

## Stopover ecology of migratory Sedge Warblers (*Acrocephalus schoenobaenus*) at Eilat, Israel

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Migrating Sedge Warblers *Acrocephalus schoenobaenus* were captured in Eilat, Israel, during their spring and autumn migration. Data on spring and autumn body masses, their interannual variation and the pattern of fuel accumulation were analysed. Body mass and body condition index significantly varied between the years of study in spring but not in autumn. This may be due to birds over-flying the area, but loop migration might also be involved. Sedge Warblers gain mass in Eilat, both in spring and in autumn. Birds in poor initial condition and those stopping over for a longer period gained more body mass faster. In spring, but not in autumn, the progress of the season was another important factor: late birds gained more body mass. The average rate of body mass gain was  $0.179\text{g day}^{-1} \pm \text{SE} = 0.026$ . This suggests that Eilat is an important staging area for Sedge Warblers in spring and to a smaller extent in autumn.

### Introduction

The birds that migrate between their Palaearctic breeding grounds and sub-Saharan winter quarters have to cross a desert belt in north Africa that is wider in the east than in the west. Many of the migrants stop in Israel because it is the last favourable stopover area for them during autumn, before crossing the Sahara on their way to east Africa. In spring, it is one of the first suitable places they encounter after crossing the Sahel, Sahara and Sinai deserts (Frumkin *et al.* 1995, Shirihai 1996). Eilat is the southernmost point in Israel and plays an important role as a stopover area for many passerine migrants (Safriel 1968, Frumkin *et al.* 1995, Morgan and Shirihai 1997, Yosef and Tryjanowski 2002a).

Migration and, more specifically, stopover ecology of Sedge Warblers (*Acrocephalus schoenobaenus*) is a subject of intensive study (Bibby *et al.* 1976, Koskimies and Saurola 1985, Celminš 1990, Ormerod 1990, Ormerod *et al.* 1991, Csörgö and Ujhelyi 1991, Literák *et al.* 1994, Gyurácz and Bank 1995, 1996, Bascuitti *et al.* 1997, Chernetsov 1996, Chernetsov and Titov 2001). However, most of the studies focused on the stopover patterns of birds migrating through continental Eurasia, and only few examined the patterns found just immediately before, or after, their crossing of a major geographical barrier (Bibby and Green 1981, Grandio 1998a, 1998b, 1999, Bermejo and De la Fuente 2002, Rubolini *et al.* 2002).

The aim of this study is to characterise the migration strategy of Sedge Warblers based on the data of birds trapped at the banding station of the International Birding and Research Center in Eilat, just before and after the crossing of the combined barrier of the Sahel, Sahara and Sinai deserts on the eastern Mediterranean flyway. We hypothesise that in autumn, the birds should accumulate fat before crossing the desert, and in spring they should refuel after the flight across the extensive desert barrier. We analysed the

change of body mass on the basis of recaptures, and also considered the interannual variation of the condition of the birds. This variation indicates the extent to which the migratory strategy of the Sedge Warbler depends on the environment (flight and foraging conditions) in each of the years.

### Study area and methods

Eilat (29°33N, 34°57E; Figure 1) is located at the northern tip of the Gulf of Aqaba/Eilat and is critical for many migrants. In spring, it is reached after a flight of almost 2 000km of continuous desert regions; to the northeast there are still 650km more of the Syrian Desert, and due east the vast Arabian Desert. Hence many birds are enticed to land in the green areas that surround Eilat and to stop over before (in autumn) or after (in spring) crossing the arid areas (Morgan and Shirihai 1997).

Due to changes in locations of the ringing station within a 5km radius, trapping effort has not been constant. However, we analysed the data for all 36 seasons from spring 1984 to autumn 2001 (18 years) assuming that the changes in location of the ringing site did not affect the results attained pertaining to the migratory patterns and the biometrics of the study species.

