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VARIATION IN BODY MASS AND FAT RESERVES OF THE SEDGE WARBLER *Acrocephalus schoenobaenus* ON AUTUMN MIGRATION IN THE L'VIV PROVINCE (W UKRAINE)

Oksana Zakala, Ihor Shydlovskyy and Przemysław Busse

ABSTRACT

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The aim of the paper is limited to a rough describing peculiarities of relations between fat deposit level and the body mass as well as a seasonal and diurnal dynamics of catching at an inland study site located far to the North from important geographical barriers on the Sedge Warbler migration to Central Africa. Material was collected in 1999 and 2000 from July (11 Jul. 1999 and 28 Jul. 2000) till 29 August in L'viv province (western Ukraine). In the present paper 1066 Sedge Warblers caught in 1999 and 407 ones caught in 2000 were taken under consideration. Their body mass and fat score were recorded according to rules published by Busse (1983, 2000). During elaboration of the data the idea of body mass standardisation for a defined fat score (T_2) was adopted (Busse 1970) and adequate correction values (c_i) were calculated. Because of the obtained results a new procedure of the correction values defining – if the data allow – is proposed.

In both years adults were highly significantly heavier than immatures. This finding leads to conclusion that summarising data for adult and immature Sedge Warblers in calculation of body mass correction values would result in significant growth of variance. Having compared the body mass in years 1999 and 2000 a pronounced difference between immatures was found. In 1999 the first period of migration was characterised by relatively high representation of adults (16.8%) and a low fat level (average fat score T = 1.76 and relative fat load t = -0.12 g for adults, while T = 1.57 and t = -0.21 g for immatures). This time was probably premigration dispersion and gaining of fat before migration rather than real migration movements. The share of adults among Sedge Warblers migrating in second and third periods was very similar in both studied years (1999 – 9.43% and 2000 – 9.46%). The fat load of birds caught during these periods was higher than in the starting period but still rather low as for long-distance migrants (T = 2.06-2.42 and t = 0.03-0.21 g for adults, T = 1.90-2.30 and t = -0.05-0.16 g for immatures). Both the fat load and body mass was growing during a day. The most interesting here were the differences in the growth rate: the average fat load grew during a day by 0.27 g while direct values of the actual body mass differed by as much as 0.84 g (that is more than two times more). This relation was repeated in 2000. That could mean that visible fat deposit does not reflect all gained fuel, but it should be studied more deeply than even big samples, from two years only, allow.

Analysing changes of the fat load and the body mass one must keep in mind that observed differences in the fat scores of birds caught in different parts of a day could be caused by two separate processes: (1) feeding and accumulation of fuel reserves (passing borders set in a fat scoring procedure) and (2) possible differentiation of the diurnal activity of birds that already have different levels of stored fat.

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Key words: Sedge Warbler, migration, body mass, fat deposit, L'viv province

INTRODUCTION

Studies of the bird migratory strategies including changes in body mass and fat accumulation are an important part of the investigation of the general pattern of the bird migration on the level of separate species and populations. Small number of papers were devoted to the Sedge Warbler migration in the eastern part of Europe, especially to the fat load (Gyurácz and Bank 1996). Therefore, studies of the autumn migration and ecology of this species on the territory of L'viv province are of particular interest.

The aim of the paper is to describe peculiarities of relations between fat deposit level and the body mass as well as seasonal and diurnal dynamics of catching at an inland study site located far to the North from important geographical barriers on the Sedge Warbler migration to Central Africa. An analysis of available material brings more questions and problems than it is possible to solve basing on this set of the data. However, the authors think that even rough listing of arising problems could help in further studies.

STUDY SITE

The investigations were conducted on the territory of "Cholginski" ornithological reserve, which is situated on the water reservoirs of the "Sulphur enterprise" between the villages Tarnavytsia, Ruleve and Cholgini (Javoriv district, L'viv province) and is situated very close to the main European watershed – Roztochya (Fig. 1). The total size of the reserve is 820 ha. It includes two water reservoirs partially filled with water. This area is of artificial origin. Soil includes the waste materials from the sulphur extraction, namely small stones, clay, sand and free sulphur. The reserve is located on the territory with moderate continental climate with moderate precipitation and warm summer. Winds of the western and north-western directions dominate in the area. The vegetation is very peculiar: Common Reed *Phragmites*

Fig. 1. Localisation of the study place: Europe – Ukraine – Cholginii

communis L., Cat's-tail *Typha angustifolia* L. and *Typha latifolia* L., Water-buttercap *Batrochius sp.* and Sedge *Carex hirta L.* are growing on the shores of the reservoirs and create rather large belt with the width of about 250 m on the territory of the reserve. The Pondweed *Potamogeton spp.* is the most common species of semiaquatic plants. Grasslands are dominating on the rest of the territory and they are overgrown by different species of grasses and the Coltsfoot *Tussilago farafara* L. Small willow bushes are rare and dispersed through the territory.

