C = 0.06a + 0.24b + 0.4c + 0.24d + 0.06e$$

where:
a, b, c, d, e – numbers of caught birds in subsequent days,
C – smoothed value for the day *c*.

If after the smoothing procedure the fragments did not fit the normal distribution, the source data was cut further into smaller fragments and smoothing was repeated. This procedure was repeated until a series of unimodal normal distributions, corresponding with the multimodal pattern of migration dynamics, was obtained (see Fig. 2). At this stage the resulted division was considered as reflecting the pattern of migration waves. Further analyses of this material were performed based on this division. Because the period of counting spotted coverts did not cover the whole period of bird catching, the waves in which it was not done were excluded from the analyses. First, average numbers of spotted coverts were calculated separately for birds from subsequent waves and the course of their intra-seasonal changes was presented (see Fig. 3), similarly to the papers by Karlsson *et al*. (1986) and Pettersson *et al*. (1990). Distributions of the number of unmoulted greater coverts were compared among waves within a season at each station by Kruskall-Wallis and *post-hoc* Dunn's tests. To explain the obtained trends and differences among waves, frequencies of birds with certain numbers of unmoulted greater coverts in distinguished waves were shown. On account of too low representation of some classes of spots number and in order to ease graphics presentation, three categories of unmoulted greater coverts were established: 0-3, 4-5 and 6-8, further in the text referred to as: low, medium and high number of spots.

RESULTS

The analyses of the yearly percentage migration dynamics allowed for distinguishing migration waves of Robins. At Mierzeja Wiślana in all autumn seasons and at Bukowo-Kopań in 2003, 10 migration waves were distinguished, in the remaining seasons at the latter station 8 and 9 migration waves occurred (Fig. 2). The course of the migration dynamics and the dates of beginnings and ends of the migration waves in the same season were very close at both stations, which was outstanding for 2003.

The mean number of unmoulted spotted coverts of immature Robins compared among the migration waves at each station showed the same intra-seasonal tendencies at all stations – in September this parameter fluctuated, but starting from the end of this month and in October a clear increasing trend was visible (Fig. 3). In all the cases this increase in the mean values amounted to *ca* 1, and at Mierzeja