Birds were mist-netted and each bird was ringed and aged and sexed (whenever possible) by external characters (Svensson 1992). Flattened maximum wing chord and tail were measured using a graded wing-ruler ( $\pm 1\text{mm}$ ), and body mass was determined with a Pesola 50g ( $\pm 0.5\text{g}$ ) spring balance. We used a measure of bird condition wherein we took wing-length as an index of body size (Pearson 1971) and factored the effect of size on body mass by calculating the condition index (expressed as mass/wing-length ratio, Safriel and Lavee 1988). We used only data from the first



**Figure 1:** Geographical location of Eilat, Israel, at the junction of the three continents Europe, Asia and Africa; and at the northern edge of the Sinai, Sahara and Sahel deserts of north Africa

captures to calculate the biometrical characteristics. All retraps were weighed with the same accuracy, and data from the first and the last capture were used in the analyses.

As an estimate of stopover duration, we used the minimum stopover length, i.e. the number of days between the last and the first capture of an individual. The use of this parameter has a number of weak points as compared with Cormack-Jolly-Seber models (Dolnik 1990, Kaiser 1995, 1999, Chernetsov and Titov 2000, Schaub *et al.* 2001) but allows estimates of stopover length of individual birds that was essential for the purpose of this study.

## Results

### Interannual variation of the condition of the birds

In spring, both body mass and condition index varied significantly between the years (Table 1). We pooled all birds captured in spring for the calculations of their condition.

In autumn, both body mass and condition index differed between hatching year (HY) and after hatching year (AHY) individuals (body mass, HY:  $10.76 \pm 1.86\text{g}$ ,  $n = 255$ ; AHY:  $11.59 \pm 1.65\text{g}$ ,  $n = 85$ ;  $t = 3.89$ ,  $P < 0.0002$ . Condition index, HY:  $0.1613 \pm 0.0269$ ,  $n = 255$ ; AHY:  $0.1719 \pm 0.0225$ ,  $n = 85$ ;  $t = 3.57$ ,  $P < 0.0005$ ). Therefore, we analysed only the masses and condition index values of HY individuals. No significant variation was found, either when the data from all study years were included, or when only the years when more than 15 juvenile Sedge Warblers were captured and analysed (Table 2, one-way ANOVA). The reason for the lack of a significant variation could be the small sample size.

The birds were on average in better condition in autumn than in spring (Table 3).

### Body mass gain during stopovers

Sedge Warblers gain more mass in autumn than in spring; the difference is close to being significant. This occurs even though the minimum stopover period is on average shorter in autumn than in spring, the difference is not far from being significant (Table 4). Nevertheless, the mean fuel deposition rate (mass gain/minimum stopover period) showed no seasonal differences ( $t = 0.65$ ,  $P = 0.52$ ) and varied from  $-3.00\text{g day}^{-1}$  to  $2.37\text{g day}^{-1}$  (average  $0.179\text{g day}^{-1} \pm \text{SE} = 0.026$ ). Stopover duration did not show a significant relationship with the fuel deposition rate in either season,  $t < 0.15$  in both cases.

In spring, the change of body mass during stopover (expressed as percentage of the initial body mass) was significantly dependent on the initial condition of the birds (negatively), stopover period (positively) and the progress of the season (positively) (Table 5A). In autumn, the effect of the progress of the season on stopover efficiency was not significant. Instead, wing-length showed a significant effect along with the initial body condition and stopover duration: birds with shorter wings tended to gain more fuel, other factors being equal (Table 5B).

## Discussion

The numbers of Sedge Warblers trapped in spring were much higher than in autumn (Table 3); this is typical of many passerine migrants in Eilat (Morgan and Shirihai 1997, Meyrom *et al.* 2001, Yosef and Tryjanowski 2002b, 2002c, 2002d) and could be attributed to the staging characteristics found at this site. However, if in the European Reed Warbler (*A. scirpaceus*) the ratio of spring:autumn numbers is 1.8:1 (Yosef and Chernetsov in prep.), it is as high as 6.0:1 in the Sedge Warbler. It has been suggested that this may be due to birds over-flying the area, as known for Iberia and northern Africa in the western flyway (Bibby and Green 1981, Bermejo and De la Fuente 2002). Morgan and Shirihai (1997) further suggested that loop migration might also be involved as documented for Masked Shrike (*Lanius nubicus*), Ortolan Bunting (*Emberiza hortulana*), and Cretzschmar's Bunting (*E. caesia*) (Yosef and Tryjanowski 2002b, 2002c, 2002d).

