FAT RESERVES AND BODY MASS IN SOME PASSERINES MIGRATING IN AUTUMN THROUGH THE SOUTHERN BALTIC COAST

Marta Ścisłowska and Przemysław Busse

ABSTRACT

Ścisłowska M., Busse P. 2005. *Fat reserves and body mass in some passerines migrating in autumn through the southern Baltic coast.* Ring 27, 1: 3-31.

The aim of the present paper is to serve with a huge data set on the fat and body mass of birds that have been caught during the field work of the Operation Baltic since 1983 (earlier data are still not available in a digitalised form). There are given fat score valuations of 38 species and correction factors for the body mass standardisation. Some comments on observed fat scores in species of different migratory habits are added. They should encourage students to continue the research process on a wider scale.

M. Ścisłowska, P. Busse (corresponding author), Bird Migration Research Station, University of Gdańsk, Przebendowo, PL-84-210 Choczewo, Poland; E-mail: busse@univ.gda.pl

Publication appointed to the SE European Bird Migration Network papers

---

Key words: fat reserves, body mass, autumn migration, passerines

INTRODUCTION

As one of the interesting aspects of the bird migration research since many years one may consider studies on body mass changes and fattening process in the course of migration (McCabe 1943; Wolfson 1945; Helms and Drury 1960; Blumental and Dolnik 1962; Dolnik and Blumental 1964; Blumental 1967; Dolnik 1967a, 1967b; Busse 1970 and so on). The process runs both during real migration of an individual and during cage life of a bird belonging to migratory population. This last characteristic shows that the process is controlled by endogenous, inherited program that bases on internal biological clock. Non-migratory species do not show such cyclic changes in fat deposition or the process is clearly different and related to other than migration phenomena (Berthold 1993). Fat reserves are basic stores of energy that is necessary to perform migration – lipids are the most energetic molecules that can be stored in the bird body. The fat reserves are distributed in different parts of the body, but as much as half of the whole stored fat can be located just under the skin,

and thus visible in apteria. The visible fat reserves of a bird are deposed in furculum, on belly and sides from where they can cover even breast muscles. The rest of fat is invisible being located inside of the body or under pterylae. Amount of this hidden part is, however, closely related to the visible fat reserves (Busse 1970). The possibility to see the under skin fat stores is used for a simple fat scoring of individuals caught for the ringing purposes and the fat scoring is nowadays a common practice in the fieldwork of ringers.

The fattening of a migrant bird and using fat reserves for an active passage is a very dynamic process. Although sometimes the bird can loose as much as 30% of its starting body mass during one continuous flight and it is able to gain as much fat daily as 10% of its fat-free body mass, the average fat load is more or less stabilised at any stage of a migratory route. The knowledge of the fattening status is an important part of the general knowledge on the migration strategy of the migrating population. Thus the data collected in different localities should be published, even if the people collecting the fat score and body mass measurements are not willing to do special local analyses. The published data could be an important part of deeper analyses.

Although the fat scoring results are the important part of the migratory state description, their role is not limited to this kind of analyses. As the fat reserves are individually and locally very variable and they are a part of the whole body mass they influence results of weighing very much. It can be stated that the body mass parameter used alone for characterising the average size of birds in population, without taking into consideration the fat scoring results, is totally virtual as the same group at different stages of migration will have different body mass only because of different fat levels. It was discussed and exemplified by Busse in the early seventies (Busse 1970). According to this paper a correction factor for the average group body mass can be derived from the relation between actual weight and fat scores of studied birds. Standardisation of the body mass was made using recalculation of the actual body mass to the body mass of birds that had a common fat score T_2 (according to a scale applied in the field – Busse and Kania 1970, Busse 2000). This procedure has already been used in some papers (*e.g.* Busse 1976, Kędzior 2002, Zakala *et al.* 2004).

The aim of the present paper is to serve with a huge data set on the fat and body mass of birds that have been caught during the field work of the Operation Baltic since 1983 (earlier data are still not available in a digitalised form). There are given observed fat scores distributions and correction factors for the body mass standardisation. Some comments on observed fat scores are added. They should encourage students to continue the research process on a wider scale.

MATERIAL AND STUDY AREA

The data were in general collected during the autumn Operation Baltic work in 1983-2002, however to the analyses some data from earlier years were included but

also some gaps in the material appeared (*e.g.* for Robin years 1968-1969 and 1980 were added, but 2001-2002 were not used). The list of the used data is presented in Table 1. For particular species from 62 to 96 021 individuals – Barred Warbler (*Syl-*

Table 1
The bird species used in the study

	Years	*N*
Acrocephalus arundinaceus	1984-2002	306
Acrocephalus palustris	1983-2002	519
Acrocephalus schoenobaenus	1983-2002	1075
Acrocephalus scirpaceus	1983-2002	9857
Aegithalos caudatus	1983-2002	5705
Anthus trivialis	1983-2002	193
Carduelis spinus	1983-2002	1435
Certhia brachydactyla	1983-2002	310
Certhia familiaris	1983-2002	2003
Emberiza citrinella	1983-2002	260
Erithacus rubecula	1968,69,80-2000	55098
Ficedula hypoleuca	1983-2002	1976
Ficedula parva	1983-2002	107
Fringilla coelebs	1983-2002	2184
Fringilla montifringilla	1983-2002	150
Hippolais icterina	1983-2002	123
Lanius collurio	1983-2002	227
Locustella naevia	1983-2002	147
Muscicapa striata	1983-2002	832
Parus ater	1983-2002	5266
Parus caeruleus	1979-2002	17244
Parus cristatus	1983-2002	169
Parus major	1983-2002	25713
Parus montanus	1983-2002	1861
Parus palustris	1983-2002	453
Phoenicurus phoenicurus	1983-2002	3037
Phylloscopus collybita	1983-2002	1186
Phylloscopus sibilatrix	1983-2002	165
Phylloscopus trochilus	1983-2002	5778
Prunella modularis	1983-2002	559
Pyrrhula pyrrhula	1983-2002	566
Regulus regulus	1980-2001	96021
Sylvia atricapilla	1983-1999	4107
Sylvia borin	1983-2002	2454
Sylvia communis	1983-2002	534
Sylvia curruca	1983-2002	1113
Sylvia nisoria	1983-2002	62
Troglodytes troglodytes	1983-2002	921

via nisoria) and Goldcrest (*Regulus regulus*), respectively – were used in calculations, thus exactness of obtained parameters is differentiated. As possibility of sexing and ageing of individuals of different species in autumn are differentiated (Busse 1984) some species data are more detailed (sex/age groups are treated separately at the level of raw data) and for some of them there are groups combined from the beginning.

The data were collected at two field stations of the Operation Baltic, situated at the Polish Baltic coast: Mierzeja Wiślana (54°21'N, 19°19'E) and Bukowo-Kopań (54°21'N, 16°17'E). Description of both stations could be found in the paper by Busse and Kania (1970). The stations are differentiated as to biotopes despite that they are localised just on spits of the coastal lagoon and a lake (Kędzior 2002). For some species the data were elaborated separately for these two stations.

METHODS

The birds were caught during the continuous work throughout a season, which used around 50 mist-nets per station. All the nets were open on day and night and the birds were caught from dawn to dusk. As a rule all caught birds were ringed, measured, weighed and scored for fat deposit. No sampling technique was applied. If a number of birds was too high for taking full measurement data set they were only sexed/aged (if possible) and ringed.

The fat scoring was performed according to the Operation Baltic standards (Busse 2000), where the same scoring procedure is applied to all bird species used for scoring (bigger species, with thick skin on the belly are not scored at all). As the scoring routine is essential for comparisons it is given here after the text in Busse (2000).

*"**Determination of fat goes through three levels** (Fig. 1):*
Level I – belly
Level II – furculum
Level III – pectoral muscles
Key to fat determination:

*I. 1. Belly is without visible fat or with reddish traces only – **II A***
2. Belly with unfused bands of fat (intestinum is visible) .... T_2
3. Belly has a fused cover of fat; intestinum is not but the liver is visible .... T_3
*4. Belly is completely covered with fat, a very narrow band of the liver may be visible but, if this is so, the roll of fat is just above it – **II B***
II A. 1. Air-sack is visible within furculum (some fat may occur) .... T_0
2. All the interior of furculum is covered with fat.. T_1
II B. 1. Fat in furculum flat or concave .... T_4
*2. Fat in furculum forms a convex cushion – **III***
III. 1. Sides of pectoral muscles without stripes of fat .... T_5
2. Sides of pectoral muscles with stripes of fat .... T_6
3. Pectoral muscles partly covered with fat .... T_7
4. Pectoral muscles completely covered with fat... T_8

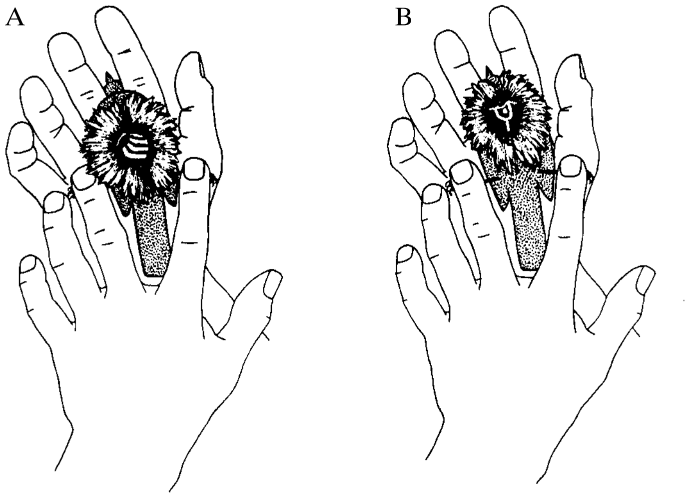


Fig. 1. Fat scoring technique according to Busse 2000. A – blowing to belly, B – blowing to furculum.

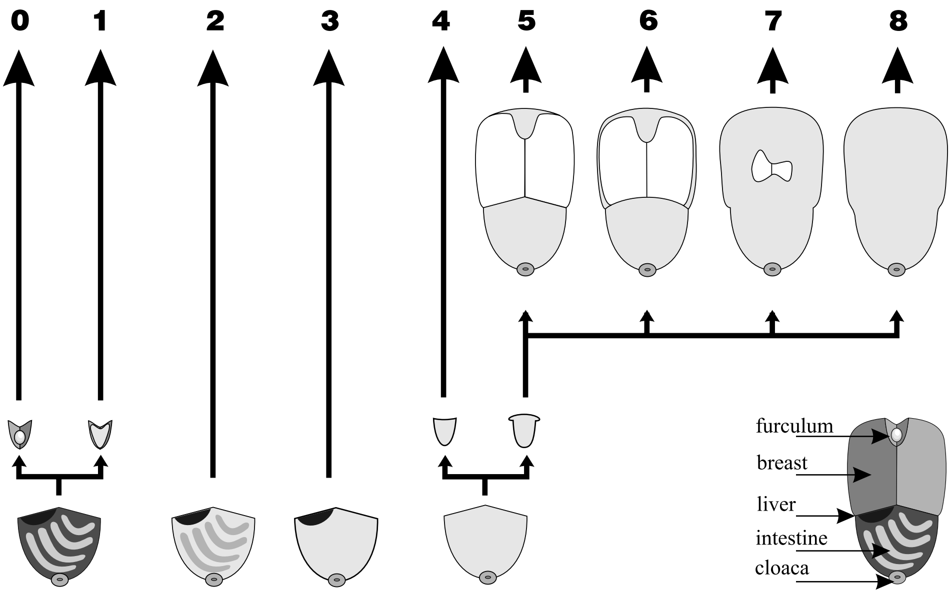


Fig. 2. Illustration to the fat scoring key: from the bottom three levels of decisions – belly – furculum – breast muscles. (After Busse 2000).

Note: In some species loss of fat does not follow exactly the same sequence in which it was attained, this results in problem with fat determination in some specimens. Anyhow, always ***follow exactly*** *the key, as specific differences are covered by species-specific validation of the scale.*

Technique

1. Lay the bird on its back on the flat of the hand (Fig. 2); the neck should be between the second and third fingers of the hand; the second and the third fingers of the second hand gently part the bird's legs; the proper position of bird is very important.

2. Blow the belly with a continuous stream of air and choose one of four possibilities under section I of the key; if you choose the second or the third subsection – you have determined fatness as T_2 or T_3 respectively.

3. If your choice is II A or II B, you must direct your blowing to the furculum and choose one of the two subsections under II A (fatness T_0 or T_1) or II B (fatness T_4 or higher – III).

4. If your choice is III, look at pectoral muscles and choose fatness T_5-T_8.

The most common mistakes

Mistakes are usually made when someone has the tendency to a "liberal" interpretation of rules, e.g. the bird has a thick cover of yellow fat on the belly but a part of intestinum visible; this should be T_2 but is classified as T_3 because it "looked like a fatty bird". Some mistakes are possible when the bird is not properly handled when the furculum contents is evaluated.

Note that sometimes fatness of an individual bird properly determined twice at the same time might not be the same. This is because in border cases different tension of the bird's belly muscles at the moment of blowing may expose (or not) the intestinum or the liver from under the fat layer. Difference in determination cannot, however, exceed one degree of fatness."

The basic part of the standard, *i.e.* scores T_0 to T_5 were used at the Operation Baltic since the early sixties (Busse 1970) when fat scoring was applied after modification of a scale proposed by Helms and Drury (1960). In 1995 the scale was widened after discussions with A. Kaiser, who proposed similar score scale (Kaiser 1993) splitting the top score T_5 into four scores (T_5-T_8). The top scores T_6-T_8 are very rare at the Polish Baltic coast stations (contrary to *e.g.* Middle East located stations – own observations), but still few "old" (till 1994) T_5 scores could contain some birds that now would be classified to higher scores. Based on last years results this bias can be estimated as insignificant.

In earlier years the birds were weighed using Pesola spring balances (to the nearest 0.5 g) while now electronic spring balances (accuracy of 0.1 g) are used. Comparisons made on big data sets of weighed Robins and Goldcrests showed that beside higher variance obtained when using Pesola, no systematic bias can be suspected.

In the first step of data preparation the averages and standard deviations of body mass were calculated for birds grouped according to fat score within sex/age groups (if possible). Then deviations of body mass averages from the body mass average of birds scored as T_2 were calculated (c_i-values). The T_2 level was used as the

basic one because birds with it are the most numerous in the field samples scored and thus the average body mass of this group is the most reliable (due to the lowest standard error). Some people claim that the standardisation should be done to "fat-free" body mass of birds scored as T_0. However, such "fat-free" birds actually are not free of fat, but still have a pronounced amount of it, although not visible. Moreover, this amount of fat remains unknown. Applying the muscle-scoring technique (Bairlein 1995) could show how much internally differentiated T_0 group of birds is – from lean, but normal, healthy condition to total starvation just before death. An additional disadvantage of using this score as the comparisons basis is that it is not common and the standard error of the average for this class is big.

Results of the first study on the topic (Busse 1970) showed that fat scores scale seemed to be quasi-linear in many cases and it was assumed as the first approximation. This allowed to use the scores as numbers on the x-axis and look for regression between the c_i-values and the fat scores. And the creation of regression lines ($y = bx + c$) was the next step in the data evaluation. Then regression coefficients b and c were compared between sex/age groups of the same species using two-tailed t-test. If equations were not differentiated at the level of minimum 0.05 significance, the groups were combined and if they significantly differed they were presented separately. As frequently regression lines deviated from the standardisation point on the graph ($x = 2$ (T_2), $y = 0.0$) that *ex definitio* must lie on the line, the values of c_i were corrected to c_s that is deviation of the body mass average for that fat score from the linear model of relations. The standardised graph can suggest whether the assumption of linearity is good enough in every case. According to species, sometimes sexes, age groups or amount of data available, the agreement between linear model and real data could be better or worse and further studies ought to be done based on the data from different parts of migration routes.

Examples of the routine used are given below using two species that are differentiated according to fat reserves characteristics:

1. Reed Warbler (*Acrocephalus scirpaceus*) – Figure 3. For this species the data were grouped into two pieces – age groups (adults and immatures – first year birds) as separation of sexes is here impossible in autumn. For both groups the regression equations were found and their parameters compared using t-test. The parameters of regression equations were significantly (b-parameter at level 0.05) or highly significantly (c-parameter at level 0.001) different. So, both groups are presented separately (see Plate II-2/III-1).
2. Siskin (*Carduelis spinus*) – Figure 4. In this species one could separate four sex/age groups (adult males, adult females, immature males and immature females). In the first step males and females were compared (Fig. 4, upper panels) and in both cases regression equations parameters were not differentiated ($p_b = 0.63$, $p_c = 0.41$ for adults and $p_b = 0.30$, $p_c = 0.61$ for immatures). Because of that, both sex groups were combined into age groups and compared with each other (Fig. 4, middle panel). As still significant differences were not found (p_b and $p_c = 0.84$) both groups were combined and relations c_i and T-score are de-

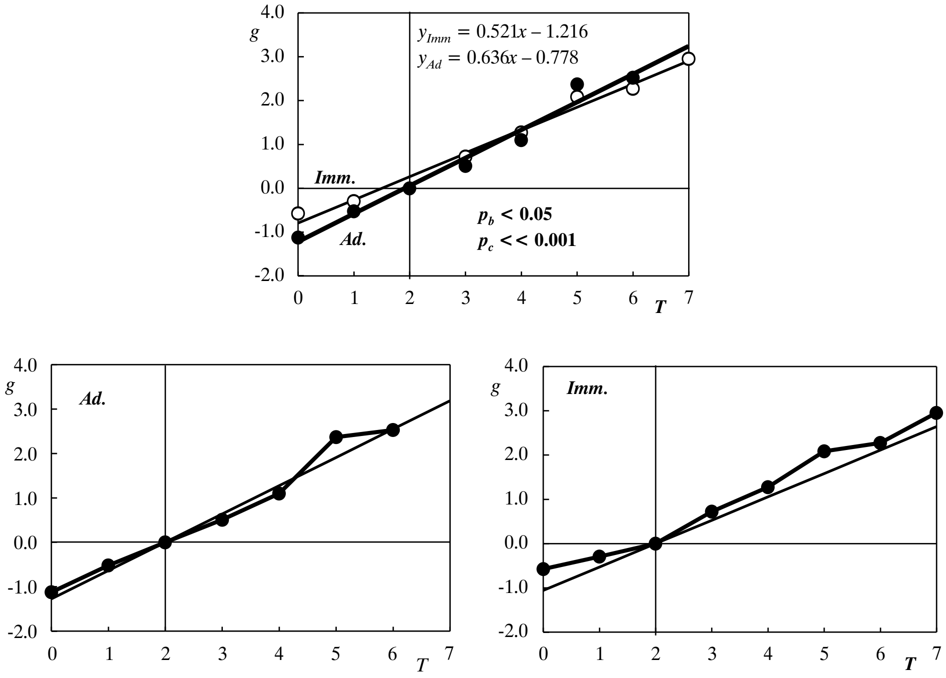


Fig. 3. Analysis of inter-group differentiation of fat-load (c_i in grams) / fat score (*T*) relations when significant difference was found. Lower panels: standardised regression lines for two age groups separately are presented.

scribed using one equation only (Fig. 4, left lower panel). Right lower panel shows the standardised graph obtained by shifting the regression line down as much as it reached co-ordinates (2, 0.0). And this graph is used for presentation on Plate V-1. In that case deviations of c_i-values from the regression line suggest that the fat scores does not fit strictly assumptions of the linear model. Such rough observations will be given in descriptions of species.