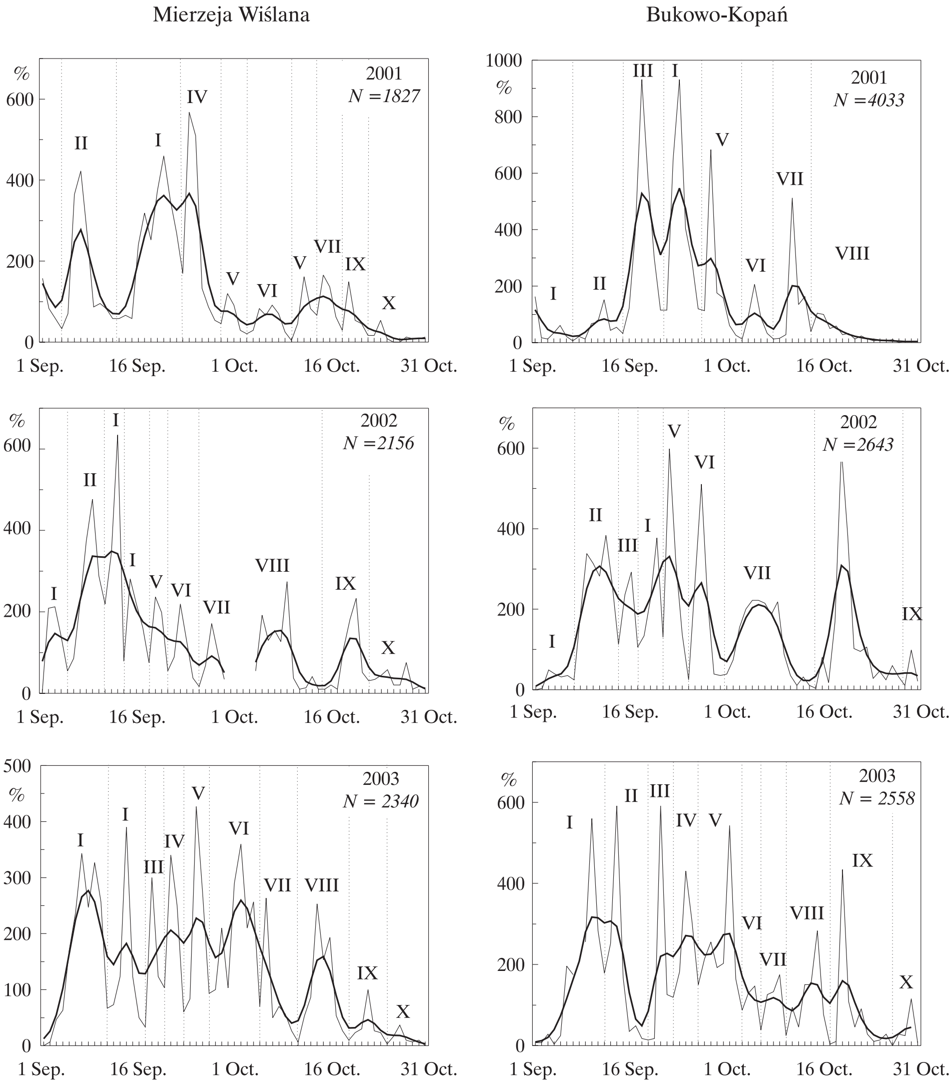

Fig. 2. Migration dynamics of Robins (percent of a daily average for a year) and its division into migration waves (dotted lines; Roman numbers – numbers of waves)

Wiślana in two seasons (2001 and 2002) was even greater (Fig. 3). These tendencies can be explained by changes in proportions of birds with different numbers of spotted coverts from wave to wave (Fig. 4). Distributions of the spotted coverts number at both stations differed significantly among the migrations waves within each season (Kruskall-Wallis test: in all cases $p < 0.01$). During all seasons frequencies of Robins with low number of spotted coverts (*i.e.* 0-3) was rather small (Fig. 4). Robins with medium number of unmoulted coverts (*i.e.* 4-5) formed over 50% of all immatures in September and in some cases till mid-October, *i.e.* usually in waves

