

STOP-OVER OF MIGRANT BLACKCAPS (*Sylvia atricapilla*) ON AUTUMN PASSAGE THROUGH THE POLISH BALTIC COAST

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ABSTRACT

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In this analysis, data on Blackcaps caught on autumn migration at the Operation Baltic stations: Bukowo-Kopań (54°28'N, 16°25'E) in 1984-1999 and Mierzeja Wiślana (54°21'N, 18°19'E) in 1982-1999 (in period: 14 August – 1 November) were used.

Total percentage of stopping-over (retrapped) Blackcaps was 11.6% at Mierzeja Wiślana and 7.9% at Bukowo-Kopań station. On average birds stayed longer at Mierzeja Wiślana (median – 5 days) than at Bukowo-Kopań (median – 4 days). Most probably, the Blackcap stop-over length and frequency depended on the food abundance in the area. Initial weight and fat load of birds retrapped later in the season were on average lower than of those caught only once, what suggests that birds stop-over to replenish their energy deficits. Weight and fat changes were influenced by the stop-over length. Individuals that left early, *i.e.* 1-2 days after ringing, not only did not gain energy, but also lost the reserves they had on their arrival.

As the season progressed, birds tended to stop-over for a shorter time. The density of individuals already present in the studied area did not affect the decision of migrating birds to stop-over.

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Key words: Blackcap, *Sylvia atricapilla*, migration, stop-over, retraps

INTRODUCTION

The autumn passage of Blackcaps at the Polish Baltic coast usually lasts from mid-August to mid-October (Busse and Halastra 1981). Up to the first half of September invertebrates dominate in their diet, mainly species of order *Diptera*. Later on, the amount of fruits eaten by birds noticeably increases (Zelenova pers. comm.). The habitats most abundant in food for the species are forests with well-developed brushwood, luxuriant parks and gardens. During migration birds spend most of the time at the stop-over sites, rebuilding their energy reserves; the flight it-

self lasts for relatively short time (Fransson 1995). Thus, detailed analysis of the stop-over phenomenon is essential to learn and understand migration of this species as a whole. Up to now, a study on the Blackcap focused only on this problem is lacking. Some publications describing migration of this species give only fragmentary descriptions of the stop-over (Langslow 1976, Philips 1994, Rodriguez 1998). On the other hand, studies confined to this phenomenon focus on other than the Blackcap species (Szulc-Olech 1965, Cherry 1982, Veiga 1986).

In my study I analysed following problems: (1) average stop-over length in the studied areas, (2) seasonal changes in number of retraps and birds caught only once, (3) effect of a number of individuals already present in the studied area on the decision to stop-over of migrating birds, (4) retraps' weight and fat changes.

MATERIAL AND METHODS

Data on Blackcaps caught on autumn migration at the Operation Baltic stations: Bukowo-Kopań (54°28'N, 16°25'E) in 1984-1999 and Mierzeja Wiślana (54°21'N, 18°19'E) in 1982-1999 were used. Bukowo-Kopań station is located within the narrow (50-150 m) forest strip along the seashore. There are low (up to 3 m height) and narrow (up to 10 m width) dunes by the shore. Then the area becomes flat. From an in-land side, by the forest there are several hundred metres of meadows, partly marshy with sparse reeds (*Phragmites communis*) and a few willow shrubs (*Salix spp.*). The forest comprises mainly young trees and brushwood of Common Pine (*Pinus sylvestris*) and Austrian Pine (*P. nigra*), mixed with birches (*Betula spp.*) in some places. There are patches of alder groves (*Alnus glutinosa*) as well. Undergrowth consists of blackberries (*Rubus spp.*), shrubs of Ramanas Rose (*Rosa rugosa*) and a few Elders (*Sambucus nigra*) on the edge.

Mierzeja Wiślana station is located on the southern edge of the Vistula Spit that separates the Vistula Lagoon from the Gdańsk Bay. The spit is quite broad (several hundred metres to 1.5 km), covered by *ca* 100-year-old pine forest. Forests growing on the dunes are scanty. Forest growing by the Vistula Lagoon is far richer, with an admixture of oaks (*Quercus spp.*) and birches. Numerous Alder Buckthorns (*Frangula alnus*), Rowans (*Sorbus aucuparia*), birches, and Common Spruces (*Picea abies*) in some places are in thick brushwood. In several places undergrowth consists of bilberries (*Vaccinium myrtillus*, *V. vitis-idaea*, and some *V. uliginosum*). On the edges of young pine forest, where most mist-nets were placed, there were Elders and blackberry-bushes as well.

A detailed description of the fieldwork methods is given by Busse and Kania (1970). Birds were mistnetted; the nets were controlled every hour from dawn to dusk. Captured birds were ringed, aged, sexed (according to Busse 1984), subcutaneous fat was scored, several biometrical measurements were taken – wing formula, wing and tail length (according to Busse 1974), birds were weighed and immediately released afterwards. Individuals that were captured again (retraps) were weighed and their fat score recorded. Data on the captured Blackcaps are given in Table 1.

Because the number of retrapped birds per year was low, I summed up all available data for each station separately.