THE DATA

The data are presented in a standardised form as a list of species in an alphabetical order by scientific names with some descriptive information arranged in points:

0. the bird species, migratory status on the area studied (***LDm*** – long-distance migrant, ***SDm*** – short-distance migrant, ***Is*** – irruptive species, ***Ws*** – wintering species, ***Ss*** – sedentary species), sample size and the *Appendix* plate(s) number(s) and page number where detailed data and species graphs are given,
1. grouping of the data,
2. the highest and the most common fat scores,
3. rough comment on fitting to the linear model,
4. the body mass difference between T_0 and T_3 and between T_0 and the highest observed here fat scores (T_{max}) expressed as percent of the average body mass of birds scored as T_2 (standard body mass) .

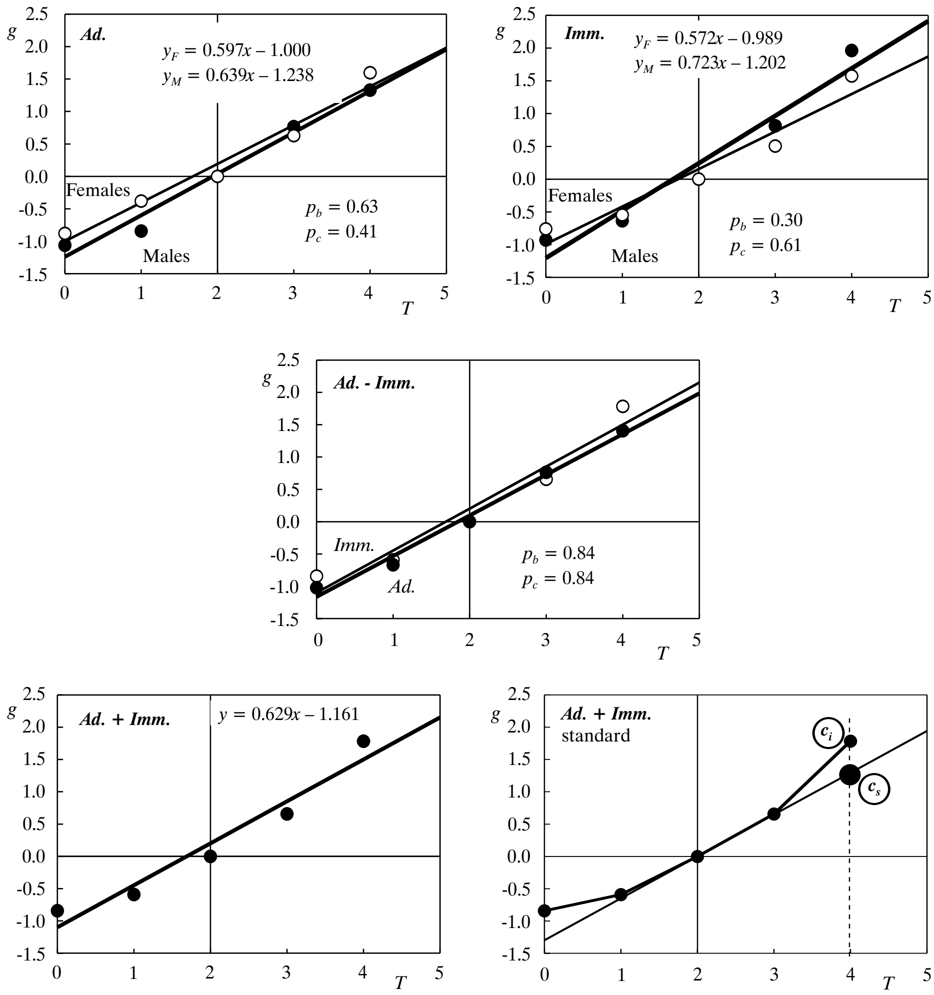


Fig. 4. Analysis of inter-group differentiation of fat-load (c_i in grams) / fat score (T) relations and standardisation procedure.

Upper panels: regression lines for adult birds (males and females) and immatures; regression lines and their equations are given as well as results of t-testing of differences between regression coefficients b and c (p-levels).

Middle panel: as above for combined males and females of adults *versus* combined males and females of immatures.

Lower panels: left – regression line and c_i-values (dots) for a common group including all adults and immatures together; right – standardised regression line (thin – that from the left panel shifted to the point {2, 0.0}); relation between c_i and c_s is shown for T_4 value.

Acrocephalus arundinaceus – Great Reed Warbler (***LDm***, $N = 306$) Plate I-1 (33)

1. The sample size allowed to present the data for immatures only.
2. On the Polish Baltic coast the highest observed fat score was T_5. Over 50% of individuals were scored as T_2 while from other scores T_0 and T_1 were more frequent than T_3-T_5.

3. It seems that the scores do not fit the linear model, so when standardising the body mass for fat, the raw deviations from T_2 (c_i) instead of the linear ones (c_s) should be used.
4. The body mass difference between T_0 and T_3 equalled 10.7% of the standard body mass; the difference between T_0 and the highest enough frequent fat score – T_4 – equalled 18.0%.

Acrocephalus palustris – Marsh Warbler (***LDm***, $N = 519$) Plate I-2 (33)

1. The only one group – immatures – is shown, as adults migrate mainly before the catching season starts.
2. The highest observed fat score was T_5. Although T_3-T_5 scores are noted here, they were found in only 10% of ringed birds. The mode was at T_2.
3. There is slightly curvilinear relation between fat score number and the relative fat load $c_{i.}$
4. The T_0-T_3 difference in the average body mass was 15.5% and the difference between T_0 and T_5 – 30.9%.

Acrocephalus schoenobaenus – Sedge Warbler (***LDm***, $N = 1075$) Plate II-1 (34)

1. Despite of generally big sample size the number of adults caught was to low for elaboration and only immatures are treated here.
2. The highest fat score noted was T_5 while T_0-T_1 dominated over T_3-T_4 scores. The most common was T_2.
3. The c_i-values pattern shows that relation with the score number is a curvilinear one.
4. The average body mass difference between T_0 and T_3 birds was 11.7% and between T_0 and T_5 – 24.2%.

Acrocephalus scirpaceus – Reed Warbler (***LDm***, $N = 9857$) Plate II-2/III-1 (34-35)

1. There were elaborated two age groups of birds – adults and immatures. As regression equation parameters were significantly different ($p_b < 0.05$ and $p_c < 0.001$) both of them are given separately.
2. The highest fat score observed was T_7, but it is scarce here. In both groups the most common fat score observed was T_2 (*ca* 38%), T_0-T_1 were frequent, while birds scored as T_3-T_6 comprised only around 24% individuals in adults and 11% – in immatures.
3. Regression coefficient (b) for adults was higher than the one for immatures. In adults the data fit the linear model well, while for immatures a slight curvature can be seen, so these relations for the species are not clear.
4. The T_0-T_3 difference in the average body mass was 13.3% for adults and slightly lower for immatures (11.0%), while for adults the T_0-T_6 difference equalled 21.8% and for immatures T_0-T_7 – 30.1%.

Aegithalos caudatus – Long-tailed Tit (***Is***, $N = 5705$) Plate III-2/IV-1 (35-36)

1. There are presented two age groups – adults and immatures – as comparison of trends showed differences between them ($p_b < 0.05$).

2. The highest observed fat score was T_4. Distributions of frequencies of fat scores in both groups are similar: the most commonly observed was T_2 – around 55% in adults and 65% in immatures (these are the highest shares of T_2 throughout all studied species). T_3 and T_4 scores were observed only in *ca* 10% of individuals.
3. The distribution of c_i-values for adults is close to linear but in the case of immatures some deviation from the straight line is observed. It is, however, in opposite direction than in all other species showing curvilinearity.
4. The difference in body mass between individuals scored as T_0 and T_3 was as small as 6.3% in immatures and 9.2% in adults. The difference for immatures between T_0 and T_4 equalled 10.9%.

Anthus trivialis – Tree Pipit (***LDm***, $N = 193$) Plate IV-2 (36)

1. Number of adults caught was so low that only immatures could be evaluated.
2. The highest fat score observed was T_4. The most common was T_2, while the share of T_3-T_4 was rather high.
3. The distribution of c_i-values is irregular (T_0 is located higher on graph than T_1) and it can suggest that fat storing in this species (at least at this stage of migration) shows some peculiarities.
4. The difference between body mass of individuals scored as T_0 and T_3 was small (4.8%), while between T_0 and T_{max} (T_4) – quite big (13.6%). This confirms unusual fattening pattern in this species.

Carduelis spinus – Siskin (***SDm***, $N = 1435$) Plate V-1 (37)

1. The analysis started with four sex/age groups (adult males, adult females, immature males and immature females). As there were no significant differences between sexes in regression equation parameters ($p_b = 0.63$, $p_c = 0.41$ for adults and $p_b = 0.30$, $p_c = 0.61$ for immatures), both groups were combined. The same comparison between ages gave similar results – the groups were not different (p_b and p_c equalled 0.84). So, finally one group, containing all individuals is presented here.
2. The maximum fat score reached here was T_5. Still the most common was T_2 score, but number of birds T_3-T_5 scored was bigger than those with T_0-T_1.
3. The c_i-values seem do not fit the linear model well.
4. The T_0-T_3 difference in average body mass was 13.2% and difference T_0-T_5 reached 26.5%.

Certhia brachydactyla – Short-toed Treecreeper (***Ss***, $N = 310$) Plate V-2 (37)

1. A limited number of caught individuals caused combining all birds into one group without former separating of age classes.
2. The highest observed fat score was T_3 only. Numbers of birds scored as T_0, T_1 and T_2 were similar, while T_3 individuals were very rare (*ca* 2%).
3. The c_i-values show high degree of irregularity.
4. The T_0-T_3 difference in body mass was very low (3.7%).

Certhia familiaris – Treecreeper (***SDm***, N = 2003) Plate VI (38)

1. Testing of regression equation parameters did not show differences between adults and immatures (p_b = 0.19), but pronounced variability within adults data caused separate presentation of both age groups.
2. The highest noted score was T_4. Distributions of numbers of adults and immatures classified to subsequent fat scores were differentiated. The most common score in both groups was T_2 (35% of adults, *ca* 50% of immatures), but in adults these with T_1 score were more common than those with T_3 score, while in immatures this relation was inverted.
3. Th c_i-values distribution does not deviate too much from the line in immatures, but in adults this pattern is very irregular.
4. Differences in body mass for birds scored T_0 and T_3 were for adults 4.8% and for immatures – 7.5%. Irregularities in the c_i-values for adults caused that the difference between adults and immatures as to body mass T_0-T_4 was bigger – 4.9% and 10.5%, respectively.

Emberiza citrinella – Yellowhammer (***Ss***, N = 260) Plate VII (39)

1. In this species there was a problem with grouping the birds: because the total number of individuals scored was limited, no sex/age groups were created and all adults were compared with all immatures. No difference was found (p_b = 0.37). Then, all males were compared with all females and highly significant difference was noted (p_b = 0.003).
2. The level of fattening in Yellowhammers is generally low and the highest score found was only T_3. For both sexes distributions of scores is clearly asymmetric with the highest frequency of T_0 score. The T_3 share in males was extremely low.
3. The c_i-values pattern is very different for males and females – very "flat" for males and quite steep for females.
4. In males there was practically no difference in the body mass for birds scored T_0 and T_2 (0.6%) while in females the difference T_0-T_3 was bigger, however still low (6.8%).

Erithacus rubecula – Robin (***SDm***, N = 55 042) Plate VIII/IX-1 (40-41)

1. A big sample size allowed more detailed presentation of the data. There are presented separately age groups – adults and immatures – from two bird stations independently. At both stations for adults and immatures no differences in regression pattern (p_b = 0.87 for Bukowo-Kopań and 0.13 for Mierzeja Wiślana) were found. The comparison of birds from Bukowo-Kopań with these from Mierzeja Wiślana showed that adults migrating through these stations are different (p_b = 0.02) while immatures are quite close to each other (p_b = 0.87). Hence, finally three groups are presented: adults from Bukowo-Kopań, adults from Mierzeja Wiślana and all immatures together. Combining all immatures into one group could be a little bit controversial in light of differences in adults but without detailed studies nothing could be said about causes of this discrepancy.

2. The highest observed fat score in all groups was T_5, however, frequency of T_4-T_5 was very low. The most common score was T_2.
3. The distributions of c_i-values in adults seem to be close to linear, but in immatures a curvature can be visible – because of a huge sample size this may be meaningful.
4. Body mass differences between birds scored as T_0 and T_3 were generally similar (immatures – 11.3%, adults at Bukowo-Kopań – 11.9% and adults at Mierzeja Wiślana – 9.6%) and the same for T_0-T_4 comparison (16.1%, 15.9% and 12.6%, respectively). The peculiarities of values for the adults caught at Mierzeja Wiślana could mean something, but deeper studies should be performed in this respect.

Ficedula hypoleuca – Pied Flycatcher (***LDm***, N = 1976) Plate IX-2/X (41-42)
1. For immature birds both sexes are presented separately as males and females showed different regression coefficient (p_b < 0.05). Due to low sample size all adults were treated together.
2. In all groups the highest observed fat score was T_4. Frequencies of fat scores were similar with a modes at T_2 (*ca* 50% share).
3. The c_i-values pattern is close to linear, but irregular, in adults and slightly curvilinear in both sex groups of immatures.
4. The T_0-T_3 difference in the body mass equalled for adults 13.8%, immature males – 13.5% and immature females – 10.4%, while T_0-T_4 difference – 17.7%, 14.9% and 14.9%, respectively.

Ficedula parva – Red-breasted Flycatcher (***LDm***, N = 107) Plate XI-1 (43)
1. All scored individuals were combined because of low sample size.
2. The highest fat score found was only T_3. The most common was T_1, and T_0 was more frequent than T_2. This is a very special case of extremely low fat load during migration.
3. The c_i-values pattern is very irregular, what can be caused both by unusual fattening regime and low sample size.
4. The T_0-T_3 difference in the body mass was very low and equalled only 6.5%, what is, once again strange for the long-distance migrant.

Fringilla coelebs – Chaffinch (***SDm***, N = 1426) Plate XI-2 (43)
1. The starting division of the data was into four sex/age groups. The comparison of regression coefficients showed differentiation neither between adult males and adult females (p_b = 0.73) nor for immatures (p_b = 0.54). The same result, but with lower p-values, was brought by the comparison of adult and immature males (p_b = 0.19) and adult and immature females (p_b = 0.09). After combining both sexes into age groups – adults and immatures – and once more checking for differentiation the test did not show differences (p_b = 0.15).
2. The highest observed score was T_4, but most individuals migrated with low fat-load – having the most commonly fat scores T_0-T_2 with a mode at T_0 and T_2.

3. The c_i-values deviate from the assumed linear model and some irregularity can be observed. Peculiarity in accumulation and/or using the fat is especially visible for T_0-T_1 and possibly this can cause misscoring of the most lean birds.
4. The body mass difference between T_0-T_3 scored individuals was at rather high level (10.1%), as was the difference between T_0-T_{max} (18.6%).

Fringilla montifringilla – Brambling (***SDm***, N = 153) Plate XII-1 (44)

1. The preparation of the data started from two sexual groups as further age division was impossible due to low sample size of adults. No difference was found in regression coefficients for males and females (p_b = 0.75), so all birds are included into one group.
2. The fat scores distribution is very similar to that of the Chaffinch, and with the same peculiarities. This support a supposition that in this genus fat is managed in a special way or at least the same problems appear during the scoring. The highest score found was T_4 and more common were T_0-T_1 than T_3-T_4 while the mode was at T_2.
3. The c_i-value for T_1 is nearly equal to T_2 (-0.05 g only), what confirms that scoring problems in this species occurs.
4. The body mass differences are again similar to these for the Chaffinch (12.8% for T_0-T_3 and 19.9% for T_0-T_4).

Hippolais icterina – Icterine Warbler (***LDm***, N = 123) Plate XII-2 (44)

1. The only one group – immatures – is presented.
2. Maximal score observed was T_4. Individuals of this species migrate with a low fat level – the most common was T_1 and T_3-T_4 were scarce (less than 10%).
3. The c_i-values show curvilinear distribution.
4. Body mass difference for T_0-T_3 equalled to 9.1% and for T_0-T_4 – 17.6%.

Lanius collurio – Red-backed Shrike (***LDm***, N = 227) Plate XIII-1 (45)

1. Only young birds are presented here.
2. The most common fat score was T_2, the highest observed here – T_4 and lower fat scores T_0-T_1 were more frequent than T_3-T_4.
3. The c_i-values fit the linear model quite well.
4. The T_0-T_3 difference in body mass was 11.9% and for T_0-T_4 it equalled 16.5%.

Locustella naevia – Grasshopper Warbler (***LDm***, N = 147) Plate XIII-2 (45)

1. Only young birds are presented due to the low number of adults.
2. The highest observed score was T_5. The most common – T_3, what is strange in a situation that T_0 and T_1 were much more frequent than T_4-T_5. The low share of T_2 is unusual too.
3. The c_i-values distribution confirms that fat storing/using in this species has its own peculiarity, which can be studied at stations where the species is more common.

4. The T_0-T_3 body mass difference was 11.4% and the observed maximum difference – 24.0%.

Muscicapa striata – Spotted Flycatcher (***LDm***, *N* = 832) Plate XIV-1 (46)

1. Regression coefficients for adults and immatures were not different (p_b = 0.40), thus all individuals were included into one group.
2. The highest score found was T_4. The mode appeared at T_2, while the number of more fatty individuals (T_3-T_4) was bigger than of the lean ones (T_0-T_1).
3. The c_i-values pattern suggests that the relation of the fat load and number of the score is not linear.
4. The T_0-T_3 body mass difference was 9.4% and T_0-T_4 – as big as 19.8%.

Parus ater – Coal Tit (***Is***, *N* = 5266) Plate XIV-2 (46)

1. After finding no statistical differences for adults and immatures (p_b = 0.31) both groups were combined.
2. The maximum score found was T_5 but the T_2 score dominated very much (45% of all individuals scored). Lean individuals (T_0-T_1) were more numerous than fatty ones (T_3-T_5).
3. The c_i-values pattern is not very clear.
4. Differences in the body mass: T_0-T_3 and T_0-T_5 were rather low (5.4% and 11.5%, respectively).

