Revista Catalana d'Ornitologia 19:30-34, 2002

Synoptic situation on long-step night migration by a Reed Warbler *Acrocephalus scirpaceus* on outward migration

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A notably long distance was covered by a Reed Warbler *Acrocephalus scirpaceus*, trapped twice within 28 hours, at two separate stopover sites during autumn migration. The individual was ringed at Capestang (southern France) and recaptured at Flix (north-east Spain). Analysis of the synoptic situation during that night has been carried out on the basis of the NCEP/NCAR CDAS/Reanalysis Project, which measures pressure data every six hours both at land surface level and at 850 hPa (c. 1570 m a.s.l.). The Reed Warbler flew some 309 km on a typical summer night with nocturnal land winds. Easterly winds, enhancing south-westerly migration, were the main currents through the night in which high-speed winds were absent. Energy calculations produced an estimate of 58.5 kJ for the energy consumption between captures, corresponding to 1.5 g of mass (fat) lost. The time spent in covering the 309 km has been calculated from data of air speed in small passerines, yielding a 8.58 hour flight with a cost of 6.8 kJ/h.

Key words: Reed Warbler, *Acrocephalus scirpaceus*, night migration, Western Mediterranean

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Received: 30.07.03; Accepted: 01.12.03 / Edited by L.Brotons

There is clear evidence that migrating birds complete the distance between breeding and wintering areas in less time in spring than in autumn (Pearson 1990). Among other factors affecting the differences between spring and autumn migration, an early arrival at the breeding areas allows reproductive advantages, especially in the competition to establish a territory. On the other hand, during outward (autumn) migration there is no such selective pressure, and birds increase the time spent in covering the route from breeding to wintering territories. Among European passerines, long-distance migrants tend to take about three months to cover the distances involved (Alerstam 1990). The distance that an individual bird covers in one day during outward migration has been studied by Klein *et al.* (1973), who found that for the Garden Warbler *Sylvia borin* and the Blackcap *Sylvia atricapilla* the daily mean speeds of migration were 74 and 49 km respectively. In long-distance migrant passerines, average daily speed is 75 km/day (Alerstam & Lindstrom 1990). To gather this sort of information researchers use ringing as a method to obtain data at regular stopover sites. Ringing data of this type provide us with important information about migration, and the capture-recapture data can highlight some extreme records of migrating birds.

In this paper, we analyse data from an individual Reed Warbler *Acrocephalus scirpaceus*, a long-distance night-migrating species. The bird was captured twice within 28 hours, covering an unusually long distance and providing an opportunity to analyse the conditions prevailing during the night between the two captures. Data dealing with the energy expenditure during this migration are also presented.

Materials and Methods

The Reed Warbler in question was captured on 5 September 1997 at Capestang (Herault, southern France (43°19'N, 03°02'E) and was recaptured 28 hours later at Sebes (Flix, northeast Spain, 41°14'N, 00°32'E) during the ringing scheme run by the Institut Català d'Ornitologia (Aymí & Tomás 2001). Biometrical data and the times of capture and release were provided by the CRBPO for the trapping at Capestang, and by those responsible for the ringing scheme for the trapping at Sebes. Energy consumed between captures was estimated on the basis that mass loss can be converted to energy value of caloric fat (39 kJ/g, Dolnik 1995). Flight costs has been calculated assuming airspeed of small passerines being about 10 m/s (Biebach 1990) and basal metabolic rate (BMR) for Sedge Warblers *Acrocephalus schoenobaenus* as 19,5 kJ/day (Bolshakov *et al.* 2003). Given that there are no data available for the Reed Warbler, and assuming the same cost as a Sedge Warbler, it is possible to obtain the flight cost estimates in daily BMR as suggested by Bulyuk & Chernetov (2000).

The synoptic situation of the night of 5th/6th September 1997 was modelled with data from the NCEP/NCAR CDAS/Reanalysis Project obtained four times a day (00:00, 06:00, 12:00 and 18:00 hours). A synoptic map has been drawn showing the weather patterns at two positions: at ground level; and at 850 hPa (c. 1570 m a.s.l.).

Results

Distances between times of captures and biometrics

The Reed Warbler was captured on 05.09.1997 at Capestang, and ringed with a numbered aluminium leg band (4226351 Paris CRBPO). Several biometrical and other data were recorded, following standard ringing practice: age; sex; flattened wing length; and weight. At Sebes, where the individual was recaptured, measurements of the third primary (ascendant), fat and muscle were also obtained (Table 1).