MATERIAL AND METHODS

Material was collected during field studies, which were conducted in 1999 and 2000 from July (11 Jul. 1999 and 28 Jul. 2000) till 29 August. Birds were trapped using mist-nets that were located in the reeds. Number of used nets varied from 17 (in 2000) to 26 (in 1999). During the rainfall all nets were removed. Nets were controlled starting from the 6.00 *a.m.* till the dusk (usually at 10.00 *p.m.*) every hour. During the very hot period of day, nets were controlled every half an hour in order to avoid the death of birds. During the ringing procedure birds were identified and measured. Their body mass and fat score was also recorded according to rules published by Busse (1983, 2000). The subcutaneous fat deposit was scored visually by subsequent inspection of belly (fat scores T_2 and T_3), belly and furculum (fat scores T_0 and T_1, T_4) and belly, furculum and breast muscles (fat scores above T_4 – to T_8; *nota bene* fat scores above T_5 were not found in the collected data set).

In the present paper 1066 Sedge Warblers caught in 1999 and 407 ones caught in 2000 were taken under consideration.

During elaboration of the data the idea of body mass standardisation for a defined fat score (T_2) was adopted (Busse 1970) and adequate correction values (c_i) were calculated. Because of the obtained results (see later) a new procedure of the correction values defining – if the data allow – is proposed. When correction values are available the body mass standardisation procedure goes through some steps (Busse 1970): (1) calculation of average actual body mass (W – as measured, in grams) and its variance (SD_W^2) for a group; (2) calculation of relative fat load (t – deviation from the fat load of birds scored as T_2, expressed in grams of fat):

$$t = (\Sigma\, n_i \times c_i) / N$$

where:
n_i – frequences of T_i (T_0, T_1, ...),
c_i – adequate correction values,
$N = \Sigma\, n_i$ – total sample size,

and its variance (SD_t^2):

$$SD_t^2 = (\Sigma\, n_i \times (t - c_i)^2) / N$$

(3) calculation of the average standardized body mass:

$$w = W - t,$$

and its variance:

$$SD_w^2 \quad SD_W^2 \quad SD_t^2$$

Standardised body mass has the property that it allows directly to compare average body masses for groups of birds that had differentiated fat load, which can influence very much the actual body mass of birds. Additionally, standardised body mass has lower variance that gives better possibility to analyse body mass differences between subsequent groups of birds.

For description of fat level and body mass relations the regression equations were defined in a form:

$$y = bx + c$$

The b and c parameters were compared using two-tailed Student t-test. The same test was used when comparing averages.

RESULTS AND DISCUSSION

Body mass and fat score relations

In the methodical paper on fat score and body mass relations Busse (1970) suggested that these relations should be checked for sex and age classes and in both, spring and autumn, migration seasons. He found that there are some sex and age differences but he did not compare data from different years. The data we collected are numerous enough to make all calculations separately for 1999 and 2000. Results for yearly totals are summarised in Table 1 and relations between body mass and fat scores for immatures (1999 and 2000) and adults (1999; in 2000 a sample size for adults was too low for presenting in the graph) are illustrated in Figure 2.

Table 1
Fat scores distributions (N_T and %), average body masses (W and their SD_W), coefficient of variation ($V\% = SD_W \times 100 / W$) and correction values c_i for Sedge Warblers caught in 1999 and 2000. Average fat scores (T and SD_T) are given for adults (*ad.*) and immatures (*imm.*).

$T(SD_T)$	N_T	%	W	SD_W	$V\%$	c_i
1999 *imm.*						
T_0	42	4.5	11.32	0.63	5.6	-0.49
T_1	164	17.4	11.48	0.64	5.6	-0.33
T_2	504	53.5	**11.81**	0.70	5.9	0.00
T_3	214	22.7	12.32	0.74	6.0	0.52
T_4	13	1.4	12.35	0.86	7.0	0.54
T_5	5	0.5	13.60	0.80	5.9	1.79
2.01 (0.83)	**942**	100	**11.86**	**0.77**	**6.5**	
1999 *ad.*						
T_0	7	6.1	11.57	0.62	5.3	-0.99
T_1	16	13.9	12.31	0.73	5.9	-0.25
T_2	49	42.6	**12.56**	0.82	6.5	0.00
T_3	38	33.0	13.24	0.95	7.2	0.68
T_4	3	2.6	13.60	0.86	6.3	1.04
T_5	2	1.7				
2.18 (0.97)	**115**	100	**12.73**	**0.97**	**7.6**	
2000 *imm.*						
T_0	8	2.2	11.31	0.43	3.8	-0.81
T_1	44	12.0	11.66	0.64	5.5	-0.46
T_2	226	61.7	**12.12**	0.77	6.4	0.00
T_3	55	15.0	12.84	0.82	6.4	0.72
T_4	30	8.2	13.47	0.81	6.0	1.35
T_5	3	0.8				
2.17 (0.85)	**366**	100	**12.28**	**0.91**	**7.4**	
2000 *ad.*						
T_0	0	0.0				
T_1	3	8.3				
T_2	26	72.2	**12.58**	0.63	5.0	
T_3	4	11.1				
T_4	2	5.6				
T_5	1	2.8				
2.22 (0.79)	**36**	100	**12.79**	**0.79**	**6.2**	

In both years adults were highly significantly heavier than immatures (1999 – by 0.87 g, $p = 1.1\,E^{-19}$; 2000 – by 0.51 g, $p = 0.0003$). One can try to explain this by the higher fat level (1999: $T_{imm.} = 2.01$ *versus* $T_{ad.} = 2.18$; 2000: $T_{imm.} = 2.17$ *versus* $T_{ad.} = 2.22$) but the fat level differences were relatively small and they seem to be in-