Parus caeruleus – Blue Tit (***SDm***, *N* = 17 244) Plate XV (47)

1. The starting division of the data was into four sex/age groups. Adult males did not differ from adult females (p_b = 0.35) and the same for immatures (p_b = 0.19), while adults differed from immatures as a whole (p_b = 0.01). Looking more deeply, there were significant differences between adult and immature females (p_b = 0.008) and not between adult and immature males (p_b = 0.18). As this seems to be a problem for even more detailed studies, at this level of generalisation two groups – adults and immatures – are presented.
2. The highest observed fat score here was T_5, but high scores T_4-T_5 were found in as few as *ca* 2% of individuals. The mode in both groups was clearly at T_2 and lean birds were more frequent than fatty ones.
3. The c_i-values show distribution close to linear.
4. The body mass difference between T_0-T_3 was similar for adults and immatures (5.9% and 6.5%, respectively). The T_0-T_4 difference for adults was still rather low (8.0%) while the T_0-T_5 difference for immatures was higher (12.9%).

Parus cristatus – Crested Tit (***Ss***, *N* = 169) Plate XVI-1 (48)

1. One combined group is presented due to low sample size.
2. In this species the highest score found was T_3 and it was represented only by *ca* 4% of individuals. The mode appeared at T_1, while T_0 and T_2 were represented by similar numbers of birds.

3. The c_i-values are distributed very irregularly.
4. The body mass averages between T_0-T_3 differed very little (2.7%)

Parus major – Great Tit (***SDm***, N = 25 713) Plate XVI-2/XVII-1 (48-49)

1. Big amount of the data allowed to start study with not only sex/age division, but also to do this separately for both ringing stations – Bukowo-Kopań and Mierzeja Wiślana. At the beginning, the comparison of regression coefficients between sexes in adults did not show differences at both stations (p_b = 0.38 for Bukowo-Kopań and 0.42 for Mierzeja Wiślana). The same for immatures (p_b = 0.74 for Bukowo-Kopań, but only 0.09 for Mierzeja Wiślana). Comparisons of adults scored at two stations gave a border significance (p_b = 0.06) while immatures differed significantly (p_b = 0.01). As it was suspected that Great Tits caught at two stations are not statistically the same, internal differentiation between age groups at stations was checked. The differences between adults and immatures within stations were not found (p_b = 0.12 at Bukowo-Kopań and 0.97 at Mierzeja Wiślana). Thus, finally, birds from two stations are presented separately.
2. The highest observed score was at both stations T_5 and modes were the same (T_2). However, at Bukowo-Kopań the share of T_1 birds was much higher than at Mierzeja Wiślana.
3. The c_i-values for Mierzeja Wiślana seem to follow exactly linear model while for Bukowo-Kopań it is not so clear.
4. The T_0-T_3 and T_0-T_5 differences in the body mass were higher at Mierzeja Wiślana (9.0% and 16.3%, respectively) than at Bukowo-Kopań (6.0% and 13.7%, respectively).

Parus montanus – Willow Tit (***Ws***, N = 1861) Plate XVII-2 (49)

1. Two age groups were taken under consideration, but they were not different (p_b = 0.78), so the group representing all birds together is given.
2. The highest observed fat score was T_3, but it was represented by a very low number of individuals (1.5%). Scores T_0-T_2 were observed in nearly equal numbers.
3. The distribution of c_i-values is rather unusual, as curvature, if any, is in opposite direction than in other species.
4. The difference in body mass between T_0 and T_3 was small (3.5%).

Parus palustris – Marsh Tit (***Ss***, N = 453) Plate XVIII-1 (50)

1. The only one group contains both age groups.
2. The highest observed score was T_3 and it was very scarce (1.3%), while the most common was T_0.
3. The distribution of c_i-values is very irregular.
4. The difference in body mass of birds scored as T_0 and T_3 was small (4.9%).

Phoenicurus phoenicurus – Redstart (***LDm***, N = 3037) Plate XVIII-2 (50)

1. Four sex/age groups were studied at the starting point. Regression coefficients for males and females, both adult and immatures, were not different (p_b = 0.20 and p_b = 0.70, respectively). All adults had not different coefficient from all immatures (p_b = 0.83) and comparisons done for adult and immature males and for adult and immature females did not show differences (p_b = 0.88 and p_b = 0.25, respectively). Thus, all individuals are included into one common group.
2. The highest fat score observed was T_4. The mode was clearly T_2 (over 50%) and next nearly equal numbers of birds had scores T_1 and T_3 (around 17%), while T_4 was rare.
3. The c_i-values are located on the graph in a curvilinear pattern.
4. The body mass difference between T_0 and T_3 individuals equalled 12.4%, while between T_0 and T_4 – 20.8%.

Phylloscopus collybita – Chiffchaff (***SDm***, N = 1186) Plate XIX-1 (51)

1. Adults and immatures were not different as to regression coefficient (p_b = 0.61), thus they are included into one group.
2. The highest, but rarely observed, score was T_5. The mode was at T_2 and more birds showed T_0-T_1 than scores above T_2.
3. The c_i-values distribution is not clear as to its linearity.
4. The body mass difference between T_0 and T_3 equalled 11.8% and between T_0 and T_5 – 20.7%.

Phylloscopus sibilatrix – Wood Warbler (***LDm***, N = 165) Plate XIX-2 (51)

1. Adult birds were rare and only immatures were included into calculations.
2. The highest score was T_5 and the mode – T_2, but in this species the T_3 score was more common than lowest scores T_0-T_1, unlike in many other species.
3. Linearity of the c_i-values distribution is not clear.
4. The difference of the body mass between T_0 and T_3 equalled 12.2%, while between T_0 and T_4 – 17.3%.

Phylloscopus trochilus – Willow Warbler (***LDm***, N = 5778) Plate XX-1 (52)

1. Adults and immatures were not different as to regression coefficient (p_b = 0.38), so all individuals are included into one group.
2. The highest score was T_5, but it was very rare (0.8%). The mode appeared at T_2 and T_3-T_4 were more ferquent than T_0-T_1.
3. The distribution of c_i-values is clearly curvilinear.
4. The body mass difference T_0-T_3 equalled 11.1% and T_0-T_5 was high (27.4%).

Prunella modularis – Dunnock (***SDm***, N = 559) Plate XX-2 (52)

1. The starting division of the data was into age groups, but they were not different (p_b = 0.81), thus all birds were included into one group.
2. The most fatty birds reached T_4. The mode was T_2 and T_0-T_1 birds were more common than T_3-T_4.

3. The c_i-values slightly deviate from linear distribution.
4. The body mass difference T_0-T_3 was 8.5%, while T_0-T_4 – 13.4%.

Pyrrhula pyrrhula – Bullfinch (***SDm***, N = 566) Plate XXI (53)

1. As adults were not numerous they were treated as one group, while immatures were divided into two sex groups. Immature males and females were not different (p_b = 0.20), thus combined into one group. Final comparison between adults and immatures showed p_b = 0.06. These groups are presented separately, however some similarities are visible (see point 2), but there are clear differences too (see point 4).
2. The highest observed score was T_4 and distribution of frequencies of scores is very similar between age groups: the mode is T_2 and there is more birds with T_0-T_1 than T_3-T_4.
3. Regression graphs show irregular patterns in the c_i-values distribution.
4. Although the T_0-T_3 differences were similar (5.3% in adults and 6.4% in immatures), the irregularities in fattening are confirmed when one compares difference in the body mass of birds scored as T_0 and T_4: in adults the difference was only 5.5% while for immatures – twice as much (13.7%).

Regulus regulus – Goldcrest (***SDm***, N = 96 021) Plate XXII-1 (54)

1. Because of a huge data set birds caught at two ringing stations were studied separately, starting with four sex/age groups for each station. Adult males and females seem to be not different enough to separate these groups (for Bukowo-Kopań: p_b = 0.07, but for Mierzeja Wiślana – 0.36). Adults from both stations were not different (p_b = 0.44). In immatures the pattern for sex groups was similar (for Bukowo-Kopań: p_b = 0.12 and for Mierzeja Wiślana – 0.73). Young birds passing two stations were similar too: p_b = 0.89. Because adults were not different from immatures (p_b = 0.63), the common presentation is done.
2. The highest fat score was T_5, but it was not numerous – 1.9% only. The commonest scores were T_2 and T_3 with very similar share. Next T_1 and T_4 had nearly the same numbers.
3. The c_i-values lie almost exactly in a straight line.
4. The difference of the body mass between T_0-T_3 was rather high (13.4%) as well as T_0-T_5 – (22.7%).

Sylvia atricapilla – Blackcap (***LDm***, N = 4107) Plate XXII-2/XXIII (54-55)

1. As the starting point for looking at the sex/age differentiation in regression coefficients there were four sex/age groups. Within sex groups some differentiation is visible: within males both age groups seems to be different quite clearly (p_b = 0.02) and similarly within females (p_b = 0.05). Adult males and adult females seem not to be different in this respect (p_b = 0.22). However, immatures show some differentiation (p_b = 0.07). Finally, because of this complicated pattern, three groups are presented here: adults, immature males and immature females.

2. In all groups the highest observed fat score was T_5, but in adults this score was rarer (3.0%) than in immatures (5.6 in males and 7.2% in females). In all groups the mode was T_2, but in adults T_0 and T_1 scores were much more frequent than in immatures (in adults – 21.6 and 25.1%, in immature males – 9.2 and 17.0%, in immature females – 11.2 and 15.4%, respectively). T_3 in adults was less frequent than in immatures.
3. In immatures the c_i-values lie quite close to the regression line while in adults T_1 scoring seems to be not exact.
4. The T_0-T_3 difference was the lowest for adults (8.6%) while for immature males – 12.3% and for immature females – 17.2%. The T_0-T_4 body mass difference was in adults still rather low (11.2%) while in immatures for T_0-T_5 it was twice as much (males – 22.7% and females – 28.2%). This can be the result of migration strategy differentiation and seems to be an interesting problem for next, detailed studies.

Sylvia borin – Garden Warbler (***LDm***, *N* = 2454) Plate XXIV (56)

1. Age groups are formally not different as to regression coefficient (p_b = 0.27), however, because of some differences found in details, age groups are presented separately.
2. In both groups the highest observed score was T_6, but the number of so fatty individuals was low (*ca* 1%). In both groups the mode appeared at T_2, but in adults the share of less fatty birds (T_1) was higher than in immatures.
3. The c_i-values distribution seems to be a quasi-linear in immatures, but irregular in adults. However, the latter could result from lower number of adult birds scored.
4. The body mass differences seem to be higher in immatures (similarly as in Blackcap) – T_0-T_3 equalled 12.2% in adults and 17.7% in immatures, and T_0-T_{max} in immatures reached as much as 37.2% of the T_2 body mass while in adults it was only 14.8%.

Sylvia communis – Whitethroat (***LDm***, *N* = 534) Plate XXV-1 (57)

1. Adults were not different from immatures (p_b = 0.44), so all birds were joined together into one presented group.
2. Maximum observed fat score was T_5, the commonest – T_2, and next as to the share – T_1.
3. Border c_i-values deviate from the line suggesting non-linear pattern.
4. The T_0-T_3 difference in body mass was 8.1% and that for T_0-T_5 – 19.2%.

Sylvia curruca – Lesser Whitethroat (***LDm***, *N* = 1113) Plate XXV-2/XXVI-1 (57-58)

1. Differentiation between adults and immatures is at the border of significance level (p_b = 0.07), so two age groups are presented separately.
2. The highest observed fat scores were in both groups T_5 and in both groups they were similarly scarce (less than 2%). Modes were the same (T_2) and distributions of frequencies are similar with more lean birds than the fatty ones.

3. The c_i-values distribution in adults is more irregular than in immatures, where it shows a slight curvature.
4. The body mass differences between T_0-T_3 were similar in both groups (10.4% in adults and 11.2% in immatures) but in immatures the T_0-T_5 difference reached as much as 24.1% while in adults it was only 12.6% (for T_0-T_4).

Sylvia nisoria – Barred Warbler (***LDm***, *N* = 62) Plate XXVI-2 (58)

1. The number of scored individuals was low, but the special pattern observed in frequency distribution was very interesting to present it.
2. The highest score was T_6, the mode appeared at T_2, but a very low number of T_0-T_1 scores was observed (only around 10%), so the Barred Warbler seems to migrate through the area applying quite unusual migration strategy, typical rather for birds crossing big barriers (with high fat load).
3. Because of the mentioned untypical pattern of scores frequency, the observed c_i-values could be calculated for a limited number of scores. At this area they are distributed close to a straight line.
4. Because of the above a comparable body mass values cannot be given.

Troglodytes troglodytes – Wren (***SDm***, *N* = 921) Plate XXVII-1 (59)

1. As there was no significant difference between adults and immatures both groups were joined.
2. Maximum fat score found was T_5, however, scores T_4-T_5 were not numerous (2.1 and 1.2%, respectively).The mode was at T_2.
3. The c_i-values for lower scores lie close to the straight line but T_4 and T_5 values deviated, possibly because of rather low sample sizes.
4. The body mass difference between T_0-T_3 was 6.3% and for T_0-T_5 – 16.3%.

SUMMARY AND COMMENTS TO THE RESULTS

As the main goal of the paper is to make accessible some basic data about the results of fat scoring at one defined area and stage of migration, results will not be discussed in detail but summarised and commented to a limited extent. Tables 2-6 contain results grouped by a characteristic of migratory habits: long-distance migrants, short-distance migrants, irruptive species, wintering species and sedentary birds. The results for these groups are summarised below:

1. Long-distance migrants (19 species)
   - In most of species the highest fat score observed at the studied area was T_5. However in the Reed Warbler it reached T_7 and in the Garden and Barred Warblers – T_6, while in the Red-breasted Flycatcher – T_3 only and in the Spotted Flycatcher, Pied Flycatcher, Tree Pipit, Icterine Warbler, Red-backed Shrike, Redstart – T_4. The differences in maximal fat score between adults and immatures (except for the Spotted Flycatcher) as well as between males and females were not found.
   - The most common fat score was typically T_2 and next – T_3.

- Regression coefficients (*b*) were usually higher for immatures than for adults, but in the Reed Warbler and the Pied Flycatcher there was opposite.
- The distribution of c_i-values in relation to regression lines suggests that in most cases there is a curvilinear relation rather than the linear one. However, there are a few examples that the linear relation could be accepted. In some species pronounced irregularities can be observed.
- The body mass differences between birds scored as T_0 and T_3 varied from 4.8% (in immature Tree Pipits) to 17.7% (in immature Garden Warblers). In species where age groups were separated, in some cases the difference in adults was bigger, but in others oppositely. On average, the T_0-T_3 body mass difference for this group of migrants equalled 11.25%. The T_0-T_{max} differences were variable too (6.5-37.2%), 19.68% on average.

2. Short-distance migrants (12 species)
   - These birds were scored maximally for T_4 or T_5 – the same in adults and immatures (except for the Chiffchaff and Wren). There were no differences between sexes.
   - The most common score was T_2 but next were typically T_0 and T_1 and not T_3 as in the long-distance migrants.
   - Regression coefficients (*b*) were usually higher for immatures than for adults, but in the Dunnock and the Goldcrest there was opposite.
   - The distribution of c_i-values in relation to regression lines suggests in most cases that there is a curvilinear relation rather than the linear one (except for Goldcrests, adult Robins, Blue Tits and Great Tits from Mierzeja Wiślana). In some species some irregularities were clearly visible (Chaffinch, Brambling and Bullfinch).
   - The T_0-T_3 differences in body mass ranged from 4.8% (in the Treecreeper) to 14.5% (in the Siskin), equalling 8.98% on average – a little bit lower than in the long-distance migrants. Differences between T_0-T_{max} were on average higher – 14.22% (4.9-26.8%), but lower than in the long-distance migrants too.
3. Irruptive species (2 species)
   - The highest fat score observed in this group was T_5 (in immature Coal Tits), but in adult Coal Tits and in the Long-tailed Tit maximal score was T_4.
   - The most common score was T_2 and T_0-T_1 were the next.
   - Regression coefficient (*b*) was higher for immature than for adult Long-tailed Tits, but in the Coal Tit there was opposite.
   - The c_i-values are distributed along the curvilinear line in both species.
   - The T_0-T_3 body mass differences were small – from 5.4 to 9.2%, 7.35% on average. The same for T_0-T_{max} – 6.3-11.5%, 9.23% on average.
4. Wintering species (1 species)
   - The highest observed fat score for both age groups of the Willow Tit – the only species belonging to this group – was T_3.
   - The most common fat score was T_0, in contrast to species being on migration.
   - The c_i-values are distributed curvilinearly.

- The T_0-T_3 body mass difference was very small: T_0-T_3 (*imm.*) – 3.6% and T_0-T_2 (*ad.*) – 2.8%.

5. Sedentary species (4 species)
   - In all species the highest observed score was T_3 and this was the case in all sex and age groups.
   - The most common scores were T_0 and T_1, the rarest – T_3.
   - The c_i-values are distributed irregularly, except for female Yellowhammers, where the relation is curvilinear.
   - Body mass differences were very small: T_0-T_3 (T_0-T_{max}) – from 0.6% in male Yellowhammers to 6.8% in female Yellowhammers, 3.74% on average for the whole group.

Table 2
Maximal fat scores for age groups in different species

Long-distance migrants

	Adultus	*Immaturus*
Acrocephalus arundinaceus	–	T_5
Acrocephalus palustris	–	T_5
Acrocephalus schoenobaenus	–	T_5
Acrocephalus scirpaceus	T_7	T_7
Anthus trivialis	–	T_4
Ficedula hypoleuca	T_4	T_4
Ficedula parva	–	T_3
Hippolais icterina	–	T_4
Lanius collurio	–	T_4
Locustella naevia	–	T_5
Muscicapa striata	T_3	T_4
Phoenicurus phoenicurus	T_4	T_4
Phylloscopus trochilus	T_5	T_5
Phylloscopus sibilatrix	–	T_5
Sylvia atricapilla	T_5	T_5
Sylvia borin	T_6	T_6
Sylvia communis	T_5	T_5
Sylvia curruca	T_5	T_5
Sylvia nisoria	–	T_6

Short-distance migrants

	Adultus	*Immaturus*
Carduelis spinus	T_5	T_5
Certhia familiaris	T_4	T_4
Erithacus rubecula	T_5	T_5
Fringilla coelebs	T_4	T_4
Fringilla montifringilla	T_4	T_4
Parus caeruleus	T_5	T_5
Parus major	T_5	T_5
Phylloscopus collybita	T_4	T_5
Prunella modularis	T_4	T_4
Pyrrhula pyrrhula	T_4	T_4
Regulus regulus	T_5	T_5
Troglodytes troglodytes	T_3	T_5

Irruptive species

	Adultus	*Immaturus*
Aegithalos caudatus	T_4	T_4
Parus ater	T_4	T_5

Wintering species

	Adultus	*Immaturus*
Parus montanus	T_3	T_3

Sedentary species

	Adultus	*Immaturus*
Certhia brachydactyla	T_3	T_3
Emberiza citrinella	T_3	T_3
Parus cristatus	T_3	T_3
Parus palustris	T_3	T_3

Table 3
Maximal fat scores for sex groups in different species.
BK – Bukowo-Kopań, MW – Mierzeja Wiślana.