Table 1
Blackcaps ringed and retrapped at Bukowo and Mierzeja Wiślana

	Bukowo		Mierzeja Wiślana	
	Ringed	Retrapped	Ringed	Retrapped
1982	0	0	88	6
1983	160	2	27	1
1984	41	1	11	0
1985	38	1	85	11
1986	21	0	144	20
1987	18	0	63	3
1988	120	7	29	1
1989	44	4	117	14
1990	91	2	94	13
1991	36	1	58	5
1992	44	0	139	9
1993	98	4	113	29
1994	253	6	106	1
1995	213	24	202	26
1996	205	50	186	40
1997	336	45	157	24
1998	308	31	68	7
1999	709	38	243	14
Total	2735	216	1930	224

Analysed data cover almost whole autumn migration period of the Blackcap (14 August – 1 November). Probability of a bird recapture should be constant throughout the whole season, that is why I decided to use data on birds that were captured for the first time on 16 October at the latest (probability of recapture of an individual that was caught for the first time later in the season becomes lower).

I assumed that all retrapped individuals were present in the study area from their ringing date (initial capture) until the date of their final capture. However, some individuals could arrive earlier than on the day of their first capture, as well as some individuals could stay longer and leave, in fact, after the day of their final capture. This is because the capture ratio (ratio of birds actually captured to those present at the moment at the study site) is 40 to 60% and is different for different species (Busse pers. comm.) This value has not been evaluated in the Blackcap yet. Nonetheless, it is obvious that an individual stayed at the study site (*i.e.* around the netting area) from the date of its first capture to the date of its final capture, what was a basis for calculating of an index of a number of “resident” birds in the area.

I used moving average method to smooth some data according to the following formula:

$$y_B = \frac{A + 2B + C}{4}$$

where:

B – smoothed value,

A, C – value that precedes and comes after B value.

I used following formula to calculate relative body mass change between the first (initial) and the last (final) capture of an individual:

$$\Delta W_{\%} = \frac{W_f - W_i}{W_i} \times 100$$

where:

W_i – initial weight (weight of an individual on the day of its first capture),

W_f – final weight (weight of an individual on the day of its last capture).

To calculate retraps' fat load changes (in grams) between their first and last captures, I used formulas proposed by Busse (1970). According to these, I calculated: (1) relative fat load of a given group of birds¹ – t , and its standard deviation – SD_t ; (2) average standardised weight² – w , and its standard deviation – SD_w .

RESULTS

Stop-over

Total percentage of stopping-over Blackcaps (caught on the days following the day of initial capture) was 7.9% at Bukowo-Kopań and 11.6% at Mierzeja Wiślana station. Most birds were retrapped last time just on the following day after the day they were ringed (Fig. 1); it is particularly clear at Bukowo-Kopań station. On average birds stayed longer at Mierzeja Wiślana (median – 5 days) than at Bukowo-Kopań (median – 4 days).

At the beginning of migration season number of individuals caught several times was distinctly higher than of those caught only once; this fact can be seen at both study sites (Fig. 2). Percentage of stopping-over birds was not constant throughout the season but it fluctuated within the broad range (Fig. 3).

I divided the migration season into four periods (Fig. 4) to check whether basic parameters defining stop-over phenomenon (*i.e.* percentage of stopping-over birds and stop-over length) change throughout the season.

At Bukowo-Kopań in the course of season birds were staging for a shorter time (Fig. 5). There was nearly significant difference among subsequent periods

¹ It is an average difference in fat load between a sample and a group of birds in which all individuals would have a fat score T_z . This difference is given in grams of fat with minus sign (-) if the average fat load of the sample group is less than T_z , or plus sign (+) if it is more than T_z .

² *i.e.* how much an individual would weigh if it changed its fat score to T_z .

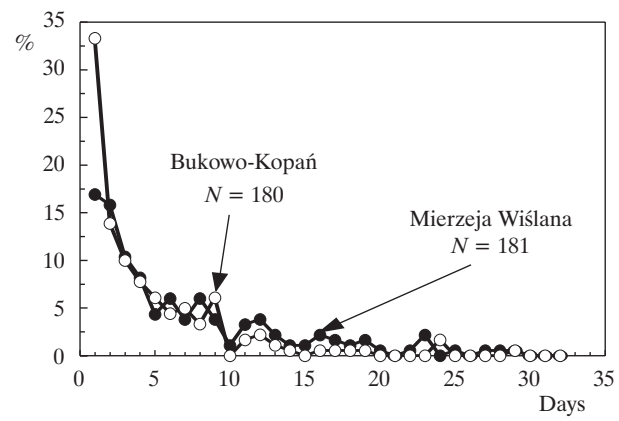


Fig. 1. Stop-over length of Blackcap retraps given as daily percentage of all birds retrapped at the station

