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Two migratory flights of Sedge Warblers *Acrocephalus schoenobaenus* from Finland to Estonia

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Abstract

We examined two cases of first-year Sedge Warblers *Acrocephalus schoenobaenus* which were ringed in Finland and recovered in Estonia on the following day. Environmental/meteorological conditions during the nights of the migratory flights are discussed, together with the possible ground speed of birds. The birds lost 1.0 and 1.2 g, respectively, probably entirely from their fat reserves. On the basis of the estimated ground speed of the birds, energy expenditure for migratory flight is discussed. One estimate, 10.9 times BMR, is very close to generally accepted values (10–12 times BMR). The other, 20.6 times BMR, may be an overestimate, but we speculate that it reflects in increased cost of flight in a cold front.

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Introduction

Bird migration consists of periods of migration flight interrupted by refuelling at stopovers. Ringing is the most widely used method of bird migration research, potentially useful when tackling problems at specific, population and individual levels (Berthold 1996). Data from birds trapped just before flight and immediately after landing can reveal information about flight direction and length. Although many passerines of various species are trapped and ringed in northern and central Europe, data on short-term recoveries are scarce (Payevsky 1973, Hildén & Saurola 1982, Ellegren 1993, Rezvyi et al. 1995, Bolshakov et al. 1999).

Material and methods

We present data on two short-term recoveries of juvenile Sedge Warblers *Acrocephalus schoenobaenus*. Both birds were trapped and recovered within a 24 hour period during their first autumn migration. Both birds were weighed before and after the flight, which allowed the estimation of fuel expenditure.

HELSINKI X 155794
60°12'N 24°49'E Espoo, Uusimaa, Finland
07/08/1992 14.1 g
58°25'N 26°04'E Vaibla, Viljandi, Estonia
08/08/1992 13.1 g 9h
Distance 210 km, direction 160°.

HELSINKI X 584281
59°49'N 22°54'E Tulliniemi, Hanko, Uusimaa, Finland 11/08/1995 13.6 g
58°05'N 24°30'E Häädemeeste-Pulgoja, Pärnu, Estonia 12/08/1995 12.4 g
Distance 181 km, direction 149°.

All the details of ringing and recovery were not available, but most probably both birds were ringed and recovered in the morning. Pre-flight body conditions (lean weight of Sedge Warblers is approx. 10.5 g) suggest that autumn migration was involved. Both flights were conducted in the season when Estonian Sedge Warblers start southward migration, and post-juvenile dispersal is succeeded by true autumn migration (Chernetsov 1998). In the Finnish population the onset of autumn migration probably occurs at around the same time.

Acrocephalus warblers are known to be nocturnal migrants (Cramp 1992). Until recently it was believed that small passerines start migratory flights at twilight, usually 30–45 minutes after sunset (Kerlinger & Moore 1989, Alerstam 1990). Recent data shows that some passerines take off later during the night (Åkesson et al. 1996, Moore & Aborne 1996). Nocturnal passerine migrants can land also during any part of the night (Bolshakov 1981a). We are therefore not able to estimate the time of take-off or of landing, or how long the Sedge Warblers were flying. Only one way of estimating the flight duration is available for us, namely from known distance and estimated ground speed. With air speed of small passerines being about 10 $m \cdot s^{-1}$ (Biebach 1990), in still air the first Sedge Warbler should have flown for 5.8 h, and the second one for 5 h (the time between sunset and sunrise at this season is approx. 8.2 hours). In a real situation we need to know the ground speed to estimate flight duration. For this estimate, data on wind speed and direction at flight altitudes along the migratory route are necessary. We used the data on high-altitude wind from Jokioinen Weather Observatory (60°49’ N, 23°30’ E). In both cases only the data from the end of the night was available (ca. 1.5 hours before local sunrise). At Tallinn Weather Observatory the data on high-altitude were available only for the morning hours (3 hours after sunrise) and for one date (9 August 1992), thus this data was not included in the analysis. Further information was derived from the weather maps for the dates in question.