Long-distance migrants

	♂♂	♀♀
Ficedula hypoleuca – imm.	T_4	T_4
Phoenicurus phoenicurus	T_4	T_4
Sylvia atricapilla – ad.	T_5	T_5
Sylvia atricapilla – imm.	T_5	T_5

Short-distance migrants

	♂♂	♀♀
Carduelis spinus	T_5	T_5
Fringilla coelebs	T_4	T_4
Fringilla montifringilla	T_4	T_4
Parus caeruleus	T_5	T_5
Parus major – BK	T_5	T_5
Parus major – MW	T_5	T_5
Pyrrhula pyrrhula – imm.	T_4	T_4
Regulus regulus – BK	T_5	T_5
Regulus regulus – MW	T_5	T_5

Sedentary species

	♂♂	♀♀
Emberiza citrinella	T_3	T_3

Table 4
Regression coefficients (b) for T / c_i relation for age groups in different species.
BK – Bukowo-Kopań, MW – Mierzeja Wiślana.

Long-distance migrants

	Adultus	*Immaturus*
Acrocephalus arundinaceus	–	1.28
Acrocephalus palustris	–	0.76
Acrocephalus schoenobaenus	–	0.58
Acrocephalus scirpaceus	0.64	0.53
Anthus trivialis	–	0.72
Ficedula hypoleuca	0.57	0.53
Ficedula parva	–	0.04
Hippolais icterina	–	0.57
Lanius collurio	–	1.18
Locustella naevia	–	0.63
Muscicapa striata	0.65	0.75
Phoenicurus phoenicurus	0.70	0.73
Phylloscopus trochilus	0.39	0.46
Phylloscopus sibilatrix	–	0.41
Sylvia atricapilla	0.62	0.95
Sylvia borin	0.74	1.22
Sylvia communis	0.46	0.58
Sylvia curruca	0.40	0.56
Sylvia nisoria	1.49	
Average	**0.575**	**0.701**

Short-distance migrants

	Adultus	*Immaturus*
Carduelis spinus	0.63	0.65
Certhia familiaris	0.15	0.24
Erithacus rubecula	0.54	0.62
Fringilla coelebs	0.63	0.81
Fringilla montifringilla	0.99	
Parus caeruleus	0.20	0.28
Parus major – BK	0.35	0.45
Parus major – MW	0.56	0.56
Phylloscopus collybita	0.30	0.33
Prunella modularis	0.65	0.58
Pyrrhula pyrrhula	0.50	0.98
Regulus regulus	0.25	0.24
Troglodytes troglodytes	0.15	0.26
Average	**0.409**	**0.472**

Irruptive species

	Adultus	*Immaturus*
Aegithalos caudatus	0.18	0.24
Parus ater	0.24	0.19

Wintering species

	Adultus	*Immaturus*
Parus montanus	0.16	0.12

Sedentary species

	Adultus	*Immaturus*
Certhia brachydactyla	0.06	
Emberiza citrinella	0.40	0.57
Parus cristatus	0.09	
Parus palustris	0.17	

Table 5

Regression coefficients (b) for T / c_i relation for sex groups in different species. BK – Bukowo-Kopań, MW – Mierzeja Wiślana.

Long-distance migrants

	♂♂	♀♀
Ficedula hypoleuca – imm.	0.60	0.46
Phoenicurus phoenicurus	0.68	0.76
Sylvia atricapilla – ad.	0.52	0.74
Sylvia atricapilla – imm.	0.87	1.04
Average	**0.667**	**0.750**

Short-distance migrants

	♂♂	♀♀
Carduelis spinus	0.71	0.58
Fringilla coelebs	0.76	0.71
Fringilla montifringilla	1.15	1.04
Parus caeruleus	0.26	0.31
Parus major – BK	0.43	0.46
Parus major – MW	0.61	0.52
Pyrrhula pyrrhula – imm.	0.76	1.15
Regulus regulus – BK	0.24	0.22
Regulus regulus – MW	0.23	0.24
Average	**0.573**	**0.580**

Sedentary species

	♂♂	♀♀
Emberiza citrinella	0.09	0.69

Table 6
Percent differences (in relation to T_2 weight) between T_0 and T_3 as well as between T_0 and T_{max} in age groups.
BK – Bukowo-Kopań, MW – Mierzeja Wiślana.

Long-distance migrants

	Mode	T_0-T_3		T_0-T_{max}	
		Ad.	*Imm.*	*Ad.*	*Imm.*
Acrocephalus arundinaceus	T_2 (51.3%)	–	10.7	–	18.0 (T_4)
Acrocephalus palustris	T_2 (38.9%)	–	15.5	–	30.9 (T_5)
Acrocephalus schoenobaenus	T_2 (42.4%)	–	11.7	–	24.2 (T_5)
Acrocephalus scirpaceus	T_2 (38.0%)	13.3	11.0	21.8 (T_6)	30.1 (T_7)
Anthus trivialis	T_2 (30.6%)	–	4.8	–	13.6 (T_4)
Ficedula hypoleuca – ♂♂	T_2 (46.2%)	13.8	13.6	17.7 (T_4)	19.5 (T_4)
Ficedula hypoleuca – ♀♀	T_2 (45.1%)		10.4		14.9 (T_4)
Ficedula parva	T_1 (37.4%)	6.5		6.5 (T_3)	
Hippolais icterina	T_1 (39.0%)	–	9.1	–	17.6 (T_4)
Lanius collurio	T_2 (33.9%)	–	11.9	–	16.5 (T_4)
Locustella naevia	T_3 (27.9%)	–	11.4	–	24.0 (T_5)
Muscicapa striata	T_2 (47.8%)	12.8	11.3	12.8 (T_4)	19.9 (T_4)
Phoenicurus phoenicurus	T_2 (51.7%)	11.4	12.5	19.8 (T_4)	20.9 (T_4)
Phylloscopus trochilus	T_2 (39.7%)	12.4	11.0	19.2 (T_4)	27.3 (T_5)
Phylloscopus sibilatrix	T_2 (42.4%)	–	12.2	–	17.3 (T_4)
Sylvia atricapilla – ♂♂	T_2 (39.3%)	8.6	12.3	11.2 (T_4)	22.7 (T_5)
Sylvia atricapilla – ♀♀	T_2 (33.5%)		17.2		28.2 (T_5)
Sylvia borin	T_2 (36.5%)	12.2	17.7	14.8 (T_4+T_5)	37.2 (T_6)
Sylvia communis	T_2 (33.5%)	3.4	8.6	9.8 (T_4)	19.3 (T_5)
Sylvia curruca	T_2 (41.8%)	10.4	11.2	12.6 (T_4)	24.1 (T_5)
Sylvia nisoria	T_2 (25.8%)	8.7		17.9	
Average		**11.25**		**19.68**	

Short-distance migrants

	Mode	T_0-T_3		T_0-T_{max}	
		Ad.	*Imm.*	*Ad.*	*Imm.*
Carduelis spinus	T_2 (38.6%)	14.5	12.6	19.6 (T_4)	26.8 (T_5)
Certhia familiaris	T_2 (43.3%)	4.8	7.4	4.9 (T_4)	10.5 (T_4)
Erithacus rubecula – BK	T_2 (46.0%)	11.9	11.3	15.9 (T_4)	16.1 (T_4)
Erithacus rubecula – MW	T_2 (42.2%)	9.6		12.6 (T_4)	
Fringilla coelebs	T_2 (32.7%)	6.9	12.3	13.3 (T_4)	15.5 (T_4)
Fringilla montifringilla	T_2 (32.7%)	12.8		19.9 (T_4)	
Parus caeruleus	T_2 (40.5%)	5.9	6.5	8.0 (T_4)	12.9 (T_5)
Parus major – BK	T_2 (41.0%)	6.0		13.7 (T_5)	
Parus major – MW	T_2 (48.6%)	9.0		16.3 (T_5)	
Phylloscopus collybita	T_2 (29.2%)	8.3	12.1	16.3 (T_4)	20.7 (T_5)
Prunella modularis	T_2 (42.4%)	12.3	8.1	12.3 (T_3)	13.3 (T_4)
Pyrrhula pyrrhula	T_2 (49.8%)	5.3	6.4	5.5 (T_4)	13.7 (T_4)
Regulus regulus	T_2 (34.2%)	12.2	13.1	22.7 (T_5)	22.7 (T_5)
Troglodytes troglodytes	T_2 (42.1%)	5.2	6.4	5.2 (T_3)	16.3 (T_5)
Average		**8.98**		**14.22**	

Irruptive species

	Mode	T_0-T_3		T_0-T_{max}	
		Ad.	*Imm.*	*Ad.*	*Imm.*
Aegithalos caudatus	T_2 (59.2%)	6.3	9.2	6.3 (T_3)	10.9 (T_4)
Parus ater	T_2 (48.5%)	8.2	5.4	8.2 (T_3)	11.5 (T_5)
Average		**7.35**		**9.23**	

Wintering species

	Mode	T_0-T_3		T_0-T_{max}	
		Ad.	*Imm.*	*Ad.*	*Imm.*
Parus montanus	T_0 (34.5%)	2.8(T_2)	3.6	2.8 (T_2)	3.6 (T_3)

Sedentary species

	Mode	T_0-T_3		T_0-T_{max}	
		Ad.	*Imm.*	*Ad.*	*Imm.*
Certhia brachydactyla	T_1 (36.8%)	3.7		3.7 (T_3)	
Emberiza citrinella – ♂♂	T_0 (52.3%)	0.6 (T_2)		0.6 (T_2)	
Emberiza citrinella – ♀♀	T_0 (38.5%)	6.8		6.8 (T_3)	
Parus cristatus	T_1 (42.6%)	2.7		2.7 (T_3)	
Parus palustris	T_0 (40.6%)	4.9		4.9 (T_3)	
Average		**3.74**		**3.74**	

Table 7
Percent differences (in relation to T_2 weight) between T_0 and T_3
as well as between T_0 and T_{max} in age groups.
BK – Bukowo-Kopań, MW – Mierzeja Wiślana.

Long-distance migrants

	Mode	T_0-T_3		T_0-T_{max}	
		♂♂	♀♀	♂♂	♀♀
Ficedula hypoleuca – imm.	T_2	13.6	10.4	19.5 (T_4)	14.9 (T_4)
Phoenicurus phoenicurus	T_2	11.7	9.6	19.5 (T_4)	21.9 (T_4)
Sylvia atricapilla – ad.	T_2	6.9	10.0	8.6 (T_4)	14.4 (T_4)
Sylvia atricapilla – imm.	T_2	12.3	17.2	22.7 (T_5)	28.2 (T_5)

Short-distance migrants

	Mode	T_0-T_3		T_0-T_{max}	
		♂♂	♀♀	♂♂	♀♀
Carduelis spinus	T_2	15.0	11.1	22.4 (T_4)	20.0 (T_4)
Fringilla coelebs	T_2	5.9	9.7	9.9 (T_4)	13.8 (T_4)
Fringilla montifringilla	T_2	10.0	14.4	24.8 (T_4)	19.2 (T_4)
Parus caeruleus	T_2	6.3	6.6	9.5 (T_4)	15.9 (T_4)
Parus major – BK	T_2	5.8	6.1	13.0 (T_5)	15.3 (T_5)
Parus major – MW	T_2	9.5	9.7	17.8 (T_5)	15.1 (T_5)
Pyrrhula pyrrhula – imm.	T_2	4.5	8.8	11.6 (T_4)	15.7 (T_4)
Regulus regulus – BK	T_2	11.6	12.0	18.1 (T_5)	19.9 (T_5)
Regulus regulus – MW	T_2	12.6	13.4	21.4 (T_5)	22.2 (T_5)

Sedentary species

	Mode	T_0-T_3		T_0-T_{max}	
		♂♂	♀♀	♂♂	♀♀
Emberiza citrinella	T_0	0.6 (T_2)	6.8	0.6 (T_2)	6.8 (T_3)

The maximum fat score observed at the southern Baltic coast is T_7, but it is extremely rare. The most common in migratory species is T_2. For long-distance migrants higher scores (T_3-T_5) are more frequent than T_0-T_1, as opposed to other groups. In most species immature birds show higher values of the regression coefficient than adults. Most of the groups show curvilinear dependence of c_i-values on fat score number, but this is demonstrated with variable degree of distinctness in different species and sex/age groups. Some relations are irregular, especially in not clearly migratory species. The body mass differences between birds scored as T_0 and

T_3 are the highest for long-distance migrants and the lowest for wintering and sedentary species.

There are many detailed peculiarities of fat scoring in different species and sex/age groups and these should be studied separately when data from different territories will be available for comparisons. This seems to be promising field of studies in programmes conducted on a big scale.

REFERENCES

Bairlein F. (Ed.). 1995. *Manual of Field Methods.* European-African Bird Migration Network, Wilhelmshaven.

Berthold P. 1993. *Bird migration.* Oxford Univ. Press, Oxford – New York – Tokyo.

Blumental T.I. 1967. *Changes in energetical reserves (body lipids) and their relationship to migration in some Passerines at Kurische Nehrung.* Migracii Ptic Pribaltiki, Leningrad: 164-202.

Blumental T.I., Dolnik V.R. 1962. *Ocenka energeticeskich pokazatielej ptic w polevych usloviach.* Ornitologia 4: 394-407. (In Russian).

Busse P. 1970. *Measurements of weight and fatness in migrating populations of birds.* Not. Orn. 11, 1: 1-15.

Busse P. 1976. *The Spring Migration of Birds at the East Part of Polish Baltic Coast.* Acta zool. Crac. 21, 6: 121-262.

Busse P. 1984. *Key to sexing and ageing of European Passerines.* Beitr. Naturk. Niedersachsens 37, Sonderheft: 1-224.

Busse P. 2000. *Bird Station Manual.* SE European Bird Migration Network, Gdańsk.

Busse P., Kania W. 1970. *Operation Baltic. Methods of work.* Acta orn. 12, 7: 231-267.

Dolnik V.R. 1967a. *On the relationship of fat deposition and migration.* Migracii Ptic Pribaltiki, Leningrad: 96-114.

Dolnik V.R. 1967b. *Annual cycles of the bioenergetical adaptations for life condition in some Passerines.* Migracii Ptic Pribaltiki, Leningrad: 115-163.

Dolnik V.R., Blumental T.I. 1964. *Bioenergetika migracii ptic.* Uspechy Sovremiennoj Biologii 58, 2 (5): 200-301. (In Russian).

Helms C.W., Drury W.H.Jr. 1960. *Winter and migratory weight and fat studies in some North American buntings.* Bird Band. 31, 1: 1-40.

Kaiser A. 1993. *A new multi-category classification of subcutaneous fat deposits of songbirds.* J. Field Ornithol. 64, 2: 246-255.

Kędzior K. 2002. *Stop-over migrant Blackcaps (Sylvia atricapilla) on autumn passage through the Polish Baltic coast.* Ring 24, 2: 31-47.

McCabe T.T. 1943. *An aspect of collectors technique.* Auk 60: 550-558.

Wolfson A. 1945. *The role of pituitary, fat deposition and body weight in bird migration.* Condor 47: 95-127.

Zakala O., Shydlovsky I., Busse P. 2004. *Variation of body-mass and fat reserves of the Sedge Warbler (Acrocephalus schoenobaenus) on autumn migration in the Lviv province, Ukraine.* Ring 26, 2: 55-69.

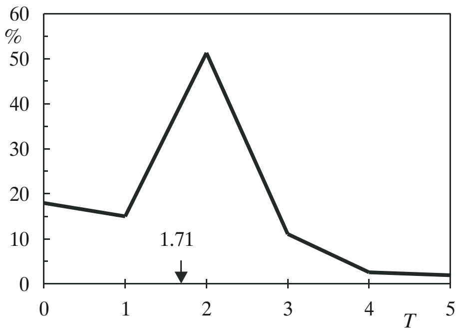
APPENDIX

Explanations to plates

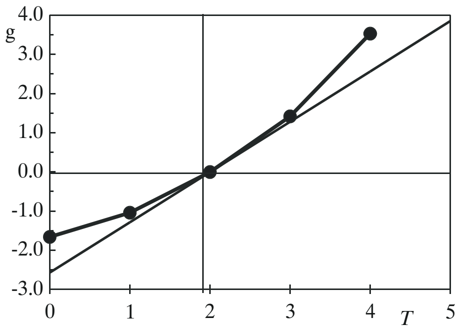
Imm.	*T*	*N*	*%*	*m*	*SD*	c_i	c_s
	0	55	18.0	27.19	1.97	-1.66	-2.57
	1	46	15.0	27.81	2.19	-1.04	-1.28
	2	157	51.3	28.85	2.44	0.00	0.00
	3	34	11.1	30.27	2.65	1.42	1.28
	4	8	2.6	32.38	3.71	3.53	2.57
	5	6	2.0				3.85
		306					

Ad. – adults
Imm. – immatures
T – fat scores
N – sample size
% – percent share

m – average body mass (g)
SD – standard deviation (g)
c_i – difference in the average body mass between the given fat score and the fat score T_2 (g)
c_s - standardised c_i (see text) (g)



Percent share of subsequent fat scores.
Arrow – average fat score in the sample.

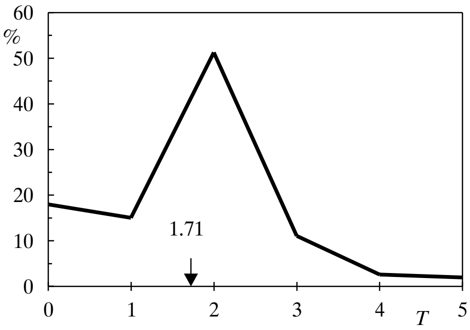


Regression line of fat load / fat score relation.
Distribution of c_i-values is shown as thick line (exact value is given).