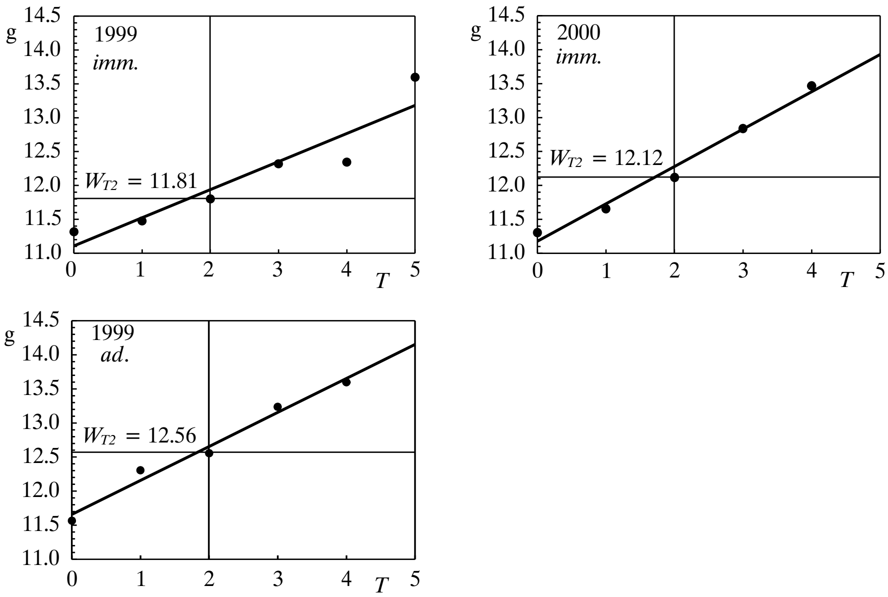

Fig. 2. Relations between fat scores and the actual body mass in years 1999 and 2000 for age groups. Average body masses for birds scored as T_2 are given.

significant (at least for adults – $p = 0.72$, while for immatures $p = 0.072$). Comparison of immatures and adults all scored as T_2 confirmed that adults were really heavier than immatures: for T_2-fat-scored birds in 1999 adults were heavier by 0.75 g ($p = 1.2\,E^{-9}$) and in 2000 they were heavier by 0.46 g ($p = 0.0007$). This finding leads to conclusion that summarising data for adult and immature Sedge Warblers in calculation of body mass correction values would result in significant growth of variance.

Having compared the body mass within the same age classes in years 1999 and 2000 one could find a pronounced difference between immatures. The difference for all caught immatures was as big as 0.42 g ($p = 1.0\,E^{-13}$), but part of this difference was due to higher fat load of the young birds migrating in 2000: average fat score for 1999 equalled 2.01, while in 2000 – 2.17 (this difference was significant at p-level = 0.002). However, immatures scored as T_2 in 2000 were still significantly heavier than the ones caught in 1999: the difference was smaller than for the all caught individuals (0.31 g) but still highly significant ($p = 3.0\,E^{-7}$). On the contrary, adult average body masses and the fat levels were very close to each other in years of the study: total body mass differed by 0.06 g only ($p = 0.71$) and total fat score by $T = 0.05$ ($p = 0.92$). Body mass for adult individuals being fat-scored as T_2 differed by 0.02 g ($p = 0.91$). These findings suggest that the fat free body mass and the level of fat load is more stable in adult Sedge Warblers, at least on this stage of migration.

The same as above, the results suggest that summarising data from different years for immature Sedge Warblers in calculation of body mass correction values would lead to significant growth of variance. So, if possible, the separately calculated correction values and not the original weighting data should be summarised.

A separate problem in combining results obtained for different groups of Sedge Warblers is whether relations between the body mass and fat scores are the same for them. This was checked using statistical comparisons of parameters of regression equations prepared for different groups under consideration. The regression patterns between correction values and fat scores are presented in Figure 3. Comparison of parameters of the regression equations for adults and immatures caught in 1999 showed that these equations were similar enough to allow to combine both age groups: for regression coefficient *b* *p*-value = 0.40 while for regression constant *c* it equalled 0.58. This allowed to join adults and immatures to have one set of correction values for 1999. The 2000 year data for adults were not enough numerous to do such a comparison, but we assumed that the adults/immatures relations were similar in this respect as body mass and fat levels were similar between adults in both studied years. Regression equations for immatures in both studied years were very similar ($p = 0.21$ for regression coefficients and $p = 0.52$ for constant). So, the correction values were calculated for both age groups jointly but still for two years separately (Table 2). Once more regression equations were similar (*p* for regression coefficient equalled 0.31 and that for regression constant – 0.56) and that allowed to combine all available data into one set of correction values (c_i in Table 3).