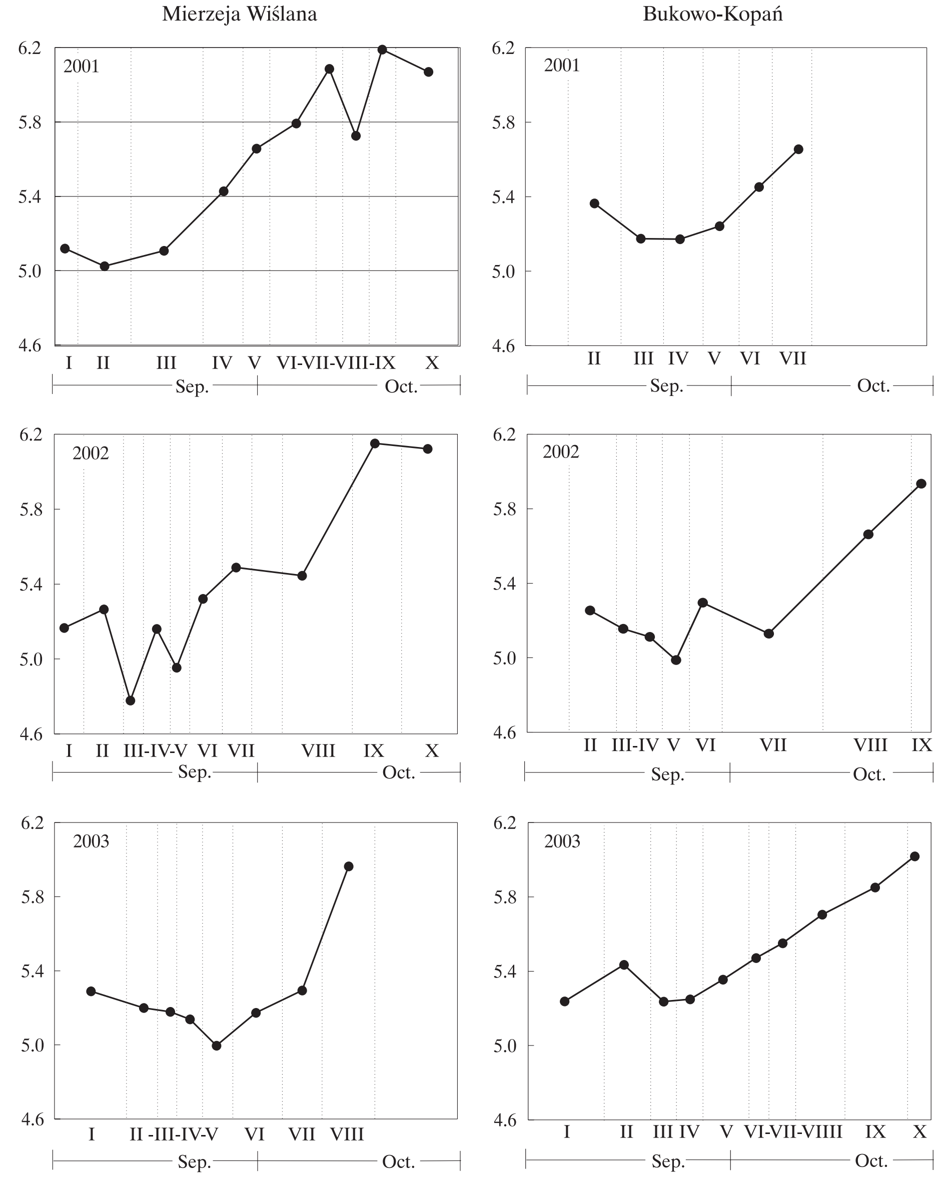

Fig. 3. Average number of unmoulted coverts in subsequent migration waves (as in Fig. 2) in all seasons at both stations.

from *I* to *VI-VII* (except for Mierzeja Wiślana in 2001 – in waves *I-III*) at both stations (Fig. 4). Later in the season Robins with high number of unmoulted covers (*i.e.* 6-8) distinctly predominated.

In two seasons – 2002 and 2003, the moment of this shift of the domination was synchronised at both stations (Fig. 4). This was outstanding in 2003, and both at Mierzeja Wiślana and Bukowo- Kopań the proportion of birds with 6-8 spotted coverts increased from *ca* 40% in wave *VII* to as much as *ca* 70% in wave *VIII*. This

