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Stopover and fat accumulation in passerine birds in autumn at Ottenby, southeastern Sweden

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Abstract

Stopover duration and fat accumulation were studied during autumn migration at two sites near Ottenby, Öland, southeastern Sweden in 1985 and 1986. The species are Thrush Nightingale, Barred Warbler , Lesser Whitethroat, Whitethroat, Willow Warbler and Red-backed Shrike. We captured the birds in mistnets between 10 July and 20 August and recorded visually the fat class and measured the body mass. Post juvenile moult was scored on juvenile birds. In several of the species fat class and body mass increased with day of season (Thrush Nightingale, Barred Warbler and Whitethroat), while in the Lesser Whitethroat there was a reduction in fat class and body mass with day of season. Recaptures revealed that the highest daily increase in body mass was 2.7% in a Willow Warbler and a Red-backed Shrike, while a Barred Warbler showed a maximum daily body mass increase of 2.4%. The duration of stopover in migrants varied between 2 and 7 days.

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Introduction

The process of migration in birds is typically divided in periods of energy accumulation and flights in the preferred migratory direction. The rate of energy accumulation is usually much less than the rate of energy consumption during flight. Since the amount of energy accumulated at stopovers and the energy discharged during flights must balance, the main proportion of the time spent on migration is spent at stopovers. In some species, like in many shorebirds, the stopover sites are well defined sites along the migration route and the birds undertake long-distance flights between them (Piersma & Jukema 1990, Gudmundsson et al. 1991). However, for many passerines suitable stopover sites are abundant along the migration route and the migration of a population may rather be characterised as a continuous flow through the landscape towards the migration goal. It is the latter group of birds that we are concerned with in this paper.

The aim of the present study was to estimate fuel accumulation rate and stopover length during autumn migration in some passerine species. Our data are entirely observational and should be regarded as baseline data of the species' natural behaviour when

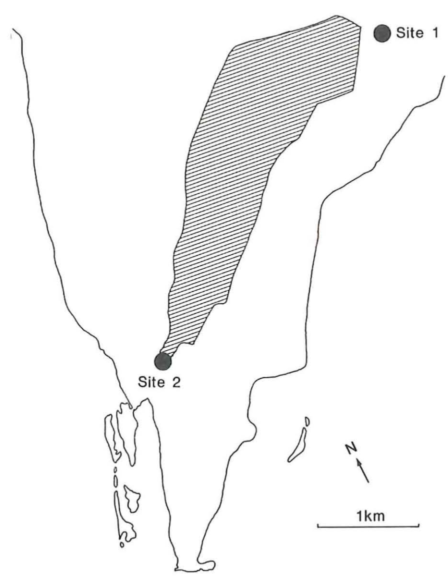

Fig.1. Map showing the Ottenby area with the study sites (1 and 2). Ottenby lund is shown as shadowed area.

Karta över Ottenbyområdet med de två studieplatserna. Ottenby lund markeras av det skuggade området.

Table 1. Mean fat class (7-grade scale for visual fat classification, see Pettersson & Hasselquist 1985) and mean mass (in g) at capture for juveniles (JUV 1=total number of juveniles, JUV 2=only juveniles classified within moult score 5 and 6) and adults in the different species, respectively. Standard deviation (SD), range and number of birds (N) are given.

För respektive art anges medelfettklass (enligt en 7-gradig skala för visuell klassificering av fett, se Pettersson & Hasselquist 1985) och medelvikt vid fångsttillfället för juvenila (JUV 1=totala antalet juveniler, JUV 2=juveniler inom pullstadium 5 och 6) och adulta fåglar. Standardavvikelsen (SD), spridningen (Range) och antalet individer (N) anges för respektive grupp.

Species *Art*	Age *Ålder*	Fat class *Fettklass*				Mass (g) *Vikt (g)*			
		Mean *Medel*	SD	Range *Spridning*	N	Mean *Medel*	SD	Range *Spridning*	N
Thrush Nightingale	JUV 1	3.3	1.4	1–6	152	28.4	2.0	20.1–31.0	151
Näktergal	JUV 2	3.9	1.3	1–6	93	25.2	2.0	21.9–31.0	93
	AD	2.9	1.4	1–5	9	24.1	2.2	21.7–28.3	8
Barred Warbler	JUV 1	2.7	1.4	1–6	92	24.3	2.1	21.0–32.5	92
Höksångare	JUV 2	3.5	1.6	1–6	31	24.9	2.6	22.2–32.5	31
	AD	2.9	1.6	0–6	23	24.6	2.0	21.8–28.5	23
Lesser Whitethroat	JUV 1	3.7	1.3	1–6	180	12.0	0.9	9.7–14.6	180
Ärtsångare	JUV 2	3.9	1.2	1–6	129	12.1	0.8	10.3–14.5	129
	AD	3.0	0.6	2–4	6	12.0	0.7	11.2–12.8	5
Whitethroat	JUV 1	2.4	1.5	0–6	260	14.8	1.1	12.4–18.9	260
Törnsångare	JUV 2	4.6	1.2	2–6	49	16.0	1.4	13.5–18.9	49
	AD	1.8	1.1	0–5	34	14.1	0.8	12.6–16.2	34
Willow Warbler	JUV 1	1.9	1.1	0–6	246	8.2	0.7	6.7–10.3	246
Lövsångare	JUV 2	2.6	1.1	1–6	81	8.2	0.7	6.8–10.3	81
	AD	1.8	1.3	0–3	5	8.0	1.1	6.7– 9.3	5
Red-backed Shrike	JUV 1	2.4	1.2	0–6	193	28.1	1.8	23.3–34.9	189
Törnskata	JUV 2	2.8	1.3	0–6	106	28.2	2.0	23.3–34.9	105
	AD	3.3	1.5	1–5	33	29.4	2.5	23.2–34.6	32

preparing for their first autumn migratory flight or when at stopover during the early phase of autumn migration. Our study site was on southern Öland, in southeastern Sweden. The study species were Thrush Nightingale *Luscinia luscinia,* Barred Warbler *Sylvianisoria,* Lesser Whitethroat *S. curruca,* Whitethroat *S. communis,* Willow Warbler *Phylloscopus trochilus* and Red-backed Shrike *Lanius collurio.*