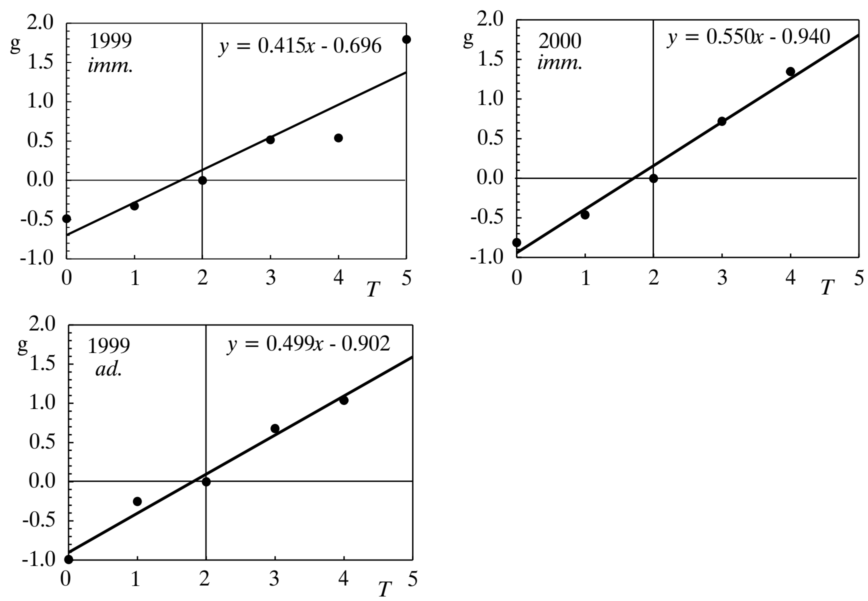

Fig. 3. Deviations of body masses of birds (*ad*. and *imm*.) scored as T_0-T_1 and T_3-T_5 from these scored as standard T_2. Linear regression equations are given.

Analysing carefully Figure 2 and 3 one can found that all regression lines lie a little bit higher than values for T_2 fat score that is, according to definition, "the standard fat score", so the correction value must be equal 0. This can point at a slight curvature of the real line expressing relations between the body mass and

Table 2
Fat scores distributions (N_T and %) and correction values c_i for all Sedge Warblers caught in 1999 and 2000. Average fat scores (T and SD_T) are given.

$T(SD_T)$	N_T	%	c_i
1999 all			
T_0	49	4.6	-0.51
T_1	183	17.2	-0.32
T_2	554	52.0	0.00
T_3	257	24.1	0.59
T_4	16	1.5	0.63
T_5	7	0.7	1.92
2.03 (0.85)	**1066**	100	
2000 all			
T_0	9	2.2	-0.81
T_1	47	11.5	-0.45
T_2	255	62.7	0.00
T_3	59	14.5	0.70
T_4	33	8.1	1.33
T_5	4	1.0	-
2.18 (0.85)	**407**	100	

Table 3
Frequences of fat scores (N_T and %) and correction values (c_i, c_r and c_{corr} – explanation in the text) for all Sedge Warblers

	N_T	%	c_i	c_r	c_{corr}
T_0	58	3.9	-0.67	-0.85	-1.01
T_1	230	15.6	-0.38	-0.34	-0.50
T_2	809	54.9	0.00	0.16	0.00
T_3	316	21.5	0.65	0.67	0.51
T_4	49	3.3	0.98	1.17	1.01
T_5	11	0.7	1.92	1.68	1.52
Total	**1473**	**100**			

the fat score. It is the most visible in Figure 4 presenting values of c_i (original data) and c_r (values received from the regression equation) from Table 3. Because of above mentioned definition of the standard fat score c_r values must be corrected by subtracting c_r value for T_2 from every other c_r values (these new are c_{corr} values in Table 3), that is to shift regression line down by 0.16 g (Figure 4, left panel). This does not change the regression equation significantly ($p = 0.46$ for regression constant). The right panel of Figure 4 shows non-linear interpretation of c_i values distribution.

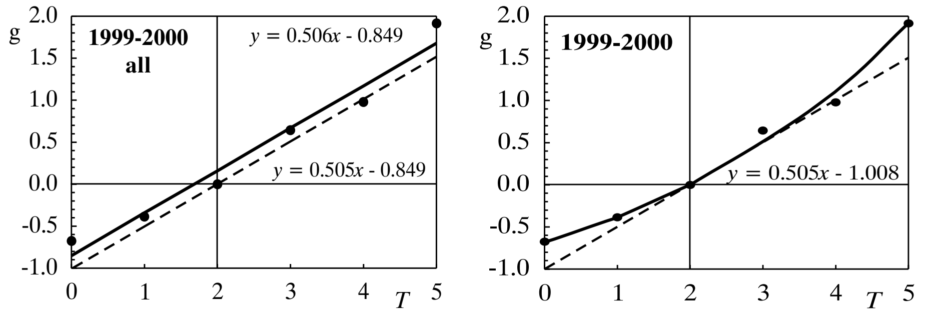

Fig. 4. Deviations of body masses of all individuals scored as T_0-T_1 and T_3-T_5 from these scored as standard T_2. Left panel: dots – calculated values, line – regression line, broken line – corrected regression line. Right panel: dots – calculated values, line – curvilinear interpretation, broken line – as at the left panel. Linear regression equations are given for linear interpretations.

Such possibility was already suggested by Busse (1970), but it seems that this problem should be discussed in detail after presenting data for more bird species.