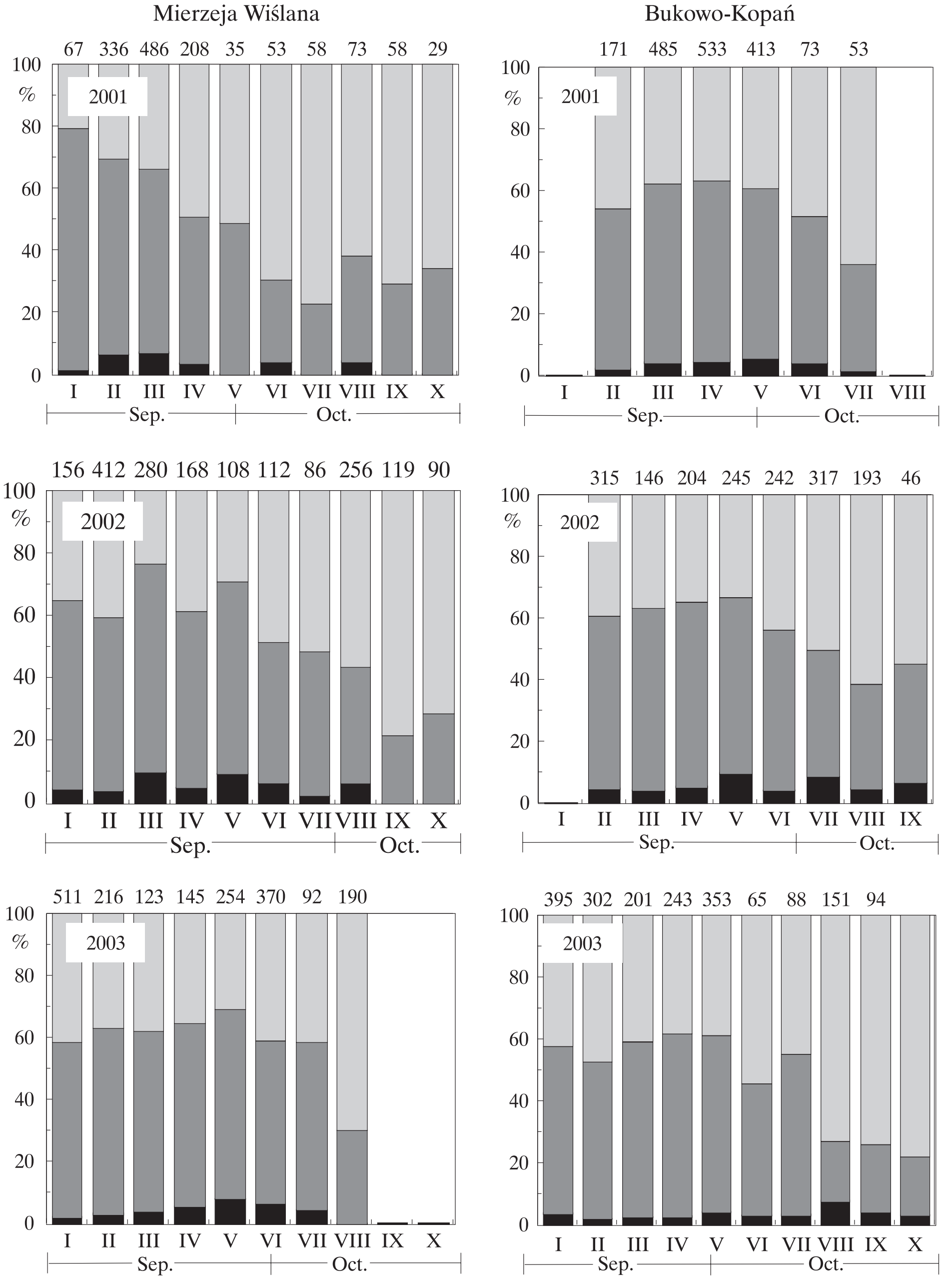

Fig. 4. Percent proportions of Robins with low (black area), medium (dark grey) and high (light grey) number of unmoulted coverts in subsequent migration waves (as in Fig. 2) at each station in studied seasons. Sample sizes for each wave are given above bars.

is particularly interesting, as in this season migration dynamics and duration of all migration waves at both stations were synchronised to a great extent and the border day between these two waves occurred exactly on the same day (see Fig. 2). Only in

2001 this correspondence between stations in the tendency of proportions of Robins with medium and high number of spots was not so clear. At Mierzeja Wiślana birds with high number of unmoulted coverts predominated (however slightly) already in wave *IV*, while at this time at Bukowo-Kopań Robins with medium number of spotted coverts were still in majority (Fig. 4). However, the distinct (15-20%) increase in the share of birds with 6-8 spots took place in a similar period at both stations – between waves *V* and *VI* at Mierzeja Wiślana and waves *VI* and *VII* at Bukowo-Kopań (Fig. 4).