Methods

We captured post-breeding and migrating passerines with mist nets at two sites at the edge of Ottenby lund, a luxurious deciduous forest (Fig. 1). One of the sites was Klockarängen, situated in the northeastern part of the area (site 1), while the other was Skogsudden, situated at the southwestern tip of Ottenby lund (site 2). The two sites are only 6 km and 2 km north of the southernmost point of Öland, where Ottenby Bird Observatory (56°12'N, 16° 24'E) is situated. The field work was carried out between 10 July and 20 August in 1985 and 1986. The habitat at both sites is characterised by high grass meadows with bushes of *Prunus, Crataegus, Rubus* and *Juniperus.*

Netting was carried out from dawn until about 11.00 hours. Birds were aged and sexed according to criteria described in Williamson (1968), Schmidt (1981) and Svensson (1984). We measured wing length (method 3; Svensson 1984), body mass to the nearest 0.1 g and scored visual subcutaneous fat according to a seven grade scale (Pettersson & Hasselquist 1985). Post-juvenile moult was scored on a six grade scale (Bensch & Lindström 1992). The same set of data was taken again on all birds recaptured after the day of first capture.

In statistical analyses we assigned 1 July as day 1. For significance tests of correlation coefficients the degrees of freedom are based on n-values as given in Table 1.

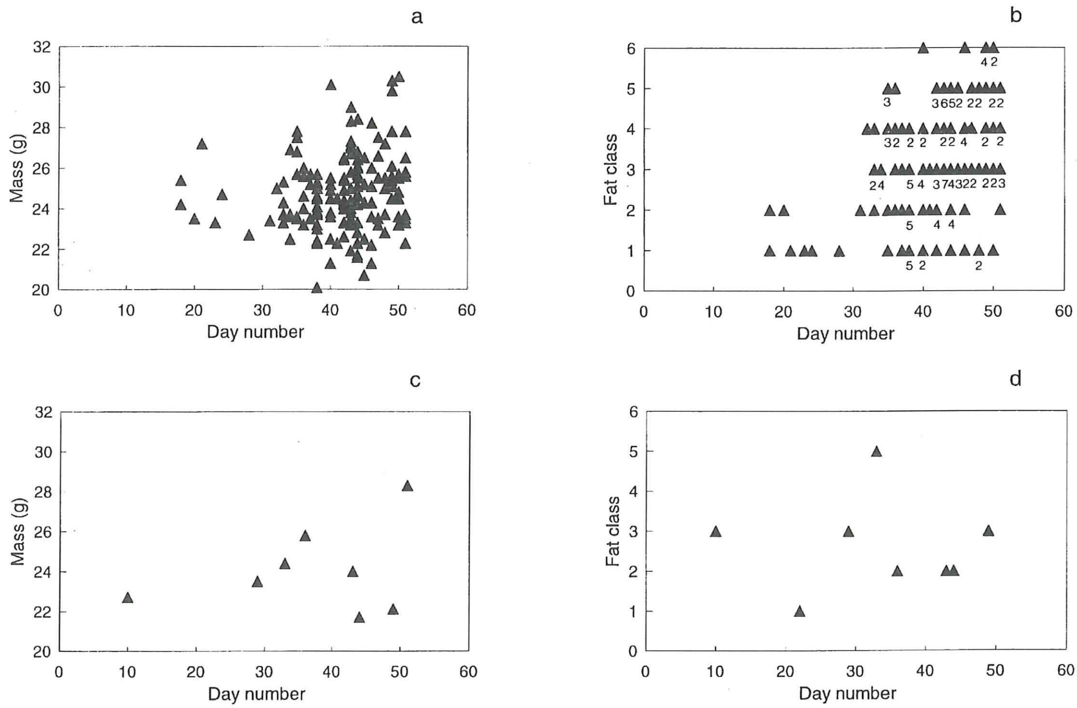

Fig. 2a–d. Body mass (g) and fat class (0–6) of juvenile (a and b, respectively; n=257) and adult (n=39) Thrush Nightingales (c and d) in relation to day of season caught between 10 July until 20 August in 1985 and 1986. Both captures and recaptures are included in the figure. Day number 1 corresponds to 1 July.

Vikt (g) och fettklass (0–6) för juvenila (a och b; n= 257) och adulta (n=39) näktergalar (c och d) fångade i Ottenby lund under perioden 10 juli till 20 augusti 1985 och 1986. Uppgifter från förstagångsfångade fåglar samt kontrollerade individer är inkluderade i figuren. Dag 1 representerar 1 juli.

Results

The overall patterns of body mass and fat class were similar at site 1 and site 2. Therefore, in the following presentation we pooled the data for the two sites. Mean mass and mean visually classified fat content for adult and juvenile birds are given for each species in Table 1. Since moult may affect fat deposition, we have also calculated mean fat and body mass for juvenile birds in their latest stages of post-juvenile body moult (scores 5 and 6; Table 1).

Overall pattern

Thrush Nightingale. In juveniles there was a significant increase in mass and fat class throughout the season (Fig. 2a and b), while for adults neither mass nor fat class showed significant correlations with day of season (Fig. 2c and d, significance levels and correlation coefficients are given in Table 2). Considering only juveniles of body moult score 5 and 6, there was a significant correlation between fat class and day of season, while the relationship between body mass and day of season tended to be significant (Table 2). The first juvenile caught in fat class 6 (highest score) was captured on 9 August. Obviously some individuals become very fat and substantially increase in body mass, especially towards the end of the study period (Fig. 2).

Barred Warbler. In both age groups there was a significant increase in body mass and fat class with season (Fig. 3a–d; Table 2). Considering only juveniles of body moult score 5 and 6, the relationship between body mass and day of season remained significant, while the relationship between fat class and day of season only tended to be significant (Table 2). The first birds with fat score 6 were captured on 2 August for juveniles and on 17 August for adults. The fattest and heaviest birds were captured towards the end of the study period.