The average speed and direction of the wind used for the estimation of ground speed, was calculated for the altitude 300–500 m, which is a typical altitude of nocturnal migrants flying over water in Northern Europe (Bolshakov 1981b, Jellmann 1989).

The major problem for the analysis of flight cost is that all body mass loss recorded must be dependent on the flight. Both birds were most probably in the end of loading fuel. Their body mass may be expected to have been stable if measured on two consecutive mornings if they had not performed a flight. Thus, we assume that body mass loss may be attributed to flight. Though this assumption is rather shaky, we have no better approach to deal with this problem.

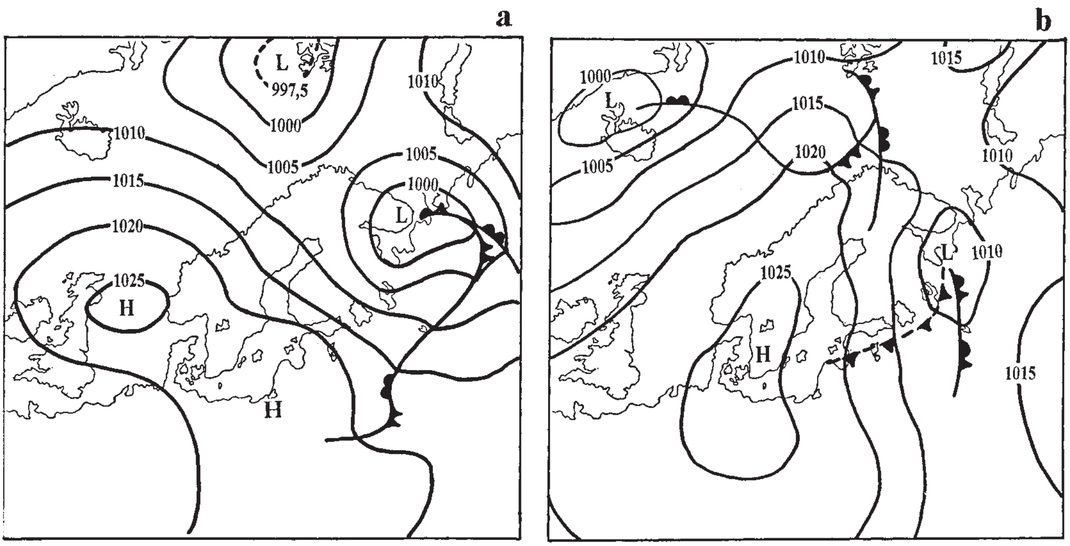

Figure 1. Low and high pressure systems over Northern Europe, warm (semicircles) and cold (triangles) fronts on nights of migratory flights: (a) 8 August 1992, 02:00 h; (b) 12 August 1995, 02:00 h.
Låg- och högtryckssystem över norra Europa med varmfronter (halvcirklar) och kallfronter (trianglar) markerade för de aktuella flygnätterna för två sävsångare. (a) 8 augusti 1992, kl. 02:00; (b) 12 augusti 1995, kl. 02:00.

Results

Synoptic situation and wind speed at flight altitude

Sedge Warbler X 155974 was flying on the night of 7/8 August 1992, probably under low cloud cover on the N and NE periphery of a high pressure system centred over the SE Baltic and Poland (Figure 1a). Wind direction at 300–500 m a.s.l. varied between 284° and 295° (mean 291°), while its velocity varied between 8 and 11 m/s, mean 9.3 m/s. At 500–1000 m and 1000–1500 m a.s.l. W and NWW winds were recorded with a mean velocity of 15.7 and 15.0 m/s, respectively.

Sedge Warbler X 584281 was flying on the night of 11/12 August 1995 when a high pressure system dominated central Europe and Scandinavia. The high lay on a N–S axis, which provided a stable air flow from the Barents Sea towards the Gulf of Finland. The intensity of this flow was supported by a low pressure area over European Russia, which was followed by secondary cold fronts. One of them was to the N of Helsinki at sunset, and to the S of Tallinn 1.5 hours before sunrise (Figure 1b). This suggests that the second bird was, at least in part, flying with the cold front. At the probable flight altitude (300–500 m a.s.l.) the average wind direction was 357°, its velocity 10.5 m/s, at 500–1000 m a.s.l. 354° and 11,0 m/s, correspondingly. At 1000–1500 m a.s.l. the wind was also N with a velocity of about 12 m/s.