Altogether some 28 hours passed between the time of the first capture and the second. In this time the Reed Warbler flew a distance of 309 km. The measurement obtained for the wing length differed slightly (0.5 mm), though this can clearly be attributed to human error. At Capestang the individual weighed 13 g, and at Sebes 11.5 g, corresponding to a weight loss of 1.5 g or 11.5% of total body weight. Given that the first capture occurred at 13:00 at the Capestang site, we consider this a rather conservative estimate of weight loss, as the bird may well have recovered condition to some degree after resuming foraging until sunset.

Synoptic situation during flight

The Reed Warbler is a nocturnal migrant (Cramp 1992). Therefore, we assume that our focal individual rested during the day at Capestang, probably waiting until dusk before flying through the night until dawn, after which it landed again (Bolshakov *et al.* 2003). A synoptic situation of midnight has been drawn with data at 00:00 GMT on 06.09.97. In order to obtain relevant data, the analysis has been done at two levels, at ground level (Figure 1) and at 850 hPa (c. 1570 m a.s.l.) (Figure 2).

During the night, summer weather was dominant. There were nocturnal land winds and diurnal sea winds during the first day (05.09.97), with mainly local winds involved. At 850 hPa there was a moderated wind from an ESE direction. On 06.09.97 the wind flow increased from an easterly direction, especially in the lower layers of the atmosphere, but wind speed remained moderate, flow ranging from 7 km/h to 15 km/h (2-4 m/s). The dominant wind direction

Table 1. Biometrics of the Reed Warbler captured at Capestang and Sebes, Flix.
Biometria de la Boscarla de canyar capturada a Capestang i a Sebes, Flix.

Site	day	hour	age	sex	wing (mm)	3rd primary (mm)	fat	muscle	weight (g)
Capestang	05.09.97	09.30	3	-	68.5	-	-	-	13.0
Sebes	06.09.97	13.00	3	-	69	53	4	1	11.5

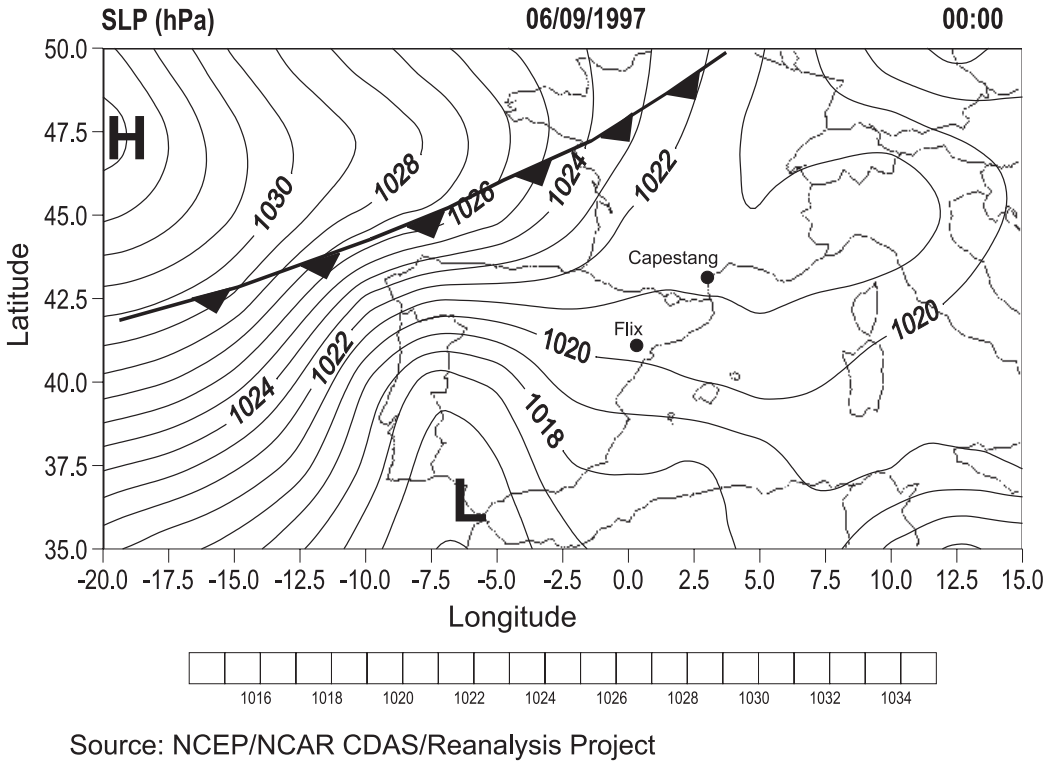

Figure 1. Synoptic situation at ground level in the Western Mediterranean at 00.00 GMT on 06.09.97. The points of first and second capture are marked.
Situació sinòptica en superfície a la Mediterrània occidental a les 00 GMT del 06.09.97. Els indrets de captura i recaptura estan indicats.

throughout was ENE. This would have enhanced performance on the southward migration route, which mainly follows the coastline, taking a south-westerly direction.