Table 2. Coefficients of correlation between fat class (r_{fat}) or mass in g (r_{mass}) with day of season are given for adults (AD), all juvenules (JUV 1) and for juveniles in the two last stages of their post-juvenile body moult (scores 5 and 6; JUV 2) for the different bird species, respectively. Significance levels for the correlations are given *:p<0.05, **: p<0.01, ***: p<0.001.

*Korrelationskoefficienter för korrelationerna mellan fettklass (r_{fat}) eller vikt i gram (r_{mass}) med tid på säsongen är redovisade artvis för adulter (AD), samtliga juveniler (JUV1) och för juveniler i de senare två pullruggningsstadierna (5 och 6; JUV2). Då korrelationerna är signifikanta anges detta enligt följande signifikansnivåer: *: p<0.05, **: p<0.01, ***: p<0.001.*

Species *Art*	Age *Ålder*	r_{mass}	r_{fat}
Thrush Nightingale	JUV 1	0.17*	0.39***
Näktergal	JUV 2	0.20	0.22*
	AD	0.25	0.28
Barred Warbler	JUV 1	0.20*	0.38***
Höksångare	JUV 2	0.38*	0.34
	AD	0.57**	0.66***
Lesser Whitethroat	JUV 1	–0.16*	–0.19**
Ärtsångare	JUV 2	–0.20*	–0.23**
	AD	0.015	0.26
Whitethroat	JUV 1	0.24***	0.41***
Törnsångare	JUV 2	0.24	0.52*
	AD	–0.0057	–0.24
Willow Warbler	JUV 1	0.035	0.42***
Lövsångare	JUV 2	0.13	0.06
	AD	0.99***	0.27
Red-backed Shrike	JUV 1	0.08	0.19**
Törnskata	JUV 2	0.10	0.01
	AD	0.15	0.24

Lesser Whitethroat. Throughout the period there was a significant decrease in mass and fat score for juveniles (Fig. 4a and b), but not for adults (Fig. 4c and d; Table 2). These negative relationships remained when including only juvenile birds of moult score 5 and 6 (Table 2). In adults the highest fat score was 4 and in juveniles the first bird with the highest fat score (6) was captured on 2 August. The main passage of juveniles seemed to appear later in the season in the Lesser Whitethroat than in the other species (cf. Fig. 4 and Fig. 2–3, 5–7).

Whitethroat. There was a significant increase in mass and fat class over the season for juveniles (Fig. 5a and b; Table 2). The corresponding correlations for birds of moult score 5 and 6 were similar (Table 2). For adults the correlations between mass and fat with season were not significant (Fig. 5c and d; Table 2). In juveniles the earliest bird with the highest fat score (6) was captured on 11 August. In adults the fattest bird belonged to fat class 5 and was caught on 19 July.

Willow Warbler. In juveniles the correlation between body mass and day of season was not significant (Fig 6a; Table 2). However, there was a significant increase in fat class throughout the study period (Fig. 6b; Table 2). Among birds in the late stages of post-juvenile moult (moult score 5 and 6) the correlations were not significant (Table 2). In adults body mass increased significantly with day of season (Fig. 6c; Table 2), while there was no significant correlation between fat class and day of season (Fig. 6d; Table 2). One juvenile bird in fat class 6 was captured on 20 August.

Red-backed Shrike. The correlation between body mass and day of season was not significant for juveniles (Fig. 7a; Table 2), but the fat score increased throughout the period (Fig. 7b; Table 2). Including only birds of post-juvenile moult score 5 and 6 resulted in non-significant correlations (Table 2). In adults there was no significant correlation between mass or fat score with time of season (Fig. 7c and d; Table 2). The first juvenile Red-backed Shrike with fat score 6 was captured on 4 August.

Recaptures

Recaptures of birds staying in the area may give information on how much and how fast individual birds put on fuel in terms of body mass and visual fat class. The data on fat class and body mass changes in birds recaptured at least one day after first capture showed no clear pattern (Table 3). Mean daily changes of fat class as well as mean daily mass changes (related to mass at first capture) did not differ significantly from zero in any of the species except in juvenile Whitethroats, which showed a significant decrease in both measures (Table 3). However, the sample sizes were small in most cases which might explain the non-significant and rather confused pattern.

The highest individual daily increases in body mass recorded were 2.7% (body mass increase of mass at first capture) for a juvenile Willow Warbler, 2.7% for a juvenile Red-backed Shrike and 2.4% for an adult Barred Warbler.