We assume that air speed of flying birds was ca. 10 m/s (Biebach 1990), and was constant throughout the flight. The ground speed of the first bird on 7/8 August 1992 in a wind vector of an average 291° at 9.3 m/s was then 13.1 m/s (47.2 km/h). Its estimated flight duration was 4.4 h. The second bird on 11/12 August 1995 in a wind vector of on average of 357° at 10.5 m/s was flying 17.8 m/s (64.1 km/h). Estimated flight duration was 2.8 h.

Energy analysis

Weight loss during the flights was 1.0 g and 1.2 g, respectively. The caloric value of mass loss during migratory flight is high and practically reaches the caloric value of fat, 39 kJ/g (Dolnik & Gavrilov 1971, Dolnik 1995). Energy loss was 39 kJ in the first bird and 46.8 kJ in the second one. In the literature we found two different values of basal metabolic rate (BMR) in the Sedge Warbler: 18.8 kJ/day (Gavrilov & Dolnik 1985) and 20.2 kJ/day (Lindström & Kvist 1995). We used the average of these values (19.5 kJ/day) and found that during the migratory flight our birds consumed energy equal to 2 and 2.4 the daily BMR. If we assume that flight duration was 4.4 and 2.8 hours (see above), the costs of flight become 8.9 and 16.7 kJ/h, or 10.9 and 20.6 times BMR, respectively.

Discussion

Unfortunately, the exact time of recovery is only known from one bird. The crucial measures of body mass right before and right after the flight periods are approximate. Further, we assumed that fat was the only substrate of metabolism during the flights, which is not the case according to current knowledge. Nevertheless, the final mass was high enough in both birds to suggest that the amount of non-fat fuel metabolised was low. We suggest that our results may be a rough estimate of flight costs, though more exact data are needed for refined analyses.

The first value is very close to 10 times BMR as suggested by Berthold (1996) and to 12 times BMR given by Dolnik (1995) as flight cost estimate. The second value (20.6 times BMR) seems to be an overestimate. It is however noteworthy that this bird was very limited in its choice of alternative wind conditions on that night. Only near the ground (170–230 m a.s.l.) was the wind weaker (344°, 7.7 m/s). The estimated ground speed was then 17.1 m/s (61.6 km/h), which yields a slightly higher flight duration of 2.9 h. Secondly, it is not entirely improbable that the value 20.6 times BMR reflects the very high flight cost in the cold front. Due to high turbulence in such conditions, flight cost of aeroplanes is much increased, and it is considered undesirable to fly in cold fronts (Baranov et al. 1971). We speculate that increased air turbulence causes high flight cost in migrating birds as well. Migrating birds are known to avoid flying in such conditions (Richardson 1978, 1990, Alerstam 1990).