Table 4
Fatness and body mass parameters for adult (*ad.*) and immature (*imm.*) Sedge Warblers caught in subsequent periods of work. *T* – average fat score, *t* – relative fat load, *W* – actual body mass, *w* – standardised body mass and their standard deviations (*SD*).

Period	Age		1999		2000	
	N (% ad.)		Avg.	*SD*	Avg.	*SD*
I	*Ad.*	*T*	1.76	0.93		
11-22 Jul. 1999	30 (16.8%)	*t*	-0.12	0.47		
		W	12.77	0.85		
		w	**12.89**	**0.71**		
I	*Imm.*	*T*	1.57	0.81		
11-22 Jul. 1999	148	*t*	-0.21	0.41		
		W	11.76	0.68		
		w	**11.97**	**0.54**		
II	*Ad.*	*T*	2.37	0.91	2.42	0.94
23 Jul.-17 Aug.1999	71 (10.7%)	*t*	0.19	0.45	0.21	0.47
31 Jul.-21 Aug. 2000	19 (7.7%)	*W*	12.81	0.98	12.97	0.81
		w	**12.62**	**0.87**	**12.76**	**0.66**
II	*Imm.*	*T*	2.15	0.80	2.10	0.77
23 Jul.-17 Aug.1999	590	*t*	0.08	0.40	0.07	0.38
31 Jul.-21 Aug. 2000	228	*W*	11.90	0.78	12.28	0.86
		w	**11.82**	**0.67**	**12.21**	**0.77**
III	*Ad.*	*T*	2.30	0.64	2.06	0.66
after 17 Aug. 1999	10 (5.0%)	*t*	0.15	0.32	0.03	0.33
after 21 Aug. 2000	16 (10.1%)	*W*	12.61	0.91	12.63	0.74
		w	**12.46**	**0.85**	**12.60**	**0.66**
	Imm.	*T*	1.90	0.81	2.30	0.91
after 17 Aug. 1999	188	*t*	-0.05	0.40	0.16	0.46
after 21 Aug. 2000	142	*W*	11.88	0.81	12.26	0.99
		w	**11.93**	**0.70**	**12.10**	**0.88**

Standardisation of body mass for different groups of migrants

As usual, when presenting graphs for catches of birds on migration, dynamics of Sedge Warbler catches during the study was differentiated much. In 1999 the season could be divided into three well pronounces periods (Fig. 5). In 2000 the work started later and only two of mentioned three periods were covered by catching activity. Border days between these periods were similar to these in 1999. In 1999 the first period was characterised by relatively high representation of adults (16.8% – Table 4) and low fat level (T = 1.76 and t = -0.12 g for adults, and T = 1.57 and t = -0.21 g for immatures). This time was probably pre-migration dispersion and gaining of fat before migration (see later) rather than real migration movements. The share of adults among Sedge Warblers migrating in second and third periods was very similar for both studied years (1999 – 9.43% and 2000 – 9.46%) though a little bit differentiated in details (Table 4). The fat load of birds caught during these periods was higher than in the starting period but still rather low as for long-distance migrants (average fat score T = 2.06-2.42 and average relative fat level t = 0.03-0.21 g for adults, while T = 1.90-2.30 and t = -0.05-0.16 g for immatures).

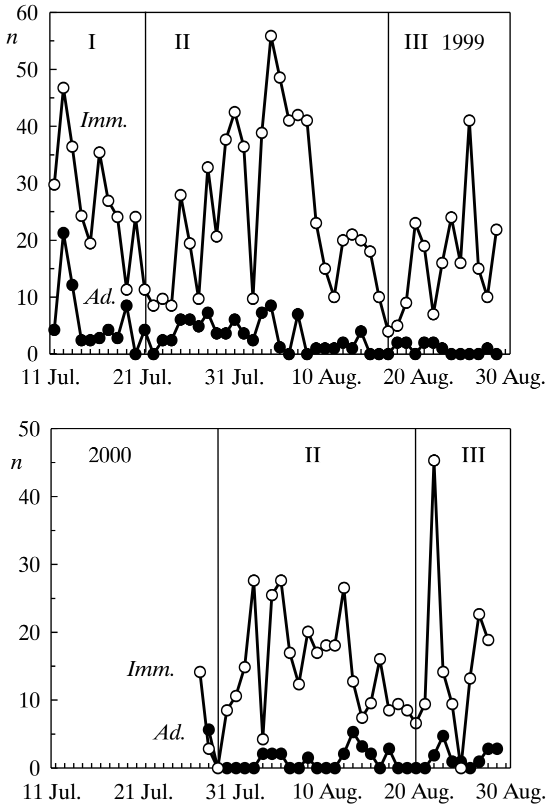

Fig. 5. Catch dynamics for adults (*ad.*) and immatures (*imm.*) in 1999 and 2000. Division of the work time into discussed periods is given.

It should be mentioned that the average fat load t was calculated twice – using c_i and c_{corr} values from Table 3 (assuming curviform *versus* linear dependency of fat scores on the fat load – Fig. 4). As results were highly significantly correlated (r = 0.99, p = 1.1 E^{-7}) the simpler – linear – model was used in Table 4. This was caused by high domination of birds scored as T_2 and T_3 over very lean and very fatty individuals in the samples. Therefore, the analyses of body mass differentiation of groups using actual body mass W and standardised body mass w led to the same conclusions. The differences could be significant, however, if numbers of very lean or very fatty birds were high.