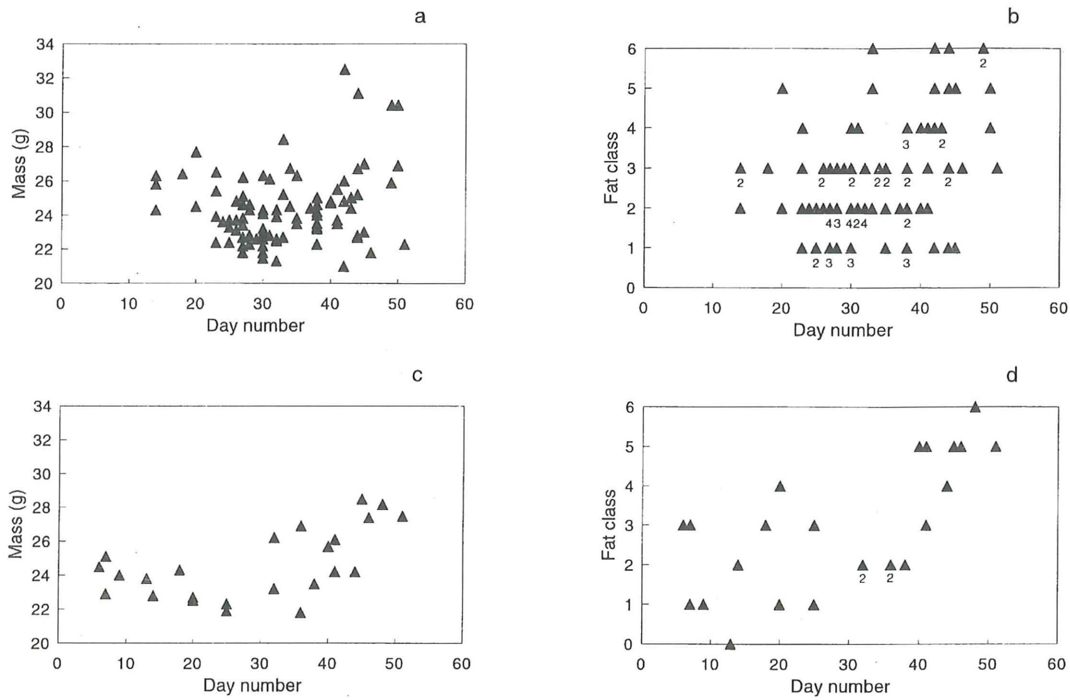

Fig. 3a–d. Body mass (g) and fat class (0–6) in relation to day of season for juvenile (a and b, respectively; n=93) and adult (n=24) Barred Warblers (c and d), respectively. For further information see Fig. 2.

Vikt (g) och fettklass (0–6) för juvenila (a och b; n=93) och adulta (n=24) höksångare (c och d). För vidare information se Fig. 2.

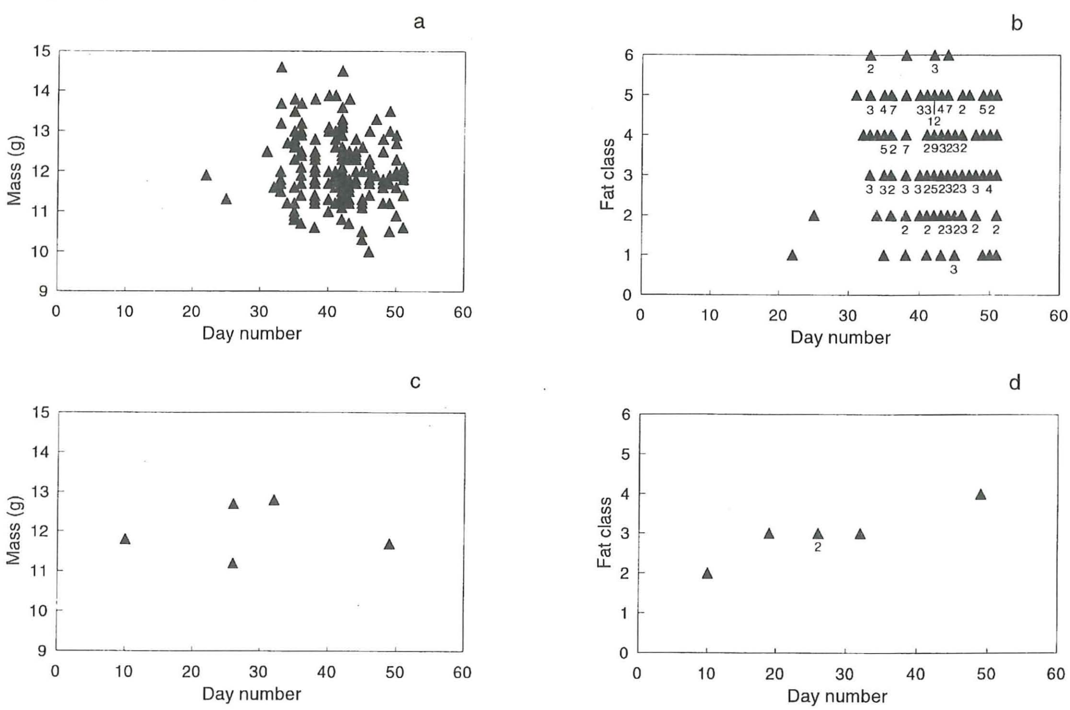

Fig. 4a–d. Body mass (g) and fat class (0–6) in relation to day of season for juvenile (a and b, respectively; n= 181) and adult (n= 6) Lesser Whitethroats (c and d), respectively. For further information see Fig. 2.

Vikt (g) och fettklass (0–6) för juvenila (a och b; n= 181) och adulta (n= 6) ärtsångare (c och d). För vidare information se Fig.2.