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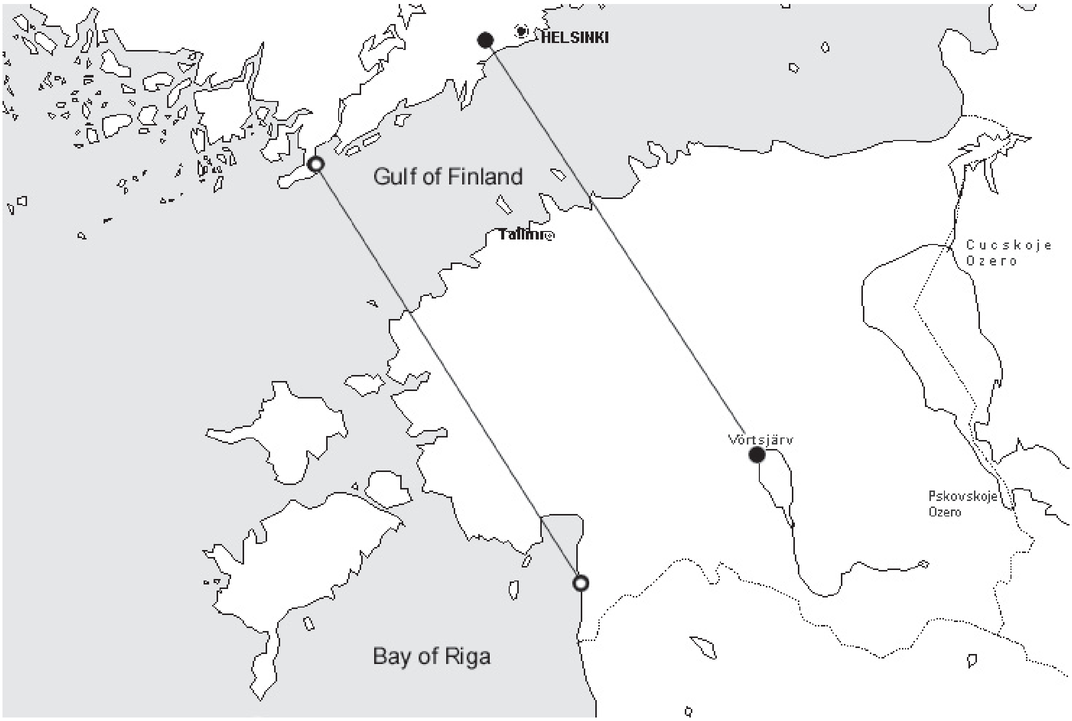

Figure 2. Flight tracks of two Sedge Warblers ringed in Finland and controlled the day after ringing in Estonia (●) bird #1, (❍) bird #2.
Flygsträckor hos två sävsångare som ringmärkts i Finland och kontrollerats i Estland dagen efter ringmärkning (●) fågel #1, (❍) fågel #2.

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Sammanfattning

Snabbkontroller av två sävsångare Acrocephalus schoenobaenus *mellan Finland och Estland*

Flygkostnaden är proportionell mot massförlusten hos fåglar. Den största delen av flygbränslet hos fåglar i vattenbalans utgörs av fett. Genom att känna den förlorade massan under flygningen kan energiförbrukningen beräknas genom att multiplicera massförlusten med energiinnehållet för fett (39 kJ/g). Detta ger en något överskattad energimängd eftersom det är känt att fåglar även förbrukar en viss mängd protein under flygningen (som har en lägre energitäthet än fett). Om man dessutom känner flygtiden kan effektförbrukningen beräknas genom att dividera energiförbrukningen med tiden. Vi analyserade massförlusten för två sävsångare som ringmärkts i Finland och kontrollerats av ringmärkare i Estland dagen efter ringmärkningen. Exakta tiden för flygstart var inte kända och vi gjorde därför antaganden vad gäller flyghastigheten relativt den omgivande luften (10 m/s) och flyghöjd. Därefter beräknades flygtiden utifrån flyghastighet, vindhastighet och vindriktning. Beräknad flygtid var 4,4 timmar respektive 2,8 timmar för de två sävsångarna. Förlorade massan uppgick till 1,0 g respektive 1,2 g, vilket kan omräknas till 8,9 kJ/timme respektive 16,7 kJ/timme. Ofta relateras effektförbrukningen till basalmetabolismen (BMR), som speglar effektförbrukningen hos ett djur i vila, mörker och utan föda i mag-tarmkanalen. Basalmetabolismen hos en sävsångare är ca 19,5 kJ/dag. Uttryckt som multipler av BMR var effektförbrukningen 10,9xBMR respektive 20,6xBMR för de två sävsångarna. Värden omkring 10xBMR är ett typiskt värde för effektförbrukning hos en tätting av sävsångarens storlek, vilket också erhölls för den ena fågeln. Den andra fågeln uppvisade en beräknad effektförbrukning ca två gånger högre än förväntat värde. Vädret vid den aktuella flygningen dominerades av en kallfront och vi spekulerar att flygning genom en kallfront kan vara förenat med förhöjda flygkostnader.