PLATE I-1

Acrocephalus arundinaceus

Imm.	*T*	*N*	*%*	*m*	*SD*	c_i	c_s
	0	55	18.0	27.19	1.97	-1.66	-2.57
	1	46	15.0	27.81	2.19	-1.04	-1.28
	2	157	51.3	28.85	2.44	0.00	0.00
	3	34	11.1	30.27	2.65	1.42	1.28
	4	8	2.6	32.38	3.71	3.53	2.57
	5	6	2.0				3.85
		306					



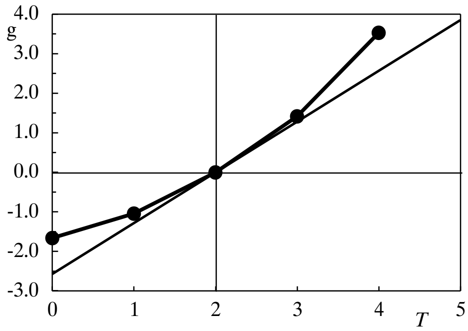
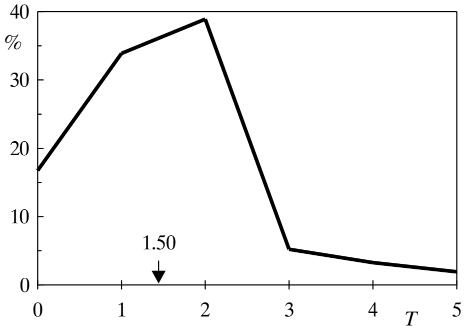


PLATE I-2

Acrocephalus palustris

Imm.	*T*	*N*	*%*	*m*	*SD*	c_i	c_s
	0	87	16.76	11.48	1.02	-0.82	-1.53
	1	176	33.91	11.74	0.88	-0.56	-0.76
	2	202	38.92	12.30	1.06	0	0.00
	3	27	5.20	13.39	1.03	1.09	0.76
	4	17	3.28	13.96	0.83	1.66	1.53
	5	10	1.93	15.28	2.05	2.98	2.29
		519					



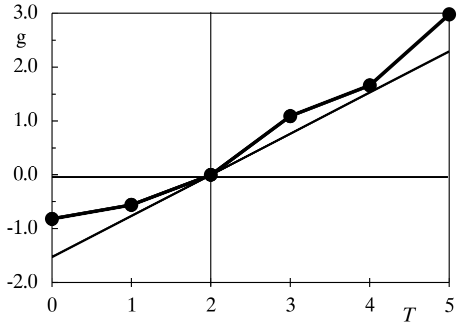
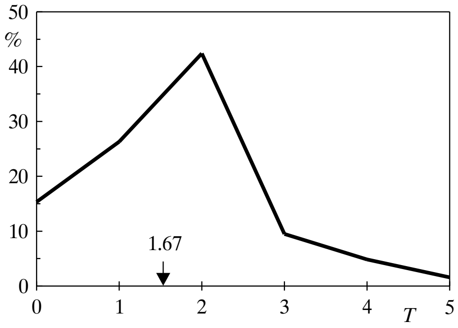


PLATE II-1

Acrocephalus schoenobaenus

Imm.	*T*	*N*	*%*	*m*	*SD*	c_i	c_s
	0	165	15.35	10.92	0.63	-0.63	-1.17
	1	283	26.33	11.16	0.77	-0.39	-0.59
	2	456	42.42	11.55	0.79	0.00	0.00
	3	102	9.49	12.27	0.99	0.72	0.59
	4	52	4.84	13.08	1.42	1.53	1.17
	5	17	1.58	13.72	1.92	2.17	1.76
		1075					



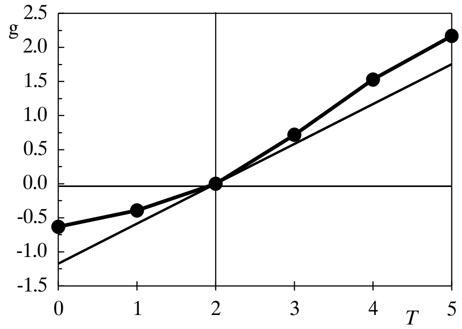
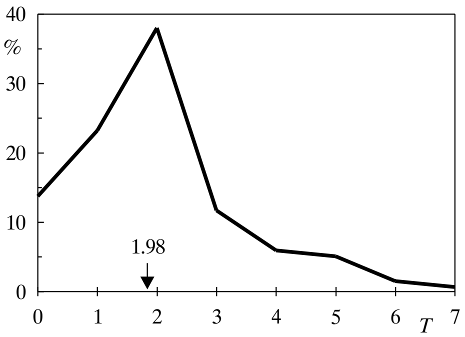


PLATE II-2

Acrocephalus scirpaceus

Ad.	*T*	*N*	*%*	*m*	*SD*	c_i	c_s
	0	81	13.8	11.13	0.92	-1.12	-1.27
	1	137	23.3	11.73	0.89	-0.52	-0.64
	2	224	38.0	12.25	0.89	0.00	0.00
	3	69	11.7	12.76	1.00	0.51	0.64
	4	35	5.9	13.35	0.89	1.10	1.27
	5	30	5.1	14.62	1.20	2.37	1.91
	6	9	1.5	14.78	1.67	2.53	2.55
	7	4	0.7				3.18
		589					



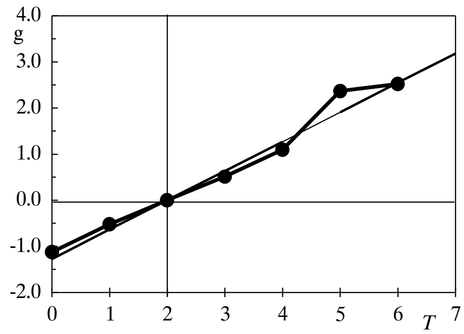
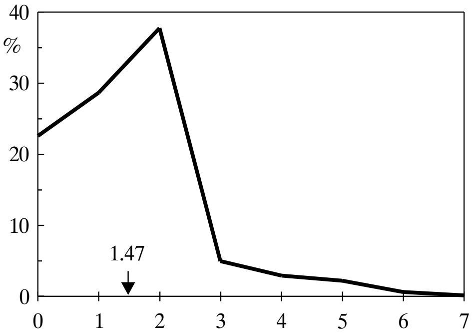


PLATE III-1

Acrocephalus scirpaceus

Imm.	*T*	*N*	*%*	*m*	*SD*	c_i	c_s
	0	2095	22.6	11.16	0.67	-0.57	-1.06
	1	2658	28.7	11.44	0.78	-0.29	-0.53
	2	3502	37.8	11.73	0.81	0.00	0.00
	3	462	5.0	12.46	1.03	0.72	0.53
	4	272	2.9	13.01	1.00	1.28	1.06
	5	207	2.2	13.82	1.11	2.09	1.59
	6	57	0.6	14.01	0.88	2.28	2.11
	7	15	0.2	14.69	1.30	2.96	2.64
		9268					



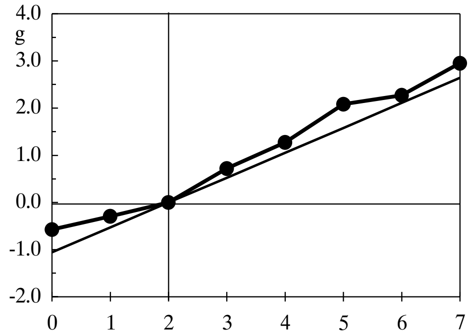
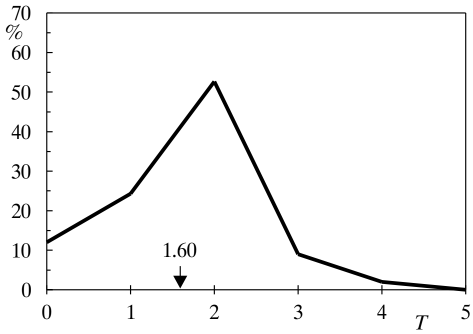


PLATE III-2

Aegithalos caudatus

Ad.	*T*	*N*	*%*	*m*	*SD*	c_i	c_s
	0	36	12.0	8.16	0.39	-0.30	-0.36
	1	73	24.3	8.26	0.56	-0.20	-0.18
	2	158	52.7	8.46	0.47	0.00	0.00
	3	27	9.0	8.69	0.77	0.23	0.18
	4	6	2.0				0.36
	5	0	0.0				0.54
		300					



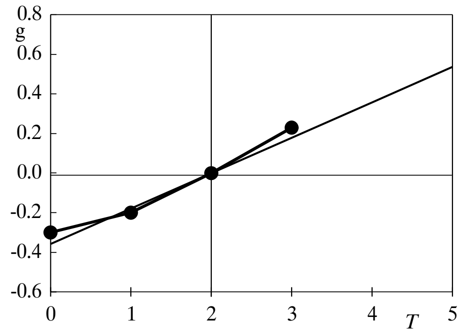
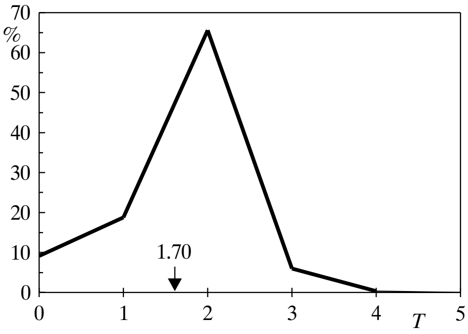


PLATE IV-1

Aegithalos caudatus

Imm.	*T*	*N*	*%*	*m*	*SD*	c_i	c_s
	0	496	9.2	8.12	0.55	-0.59	-0.49
	1	1015	18.8	8.38	0.52	-0.33	-0.24
	2	3548	65.6	8.71	0.52	0.00	0.00
	3	325	6.0	8.92	0.58	0.21	0.24
	4	21	0.4	9.07	0.47	0.36	0.49
	5	0	0.0				0.73
		5405					



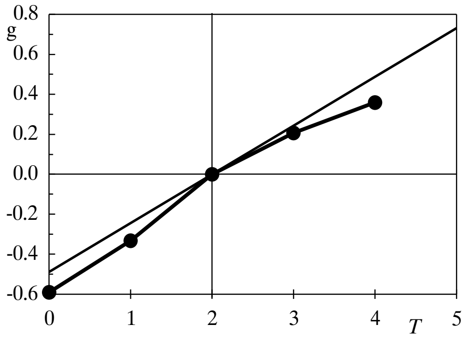
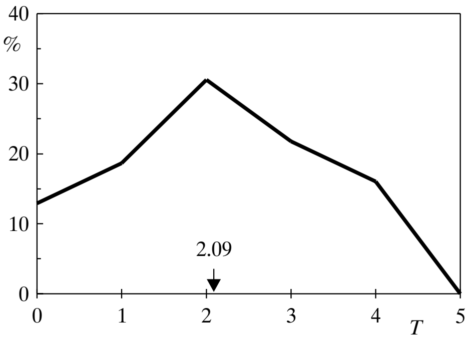


PLATE IV-2

Anthus trivialis

Imm.	*T*	*N*	*%*	*m*	*SD*	c_i	c_s
	0	25	13.0	21.58	2.11	-0.47	-1.44
	1	36	18.7	21.42	1.63	-0.63	-0.72
	2	59	30.6	22.05	1.34	0.00	0.00
	3	42	21.8	22.64	1.45	0.59	0.72
	4	31	16.1	24.57	2.35	2.52	1.44
	5	0	0.0				2.16
		193					



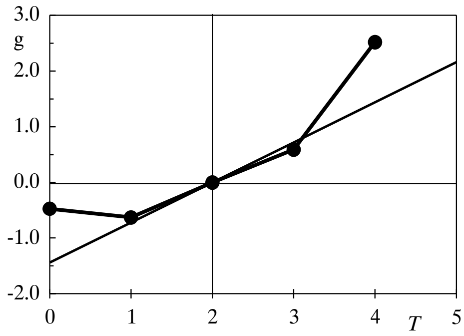
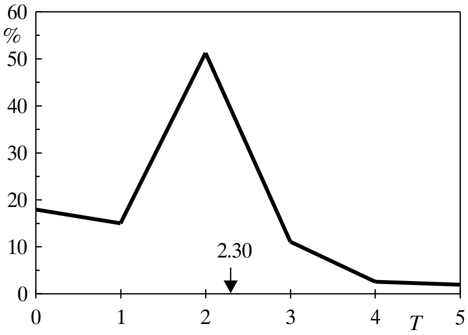


PLATE V-1

Carduelis spinus

All	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	130	9.1	11.13	1.04	-0.90	-1.30
	1	197	13.7	11.39	0.91	-0.64	-0.65
	2	554	38.6	12.03	0.89	0.00	0.00
	3	238	16.6	12.72	0.96	0.69	0.65
	4	299	20.8	13.70	1.00	1.67	1.30
	5	17	1.2	14.32	1.08	2.29	1.94
		1435					



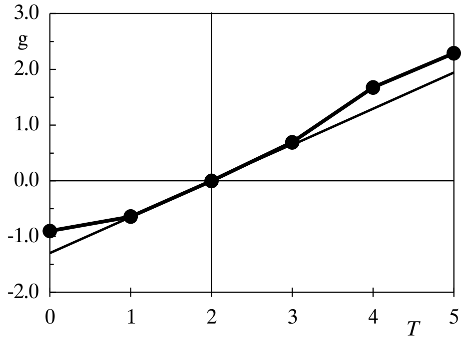
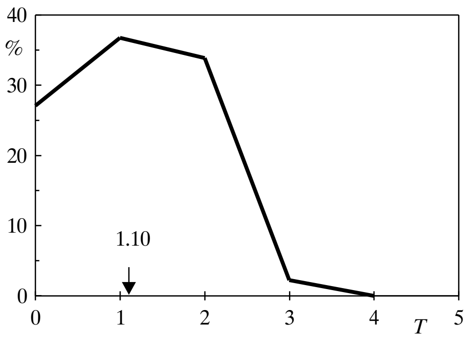


PLATE V-2

Certhia brachydactyla

All	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	84	27.1	8.73	0.75	-0.34	-0.12
	1	114	36.8	8.90	0.82	-0.17	-0.06
	2	105	33.9	9.07	1.13	0.00	0.00
	3	7	2.3	8.87	0.39	-0.20	0.06
	4	0	0.0				0.12
	5	0	0.0				0.18
		310					



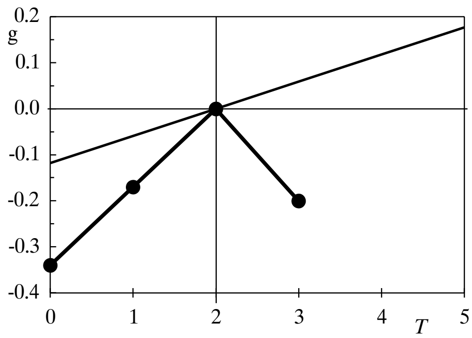


PLATE VI-1

Certhia familiaris

Ad.	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	21	16.7	8.64	0.67	-0.11	-0.31
	1	36	28.6	8.39	1.61	-0.36	-0.15
	2	44	34.9	8.75	0.67	0.00	0.00
	3	18	14.3	9.06	0.65	0.31	0.15
	4	7	5.6	9.07	0.62	0.32	0.31
	5	0	0.0				0.46
		126					

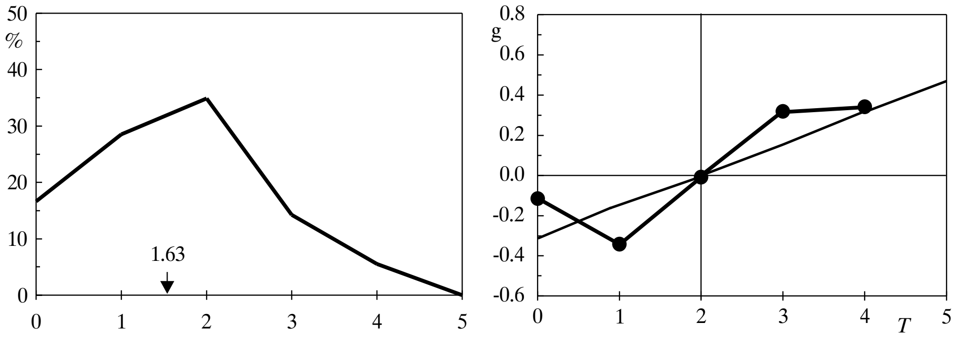


PLATE VI-2

Certhia familiaris

Imm.	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	195	10.4	8.53	0.65	-0.38	-0.47
	1	284	15.1	8.65	0.83	-0.26	-0.24
	2	900	47.9	8.91	0.67	0.00	0.00
	3	434	23.1	9.20	0.77	0.28	0.24
	4	64	3.4	9.47	0.63	0.56	0.47
	5	0	0.0				0.71
		1877					

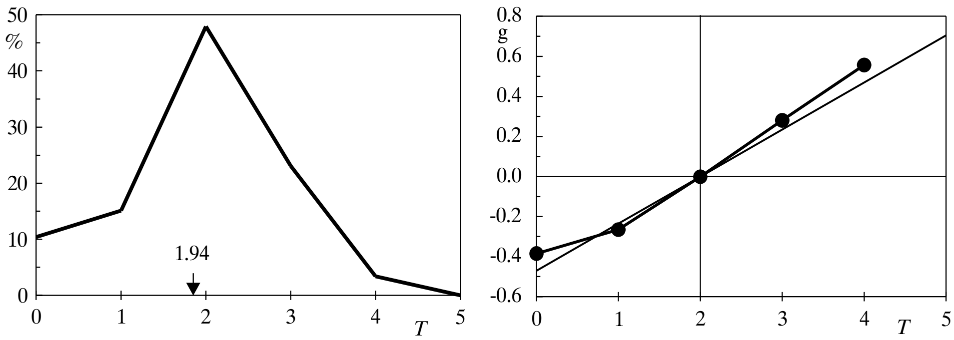


PLATE VII-1

Emberiza citrinella

♂♂	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	68	52.3	29.47	1.71	-0.18	-0.18
	1	38	29.2	29.63	1.94	-0.02	-0.09
	2	20	15.4	29.65	1.97	0.00	0.00
	3	4	3.1				0.09
	4	0	0.0				0.18
	5	0	0.0				0.27
		130					

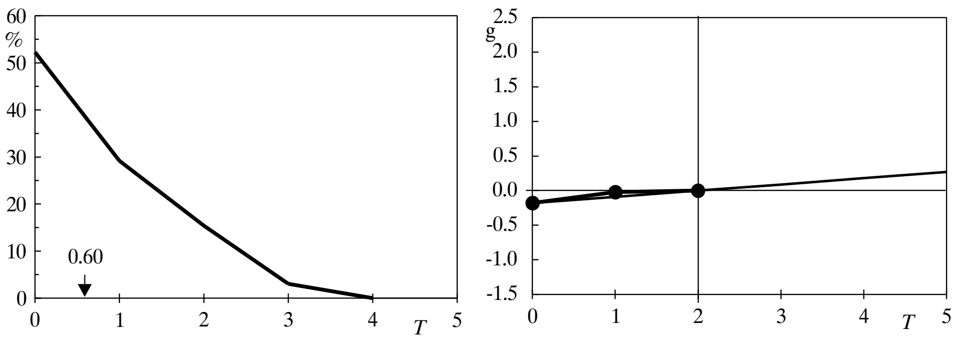


PLATE VII-2

Emberiza citrinella

♀♀	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	50	38.5	28.25	1.66	-1.12	-1.37
	1	30	23.1	28.54	1.75	-0.83	-0.69
	2	37	28.5	29.37	3.09	0.00	0.00
	3	13	10.0	30.26	2.58	0.89	0.69
	4	0	0.0				1.37
	5	0	0.0				2.06
		130					

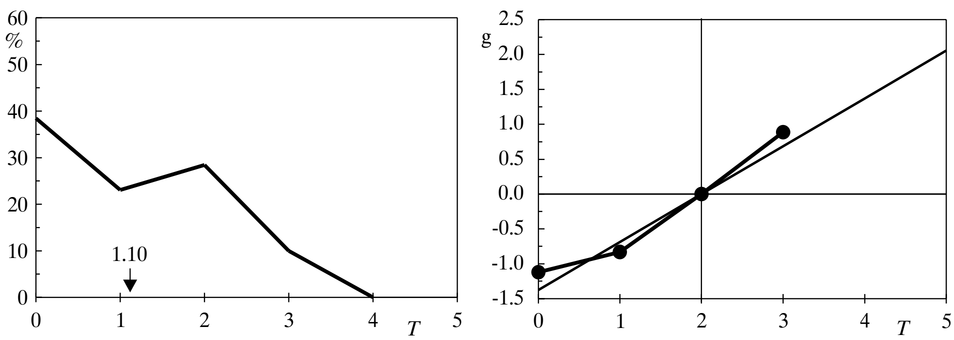


PLATE VIII-1

Erithacus rubecula

Ad.	*T*	*N*	%	*m*	*SD*	c_i	c_s
Bukowo--Kopań	0	148	7.5	14.87	1.14	-1.25	-1.27
	1	328	16.6	15.60	1.21	-0.52	-0.63
	2	824	41.8	16.12	1.01	0.00	0.00
	3	622	31.5	16.79	1.06	0.67	0.63
	4	48	2.4	17.44	1.05	1.32	1.27
	5	3	0.2				1.90
		1973					