Sedge Warblers show a significant interannual variation in their average body condition in spring. This suggests that environmental conditions that they experience on the wintering grounds and during flights and stopovers differ between the years, and probably influence their migratory performance (eg. Foppen *et al.* 1999). In autumn, interannual variation was not significant, possibly due to the small sample size. Interannual variation of body mass and body condition has been reported for Sedge Warblers in Wales (Ormerod *et al.* 1991) and in the eastern Baltic (Chernetsov 1999), for European Reed Warblers and Reed Buntings (*E. schoeniclus*) in the eastern Baltic and in Israel (Chernetsov 1999, 2001, Meyrom *et al.* 2001, Yosef and Chernetsov in prep.) and appears to be a general pattern in long range migratory passerines.

**Table 1:** Interannual variation of body weight (BW) and condition index (CI) in Sedge Warblers in spring

Year	BW	SD	CI	SD	n
1984	9.51	0.93	0.142	0.013	82
1985	9.88	1.33	0.145	0.020	127
1986	10.47	1.33	0.153	0.019	348
1988	10.68	1.41	0.157	0.020	121
1989	9.66	1.16	0.142	0.017	115
1990	10.08	1.05	0.148	0.015	102
1991	10.45	1.23	0.154	0.017	248
1992	9.87	1.27	0.144	0.018	383
1993	10.12	1.28	0.149	0.018	235
1994	10.63	1.35	0.156	0.018	87
1995	10.45	1.32	0.154	0.018	41
1996	10.12	1.03	0.147	0.023	60
1997	10.55	0.98	0.154	0.015	29
1998	13.10	1.55	0.199	0.022	14
1999	9.68	0.82	0.144	0.013	99
2001	10.74	1.55	0.161	0.023	56

one-way ANOVA

 $F_{15,2136} = 16.3; P < 0.0001$  $F_{15,2130} = 18.4; P < 0.0001$ Data from 1997–1998 excluded:  $F_{13,2290} = 13.2; P < 0.0001$ **Table 2:** Interannual variation of body weight (BW) and condition index (CI) of hatching-year Sedge Warblers in autumn

Year	BW	SD	CI	SD	n
1984	11.29	3.29	0.169	0.048	17
1985	10.67	1.85	0.158	0.027	57
1986	10.62	1.72	0.160	0.027	25
1988	10.37	1.44	0.154	0.018	4
1989	10.67	2.07	0.160	0.029	12
1990	10.56	1.84	0.172	0.025	5
1991	10.74	1.41	0.161	0.022	28
1992	11.47	1.68	0.170	0.023	22
1993	11.24	1.55	0.169	0.023	17
1995	10.37	3.00	0.151	0.042	3
1996	10.60	1.91	0.160	0.028	19
1998	10.00	10.00	0.152	0.159	2
1999	10.25	1.41	0.156	0.023	13
2000	10.28	1.49	0.156	0.021	28
2001	10.93	3.52	0.167	0.052	3

one-way ANOVA

 $F_{13,240} = 0.74; P = 0.73$  $F_{13,240} = 0.67; P = 0.80$ Only years when  $n > 15$ :  $F_{7,205} = 1.13; P = 0.35$  $F_{7,204} = 1.02; P = 0.42$ **Table 3:** Body mass and condition index of Sedge Warblers in spring and in autumn

	Body mass (g) $\pm$ SE	Condition index $\pm$ SE	n
spring	10.19 $\pm$ 0.03	0.1497 $\pm$ 0.0004	2 146
autumn	10.96 $\pm$ 0.10	0.1638 $\pm$ 0.0014	356
	$t = 7.66; P < 0.0001$	$t = 9.83; P < 0.0001$	

In autumn, birds in their hatching year were on average in poorer condition than adults; and this concurs with Koskimies and Saurola (1985) and Chernetsov (1999) who found that in the eastern Baltic, the AHY individuals were also in better condition than juveniles.

The difference in the average body mass and body condition index between the seasons, though highly significant (Table 3), is by far not as striking as could be expected, bearing in mind that the birds involved are captured just before and just after the crossing of a major barrier. This could be an indication that many individuals are not trapped just after arrival in spring and immediately before departure in autumn. In spring, some birds are initially captured after they have already improved their condition, and in autumn, not all birds captured are ready to take off for a migratory flight. Capture probability of migrants is known to be quite low at most sites (Kaiser 1995, Chernetsov and Titov 2000), and the pattern in Eilat seems to be consistent with this.