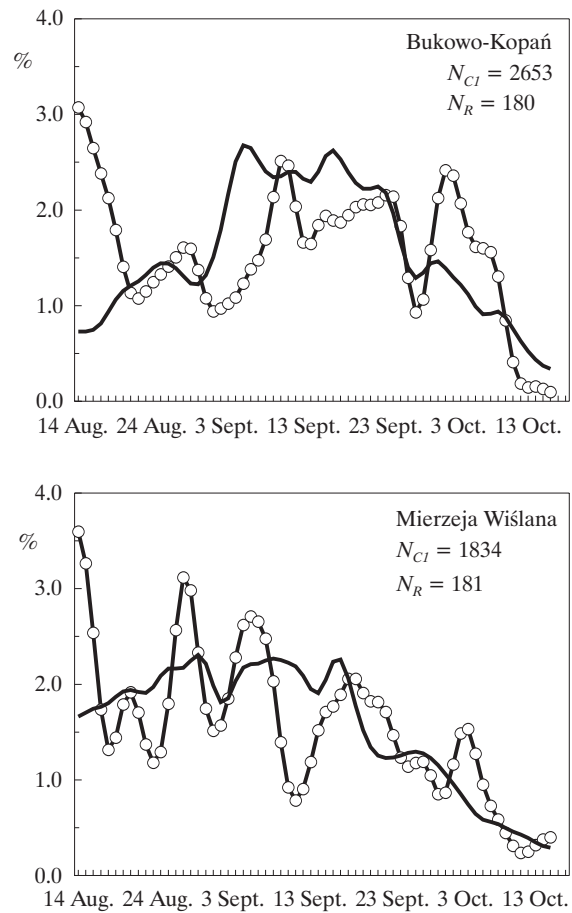


Fig. 2. Seasonal dynamics of Blackcaps caught only once (continuous line, CI) and retrapped later the same season (circles, R). Curves smoothed by moving average.

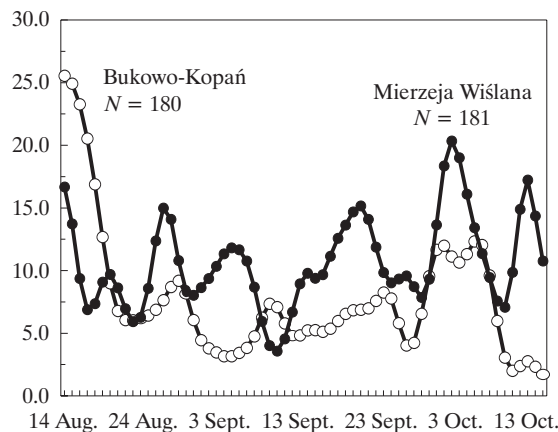


Fig. 3. Percentage of individuals that were caught in subsequent days and then were retrapped at the station. Curves smoothed by moving average.

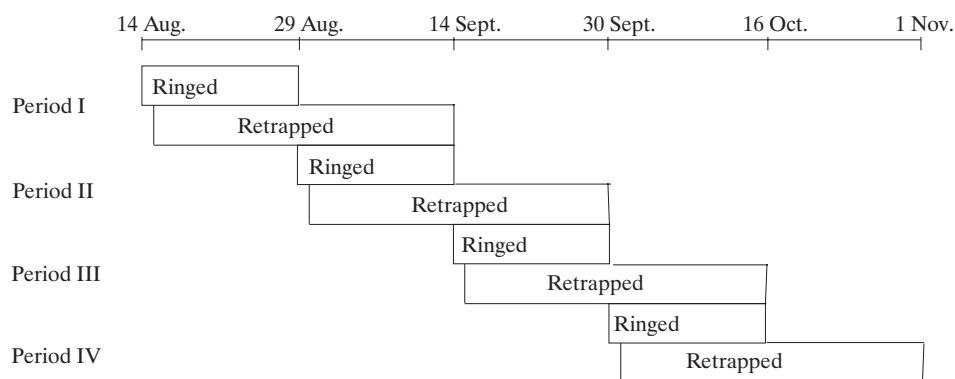


Fig. 4. Periods within the season used in analysis of stop-over length

(Kruskal-Wallis test: $H = 7.41$, $p = 0.06$). The first one differed markedly from others as birds were staging in it for the longest (Fig. 5). Similar pattern could be found at Mierzeja Wiślana, except for the fact that stop-over length in the fourth period was similar to the first one – at the beginning of migration season. Subsequent periods differed significantly among themselves (Kruskal-Wallis test: $H = 9.69$, $p = 0.02$), stop-over length was significantly higher in I and IV period.

Veiga (1986) suggested that the number of stopping-over birds could depend on the number of birds already present in the area, so I decided to check whether it was true also for the Blackcap. It appeared that the number of “resident” birds at Bukowo-Kopań (*i.e.* individuals that were present there at least from the day before) did not affect inversely (correlation coefficient: $r = 0.12$, $p < 0.05$) the number of “new” stopping-over birds (Fig. 6). At Mierzeja Wiślana station there was a weak negative correlation ($r = -0.21$, $p < 0.05$). However, such results may be the effect of relatively low number of retraps and summing up of data from different years.