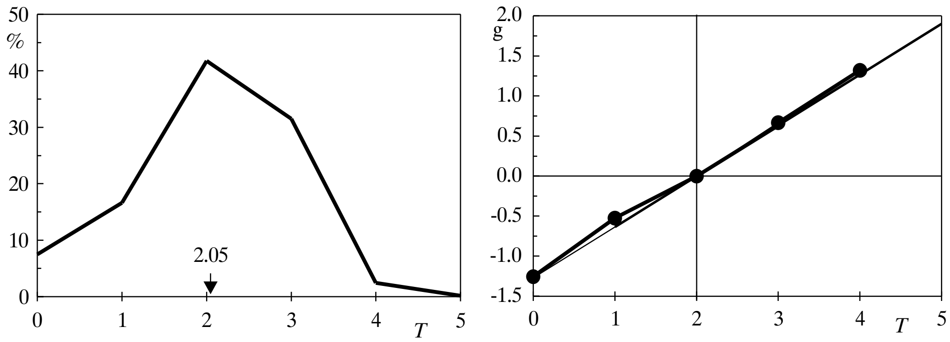


PLATE VIII-2

Erithacus rubecula

Ad.	*T*	*N*	%	*m*	*SD*	c_i	c_s
Mierzeja Wiślana	0	196	7.3	15.44	1.13	-0.95	-1.08
	1	401	14.9	15.77	1.33	-0.63	-0.54
	2	1025	38.2	16.40	1.05	0.00	0.00
	3	895	33.3	17.02	1.25	0.62	0.54
	4	160	6.0	17.50	1.11	1.11	1.08
	5	8	0.3				1.61
		2685					

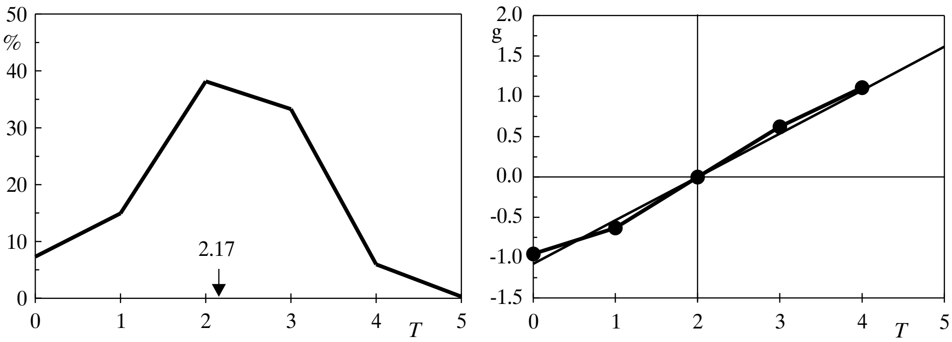


PLATE IX-1

Erithacus rubecula

Imm.	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	6763	13.4	14.97	1.05	-1.01	-1.29
	1	9958	19.8	15.48	0.98	-0.51	-0.64
	2	22314	44.3	15.98	1.01	0.00	0.00
	3	10092	20.0	16.77	1.08	0.79	0.64
	4	1220	2.4	17.54	1.11	1.56	1.29
	5	37	0.1				1.93
		50384					

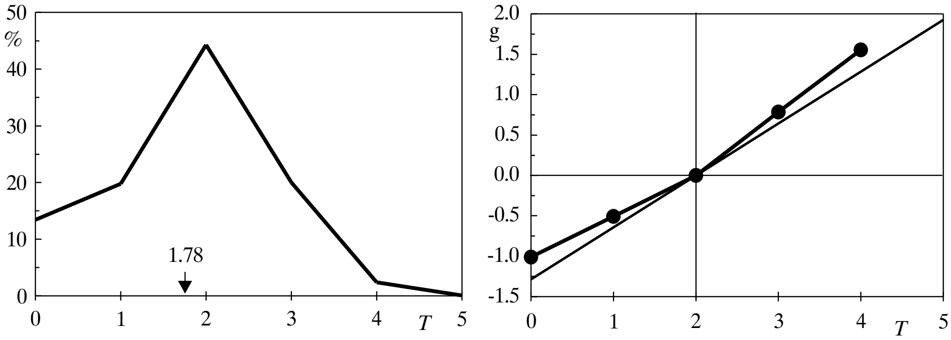


PLATE IX-2

Ficedula hypoleuca

Ad.	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	7	5.2	11.14	0.74	-1.36	-1.14
	1	20	14.9	11.57	0.85	-0.93	-0.57
	2	64	47.8	12.50	0.87	0.00	0.00
	3	31	23.1	12.86	0.86	0.36	0.57
	4	12	9.0	13.35	0.94	0.85	1.14
	5	0	0.0				1.71
		134					

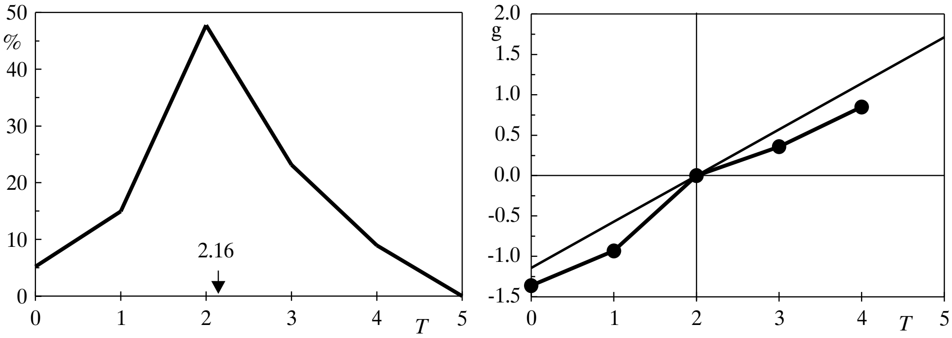
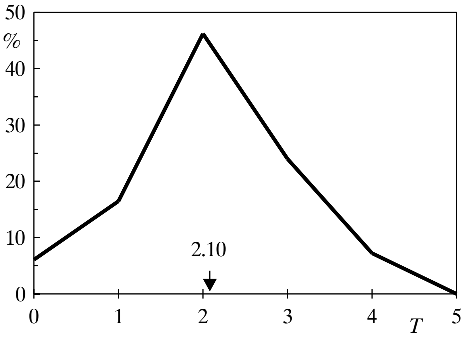


PLATE X-1

Ficedula hypoleuca

♂♂ *Imm.*	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	72	6.1	11.28	0.78	-1.04	-1.20
	1	195	16.5	11.77	0.86	-0.55	-0.60
	2	548	46.2	12.32	0.89	0.00	0.00
	3	284	24.0	12.95	0.96	0.63	0.60
	4	86	7.3	13.68	1.08	1.36	1.20
	5	0	0.0				1.80
		1185					



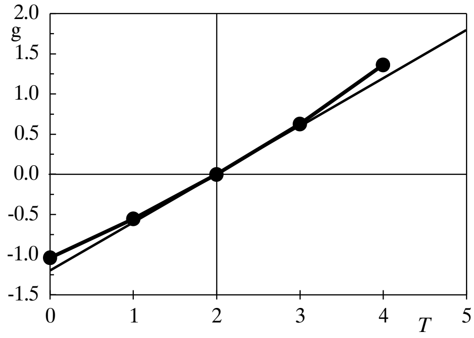
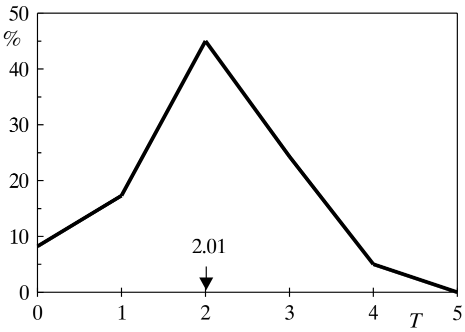


PLATE X-2

Ficedula hypoleuca

♀♀ *Imm.*	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	54	8.2	11.58	0.89	-0.67	-0.92
	1	114	17.4	11.91	0.87	-0.34	-0.46
	2	296	45.1	12.25	0.90	0.00	0.00
	3	160	24.4	12.86	1.18	0.61	0.46
	4	33	5.0	13.41	0.81	1.16	0.92
	5	0	0.0				1.38
		657					



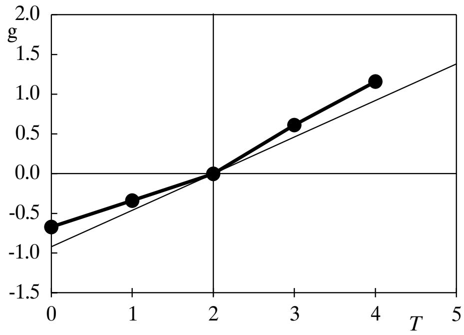


PLATE XI-1

Ficedula parva

All	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	36	33.6	9.75	0.66	-0.13	-0.38
	1	40	37.4	9.92	1.63	0.04	-0.19
	2	24	22.4	9.88	1.68	0.00	0.00
	3	7	6.5	10.39	0.55	0.51	0.19
	4	0	0.0				0.38
	5	0	0.0				0.56
		107					

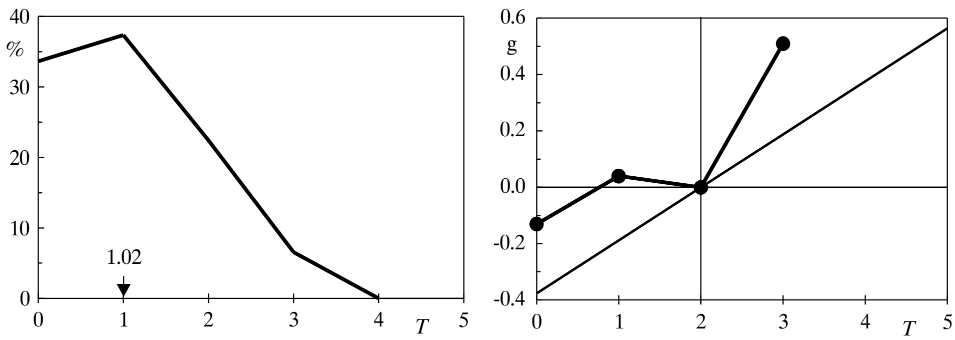


PLATE XI-2

Fringilla coelebs

All	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	460	32.3	20.21	1.79	-1.09	-1.47
	1	306	21.5	21.16	1.66	-0.14	-0.73
	2	466	32.7	21.30	1.71	0.00	0.00
	3	114	8.0	22.37	1.69	1.07	0.73
	4	80	5.6	23.27	1.83	1.97	1.47
	5	0	0.0				2.20
		1426					

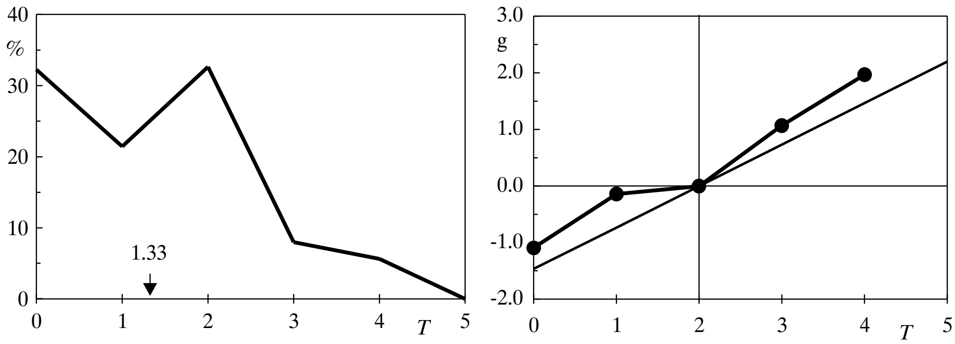
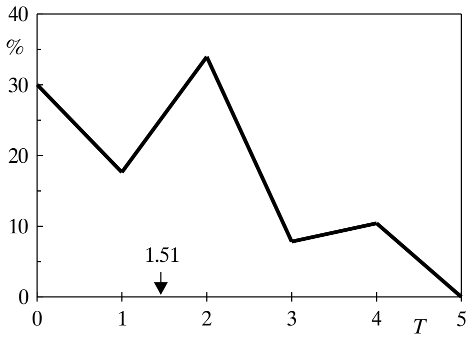


PLATE XII-1

Fringilla montifringilla

All	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	46	30.1	20.16	1.60	-1.59	-1.98
	1	27	17.6	21.70	2.25	-0.05	-0.99
	2	52	34.0	21.75	1.60	0.00	0.00
	3	12	7.8	22.94	1.68	1.19	0.99
	4	16	10.5	24.49	2.51	2.74	1.98
	5	0	0.0				2.97
		153					



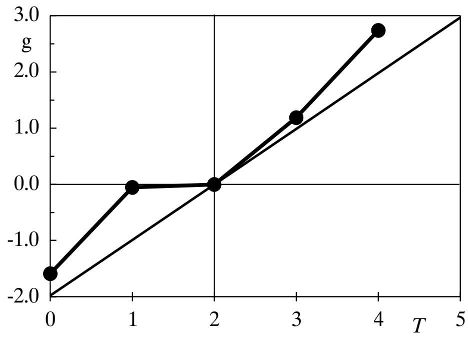
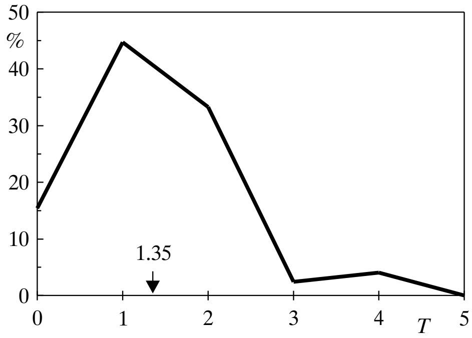


PLATE XII-2

Hippolais icterina

Imm.	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	19	15.4	12.61	0.70	-0.50	-1.14
	1	55	44.7	12.74	0.77	-0.37	-0.57
	2	41	33.3	13.11	0.83	0.00	0.00
	3	3	2.4	13.80	0.35	0.69	0.57
	4	5	4.1	14.92	0.64	1.81	1.14
	5	0	0.0				1.70
		123					



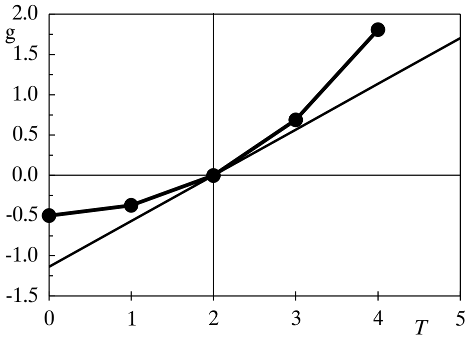
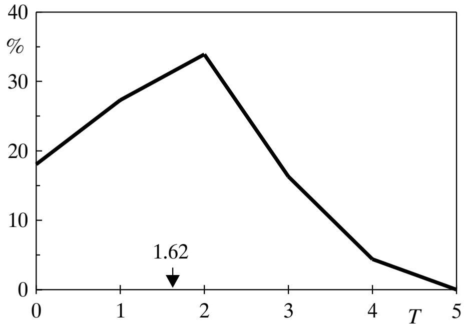


PLATE XIII-1

Lanius collurio

Imm.	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	41	18.1	26.69	1.82	-2.47	-2.36
	1	62	27.3	27.73	2.12	-1.43	-1.18
	2	77	33.9	29.16	2.08	0.00	0.00
	3	37	16.3	30.15	2.22	0.99	1.18
	4	10	4.4	31.49	2.25	2.33	2.36
	5	0	0.0				3.55
		227					



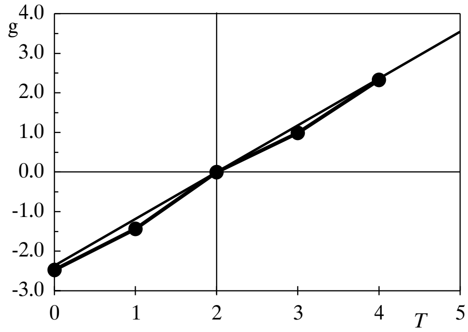
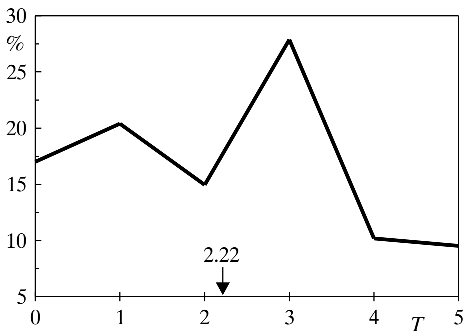


PLATE XIII-2

Locustella naevia

Imm.	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	25	17.0	12.37	1.37	-1.41	-1.25
	1	30	20.4	13.00	1.39	-0.78	-0.63
	2	22	15.0	13.78	1.68	0.00	0.00
	3	41	27.9	13.94	1.26	0.16	0.63
	4	15	10.2	14.75	1.25	0.97	1.25
	5	14	9.5	15.68	1.31	1.90	1.88
		147					



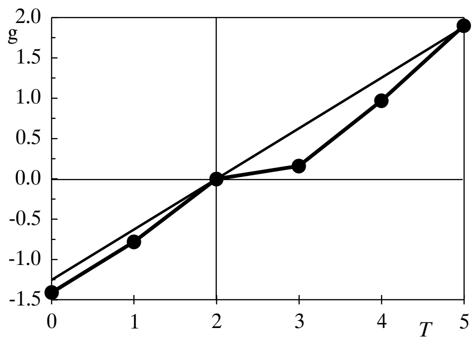


PLATE XIV-1

Muscicapa striata

All	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	57	6.9	14.48	1.42	-0.94	-1.49
	1	111	13.3	14.89	1.07	-0.53	-0.75
	2	398	47.8	15.42	1.07	0.00	0.00
	3	239	28.7	16.23	1.10	0.81	0.75
	4	27	3.2	17.54	1.10	2.12	1.49
	5	0	0.0				2.24
		832					