The average body mass of the Sedge Warblers trapped in the spring at Eilat after crossing the east African deserts (Table 3) is comparable to those reported at Defilia, Morocco, wherein the birds also have to cross the Sahara at its western extremities (10.19,  $n = 2\ 146$  vs 9.5,  $n = 91$ ; Ash 1969). The birds caught in Morocco in the spring were considerably lighter than those that had not yet initiated the migration in sub-Saharan Nigeria (14.4g,  $n = 7$ ). Although

the sample size is limited, it is of interest that the birds caught at Eilat before the desert crossings were considerably lighter (10.96g) than those in Nigeria. We think that this cannot be explained by migratory strategies alone (e.g. Biebach 1990), but by the fact that a larger proportion of the birds trapped at Eilat are disadvantaged physically (loss of flight feathers, injuries, deformities etc.; RY, unpubl. data) and influences their decision for stopover at Eilat, resulting in a lower average body mass, while the majority of the population either over-fly the region or undertake a loop migration.

Sedge Warblers gain mass in Eilat, after crossing the desert belt in spring and before embarking for a long flight in autumn. Birds in poor initial condition and those stopping over for a longer period gained more body mass than those with a comparatively good body condition and that did not stop over for more than a few days. This pattern suggests that the site is indeed used for refueling, and the stopovers observed are not just a result of inclement weather or other migration inhibiting factors. In spring, the progress of the season was also an important factor: late birds gained more body mass, probably to catch up with the earlier passage conspecifics. However, another possibility is that suggested by Morgan and Shinhai (1997) who on the basis of the capture pattern thought that two discrete populations of Sedge Warblers migrate through Eilat in spring. It is not impossible that these populations differ in their breeding destinations and therefore use different migratory strategies. We also refrained from calculating annual median dates of passage due to the presence of these two waves of migration, apart from the fact that capture effort has not been constant throughout the 18 years of this study.

The number of birds using this site in autumn is low, possibly due to their special migratory strategy (Bibby and Green 1981) or physical disadvantage as mentioned above.

**Table 4:** Mass gain as percentage of initial mass and stopover periods in Sedge Warblers in Eilat

	Mass gain (%) ± SE	Minimum stopover period (days) ± SE	n
Spring	8.3 ± 0.78	5.8 ± 0.37	316
Autumn	14.1 ± 3.17	4.4 ± 0.45	49
	t = 1.77; P = 0.082	z = 1.71; P = 0.086 (Mann-Whitney test)	

**Table 5:** Results of multiple regression analysis of changes in body-mass according to body condition index at first capture (CI1), wing-length (WL), minimum stopover length (MSL), and Julian date (JD). CI1 and MSL were log-transformed before analyses

A. Spring			
Wing-length excluded due to low statistical significance (P > 0.50)			
Variable	B ± SE	t	P
CI1	-102.84 ± 0.74	-4.96	<0.0001
MSL	12.89 ± 2.08	6.16	<0.0001
JD	0.10 ± 0.035	2.89	<0.005
R <sup>2</sup> = 0.22			<0.0001
B. Autumn			
Julian date excluded due to low statistical significance (P > 0.30)			
Variable	B ± SE	t	P
CI1	-127.94 ± 33.65	-3.80	<0.0005
MSL	35.26 ± 7.55	4.67	<0.0001
WL	-1.88 ± 0.85	-2.20	=0.033
R <sup>2</sup> = 0.50			<0.0001

The rate of fuel gain in Eilat is quite good, even though higher rates have been reported from some central and southern European sites (Schaub and Jenni 2000). There are sound reasons to believe that capture probability of stopover migrants is related to their condition, fat birds (and those gaining mass) being less likely to be captured than their lean or losing mass conspecifics. Our data may thus be biased towards birds which gain mass slowly, and the real average fuel deposition rate and stopover efficiency are higher than those reported in this study.

In autumn, the progress of the season showed no significant effect on stopover efficiency. It remains unclear why Sedge Warblers with shorter wings gained mass more quickly than the longer winged individuals (Table 5B). This effect was not very significant (P = 0.033), which together with a small sample size (n = 49) suggests that this is an topic of interest that needs to be studied further in future studies.