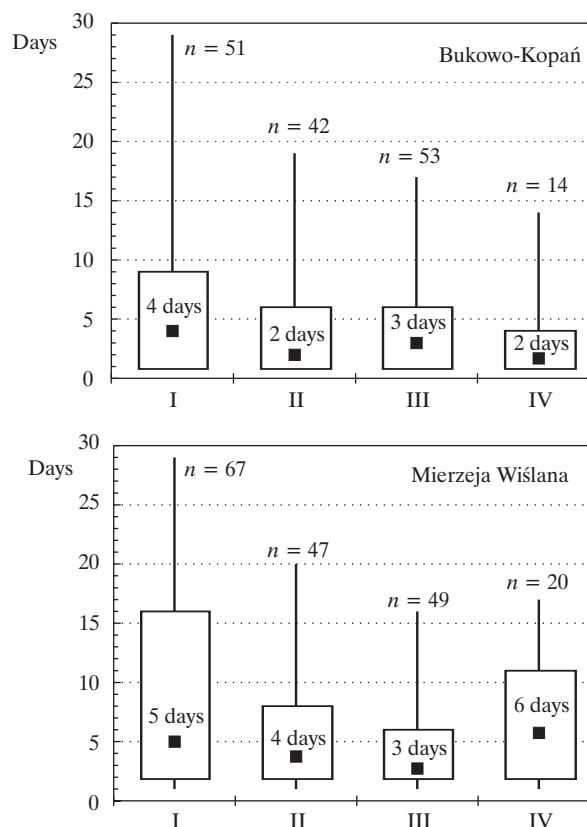


Fig. 5. Stop-over length in subsequent periods (see Fig. 4). Median (black squares), 25-75% quartiles (rectangles) and ranges (lines) are given as well as sample sizes (n).

Weight and fat load of stopping-over birds

Weight and fat load on the day of first capture

Initial weight (Fig. 7) and relative fat load of birds caught only once were on average higher than of those stopping for a longer time and caught at least twice. Differences in actual weight of birds (Table 2) were highly statistically significant both at Bukowo-Kopań (Cochran-Cox test: $t = 7.65$, $df = 1989.3$, two tailed $p < 0.01$) and Mierzeja Wiślana (Cochran-Cox test: $t = 7.54$, $df = 1967.4$, two tailed $p < 0.01$). The same applies to relative fat load of birds caught only once compared to birds caught several times (Mann-Whitney U -test: $U_{\text{Bukowo-Kopań}} = 170857$, $p < 0.001$; $U_{\text{Mierzeja Wiślana}} = 3714.5$, $p = 0.001$). Nevertheless, no difference was found in a standardised weight, what could suggest that both staging birds and those continuing migration did not originate from different biometrical populations.

Comparison of data from Bukowo-Kopań and Mierzeja Wiślana showed that there was statistically significant difference in average actual weight of birds caught

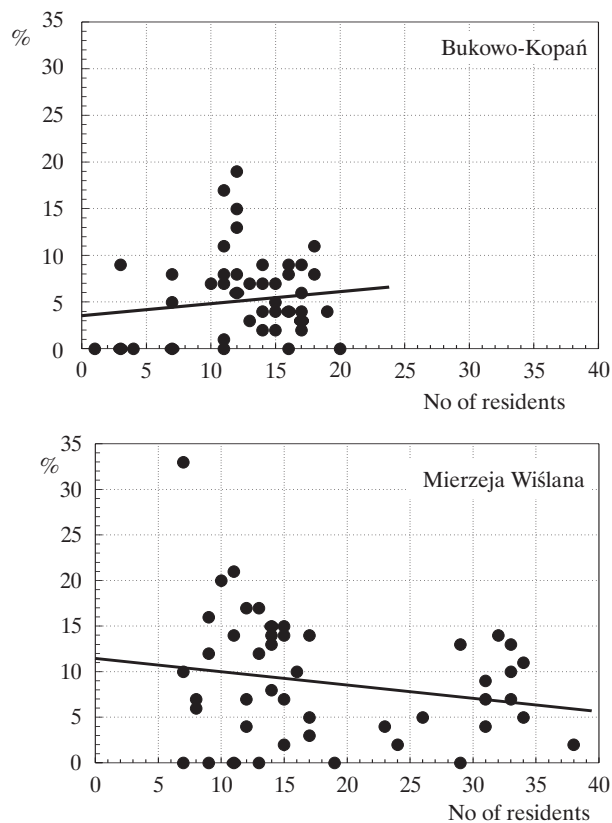


Fig. 6. Relation between the number of “resident” birds and the percentage of “settling” birds

Table 2

Averages and standard deviations of: actual weight (W), relative fat load (t) and standardised weight (w) at first capture. D – difference between values for birds caught only once and those retrapped later (significant D shown in bold).

	Bukowo-Kopań			Mierzeja Wiślana		
	Never retrapped	Retrapped	D	Never retrapped	Retrapped	D
N	2455	199		1793	169	
W [g]	19.36	18.73	0.63	19.60	19.01	0.59
SD_W	1.90	1.78		1.87	1.64	
t [g]	0.40	-0.29	0.69	0.20	-0.32	0.52
SD_t	1.20	0.94		1.22	0.97	
w [g]	18.96	19.01	0.05	19.40	19.33	0.07
SD_w	1.50	1.52		1.38	1.33	

several times at these two stations: at Bukowo-Kopań the initial actual weight (on the day of ringing) was lower (18.73 g) than at Mierzeja Wiślana (19.01 g) – Cochran-Cox test: $t = -3.7$, $df = 1984.8$, two tailed $p = 0.00002$. The same statement