In every period adult birds were heavier than immatures – and heavier than it could be expected from higher fat load (it is also visible in comparison of standardised values w). There were no bigger differences in the standard body mass between birds caught in different periods of the same year (Table 4) but there was a highly significant difference between birds caught in 1999 and 2000 – 11.95 g *versus* 12.33 g (p = 2.5 E^{-13}) while the fat load difference explains only 0.08 g (t for 1999 equals 0.01 g and that for 2000 – 0.09 g).

Diurnal variation of the fat scores and the body mass

During a day both fat load and the body mass of the bird were growing (Fig. 6). In 1999 the variation around the regression line was small while in 2000 it was quite

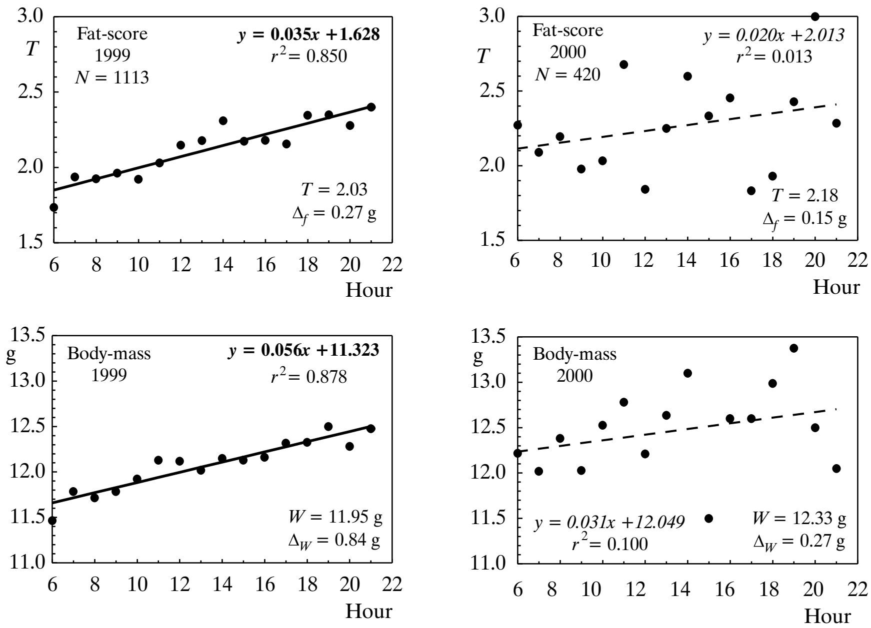

Fig. 6. Relations between time of catches and fat score and body mass of all individuals caught in 1999 and 2000. N – sample size, T – average fat score, W – average actual body mass, Δ_f – difference of the fat load of birds caught at 6.00 *a.m.* and 9.00 *p.m.* (in grams of fat), Δ_w – difference of the body-mass of birds caught at 6.00 a.m. and 9.00 p.m. Regression equations are given (statistically significant – in bold) and values of r^2 as well.

big – what caused that regression coefficients for 1999 were statistically significant while in 2000 – they were not. It was probably because of lower number of birds processed in 2000. The most interesting here were the differences in the growth of documented fat load and body mass during a day: the average fat load grew during a day by 0.27 g (after the data in Table 3 – a difference in *T*-scale equal to 0.55 means 0.27 g of fat) while direct values of the actual body mass differed by as much as 0.84 g (that is more than two times). This relation was repeated in 2000 when these numbers were 0.15 g of the visible fat and 0.27 g of the body mass. That could mean that visible fat deposit does not reflect all gained fuel, *e.g.* that invisible part of it is stored as the glycogen, which is less energetically efficient but easier to metabolise in a short-distance flight. This hidden part of the body mass gained between 6.00 *a.m.* and 9.00 *p.m.* by immature birds caught in 1999 and scored as T_2 reached