DISCUSSION

At ringing stations located along passerine migration flyways there has been observed that in subsequent periods of the migration season birds of the same species can differ in the range and advancement of moult (Karlsson *et al*. 1986, Pettersson *et al*. 1990, Rymkevich 1990 after Jenni and Winkler 1994, Malinowska 2000). In the present study, differences in the extent of greater wing coverts moult were also found in Robins migrating through stations Mierzeja Wiślana and Bukowo-Kopań in all studied seasons. The obtained results showed a similar tendency of changes in the number of unmoulted (spotted) coverts in birds caught in all seasons and at both stations (see Fig. 3). In all cases, in the course of the season birds tended to have more unmoulted coverts, and Robins caught in the second half of October were distinctly less advanced in moult of wing coverts than earlier migrants (see Fig. 4). The same tendency was observed in the 1970s in Robins migrating through the Polish coastal station Hel, located *ca* 100-200 km from the stations described hereby (Malinowska 2000). At Hel, in years when birds were caught only in September, daily mean numbers of spotted coverts in Robins differed only slightly. However, in 1973 when the period of bird ringing was extended till mid-October, in that month mean daily numbers of spotted coverts were significantly higher than in September. Similar tendencies were found also in Robins caught on migration at Swedish island station Ottenby and coastal Falsterbo (Karlsson *et al.* 1986, Pettersson *et al.* 1990). In birds ringed at Ottenby, the mean number of coverts with spots increased with the progress of the season. In the second half of October, similarly as described hereby, the mean number of unmoulted greater coverts was higher than in the earlier part of the season (Pettersson *et al.* 1990). Analogously, in Falsterbo a distinct increase in the number of spotted coverts occurred from the second decade of October (Karlsson *et al.* 1986). In the north-western Russia, similarly as in the present study, it was observed that Robins caught earlier in autumn migration season, had usually 4-5 unmoulted greater coverts, while birds caught later used to leave up to 7 unmoulted coverts (Rymkevich 1990 after Jenni and Winkler 1994).

The reason for the observed changes in the extent of greater coverts' moult could be differences in timing of breeding among Robins originating from different parts of the breeding range as well as weather conditions and food availability in the nesting area (Jenni and Winkler 1994). In passerines, some populations can differ in the extent and rate of the post-juvenile moult – birds originating from the northern part of the breeding area moult less intensively than those from its southern regions, while in birds coming from the same latitude such differences were not found. Limiting of moult is probably an adaptation of birds from more northern areas to shorter time between fledging and start of migration.

A similar difference occurs between birds from early and late broods – birds hatched later begin migration with less advanced moult of contour feathers. Such restriction of the extent of renewed parts of plumage in Robin refers mainly to greater coverts, the carpal covert and allula feathers (Jenni and Winkler 1994). It should be borne in mind that in Robin there can be differences not only in the timing of a single brood, but they can have also two broods within a season (Cramp 1988, Zimin 1988 after Payevsky 1998). Moult of birds from later broods is quicker than of those from early ones. It is accelerated either by the simultaneous increase in the number of renewed feathers and of moult centres or by the limiting of the extent of moult in some parts of plumage (Jenni and Winkler 1994). Obviously, in Robin, the second strategy occurs, as in late migrants the reduction of the extent of greater coverts moult was observed both in the present study and in earlier papers (Karlsson *et al*. 1986, Pettersson *et al*. 1990, Rymkevich 1990 after Jenni and Winkler 1994, Malinowska 2000).