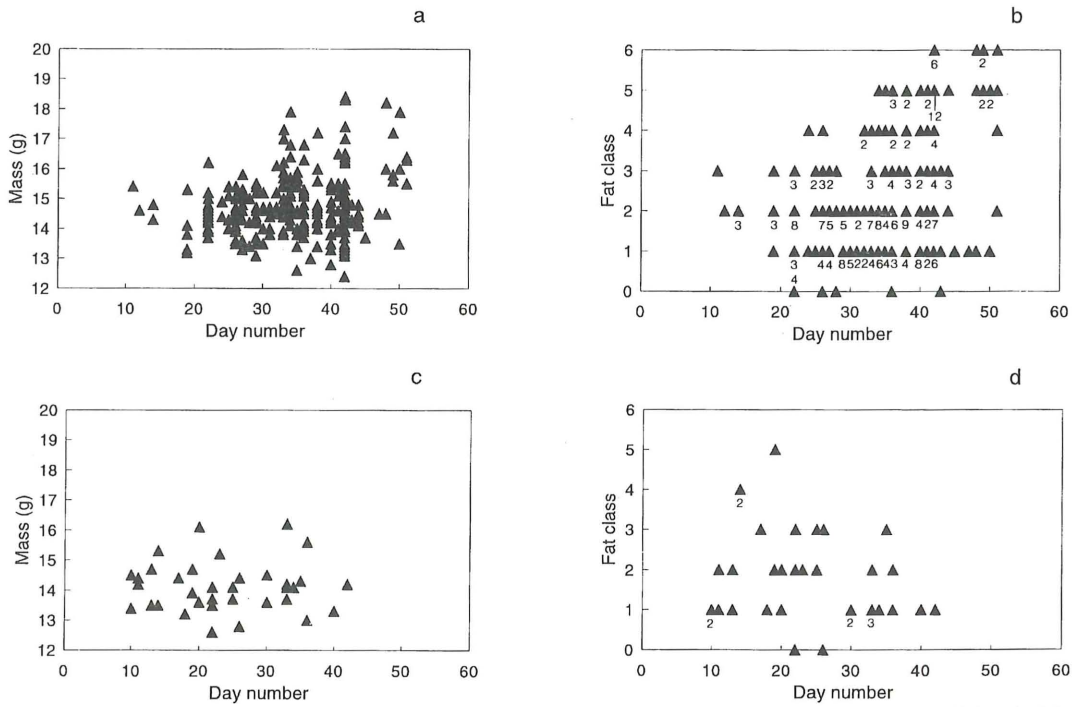

Fig. 5a–d. Body mass (g) and fat class (0–6) in relation to day of season for juvenile (a and b, respectively; n= 257) and adult (n= 39) Whitethroats (c and d), respectively. For further information see Fig. 2.

Vikt (g) och fettklass (0–6) för juvenila (a och b; n=257) och adulta (n=39) törnsångare (c och d). För vidare information se Fig. 2.

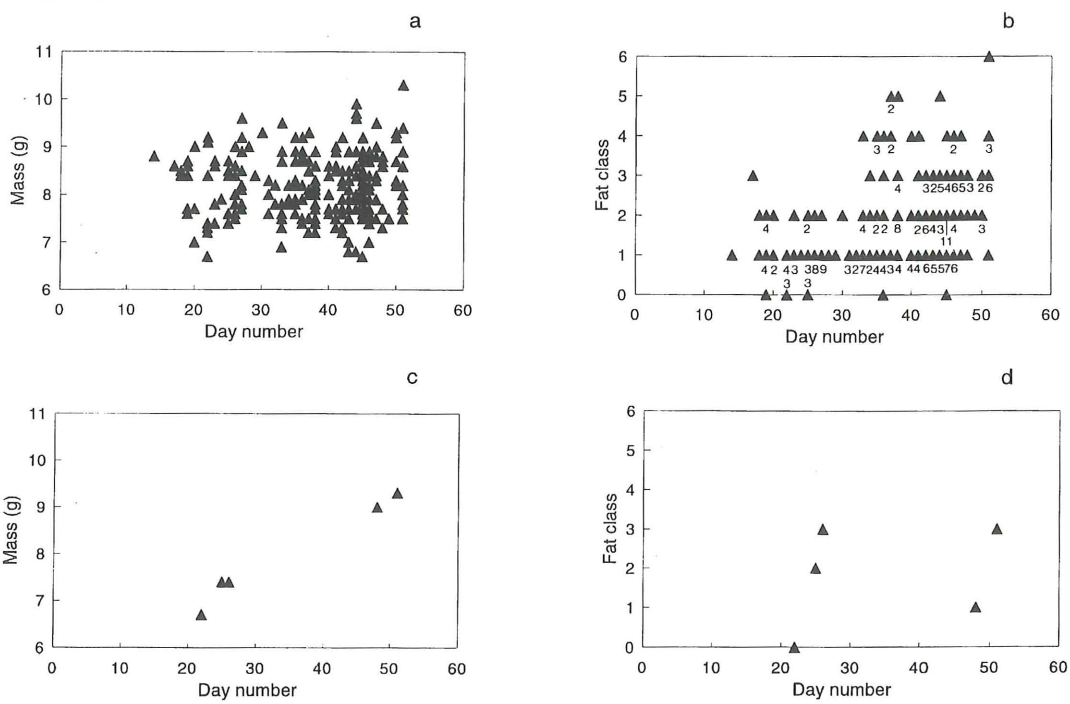

Fig. 6a–d. Body mass (g) and fat class (0–6) in relation to day of season for juvenile (a and b, respectively; n= 247) and adult (n= 5) Willow Warblers (c and d), respectively. For further information see Fig. 2.

Vikt (g) och fettklass (0–6) för juvenila (a och b; n= 247) och adulta (n= 5) lövsångare (c och d). För vidare information se Fig.2.

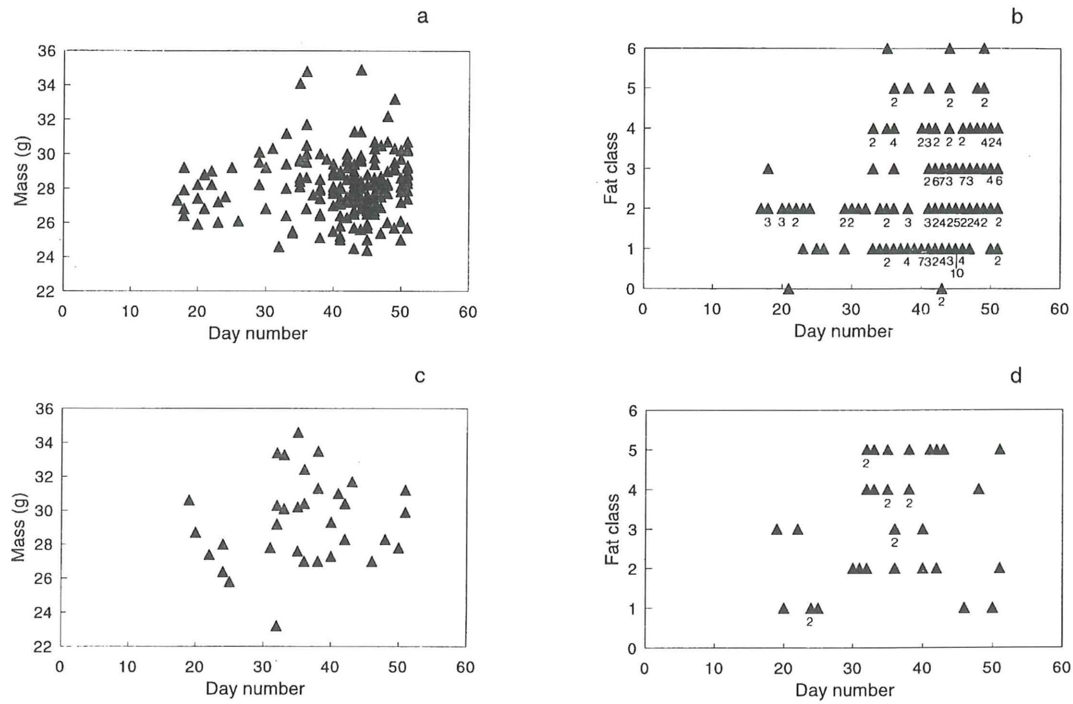

Fig. 7a–d. Body mass (g) and fat class (0–6) in relation to day of season for juvenile (a and b, respectively; n= 188) and adult (n= 34) Red-backed Shrikes (c and d), respectively. For further information see Fig. 2.