We conclude, based on the data presented above, that Eilat is an especially important staging area for Sedge Warblers in the spring migration when they arrive emaciated after the long and arduous crossing of the north African deserts. This stresses the importance of the conservation of the staging areas that facilitate stopover for inter-continental migrants, especially in heavily human disturbed areas such as Eilat.

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## References

- Ash JS 1969. Spring weights of trans-Saharan migrants in Morocco. *Ibis* 111: 1–10
- Bascuiti P, Negra O and Spina F 1997. Autumn migration strategies of the Sedge Warbler *Acrocephalus schoenobaenus* in northern Italy. *Ringling & Migration* 18: 59–67
- Bermejo A and De la Puente J 2002. Stopover characteristics of Sedge Warblers (*Acrocephalus schoenobaenus*) in central Iberia. *Die Vogelwarte* 41: 181–189
- Bibby CJ, Green RE, Papler RGM and Papler PA 1976. Sedge Warbler migration and reed aphids. *British Birds* 69: 384–399
- Bibby CJ and Green RE 1981. Autumn migration strategies of Reed and Sedge Warblers. *Ornis Scandinavica* 12: 1–12
- Biebach H 1990. Strategies of trans-Sahara migrants. In: Gwinner E (ed) *Bird Migration*. pp 352–367. Springer-Verlag, Berlin
- Čelmins A 1990. Preliminary results of "Acroproject" in Latvia. *Baltic Birds* 5, Vol. 1, pp 67–70. Rīga, Zinatne.
- Chernetsov N 1996. Preliminary hypotheses on migration of the Sedge Warbler (*Acrocephalus schoenobaenus*) in the Eastern Baltic. *Die Vogelwarte* 38: 201–210
- Chernetsov N 1999. Migration Strategies of *Acrocephalus* Warblers within Europe. PhD thesis, St Petersburg Zoological Institute, Russia (in Russian)
- Chernetsov N 2001. Condition of Reed Buntings (*Emberiza schoeniclus*) on spring and autumn migration on the Courish Spit, Eastern Baltic. In: Tryjanowski P, Osiejuk TS and Kupczyk M (eds) *Bunting Studies in Europe* pp 105–109. Bogucki Wyd. Nauk. Poznań
- Chernetsov N and Titov N 2000. Design of a trapping station for studying migratory stopovers by capture-mark-recapture analysis. *Avian Ecology and Behaviour* 5: 27–33
- Chernetsov N and Titov N 2001. Movement patterns of European Reed Warblers *Acrocephalus scirpaceus* and Sedge Warblers *A. schoenobaenus* before and during autumn migration. *Ardea* 89: 509–515
- Csörgő T and Ujhelyi P 1991. Migration strategies of *Acrocephalus* species from an analysis of recaptures. The 3<sup>rd</sup> Scientific Meeting Hungarian Ornithological and Nature Protection Society, Szombathely. pp 111–122 (in Hungarian with English summary)
- Dolnik VR 1990. Bird migration across arid and mountain regions of middle Asia and Kazakhstan. In: Gwinner E (ed) *Bird Migration: Physiology and Ecophysiology*. pp 368–386. Springer-Verlag, Berlin, Heidelberg and New York
- Foppen R, Ter Braak CJF, Verboom J and Reijnen R 1999. Dutch Sedge Warblers *Acrocephalus schoenobaenus* and West-African rainfall: empirical data and simulation modeling show low population resilience in fragmented marshlands. *Ardea* 87: 113–127
- Frumkin R, Pinshow B and Kleinhaus S 1995. A review of bird migration over Israel. *Journal für Ornithologie* 136: 127–147
- Grandio JM 1998a. Comparación del peso y su incremento, del tiempo de estancia y de la abundancia del Carricerín Común (*Acrocephalus schoenobaenus*) entre dos zonas de la marisma de Txingudi (N de España). *Ardeola* 45: 137–142
- Grandio JM 1998b. Consideraciones sobre la estrategia migratoria postnupcial del Carricerín Común *Acrocephalus schoenobaenus* en la Península Ibérica. *Ardeola* 45: 213–215
- Grandio JM 1999. Migración postnupcial diferencial del Carricerín