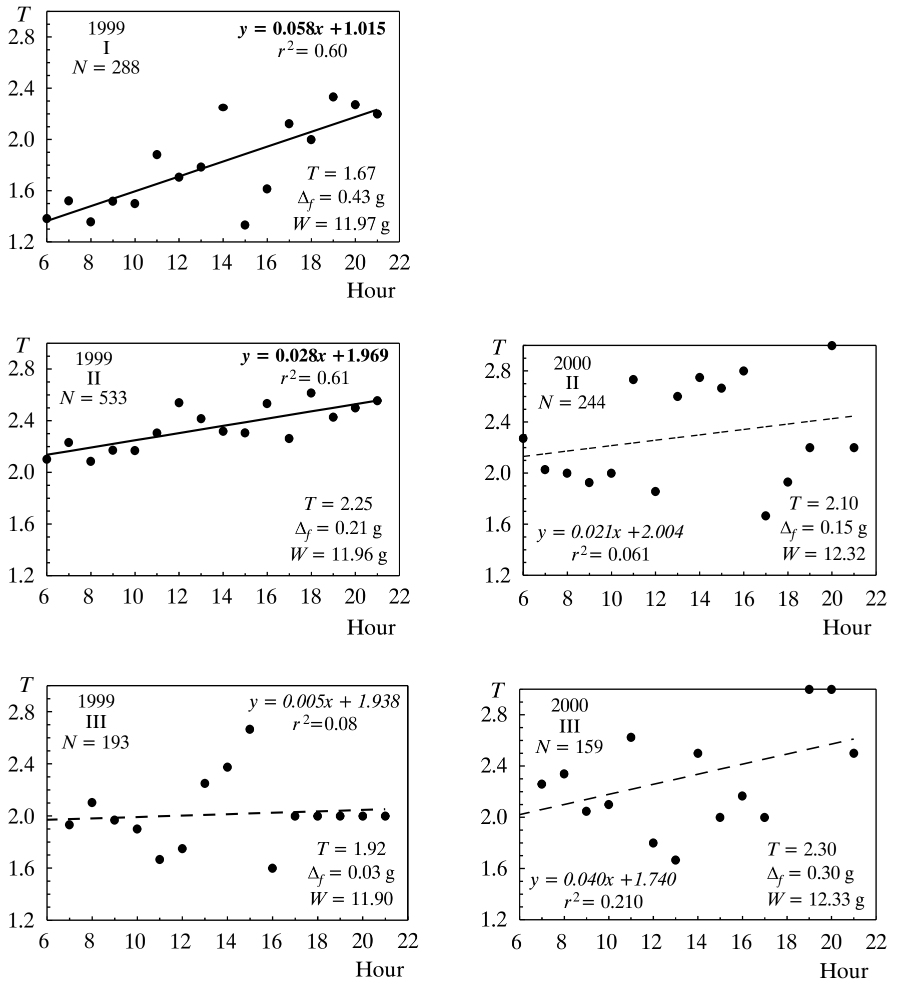

Fig. 7. Relations between time of catches and fat score and body mass of individuals caught in subsequent periods of 1999 and 2000. Explanations as at Figure 6.

the amount of 0.69 g, which is around 6% of the average body mass. This is surely a problem for special studies. Possibly the problem was so visible here when birds migrated using the short-step strategy requiring relatively low fat reserves. This share of reserves could be much less visible in fatty birds that are prepared to a long flight over big barriers and much more pronounced in birds with low fat reserves (as T_0-T_1). The available data, although quite numerous, are not sufficient to go into the problem in detail – the share of extreme, as to the fat load, individuals was too small in the studied sample. The analyses could be even more difficult because the slopes of regression lines (*b* coefficients) are time-dependent and birds gain fat in different periods, and years, differently (see Fig. 7). This can be caused by changing feeding conditions that are not stable, even in the same place, in the course of migration. In 1999 gaining of visible fat stores was the quickest during pre-migration period while it was negligible in the last period. On the contrary, in 2000 the last period was characterised by high fattening rate.

Similarly, a diurnal activity of birds, as reflected by catches in subsequent hours, was differentiated rather much (Fig. 8): in 1999 the curve was rather flat with still pronounced catches during noon and afternoon hours while in 2000 the afternoon catches were very low. Within the year 1999 the diurnal activity during the first period of work was quickly declining from the early morning peak in contrast to much softer declining rate in periods *II* and *III*. This suggests that the diurnal activity of birds depends on environmental factors, still unknown, and/or physiological state of

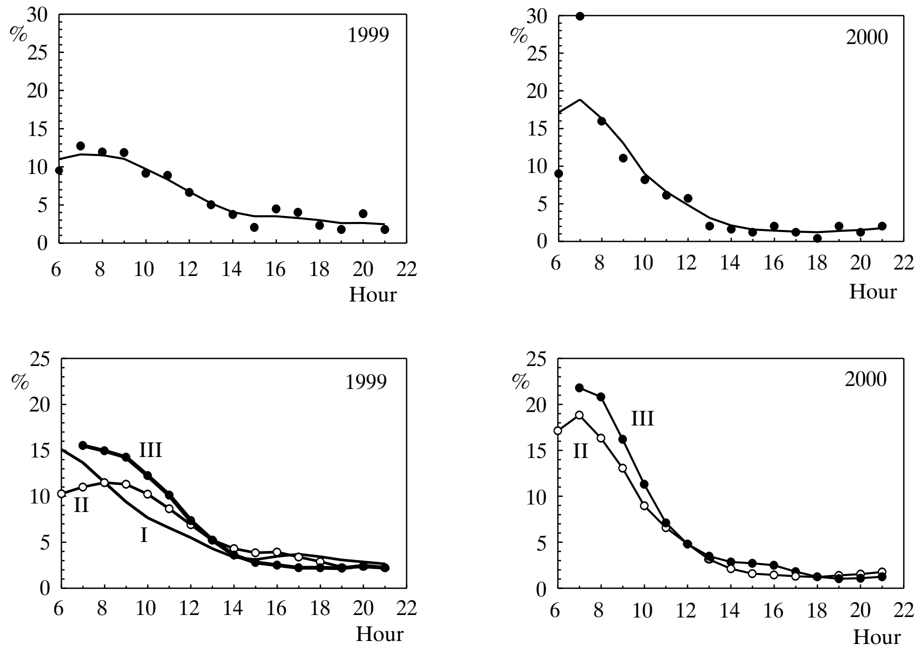

Fig. 8. Diurnal dynamics of all catches in 1999 and 2000 (top panels) and during subsequent periods of these years (in percent of whole day catch numbers)

migrants (*e.g.* the fat load at the arrival – recall the fat score differences between birds caught in 1999 and 2000 as well as between individuals caught in different periods of the year).