Vikt (g) och fettklass (0–6) för juvenila (a och b; n= 188) och adulta (n= 34) törnskator (c och d). För vidare information se Fig.2.

Table 3. Daily fat class change and daily body mass change (calculated as percentual change of mass when first captured per day) in birds recaptured at least one day after first capture at sites 1 and 2. Statistical analyses were made using t-tests and the significance level is denoted as *=P<0.05, **P<0.01.

*Daglig förändring i fettklass och kroppsvikt (beräknad som procentuell ändring i vikt från första vikt per dag) för fåglar som återfångats minst en dag efter första fångst vid plats 1 och 2. Signifikanta korrelationer markeras med *= P<0.05, **= P<0.01.*

Species *Art*	Age *Ålder*	Fat class change *Ändring i fettklass*	SD	Mass change (%) *Viktändring (%)*	SD	N
Thrush Nightingale	AD	0.35	0.21	0.66	0.42	2
Näktergal	JUV	–0.013	0.84	–0.34	1.56	10
Barred Warbler	AD	0.12	0.31	0.96	1.29	3
Höksångare	JUV	0.02	0.40	0.05	1.25	19
Lesser Whitethroat	AD	0.00	–	–	–	1
Ärtsångare	JUV	–0.33	0.58	–1.40	2.11	3
Whitethroat	AD	0.06	0.13	0.13	0.16	7
Törnsångare	JUV	–0.07**	0.15	–0.39*	0.92	35
Willow Warbler	AD	–	–	–	–	–
Lövsångare	JUV	–0.06	0.31	0.37	1.66	4
Red-backed Shrike	AD	–1.5	–	–0.88	–	1
Törnskata	JUV	0.12	0.42	–0.56	1.87	18

Table 4. Percent of ringed birds recaptured at least one day after first capture at site 1 and 2. Numbers of recaptured and ringed birds at the respective site are denoted within parentheses.

Proportionen ringmärkta fåglar som återfångats åtminstone en dag efter första fångsttillfället (i procent) vid plats 1 och 2. Antal kontroller och ringmärkta fåglar vid respektive plats är angivna inom parentes.

Species *Art*	Age *Ålder*	Site 1 *Plats 1*	Site 2 *Plats 2*
Thrush Nightingale	AD	0 (0/2)	50 (2/4)
Näktergal	JUV	11 (9/79)	1.6 (1/61)
Barred Warbler	AD	11 (3/26)	0 (0/4)
Höksångare	JUV	43 (18/42)	5.9 (1/17)
Lesser Whitethroat	AD	– (0/0)	2.5 (2/80)
Ärtsångare	JUV	1.0 (1/98)	2.5 (2/80)
Whitethroat	AD	40 (2/5)	36 (5/14)
Törnsångare	JUV	11 (14/132)	16 (22/134)
Willow Warbler	AD	0 (0/4)	0 (0/1)
Lövsångare	JUV	2.1 (3/143)	1.0 (1/102)
Red-backed Shrike	AD	6.2 (1/16)	0 (0/17)
Törnskata	JUV	11 (14/123)	8.5 (4/47)

Daily change in fat class and daily change in body mass were positively correlated in juvenile Barred Warblers (r= 0.79; P<0.001) and in juvenile Lesser Whitethroats (r=1.0; P<0.01), while the other species and age categories showed non-significant positive or negative correlations coefficients.

Length of stopover varied between 1 and 31 days with median lengths of stopover varying between 2 days for Willow Warblers and 7 days for Barred Warblers, being 4–5 days for the other species. The bird staying for 31 days was an adult Barred Warbler breeding in the area.

The proportional numbers of birds recaptured at least one day after first capture at the two sites are shown in Table 4. Age related differences in recapture frequency emerged in the Barred Warbler, where juveniles were more often recaptured than adults (C^2=4.14, df=1, P<0.05), while in the Whitethroat adults were more likely to be recaptured than juveniles (C^2=5.81, df=1, P<0.05).

Discussion

The results of this study clearly revealed a body mass increase with the course of the season for juvenile Thrush Nightingales and Barred Warblers. This increase was associated with increases in fat scores in these species. Fat score also increased with day of season for juvenile Whitethroats, Willow Warblers and Red-backed Shrikes. In juvenile Lesser Whitethroats there was a significant decrease in fat class with day of season. When including only birds with moult scores 5 and 6 in the analyses (corresponding to almost completed and completed post-juvenile moult, respectively), the patterns remained quite the same when including all juvenile birds. Among adult birds the sample sizes were substantially smaller than for juveniles, but the general trend with increasing body mass and fat class with the progress of the season was indicated.