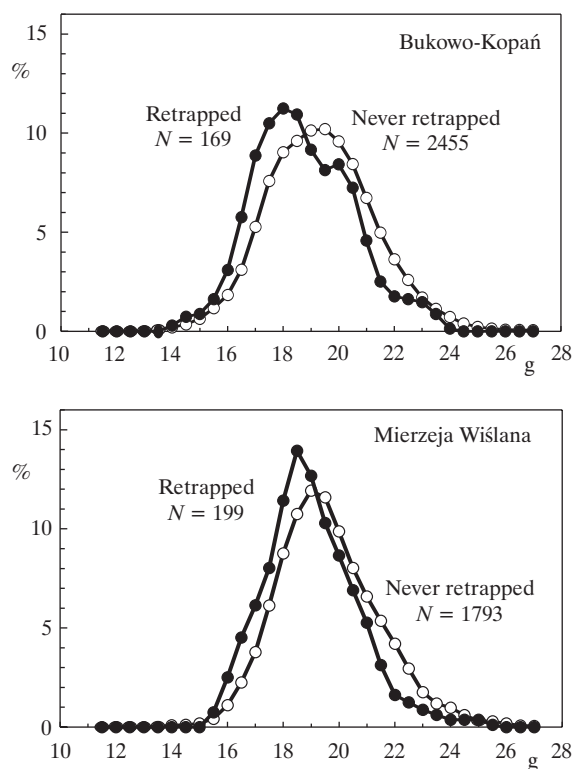


Fig. 7. Distribution of actual weight at first capture of birds caught only once and those retrapped later in the season. Curves smoothed by moving average.

could apply to the values of standardised weight. However, difference in average relative fat load of birds caught several times (only 0.03 g) was statistically non-significant.

Weight and fat load on the day of last capture

Differences in actual weight, relative fat load and standardised weight between first and last captures at both study sites are shown in Table 3. Average actual weight on first and last capture of birds caught several times at Bukowo-Kopań did not differ significantly (paired t -test: $t = -0.60$, $df = 168$, $p = 0.55$). At Mierzeja Wiślana this difference was significant (paired t -test: $t = -2.29$, $df = 198$, $p = 0.03$). No significant difference in relative fat load between first and last capture (Wilcoxon test: $Z_{\text{Bukowo-Kopań}} = 0.45$, $p = 0.65$; $Z_{\text{Mierzeja Wiślana}} = 1.00$, $p = 0.32$) suggests that birds leave the area without their fat reserves being replenished – if we assume that on the date of their final capture birds resume their migration.

Figure 8 shows relative body mass changes between first and last capture of birds grouped according to their duration of stay at the station. Birds that stopped at Bukowo-Kopań for one, two or nine days, left the area weighing less than when they arrived. Such birds comprised over 50% of stopping-over Blackcaps at Bukowo-Kopań. At Mierzeja Wiślana this decrease in body mass applied only to

Table 3

Averages and standard deviations of: actual weight (W), relative fat load (t) and standardised weight (w) at first and last capture. D – difference between values for first and last capture (significant D shown in bold).

	Bukowo-Kopań			Mierzeja Wiślana		
	First capture	Last capture	D	First capture	Last capture	D
N	169	248		199	200	
W [g]	18.73	18.85	0.12	19.01	19.52	0.51
SD_W	1.78	2.10		1.64	2.22	
t [g]	-0.29	-0.30	-0.01	-0.32	-0.20	0.12
SD_t	0.94	1.03		0.97	1.13	
w [g]	19.01	19.08	0.07	19.33	19.73	0.40
SD_w	1.52	1.84		1.33	1.91	

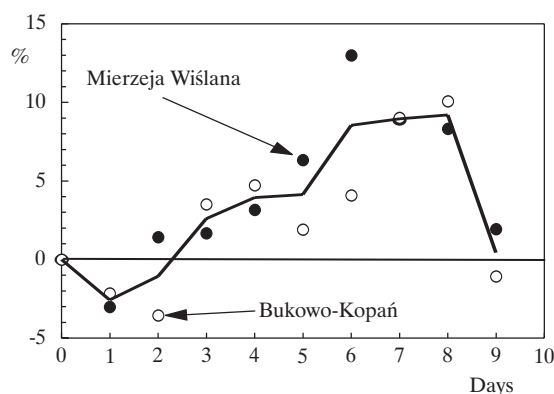


Fig. 8. Retraps' average actual weight changes between first (on ringing day – day 0) and last capture in relation to the duration of stay (days). Average curve and data for both stations are shown.

birds leaving the area the day after ringing; this group was *ca.* 17% of all staging Blackcaps. The remaining birds (83%) gained weight during stop-over at this site. This figure shows also that the peak of weight gain (10% of initial weight – 1.25% daily) occurred as late as on the eighth day of stop-over period at Bukowo-Kopań. The Blackcaps at Mierzeja Wiślana gained weight faster. Individuals caught for the last time on the sixth day after ringing gained nearly 14% (2.33% daily) of their initial weight.

Retraps' average relative fat load at final capture was lower than at their first capture if these birds stayed in the studied area for one, two or three days (Fig. 9). This applies both to Bukowo-Kopań and Mierzeja Wiślana. At both stations more or less the same number of individuals lost and increased their fat stores.

Analysis of average actual weight changes in subsequent pentades showed that retraps leaving the studied area did not always reach body mass as high as birds that did not stop for a longer time (Fig. 10). Statistically significant differences are shown in Table 4.

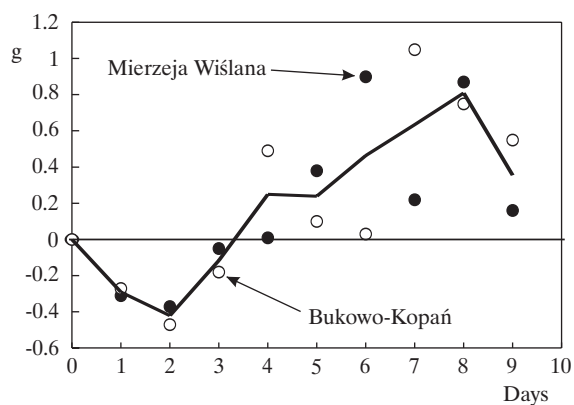


Fig. 9. Retraps' average relative fat load changes between first (on ringing day – day 0) and last capture in relation to the duration of stay (days). Average curve and data for both stations are shown.