Analysing changes of the fat load and the body mass one must keep in mind that observed differences in the fat scores of birds caught in different parts of a day could be caused by two separate processes: (1) feeding and accumulation of fuel reserves (passing borders set in a fat scoring procedure) and (2) possible differentiation of the diurnal activity of birds that already have different levels of stored fat. Usually dealing with the problem one takes into account the first of mentioned processes as the second one is difficult to separate and analyse. Figure 9 tries to visualise differences in diurnal distribution of catches of birds scored to various fat classes

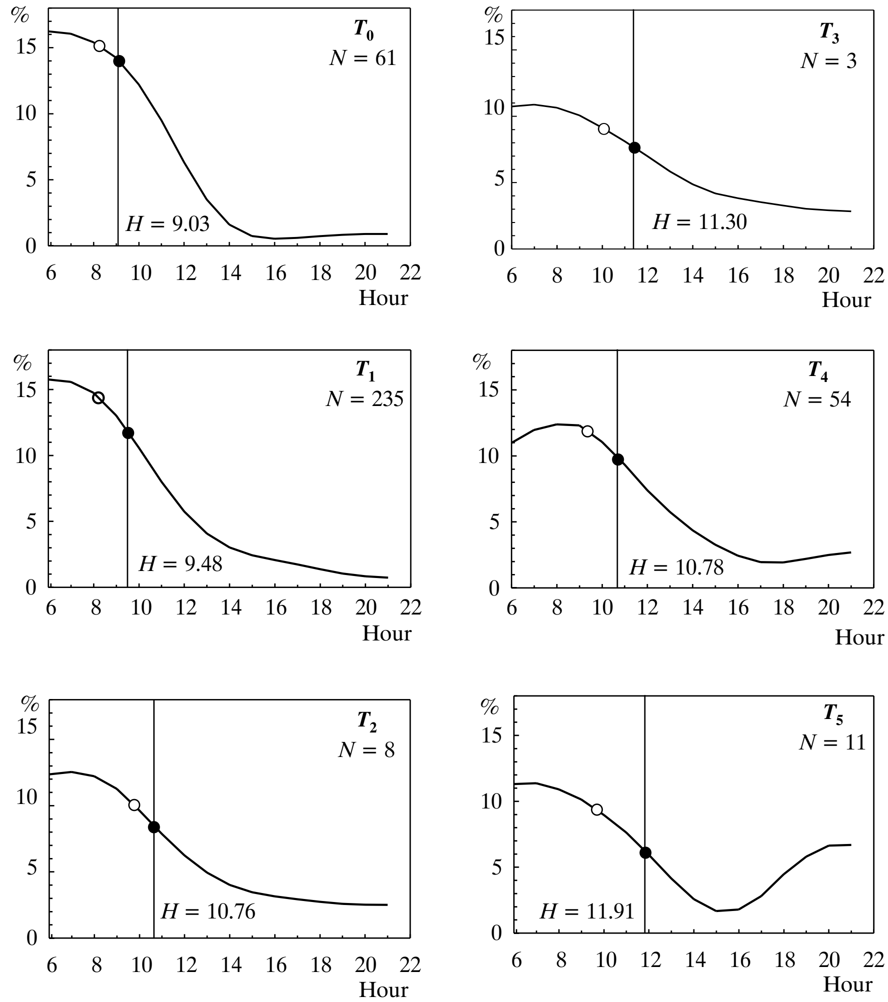

Fig. 9. Diurnal dynamics of catches of individuals assigned to different fat scores. Open circles – medians, filled circles – average catch hours (*H* – given in decimal form).

T_0-T_5. It shows that distributions for subsequent fat scores continuously change their shapes – from rapidly decline after early morning peak, through very flat and low during second half of a day (fat score T_0) to bimodal distribution for the highest fat score T_5. Both measures of the central point of distribution – average and median hours – points at shifting the catches to later and later parts of a day when we look at more and more fatty birds ($r_{avg} = 0.92, p = 0.009$ and $r_{med} = 0.84, p = 0.037$). This fact cannot be explained by simple accumulation of more fat and thus overrunning fat scores border criteria. However, deeper discussion of the problem needs more numerous and more differentiated data (from more years and from various localities).

CONCLUSIONS

1. Simple summarising of data for adults and immatures in the calculation of body mass correction values could lead to a significant growth of variance; summarising of independently calculated values is allowed,
2. Average body mass of birds with the same fat score could be significantly different in different years; if the data allow, correction values should be calculated separately and then summarised,
3. For the Sedge Warbler different age groups and years, correction values can be used when calculated according to points 1 and 2 above.
4. Diurnal changes of visible fat load and body mass are significantly differentiated and the problem seems to be very important for the future studies,
5. Analysing changes of the fat load and the body mass one must keep in mind that observed differences in the fat scores of birds caught in different parts of a day could be caused by two separate processes: (1) feeding and accumulation of fuel reserves (passing borders set in a fat-scoring procedure) and (2) possible differentiation of the diurnal activity of birds that already have different levels of stored fat.

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