Energy analysis

During the flight the Reed Warbler lost 1.5 g of weight (fat). This value represent roughly 58.5 kJ (Dolnik, 1995), or an energy consumption of 3 daily BMR. Following data of Bulyuk & Chernetsov (2000), to cover 309 km at an airspeed flight of roughly 10 $m \cdot s^{-1}$ (Biebach, 1990) in calm conditions, the Reed Warbler should have spent about 8.58 hours. Due to the influence of moderate winds with a direction that enhanced the flight (ENE), the time spent on the journey is likely to be somewhat shorter than the one recorded. The energy cost of the flight would be roughly 6.8 kJ/h, which corresponds to 8.39 BMR.

Discussion

The distance covered between stops by the Reed Warbler described here was unexpectedly long, given that this bird was engaged in its autumn migration. In general, birds flying between their breeding and wintering grounds tend to spend twice or thrice the time that they require for their return migration in the spring (Pearson 1990). Time, energy and safety are selective factors affecting migratory strategies in birds (Alerstam & Lindström 1990). Other factors, such as the meteorological conditions during the flight, could also affect the success of migration (Richardson 1978, 1990). Wind is a factor that can have major effects on flight during migration (Alerstam 1979). Wherever possible, birds use tailwinds to improve their flight performance (Butler *et al.* 1997). With these winds, the speed of migration is greater than on calm days, and this of course permits the birds to cover

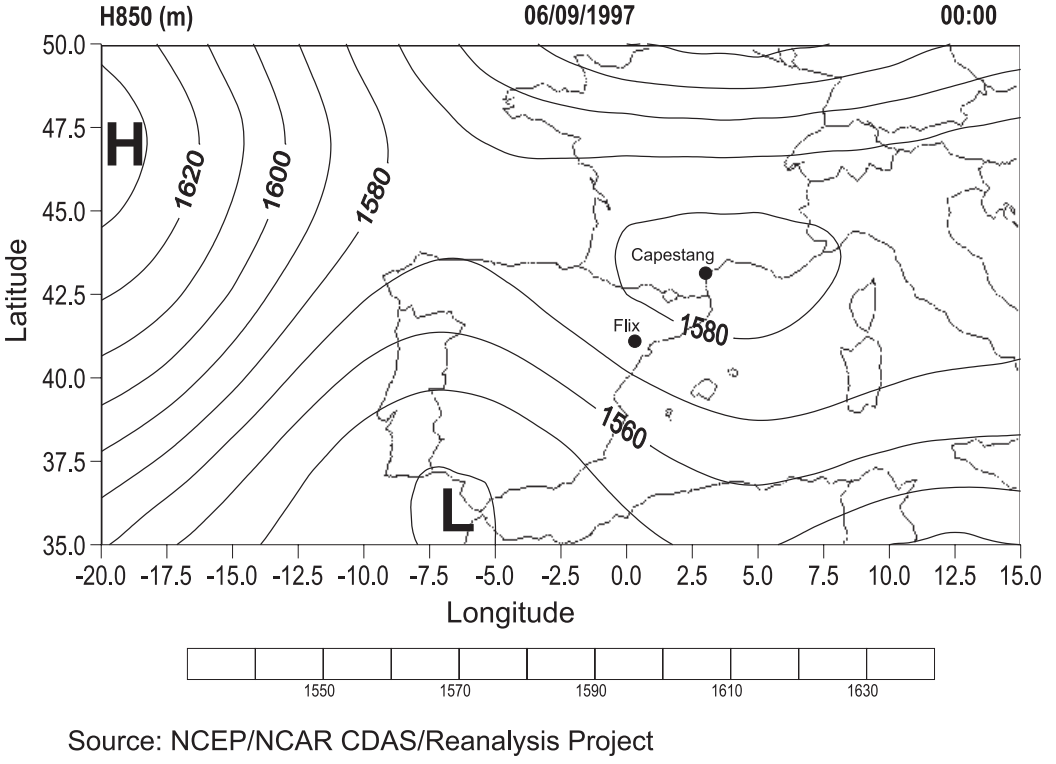

Figure 2. Synoptic situation at 850 hPa in the Western Mediterranean at 00.00 GMT on 06.09.97. The points of first and second capture are marked.
Situació sinòptica a 850 hPa a la Mediterrània occidental a les 00.00 GMT del 06.09.97. Els indrets de captura i recaptura estan indicats.