Migratory birds are known to accumulate large amounts of fat just prior to the crossing of ecological barriers such as seas or deserts (body mass may increase by up to 100% due to fat accumulation), but when migrating over more benign areas they usually show low or moderate fat reserves (e.g. Alerstam 1990). In this perspective it could be interesting to compare body mass data of our study on southern Öland with published data from some other localities. The mean body mass of the Barred Warbler on Öland was slightly higher than that reported during winter in Ethiopia, and the heaviest bird on Öland was heavier than the heaviest spring migrating bird in Ethiopia (28 g; Ash 1994). For the Lesser Whitethroat the mean body mass was somewhat higher on Öland than during winter in Ethiopia (mean September–February: 11.3 g; Ash 1994). However, during spring migration in Ethiopia Lesser Whitethroats showed higher body masses (about 15% above winter mean body mass) with a maximum of 18.3 g (Ash 1994). Whitethroats have been studied in autumn at a site only about 120 km north of our study site (Larsson 1988). These birds showed slightly higher mean body mass (15.7 g) than on Öland and a substantially higher recapture frequency (31%), which indicates that they were using the site for fuel accumulation to a higher extent as compared to our study site. In England, Whitethroats showed no body mass change during moult, but thereafter body mass increased by 30% with masses up to 22 g (Boddy 1983). Whitethroats preparing for spring migration in Ethiopia also showed substantial body mass increases (mean of 4 birds caught in May: 20.7 g; Ash 1994). Finally, Willow Warblers and Red-backed Shrikes showed low and moderate body masses on Öland. However, maximum masses recorded for Red-backed Shrikes (35 g) are of equal magnitude as for birds preparing to cross the Sahara (Moreau 1969, Pearson 1970). To conclude this comparison, we note that most species on southern Öland show low to moderate mean fat loads and body masses. Individuals of Thrush Nightingale, Barred Warbler and Red-backed Shrike may show very high body masses. This might be associated with a more southerly to southeasterly migration direction in these species involving an immediate flight across the Baltic Sea, while the other species (except the enigmatic Lesser Whitethroat) mainly migrate towards southwest over land.

When tracking what happened with respect to body mass and fat class to birds trapped more than once, a less clear picture emerged. This seems strange since an increase of mass and fat within the population should be reflected also by individuals fattening up. One explanation could be that we have a sequential passage of different populations with different characteristic fat levels and masses, and individual birds staying in the area and failing to accumulate fat. However, we think this is an unlikely explanation since we know from ringing that many birds of the study species breed in the area. Some individuals stayed in the area for more than three weeks and the birds recaptured after a longer stay generally showed a positive change in fat class. That birds arriving at a stopover first lose mass and then start to gain mass is a well known phenomenon (e.g. Mascher 1966, Mehlum 1983, Hansson & Pettersson 1989). This can be due to the time lag after arrival before the bird obtains access to a feeding territory (Rappole & Warner 1976, Bibby & Green 1980, Carpenter et al. 1983) or unfamiliarity with a new site (Hansson & Pettersson 1989). However, this can hardly be the explanation for the locally breeding birds losing mass or gaining mass very slowly. An alternative explanation which may apply to these birds is the possible trauma and associated mass decrease that they experience from being caught and handled.

Alerstam & Lindström (1990) compiled data on body mass gain rates for a sample of passerine species and found a median value of 2.4% (daily mass increase of lean body mass), which is similar to our maximum recordings of rate of mass gain. A Bluethroat held in captivity gained 4.5% of its lean body mass per day (Kvist et al. 1993), probably showing the limit of the potential capacity of gaining fuel. However, Bluethroats at stopovers in the field seem to gain mass at a much lower rate (Lindström & Hasselquist 1989, Ellegren 1991, Lindström & Alerstam 1992). The retrapped birds in this study showed very small mass gains or even mass losses as found for the Whitethroat (Table 3). A plausible explanation to the slight mass and fat gain in adults is that these birds undergo their major annual moult during the actual period, which is an energetically very costly activity (Lindström et al. 1993). Also juvenile birds undertake a partial body moult including body feathers during the period of study (cf. Norman 1990), which might be a reason for the relatively modest rates of fat accumulation also among juveniles.

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Sammanfattning

Rastning och fettpålagring hos tättingar i Ottenby, sydöstra Sverige.

Fåglars flyttning består dels av perioder då flygbränsle, främst i form av fett, lagras i/på kroppen på rastplatser och dels av flygperioder då fåglarna omsätter sina bränslereserver för att transportera sig i riktning mot flyttningsmålet. I allmänhet spenderar fåglarna en längre tidsperiod på rastplatser relativt flygtiden, eftersom det tar längre tid att lagra på sig fett än att konsumera det under flygning. I den här studien presenterar vi data på fettklass, vikt och rastningstidens längd under höstflyttningen för några arter tättingar. Våra data utgörs av observationer av naturligt flyttande fåglar som infångats på rastplatser innan de ger sig av på sin höstflyttning. Undersökningen genomfördes vid Ottenby lund på Södra Öland där vi studerat följande arter: näktergal *Luscinia luscinia*, höksångare *Sylvia nisoria*, ärtsångare *S. curruca*, törnsångare *S. communis*, lövsångare *Phylloscopus trochilus* och törnskata *Lanius collurio*.

Metoder

Vi fångade fåglarna efter avslutad häckning och under flyttningen med hjälp av slöjnät vid två platser i kanten av Ottenby lund, som är en rik lövskogsbiotop. Klockarängen (plats 1, se Fig. 1) är belägen i nordöstra delen av studieområdet, medan den andra fångstplatsen (Skogsudden, plats 2, se Fig. 1) ligger vid den sydvästra spetsen av Ottenby lund ungefär 2 km norr om Ölands södra udde och Ottenby Fågelstation (56°12'N, 16°24'E).

Fältarbetet utfördes mellan 10 juli och 20 augusti under 1985 och 1986. Biotopen vid de två fångstplatserna (plats 1 och 2), karaktäriseras av högvuxen gräsmark med inslag av buskar av släktena *Prunus*, *Crataegus*, *Rubus* och *Juniperus*. Fågelfångst företogs från gryning till ungefär kl. 11.00. Fåglarna ålders- och könsbestämdes enligt kriterier i Williamson (1968), Schmidt (1981) och Svensson (1984). Vi mätte vinglängd till närmaste hel mm (metod 3, Svensson 1984), kroppsvikt till närmaste 0.1 g, uppskattade visuellt mängden fett enligt en sjugradig skala (Pettersson & Hasselquist 1985) och klassificerade ungfåglarnas kroppsruggning enligt en sex-gradig skala (Bensch & Lindström 1992). Dessa mått upprepades på de individer som återfångades minst en dag efter första fångsttillfället. I den statistiska analysen satte vi 1 juli som dag 1.