Table 4

Statistical significance of differences between average actual weight (W) of individuals retrapped last time within subsequent pentades and individuals that were caught in these pentades and never retrapped later. Values of t -test are shown. Significant p shown in bold.

Pentades	Never retrapped		Retrapped last time		t	p
	N	W	N	W		
Bukowo-Kopań						
14-18 Aug.	64	18.59	4	18.35	0.34	0.73
19-23 Aug.	123	19.07	13	17.72	3.05	0.003
24-28 Aug.	146	19.10	12	17.75	2.60	0.01
29 Aug.-2 Sept.	150	19.40	11	18.90	0.90	0.37
3-7 Sept.	209	19.76	11	19.80	-0.08	0.94
8-12 Sept.	209	19.17	15	19.11	0.12	0.91
13-17 Sept.	192	19.70	14	18.37	2.46	0.02
18-22 Sept.	279	19.58	15	18.33	2.25	0.02
23-27 Sept.	201	19.19	24	18.87	0.84	0.4
28 Sept.-2 Oct.	164	19.20	11	19.18	0.02	0.98
3-7 Oct.	87	19.53	18	19.34	0.33	0.74
8-12 Oct.	100	19.13	18	18.05	1.70	0.09
Mierzeja Wiślana						
14-18 Aug.	129	19.02	8	18.56	0.78	0.44
19-23 Aug.	166	18.87	11	18.16	1.65	0.1
24-28 Aug.	173	19.43	17	18.51	2.20	0.03
29 Aug.-2 Sept.	195	19.70	20	18.98	2.00	0.046
3-7 Sept.	167	19.98	15	20.63	-1.03	0.32
8-12 Sept.	197	19.69	19	19.44	0.59	0.56
13-17 Sept.	167	19.96	24	18.96	2.45	0.02
18-22 Sept.	189	20.01	22	19.12	1.99	0.048
23-27 Sept.	91	19.54	11	20.00	-0.76	0.45
28 Sept.-2 Oct.	97	19.97	19	22.98	-2.29	0.02
3-7 Oct.	70	20.43	9	21.06	-0.83	0.41
8-12 Oct.	36	19.41	7	19.46	-0.04	0.96

For both studied areas curves that present birds' actual weight show some similarities (Fig. 10), except for the pentade 55 (28 September – 2 October), as at Mierzeja Wiślana the final capture mass of retraps was significantly higher than the body mass of birds caught only once and ringed in the same time as retraps. Analysis of average relative fat load changes in pentades gave similar results (Fig. 11). Fat load increased in the pentade 55 at Mierzeja Wiślana, too; fat deposits of all birds seemed to increase during the studied period at both stations. Details are given in Table 5.

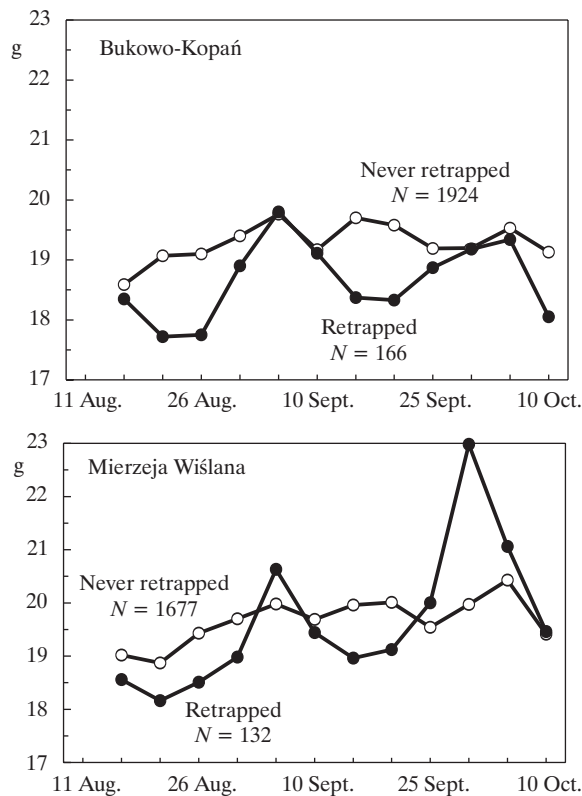


Fig. 10. Relation between actual weight (W) of individuals caught only once and the weight of retraps at last capture (cf. Table 4). Curves smoothed by moving average.

DISCUSSION

Cherry (1982) has shown differences in stop-over length and fat stores gain in the White-crowned Sparrow (*Zonotrichia leucophrys*) at different stop-over sites. He supposed that these differences could be caused by environmental conditions (food availability, weather) and difference in migration progress.