- Común (*Acrocephalus schoenobaenus*) en la marisma de Txingudi (N de España). *Ardeola* 46: 171–178
- Gyurácz J and Bank L 1995. Autumn migration dynamics of the Sedge Warbler (*Acrocephalus schoenobaenus*) in Southern Hungary. *Ornis Hungarica* 5: 23–32
- Gyurácz J and Bank L 1996. Body mass and fat load of autumn migration Sedge Warblers (*Acrocephalus schoenobaenus*) in relation to age in south Hungary. *Acta Zoologica Hungarica* 42: 271–279
- Kaiser A 1995. Estimating turnover, movements and capture parameters of resting passerines in standardized capture-recapture studies. *Journal of Applied Statistics* 22: 1039–1047
- Kaiser A 1999. Stopover strategies in birds: a review of methods for estimating stopover length. *Bird Study* 46 Suppl.: 299–308
- Koskimes P and Saurola P 1985. Autumn migration strategies of the Sedge Warbler *Acrocephalus schoenobaenus* in Finland: a preliminary report. *Ornis Fennica* 62: 145–152
- Literák I, Honza M and Kondelka D 1994. Postbreeding migration of the Sedge Warbler *Acrocephalus schoenobaenus* in the Czech Republic. *Ornis Fennica* 71: 151–155
- Meyrom K, Yosef R and Tryjanowski P 2001. Phenology and biometrics of migratory Reed Bunting (*Emberiza schoeniclus*) in Israel. *Israel Journal of Zoology* 47: 161–165
- Morgan JH and Shirihai H 1997. Passerines and passerine migration in Eilat. *International Birding and Research Center in Eilat, Technical Publication Vol. 6, no. 1*. Eilat, Israel
- Ormerod SJ 1990. Time of passage, habitat use and mass change of *Acrocephalus* warblers in a South Wales reedswamp. *Ringling & Migration* 11: 1–11
- Ormerod SJ, Jenkins RKB and Prosser PJ 1991. Further studies on the premigratory weights of Sedge Warbler *Acrocephalus schoenobaenus* in south west Wales: patterns between sites and years. *Ringling & Migration* 12: 103–112
- Pearson DJ 1971. Weights of some Palearctic migrants in Uganda. *Ibis* 113: 173–184
- Rubolini D, Pastor AG, Pilastro A and Spina F 2002. Ecological barriers shaping fuel stores in Barn Swallows *Hirundo rustica* following the central and western Mediterranean flyways. *Journal of Avian Biology* 33: 15–22
- Safriel U 1988. Bird migration at Eilat, Israel. *Ibis* 110: 283–320
- Safriel UN and Lavee D 1988. Weight changes of cross-desert migrants at an oasis — Do energetic considerations alone determine the length of stopover? *Oecologia* 76: 611–619
- Schaub M and Jenni L 2000. Fuel deposition rate of three passerine bird species along the migratory route. *Oecologia* 122: 308–317
- Schaub M, Pradel R, Jenni L and Lebreton J-D 2001. Migrating birds stop over longer than usually thought: an improved capture-recapture analysis. *Ecology* 82: 852–859
- Shirihai H 1996. *The Birds of Israel*. Academic Press, London
- Svensson L 1992. *Identification Guide to European Passerines*. 4<sup>th</sup> edn. Stockholm.
- Yosef R and Tryjanowski P 2002a. Avian species saturation at a long-term ringing station — a never-ending story? *Journal of the Yamashina Institute for Ornithology, 50<sup>th</sup> Anniversary Issue* 34: 89–95
- Yosef R and Tryjanowski P 2002b. Migratory Masked Shrikes *Lanius nubicus* staging at the desert edge: phenology, and sex- and age-related differences in body mass. *Ostrich* 73: 162–165
- Yosef R and Tryjanowski P 2002c. Differential spring migration of Ortolan Bunting (*Emberiza hortulana*) by sex and age at Eilat, Israel. *Ornis Fennica* 79: 173–180
- Yosef R and Tryjanowski P 2002d. Spring migration ecology of the Czetcschmar's Bunting (*Emberiza caesia*) through Eilat, Israel. *Israel Journal of Zoology* 48: 149–153