Resultat

Mönstret för kroppsvikt- och fettklassvariation var mycket likartat vid de två fångstplatserna, varför vi slagit samman materialet från dessa båda platser. Medelvärden för vikt och fettklass för de olika arterna och ålderskategorier presenteras i Tabell 1. Medelvärden för juvenila fåglars vikt och fettklass i ruggningsstadium 5–6 (nästan färdig och färdig kroppsruggning) presenteras likaså i Tabell 1.

Generellt mönster

Näktergal: För ungfåglar ökade vikt och fettklass hos de fångade individerna med säsongen (Fig. 2a och b, signifikansnivåer och korrelationskoefficienter anges i Tabell 2), medan för adulter varken korrelationen mellan vikt eller fett och dag på säsongen var signifikant (Fig. 2c och d). Första ungfågeln i den högsta fettklassen fångades den 9 augusti.

Höksångare: Vikt och fettklass ökade signifikant under fångstperioden för både juveniler och adulter (Fig. 3a–d; Tabell 2). De första fåglarna med den högsta fettklassen fångades 2 augusti för juveniler och 17 augusti för adulter.

Ärtsångare: Under säsongen minskade vikt och fettklass signifikant för juveniler (Fig. 4a och b), men inte för adulter (Fig 4c och d; Tabell 2). Högsta fettklassen för adulter var endast klass fyra, medan den fetaste ungfågeln (klass 6) fångades den 2 augusti. Huvudpassagen av ungfåglar verkade ske senare på säsongen för ärtsångare jämfört med övriga arter.

Törnsångare: Fett och vikt ökade signifikant under fångstperioden för unga törnsångare (Fig. 5 a och b), men inte för adulta (Fig. 5c och d; Tabell 2). Den första ungfågeln med fettmängd motsvarande klass sex fångades 11 augusti, medan den fetaste adulten tillhörde fettklass fem.

Lövsångare: För ungfåglar ökade fettklass med dag på säsongen medan vikten inte ökade signifikant under perioden (Fig. 6a och b; Tabell 2). För adulta lövsångare var förhållandet omvänt då vikten ökade med säsongen och det fanns inte något samband mellan fettklass och tid under fångstperioden (Fig. 6c och d; Tabell 2). En ungfågel med fettklass sex fångades den 20 augusti.

Törnskata: Det var inte någon korrelation mellan vikt och dag på säsongen för juvenila törnskator, men fettmängden ökade i den senare halvan av perioden (Fig. 7a och b; Tabell 2). För adulter kunde inget samband mellan vikt eller fettklass och tid på säsongen konstateras (Fig. 7c och d; Tabell 2). Den första juvenila törnskatan tillhörande den högsta fettklassen (6) fångades den 4 augusti.

Återfångster

Uppgifterna om förändring i fettklass eller kroppsvikt hos fåglar som kontrollerats minst en dag efter första fångsttillfället gav inget klart mönster (Tabell 1). Medelförändring i vikt eller fettklass per dag, relativt första fångstdag skilde sig inte signifikant från noll för någon av studiearterna, med juvenila törnsångare som enda undantag och som uppvisade en signifikant minskning i båda måtten (Tabell 1).

Den högsta individuella dagliga ökningen i kroppsvikt var 2.7% (ökning av kroppsvikt relativt första fångsttillfället) för en juvenil lövsångare, 2.7% för en juvenil törnskata och 2.4% för en adult höksångare.

Daglig förändring av fettklass och kroppsvikt var positivt korrelerade för unga höksångare (r=0.79; p<0.001) samt för unga ärtsångare (r=1.0; p<0.01), medan övriga arter och ålderskategorier visade ickesignifikanta positiva eller negativa korrelationer.

Rastningstiden varierade mellan en och 31 dagar, med medianrastningslängd varierande mellan två dagar för lövsångare och sju dagar för höksångare, och mellan 4–5 dagar för övriga arter. De längsta rasttiderna härrör sannolikt från lokala häckfåglar i området.

Proportionen fåglar som återfångats åtminstone en dag efter första fångsttillfället vid de båda platserna visas i Tabell 3. Unga höksångare återfångades oftare än adulta (c^2=4.14, df=1, p<0.05) medan motsatsen gällde för törnsångare (c^2=5.81, df=1, p<0.05).

Diskussion

Resultaten av studien visar tydligt att kroppsvikten och fettmängden ökade med säsongen för juvenila näktergalar och höksångare. Fettklass ökade under perioden även för juvenila törnsångare, lövsångare och törnskator. För juvenila ärtsångare minskade däremot fettklassen med dag på säsongen. Generellt fångades färre adulter jämfört med juveniler, men en tendens till ökande fettreserver och kroppsvikt kunde ändå konstateras.

Vid en jämförelse av vikter hos fåglarnas i denna studie med vikter rapporterade från andra platser fann vi i genomsnitt ganska låga eller måttliga vikter hos Ölandsfåglarna. Det fanns dock undantag bland näktergal, höksångare och törnskata där åtminstone vissa individer uppvisar stora fettmängder och vikter, fullt jämförbara med värden registrerade hos fåglar av dessa arter som just skall flyga över Sahara.

En möjlig förklaring till att vi inte kunde se någon allmän tendens till ökning av vikt eller fettklass bland kontrollerna under perioden kan vara att fångstplatserna berörs av successivt passerande populationer, med olika typiska fett och viktnivåer och att fåglarna misslyckas att lägga på sig fett i området. Vi anser dock att detta inte är en trolig förklaring, eftersom vi vet från ringmärkning att många av studiearterna häckar i området. Noterbart är dock att några individer stannade längre tid i området (>3 veckor) och fåglar som återfångades efter längre tid visade generellt en ökning i fettklass. Många fåglar ruggade under perioden vilket kan förklara de små eller obetydliga viktökningar, eftersom ruggning är en energikrävande process.