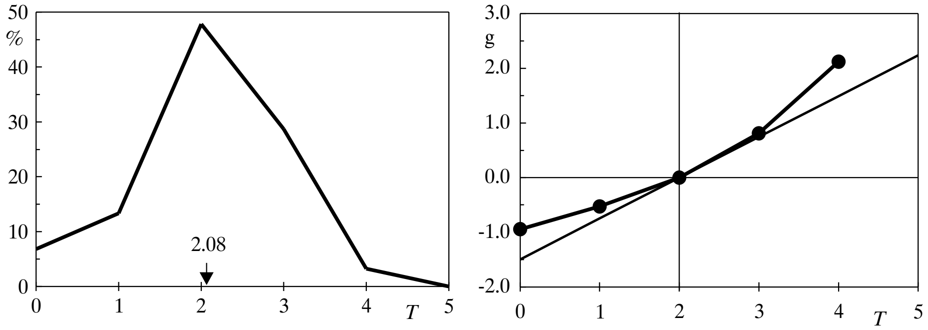


PLATE XIV-2

Parus ater

All	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	788	15.0	9.02	0.67	-0.41	-0.39
	1	1061	20.1	9.25	1.11	-0.18	-0.19
	2	2552	48.5	9.43	0.71	0.00	0.00
	3	755	14.3	9.54	0.64	0.11	0.19
	4	102	1.9	9.66	0.55	0.23	0.39
	5	8	0.2	10.11	0.74	0.68	0.58
		5266					

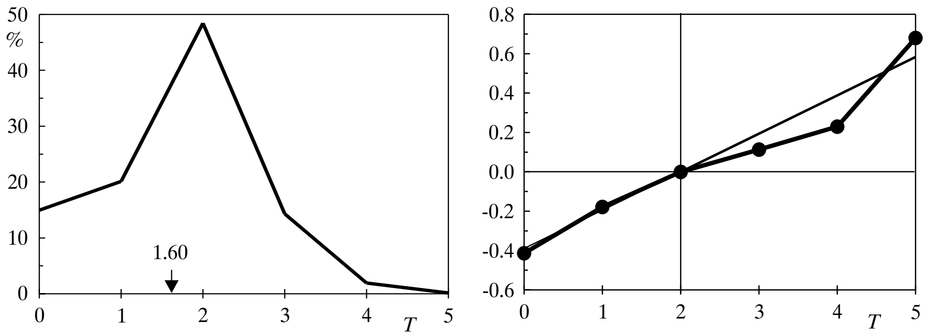
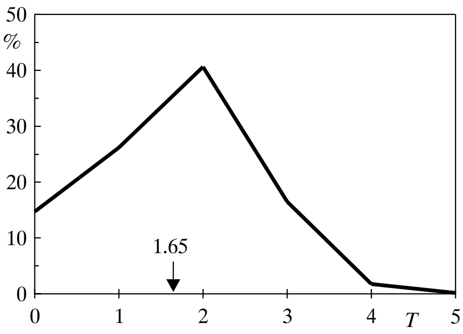


PLATE XV-1

Parus caeruleus

Ad.	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	296	14.7	10.40	0.57	-0.52	-0.41
	1	526	26.2	10.73	0.75	-0.18	-0.20
	2	816	40.6	10.92	0.83	0.00	0.00
	3	332	16.5	11.03	0.72	0.12	0.20
	4	35	1.7	11.27	1.09	0.35	0.41
	5	3	0.1				0.61
		2008					



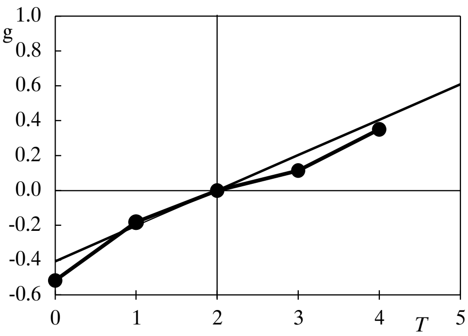
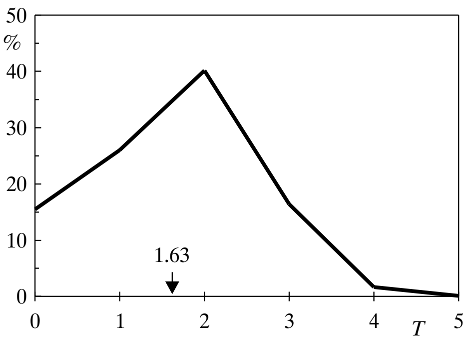


PLATE XV-2

Parus caeruleus

Imm.	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	2364	15.5	10.52	0.65	-0.49	-0.57
	1	3971	26.1	10.74	0.69	-0.27	-0.29
	2	6119	40.2	11.00	0.75	0.00	0.00
	3	2506	16.4	11.22	0.74	0.22	0.29
	4	257	1.7	11.62	0.80	0.61	0.57
	5	19	0.1	11.94	0.27	0.94	0.86
		15236					



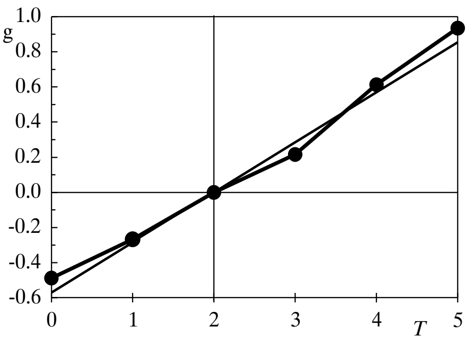
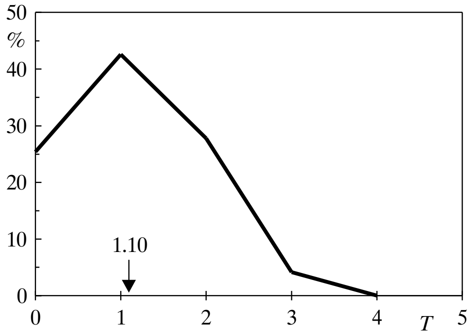


PLATE XVI-1

Parus cristatus

All	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	43	25.4	11.42	1.25	-0.05	-0.18
	1	72	42.6	11.52	0.71	0.05	-0.09
	2	47	27.8	11.47	1.15	0.00	0.00
	3	7	4.1	11.73	0.49	0.26	0.09
	4	0	0.0				0.18
	5	0	0.0				0.26
		169					



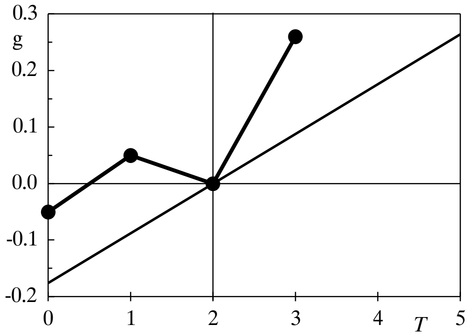
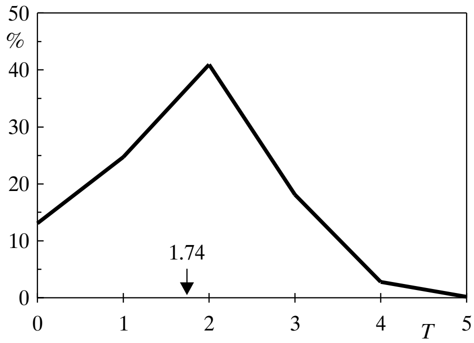


PLATE XVI-2

Parus major

All	*T*	*N*	%	*m*	*SD*	c_i	c_s
Bukowo--Kopań	0	1350	13.1	16.67	0.87	-0.59	-0.89
	1	2551	24.7	16.96	0.93	-0.30	-0.45
	2	4228	41.0	17.26	1.03	0.00	0.00
	3	1872	18.1	17.71	1.25	0.45	0.45
	4	292	2.8	18.08	0.91	0.82	0.89
	5	22	0.2	19.04	0.88	1.78	1.34
		10315					



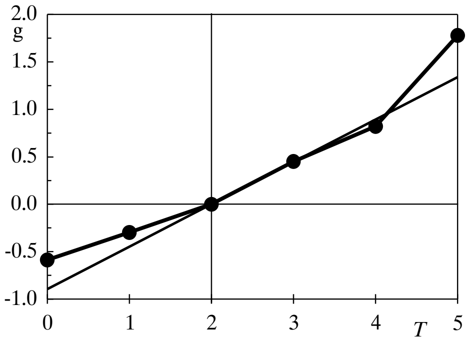
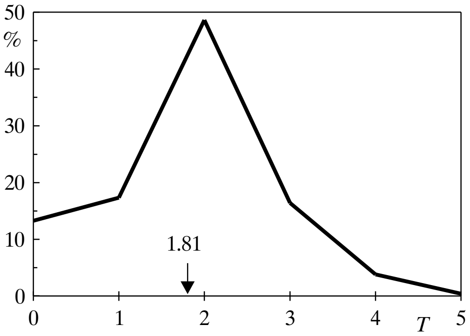


PLATE XVII-1

Parus major

All	T	N	%	m	SD	c_i	c_s
Mierzeja Wiślana	0	2049	13.3	16.62	0.92	-1.06	-1.13
	1	2675	17.4	17.19	1.02	-0.49	-0.56
	2	7489	48.6	17.68	1.03	0.00	0.00
	3	2531	16.4	18.23	1.03	0.54	0.56
	4	592	3.8	18.79	1.12	1.10	1.13
	5	62	0.4	19.51	1.06	1.82	1.69
		15398					



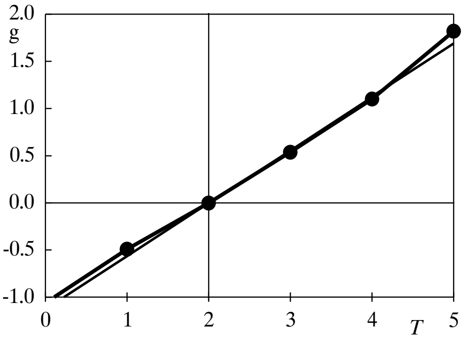
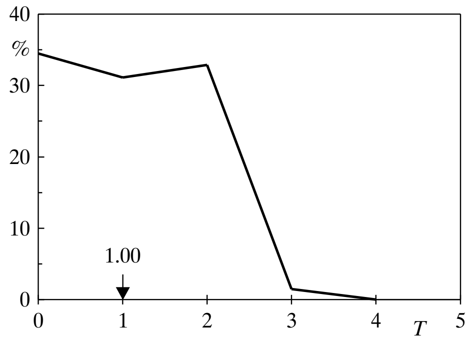


PLATE XVII-2

Parus montanus

All	T	N	%	m	SD	c_i	c_s
	0	642	34.5	10.50	0.74	-0.33	-0.25
	1	579	31.1	10.72	0.74	-0.10	-0.12
	2	612	32.9	10.83	0.79	0.00	0.00
	3	28	1.5	10.88	1.43	0.05	0.12
	4	0	0.0				0.25
	5	0	0.0				0.37
		1861					



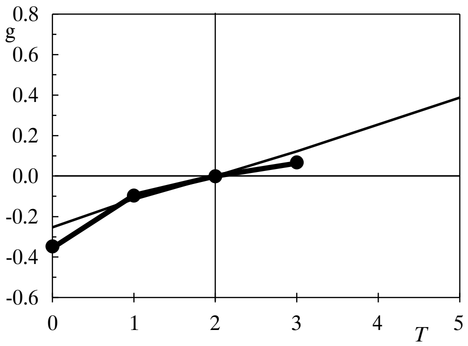
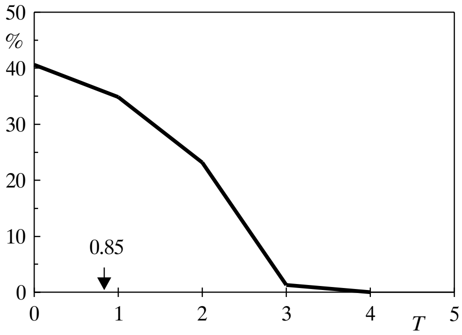


PLATE XVIII-1

Parus palustris

All	T	N	%	m	SD	c_i	c_s
	0	184	40.6	10.97	0.65	-0.17	-0.33
	1	158	34.9	11.12	0.63	-0.02	-0.17
	2	105	23.2	11.14	0.67	0.00	0.00
	3	6	1.3	11.52	0.49	0.38	0.17
	4	0	0.0				0.33
	5	0	0.0				0.50
		453					



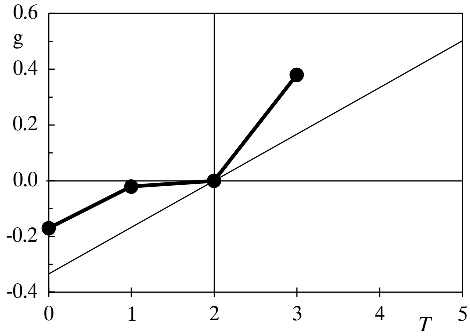
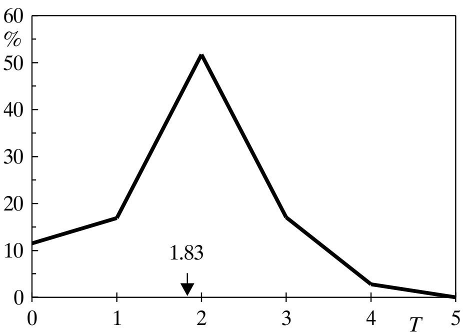


PLATE XVIII-2

Phoenicurus phoenicurus

All	T	N	%	m	SD	c_i	c_s
	0	350	11.5	13.36	1.40	-0.89	-1.45
	1	514	16.9	13.78	1.04	-0.47	-0.72
	2	1571	51.7	14.25	0.97	0.00	0.00
	3	518	17.1	15.12	1.06	0.87	0.72
	4	84	2.8	16.32	1.24	2.07	1.45
	5	0	0.0				2.17
		3037					



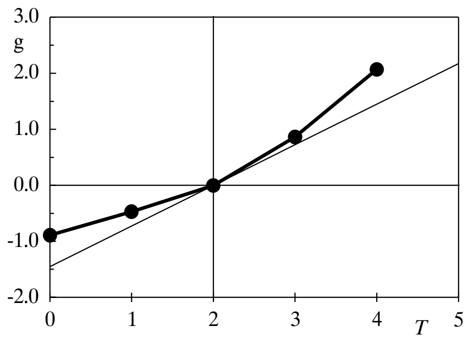
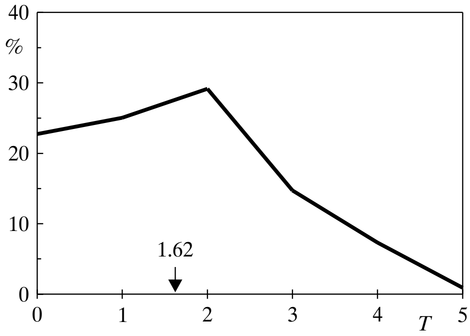


PLATE XIX-1

Phylloscopus collybita

All	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	270	22.8	7.36	0.76	-0.33	-0.65
	1	297	25.0	7.59	0.67	-0.10	-0.33
	2	346	29.2	7.69	0.72	0.00	0.00
	3	175	14.8	8.27	0.87	0.58	0.33
	4	87	7.3	8.57	0.84	0.88	0.65
	5	11	0.9	8.95	0.85	1.26	0.98
		1186					



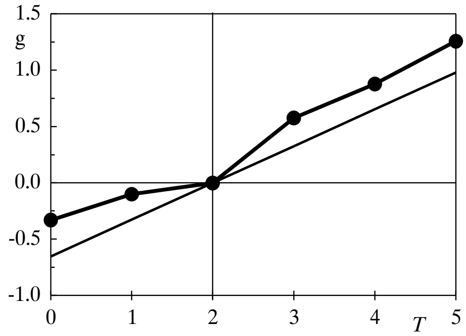
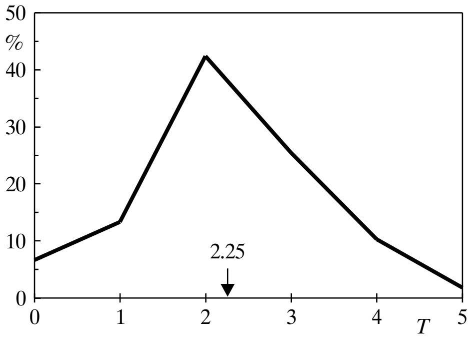


PLATE XIX-2

Phylloscopus sibilatrix

Imm.	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	11	6.7	9.07	1.09	-0.55	-0.81
	1	22	13.3	9.49	0.73	-0.13	-0.41
	2	70	42.4	9.62	0.88	0.00	0.00
	3	42	25.5	10.24	0.72	0.62	0.41
	4	17	10.3	10.73	0.65	1.11	0.81
	5	3	1.8				1.22
		165					



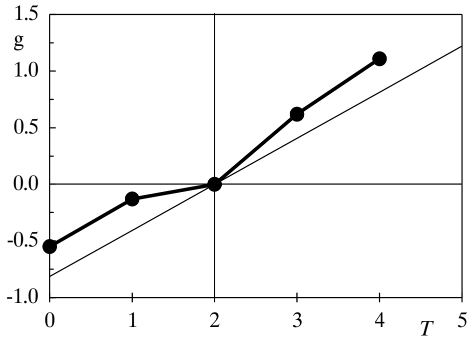
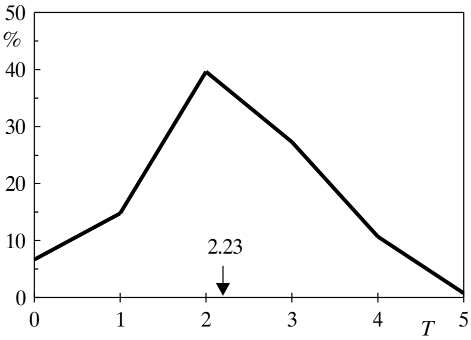


PLATE XX-1

Phylloscopus trochilus

All	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	388	6.7	8.10	0.80	-0.54	-0.91
	1	856	14.8	8.33	0.74	-0.31	-0.46
	2	2292	39.7	8.64	0.88	0.00	0.00
	3	1579	27.3	9.06	0.84	0.42	0.46
	4	618	10.7	9.58	0.85	0.95	0.91
	5	45	0.8	10.47	1.00	1.83	1.37
		5778					



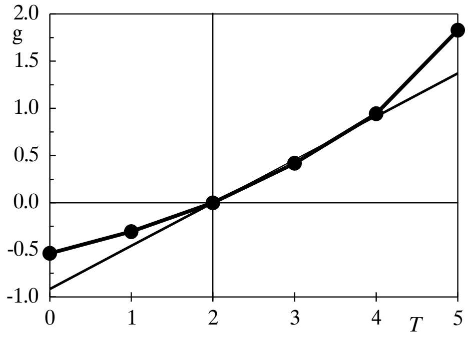
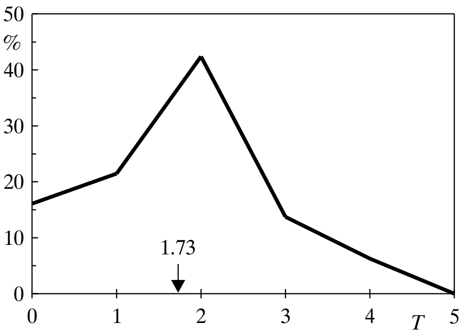


PLATE XX-2

Prunella modularis

All	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	90	16.1	17.50	1.48	-0.92	-1.18
	1	120	21.5	18.15	1.76	-0.28	-0.59
	2	237	42.4	18.43	1.81	0.00	0.00
	3	77	13.8	19.08	1.23	0.65	0.59
	4	35	6.3	19.98	1.33	1.55	1.18
	5	0	0.0				1.76
		559					