greater distances. Moreover, birds can select their flight altitude in order to maximize wind support (Bruderer *et al.* 1995). The analysis of the synoptic situation during the flight of the Reed Warbler studied shows the presence of a weak wind at the start of the night and a later increase to a low-speed wind. Due to the main direction of the flow (ENE) and the velocity (7-15 km/h), the Reed Warbler was assisted with a kind of tailwind which probably affected the distance covered during the flight. In stopover sites, wind can affect decisions related to the timing of migration (departure, Akesson, 2000; landing, Barriocanal *et al.* 2002). The effects of wind in several ways have a major impact on the overall nature of bird migration. As stated by Bolshakok *et al.* (2003) Reed Warblers in central and northern Europe typically fly during the night an average of 4-6 hours with a 1-day stopover in spring. In our case we have calculated a maximum of 8.58 hours of flight through the night, this value being 8.39 times BMR close to the value proposed by Berthold (1996), who proposed an estimated value of flight cost of 10 times BMR.

Further empirical research on outward migration is needed in order to determine the general schedule for night-migrating insectivorous species, when selective pressures appear to be weaker than in spring. The case presented here might be considered an extreme case of a single bird during its outward migration, or as being indicative of hitherto unsuspected distances being travelled on occasion, in association with some unknown factors.

Acknowledgements

We are grateful to Gabriel Gargallo, Joan Carles Abella and Olivier Dehorter for providing the capture/recapture data. Andy Leggat corrected the English and improved the paper. We are indebted to an

anonymous referee who helped us to improve an earlier draft.

Resum

Situació sinòptica en un llarg recorregut nocturn realitzat per una Boscarla de Canyar *Acrocephalus scirpaceus* en migració postnupcial

S'ha estudiat la distància recorreguda per una Boscarla de Canyar *Acrocephalus scirpaceus* capturada dues vegades en 28 hores a dos llocs de parada diferenciats. S'ha realitzat una anàlisi de la situació sinòptica durant la nit amb dades del NCEP/NCAR CDAS/Reanalysis Project mesurades cada 6 hores. L'anàlisi s'ha realitzat a la superfície i a 850 hPa. La Boscarla va recórrer 309 km en una nit amb condicions meteorològiques típiques d'estiu, amb vents de terra. En general varen ser vents de l'est, fluxos que beneficien les aus que migren cap al SW. En cap cas es varen donar vents d'elevada velocitat. Els càlculs de consum energètic mostren una despesa de 58,5 kJ que corresponen als 1,5 g de greix perduts entre les recaptures. Considerant la velocitat mitjana dels petits passeriformes durant la migració, la Boscarla va invertir en el seu recorregut un total de 8,58 hores que corresponen a un cost de 6,8 kJ/h.

Resumen

Situación sinóptica en un largo recorrido nocturno realizado por un Carricero Común *Acrocephalus scirpaceus* en migración postnupcial

Se ha estudiado la distancia recorrida por un Carricero Común *Acrocephalus scirpaceus* capturado dos veces en 28 horas en dos localidades de parada diferenciadas. Se ha realizado un análisis de la situación sinóptica durante la noche con datos del NCEP/NCAR CDAS/Reanalysis Project medidos cada 6 horas. El análisis se ha realizado en la superficie y a 850 hPa. El Carricero recorrió 309 km en una noche con características meteorológicas típicas de una noche de verano con vientos de tierra. En general fueron vientos del este, flujos que benefician a las aves que migran hacia el SO. En ningún caso hubo vientos de elevada velocidad. Los cálculos de consumo energético muestran un gasto de 58,5 kJ que corresponden a los 1,5 g de grasa perdidos entre las recapturas. Considerando la velocidad mediana de los pequeños paseriformes durante la migración, el Carricero invirtió en su recorrido un total de 8,58 horas que corresponden a un coste de 6,8 kJ/h.

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