Amongst Robins migrating through the Polish and Swedish Baltic coast and the north-western Russia, trends of changes in proportions of birds with different number of unmoulted coverts were very similar (Karlsson *et al*. 1986, Pettersson *et al.* 1990*,* Rymkevich 1990 after Jenni and Winkler 1994). This would suggest that over these regions there migrate the same breeding populations and in the same sequence. Such a conclusion is supported by recoveries of Robins ringed on migration at the Baltic coastal stations, which showed no distinct differences in breeding origin of birds caught in different part of the southern Baltic region (Remisiewicz 2001). Pettersson and Lindholm (1983), based on ringing recoveries, suggested that Robins migrating through Ottenby early in autumn originated mainly from Sweden, while later migrants came from more eastern breeding grounds (Finland, Russia). This was confirmed by other studies, as Robins ringed in southern Sweden were recovered in autumn and winter only along Western migration route (*i.e.* along the Atlantic coasts of Europe and Northern Africa), used by the earliest migrants caught in the Baltic region. Thus, it is likely that the Robins with more advanced moult originate from the Baltic region while those with higher number of unmoulted coverts observed on the Baltic coasts in October, come from the north-eastern part of the breeding range. This would be in agreement with the cited rule about restrictions in moult advancement in more northern breeding populations (Jenni and Winkler 1994).

In addition, differences in migration direction and in occupied wintering grounds were described in Robins caught on passage through the Baltic coast, based on results of directional preferences and ringing recoveries of migrants (Högstedt and Persson 1971, Pettersson and Linhdolm 1983, Pettersson *et al.* 1990, Remisiewicz 2002, Ściborska and Busse 2004). Generally, the earliest migrating Robins head to more western parts to of the wintering grounds, while the late migrants are directed to eastern winter-quarters. Pettersson *et al*. (1990) revealed that Robins differed in moult extent within the wintering range. Birds wintering in south-western winter-quarters (Spain, France) had less unmoulted coverts than Robins caught in the south-eastern Balkan winter-quarter (Greece, Cyprus). Thus, early migrants from the Baltic coast with more advanced moult were probably heading to the south-western winter-quarters, while those late, less advanced moulters could continue migration in the south-eastern direction. According to the ringing recoveries, the earliest migrants heading to the Balkan winter-quarter occurred on the Baltic coast as late as on 25 September and the mean migration date of this group of migrants was 8 October (Remisiewicz 2002). This would correspond very well with the first occurrence and timing of predomination of Robins with high number of unmoulted coverts observed in the present study (*cf.* Fig. 4). Among birds caught in September, such distinct differences in moult extent were not found, despite the fact that in this period over the Baltic region there migrate Robins heading to different breeding quarters, except for the Balkan one (to Western, Mediterranean and Apennine quarters – Remisiewicz 2002). This could be explained by small differences in the number of unmoulted coverts between Robins caught in Spain (Western quarter) and France (Mediterranean quarter) described by Pettersson *et al*. (1990), and by greatly overlapping in September periods of passage through the Baltic coasts of Robins heading to all these three winter-quarters (Remisiewicz 2002, Ściborska and Busse 2004).

To sum up, the differences in the extent of moult of greater coverts among Robins migrating through the Baltic coast, described hereby, can be caused by two overlapping phenomena. Firstly, late migrants probably originate from more north-eastern breeding ground than the earlier ones, thus they have shorter time to complete moult of greater coverts before starting migration. Secondly, within each breeding populations there can be Robins from early and late broods. They can migrate together, which would explain variation in the number of unmoulted coverts in birds caught at the same time at a certain stage of migration. However, it is also possible that within the migration period of each breeding population, more advanced moulters from earlier broods go as first, followed by individuals hatched later. With some shift and overlap in migration timing of different populations (Remisiewicz 2002) this would give the same effect – some variation in the number of unmoulted coverts in birds caught at the same time on passage and less advanced moult of late migrants. Correspondence of the observed trends in moult advancement with literature data on differences in breeding and wintering areas of Robin caught on the Baltic coast (*op. cit.*) indicates that the populational differences play an important role in the observed variation. However, the impact of each of both factors on the observed trends could be assessed only with further development of our knowledge on population differentiation of Robins migrating over the Baltic region, based on their biometric or morphological variation or tests of their directional preferences.

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