My study on the Blackcap shows that the retraps stop on average for a shorter time at Bukowo-Kopań station than at Mierzeja Wiślana, almost throughout the

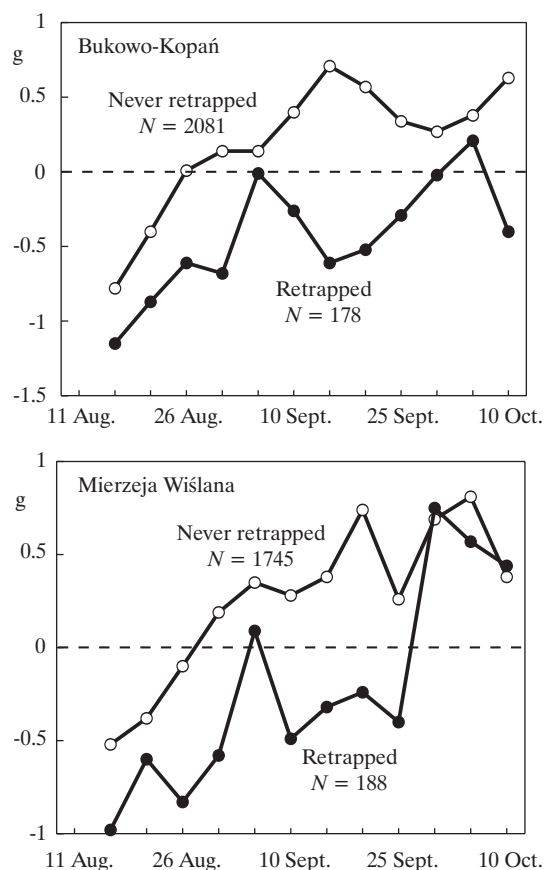


Fig. 11. Relation between relative fat load (t) of individuals caught only once and the fat load of retraps at last capture (cf. Table 5). Curves smoothed by moving average.

whole migration season. Only individuals caught several times in the second part of September, stay on average for the same time at both stations. Weather conditions are quite similar in these areas (both stations are rather not far from each other), thus such conspicuous differences in stop-over length most probably result from different habitat quality. The Blackcaps tend to stop at Bukowo-Kopań station much less often than at Mierzeja Wiślana. Nevertheless, it does not result from a higher necessity to refuel at the latter, as the initial fat load of birds caught at Mierzeja Wiślana is similar to that at Bukowo-Kopań, actual body weight is significantly higher. My conclusion is that the reason for birds frequent and long stop-over at Mierzeja Wiślana are much better foraging conditions of this area, that enable birds to replenish their fat reserves before the next stage of migration.

In the initial migration phase (ca 14-16 August), when the passage speed is not very high, individuals that show extended stop-over periods dominate. They are mostly birds in juvenile plumage that were caught probably during the post-breeding dispersion.

Table 5

Statistical significance of differences between average relative fat load (t) of individuals retrapped last time within subsequent pentades and individuals that were caught in these pentades and never retrapped later. Values of Mann-Whitney U -test or Z -test are shown. Significant p shown in bold.

Pentades	Never retrapped		Retrapped last time		U	p
	N	t	N	t		
Bukowo-Kopań						
14-18 Aug.	72	-0.78	6	-1.15	178	0.49
19-23 Aug.	138	-0.40	18	-0.87	991	0.17
24-28 Aug.	170	0.01	12	-0.61	656	0.043
29 Aug.-2 Sept.	167	0.14	11	-0.68	544	0.022
3-7 Sept.	212	0.14	13	-0.01	1030	0.13
8-12 Sept.	249	0.40	15	-0.26	1178	0.015
13-17 Sept.	221	0.71	16	-0.61	665	0.0001
18-22 Sept.	287	0.57	16	-0.52	1050	0.0002
23-27 Sept.	202	0.34	24	-0.29	2.52 ¹⁾	0.01
28 Sept.-2 Oct.	164	0.27	11	-0.02	784	0.48
3-7 Oct.	93	0.38	18	0.21	797	0.75
8-12 Oct.	106	0.63	18	-0.40	517	0.002
Mierzeja Wiślana						
14-18 Aug.	132	-0.52	9	-0.98	432	0.18
19-23 Aug.	177	-0.38	12	-0.60	932	0.48
24-28 Aug.	178	-0.10	17	-0.83	903	0.005
29 Aug.-2 Sept.	202	0.19	21	-0.58	2.86 ¹⁾	0.004
3-7 Sept.	172	0.35	16	0.09	1164	0.31
8-12 Sept.	204	0.28	23	-0.49	3.19 ¹⁾	0.001
13-17 Sept.	171	0.38	24	-0.32	3.05 ¹⁾	0.003
18-22 Sept.	192	0.74	23	-0.24	3.63 ¹⁾	0.0003
23-27 Sept.	100	0.26	13	-0.40	471	0.11
28 Sept.-2 Oct.	104	0.69	13	0.75	720	0.95
3-7 Oct.	75	0.81	9	0.57	288	0.48
8-12 Oct.	38	0.38	8	0.44	140	0.74

¹⁾ Z -test

Veiga (1986) in the study on behaviour of migrant Pied Flycatcher (*Ficedula hypoleuca*) at stop-over sites showed that birds already present in the area were aggressive towards “newcomers”. He showed also that the settling rate was inversely correlated with the density of birds already staging. He suggested that the high density of staging birds was a limiting factor for the number of birds that recently arrived – this hypothesis was supported by previous studies by Orians (1961), Watson (1967), Krebs (1971) and Davies (1978). “Resident” birds defend their territories from individuals migrating later. My analysis suggests that Blackcaps do not show so distinct territorial behaviour during the migration as Pied Flycatchers do. The explanation of the lack of such behaviour at Bukowo-Kopań station can be both rather low number of birds stopping for a longer time – thus there is no need to compete for resources; and the low “profitability” of territory establishment due to poor foraging conditions – birds leave the area as soon as possible, quite often without even having replenished their weight and fat deficits.