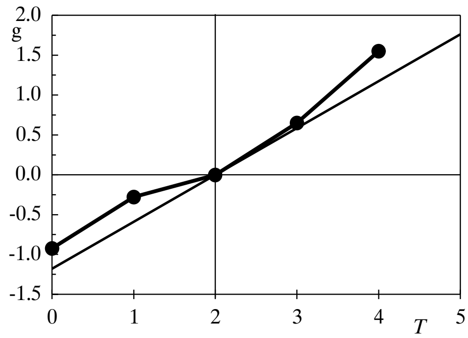
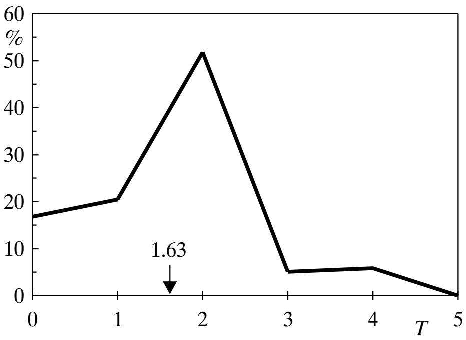


PLATE XXI-1

Pyrrhula pyrrhula

Ad.	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	23	16.8	30.10	2.76	-0.31	-0.99
	1	28	20.4	30.06	2.14	-0.35	-0.50
	2	71	51.8	30.41	2.06	0.00	0.00
	3	7	5.1	31.71	1.70	1.30	0.50
	4	8	5.8	31.76	2.70	1.35	0.99
	5	0	0.0				1.49
		137					



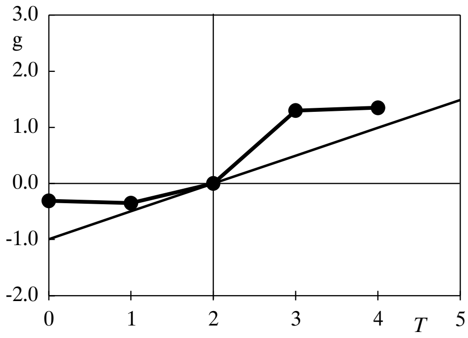
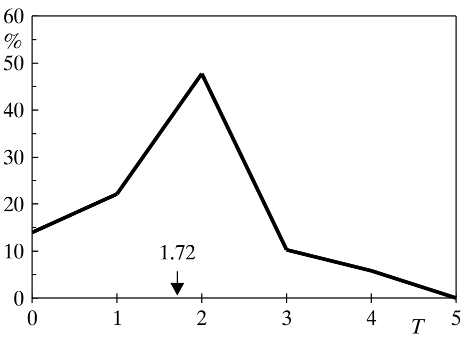


PLATE XXI-2

Pyrrhula pyrrhula

Imm.	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	60	14.0	28.53	2.40	-1.48	-1.96
	1	95	22.1	28.87	3.46	-1.14	-0.98
	2	205	47.8	30.01	1.81	0.00	0.00
	3	44	10.3	30.46	2.43	0.45	0.98
	4	25	5.8	32.63	2.68	2.62	1.96
	5	0	0.0				2.93
		429					



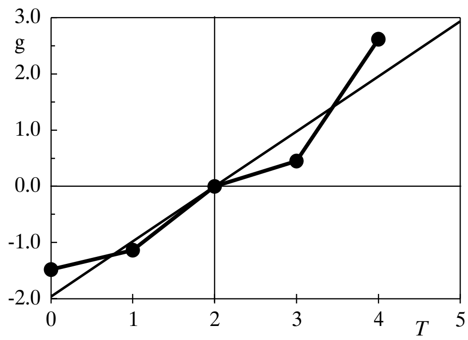
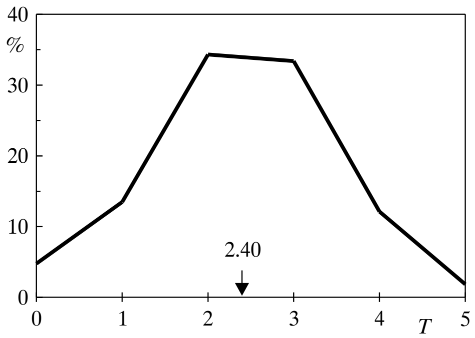


PLATE XXII-1

Regulus regulus

All	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	4567	4.8	5.15	0.37	-0.49	-0.49
	1	12962	13.5	5.45	0.36	-0.19	-0.24
	2	32979	34.3	5.63	0.40	0.00	0.00
	3	32081	33.4	5.88	0.42	0.25	0.24
	4	11653	12.1	6.10	0.40	0.46	0.49
	5	1779	1.9	6.42	0.45	0.79	0.73
		96021					



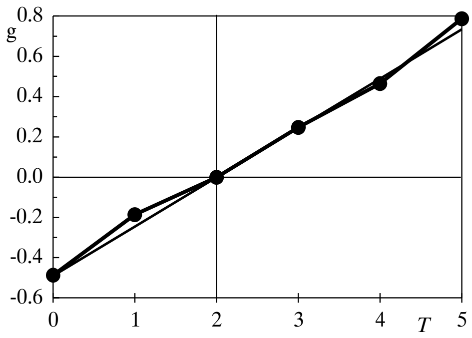
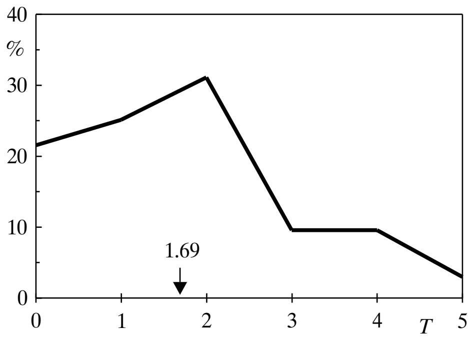


PLATE XXII-2

Sylvia atricapilla

Ad.	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	36	21.6	18.34	1.28	-1.13	-1.24
	1	42	25.1	18.18	1.27	-1.29	-0.62
	2	52	31.1	19.47	1.31	0.00	0.00
	3	16	9.6	20.01	1.49	0.54	0.62
	4	16	9.6	20.53	1.51	1.06	1.24
	5	5	3.0				1.86
		167					



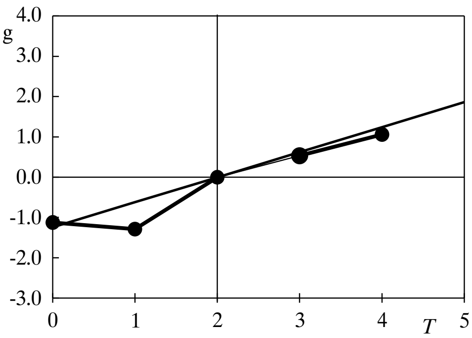


PLATE XXIII-1

Sylvia atricapilla

♂♂ *Imm.*	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	201	9.2	17.80	1.21	-1.29	-1.74
	1	371	17.0	18.15	1.29	-0.94	-0.87
	2	856	39.3	19.09	1.52	0.00	0.00
	3	434	19.9	20.14	1.57	1.05	0.87
	4	197	9.0	20.76	1.54	1.67	1.74
	5	121	5.6	22.13	1.83	3.04	2.62
		2180					

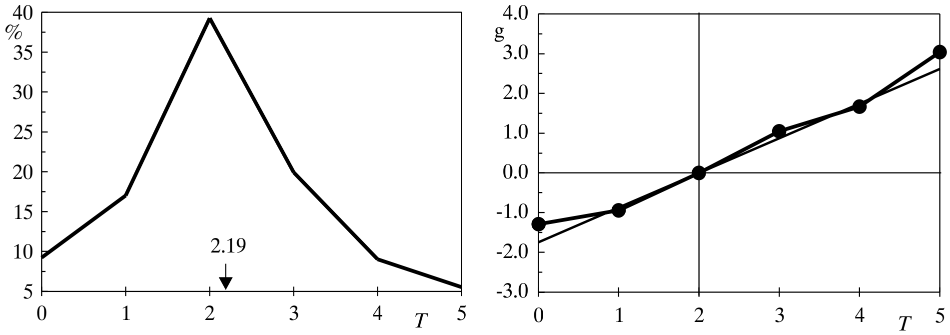


PLATE XXIII-2

Sylvia atricapilla

♀♀ *Imm.*	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	197	11.2	17.06	1.53	-2.18	-2.07
	1	271	15.4	18.39	1.29	-0.85	-1.03
	2	590	33.5	19.24	1.67	0.00	0.00
	3	375	21.3	20.36	1.66	1.12	1.03
	4	201	11.4	21.04	1.64	1.8	2.07
	5	126	7.2	22.49	1.61	3.25	3.10
		1760					

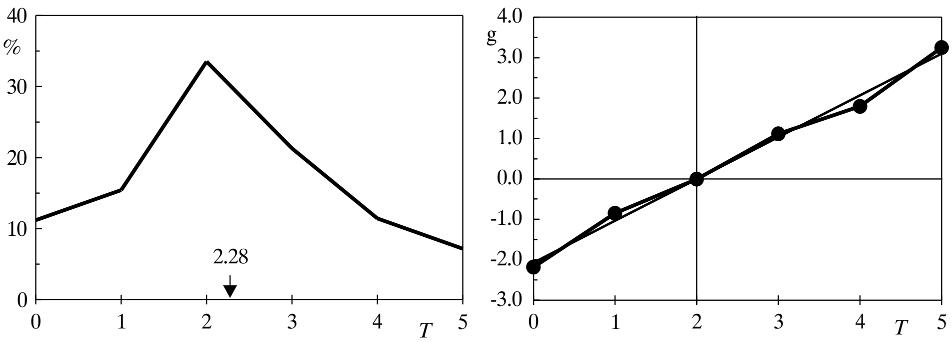


PLATE XXIV-1

Sylvia borin

Ad.	*T*	*N*	*%*	*m*	*SD*	c_i	c_s
	0	8	8.2	18.45	1.17	-0.18	-1.49
	1	26	26.8	18.00	1.57	-0.63	-0.74
	2	32	33.0	18.63	1.76	0.00	0.00
	3	20	20.6	20.72	2.19	2.09	0.74
	4	6	6.2	21.20	1.78	2.57	1.49
	5	4	4.1				2.23
	6	1	1.0				2.98
		97					

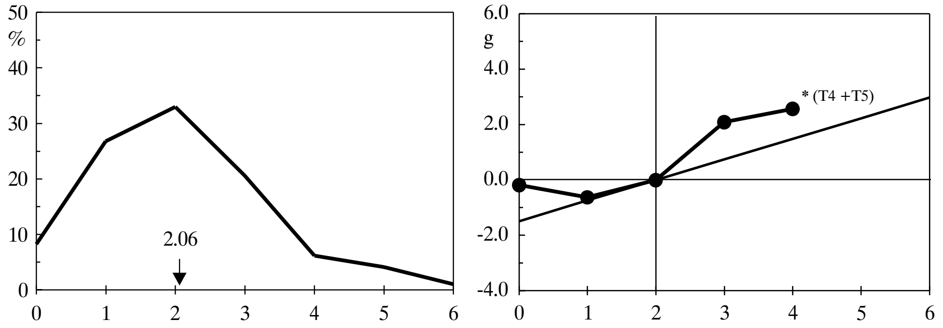


PLATE XXIV-2

Sylvia borin

Imm.	*T*	*N*	*%*	*m*	*SD*	c_i	c_s
	0	167	7.1	17.26	1.46	-1.79	-2.45
	1	373	15.8	17.83	1.36	-1.23	-1.22
	2	943	40.0	19.05	1.79	0.00	0.00
	3	503	21.3	20.64	1.97	1.59	1.22
	4	238	10.1	21.64	1.92	2.59	2.45
	5	115	4.9	23.06	2.31	4.00	3.67
	6	18	0.8	24.34	1.86	5.29	4.90
		2357					

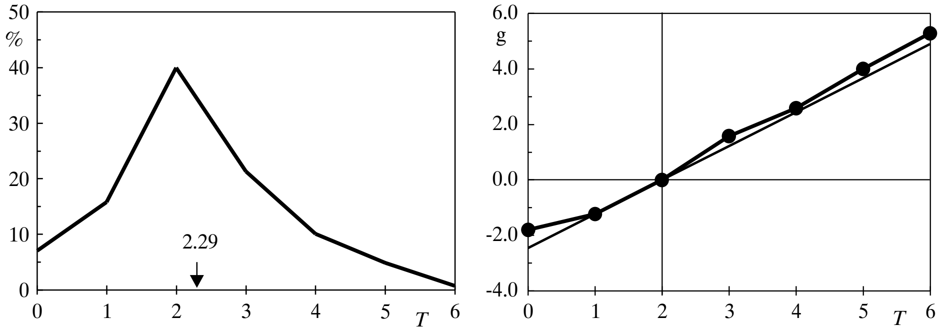
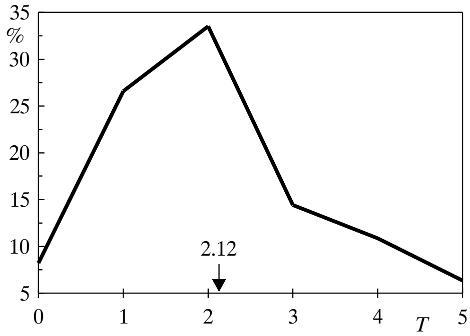


PLATE XXV-1

Sylvia communis

All	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	44	8.2	14.57	0.88	-0.72	-1.15
	1	142	26.6	14.72	1.07	-0.57	-0.57
	2	179	33.5	15.29	1.15	0.00	0.00
	3	77	14.4	15.81	1.53	0.52	0.57
	4	58	10.9	16.35	1.28	1.06	1.15
	5	34	6.4	17.51	0.84	2.22	1.72
		534					



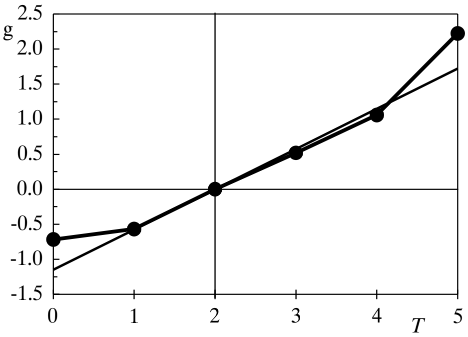
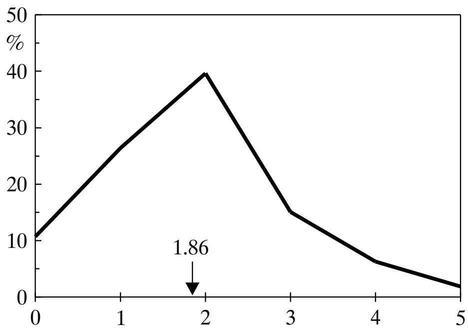


PLATE XXV-2

Sylvia curruca

Ad.	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	17	10.7	11.44	0.77	-0.40	-0.80
	1	42	26.4	11.66	1.15	-0.18	-0.40
	2	63	39.6	11.84	0.92	0.00	0.00
	3	24	15.1	12.67	0.85	0.83	0.40
	4	10	6.3	12.93	0.56	1.09	0.80
	5	3	1.9				1.20
		159					



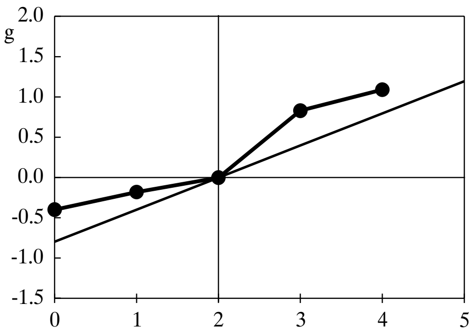
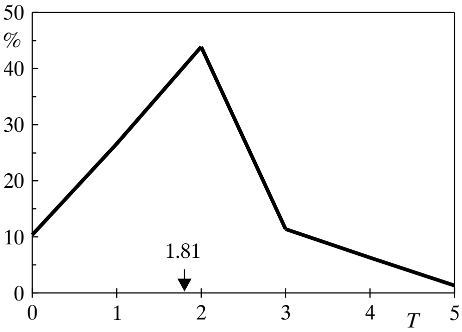


PLATE XXVI-1

Sylvia curruca

Imm.	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	99	10.4	11.11	0.81	-0.91	-1.11
	1	254	26.6	11.56	0.91	-0.45	-0.56
	2	419	43.9	12.01	1.11	0.00	0.00
	3	109	11.4	12.45	1.12	0.44	0.56
	4	60	6.3	13.10	1.10	1.09	1.11
	5	13	1.4	13.99	0.80	1.98	1.67
		954					



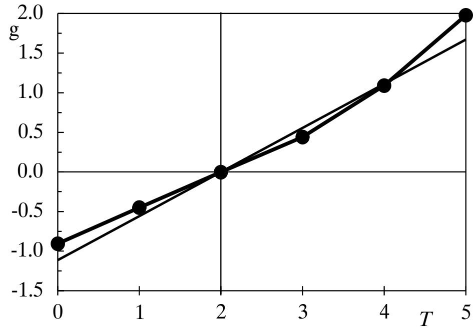
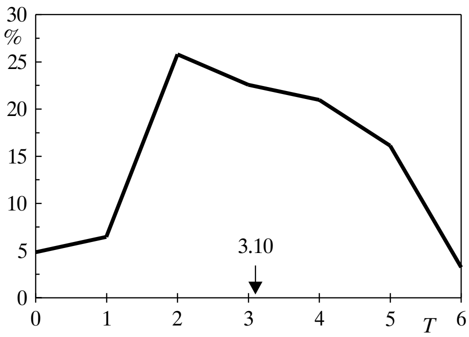


PLATE XXVI-2

Sylvia nisoria

All	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	3	4.8				-2.98
	1	4	6.5				-1.49
	2	16	25.8	26.54	2.17	0.00	0.00
	3	14	22.6	28.16	1.98	1.62	1.49
	4	13	21.0	28.86	2.44	2.32	2.98
	5	10	16.1	31.28	4.29	4.74	4.48
	6	2	3.2				5.97
		62					



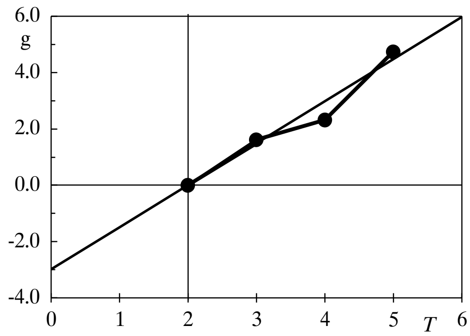


PLATE XXVII-1

Troglodytes troglodytes

All	*T*	*N*	%	*m*	*SD*	c_i	c_s
	0	118	12.8	8.98	0.88	-0.39	-0.51
	1	184	20.0	9.07	0.86	-0.30	-0.25
	2	388	42.1	9.37	0.94	0.00	0.00
	3	201	21.8	9.57	0.99	0.20	0.25
	4	19	2.1	9.43	1.07	0.06	0.51
	5	11	1.2	10.51	0.99	1.14	0.76
		921