According to my analysis of the stop-over length in both studied areas, migration speed increases in the course of the passage (staging periods become shorter), what is in accordance with the studies by Philips (1994) and Fransson (1995). An exception to that are birds ringed at Mierzeja Wiślana in the first half of October. Because it is rather late in the migration season it is possible that these individuals were simply weak or showing some disorders in their migration mechanism. At Bukowo-Kopań station the Blackcaps tend to shorten stop-over period later in the season. According to Fransson (1995) the increase in migration speed is an adaptation to stress caused by progressing autumn. Such increase means also the increase in costs: increase in energy expenditure, higher risk of predation (time for anti-predatory activity is shortened to gain more time to forage). Birds caught late in autumn at Bukowo-Kopań station continue their migration after very short stop-over, thus they have to migrate with lower energy reserves (Fig. 10 and 11 – 57 pentade: 8-12 October).

Birds caught several times have much lower average weight and fat load at initial capture than the individuals caught only once. This fact suggests that birds “decide” to stop-over in order to replenish their energy deficits. At Bukowo-Kopań station most retraps do not show an increase either in weight or in fat load before their departure from staging area. At Mierzeja Wiślana there is a pronounced increase in body mass, although the increase in fat stores is statistically non-significant. The question arises: why do birds resume their migration without achieving the goal – *i.e.* replenishing their energy deficits? The answer can be found when we analyse body mass and fat stores changes during the stop-over period (Fig. 8 and 9). Langslow (1976) explained that in stopping-over Blackcaps the physiology changes enabling birds to start feeding and fattening do not launch immediately after the arrival but only after about 48 hours.

A decrease in fat stores and body mass in first days after the initial captures of Robins (*Erithacus rubecula*) stopping at Bukowo-Kopań station was observed also by Szulc-Olech (1964). The author cites another report concerning this phenomenon on Robins at Fair Isle (Davis 1962 after Szulc-Olech 1964). Rappole and Warner in their studies on the Northern Waterthrush (*Seiurus noveboracensis*) found that birds started to gain weight after they had established their territories, what usually took a few days (Rappole and Warner 1976 after Cherry 1982). Cherry (1982), however, in the study on the White-crowned Sparrow, found that the increase in body mass started immediately after initial capture and explained this by the fact that this species was not territorial during migration.

My study shows that more than a half of retraps caught at Bukowo-Kopań leave this place after 1-3 days, that is before they start to gain mass or accumulate fat. Thus they leave the area with lower energy reserves when compared to the initial state. Only a small number of birds leave this area later, when they reach favourable energy balance. It is probable that Blackcaps stopping at Bukowo-Kopań are able to “assess” negatively quality of the habitat, thus they leave the area to find better foraging conditions further on their route. At Mierzeja Wiślana the initial period,

when birds decrease in their weight, is shorter and individuals caught as early as 2 days after the initial capture show body mass increase. About 80% of all retraps (from the whole season) stay in this area for more than one day, thus the significant increase in weight before leaving Mierzeja Wiślana is a characteristic of whole retraps group. Decrease in fat load is characteristic for retraps caught for the last time on the second and third day after their first capture at Mierzeja Wiślana. Average relative fat load starts to increase on the fifth day of the staging period; by that time *ca* 50% of retraps leave the studied area. Conclusion is that only retraps staying longer than 2-3 days in the studied areas rebuild their energy reserves. At Bukowo-Kopań station though, their number is lower than 50%.

Kaiser (1992) gives the comparison of birds' weight and fat during the "pre-migratory" phase and during the actual migration period, when the number of individuals caught only once noticeably increases. Both body mass and subcutaneous fat are significantly higher during the migration period. In my study changes in average actual weight and relative fat load of birds caught between 14 August and 12 October are presented at Figure 10 and 11, respectively. Initial stage of lower weight and very low fat load corresponds quite well to "pre-migratory" phase defined by Kaiser. As the season progresses, weight and fat increase. According to Philips (1994) this is a reaction to longer nights. He suggests that birds have larger fat reserves – and thus they weigh more – at the end of the season in order to survive in spite of increased energy expenditure at night. Ehnbohm *et al.* (1993), however, interpreted October increase in fat stores of Robins in Urasa (Sweden) in as a shift in bird migration strategy at the end of the season, from "short-stage" to "long-stage".

To summarize the discussion, following conclusions can be given:

- (1) The Blackcap stop-over length depends on the food abundance in the area. Birds very quickly learn about foraging conditions of the place and if they are poor, they resume migration as soon as weather conditions are favourable.
- (2) If the staging area is not attractive enough in terms of food conditions, the density of "resident" birds, that arrived earlier, does not affect the decision of "new-comers" to stop-over for a longer time.
- (3) Weight and fat changes are influenced by the stop-over length. Individuals that leave early, *i.e.* 1-2 days after ringing, not only do not gain energy, but also lose the reserves they had on their arrival.
- (4) As the season progresses, birds tend to stop-over for a shorter time.

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