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Stopover site fidelity of four migrant warblers in the Iberian Peninsula

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This paper analyses by means of ringing data the stopover site fidelity of four warbler species (*Sylvia atricapilla*, *Sylvia borin*, *Phylloscopus collybita* and *Acrocephalus scirpaceus*) during their migrations across the Iberian Peninsula. The mean recovery rates observed during migration periods (mean 0.28, range 0–0.54) were around 50% of the ones observed during the breeding and wintering seasons (mean 0.51, range 0.41–0.58). These differences in recovery rate were statistically significant in all species but *Acrocephalus scirpaceus*. This warbler, with its more restricted habitat requirements, showed higher recovery rates during the spring and autumn migration periods confirming the hypothesis that species depending on scarce, patchily distributed stopover habitats during their migrations show stronger stopover site fidelity during their journeys. Our results support the view that some migrant species actively select stopover sites during their migrations.

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The philopatry of many small birds to their breeding grounds is well documented (reviews in Baker 1978, Sokolov 1988). There is also good information about fidelity to their wintering grounds in a number of Mediterranean and trans-Saharan migrants (De Roo and Deheegher 1969, Ralph and Mewaldt 1976, Herrera and Rodriguez 1979, Finlayson 1980, Benvenuti and Ioale 1980, Ortiz-Crespo 1971, Dowsett-Lemaire and Dowsett 1987, Aidley and Wilkinson 1987, Cuadrado 1992), and evidence is slowly accumulating that individuals may indeed use the same stopover areas at roughly the same time during successive migrations (Nisbet 1969, Goodpasture 1979, Curry-Lindahl 1981, Winker et al. 1991). However, the importance of this in different bird species remains largely unknown, despite its theoretical and applied interest. This may be due to the inconspicuous habits and poor detectability of many small night migrants. In fact, the observed stopover site fidelity (F') of a given small-bird population (usually controlled by ringing) may be modelled as:

$$F' = f(F, M, T, E, HS)$$

where F is the actual stopover site fidelity within the population; M is the mortality of ringed birds, that lowers recovery rate (e.g. Lavee et al. 1991); T is the time spent by grounded migrants at the stopover sites, which is positively related to their probability of being recorded (Moreau 1961); E is the netting effort, which is also positively related to the bird's probability of being recorded (Seber 1982) and HS is the habitat selection pattern of the migrant species (Bairlein 1983, Hutto 1985). HS may be positively related to F' if species linked to habitats that are scarce along their migration routes are forced to crowd in the few patches of suitable habitat that are available, thus becoming easier to capture.

In this paper we use ringing data to analyse the distribution of F' during the breeding, wintering and migration (spring and autumn) periods of four species of warblers in the Iberian Peninsula. Our goals were: to (a) evaluate the importance of stopover site fidelity in this group of passerines; (b) compare site fidelity to stopover sites with that to breeding and wintering grounds; and (c) test the hypothesis that higher scores of F' will be found in those species that depend on scarce, patchily distributed habitats for their migration.

Table 1. Recovery rates according to migratory periods. In brackets the total number of recoveries in each period (see text).

	Wintering	Spring migr.	Breeding	Autumn migr.
S. borin	–	0 (12)	0.58 (19)	0.27 (52)
S. atricapilla	0.41 (312)	0.28 (197)	0.48 (60)	0.22 (229)
P. collybita	0.51 (138)	0.16 (19)	0.50 (2)	0.30 (76)
A. scirpaceus	–	0.54 (13)	0.58 (19)	0.49 (80)

Methods

We used the recoveries of warblers ringed and recovered by means of mistnets in Spain during the period 1958–1992 in the data banks of ICONA (Instituto para la Conservación de la Naturaleza) and SEO (Sociedad Española de Ornitología; see Cantos 1992). Only four warbler species, two Mediterranean migrants, *Sylvia atricapilla* (n = 798) and *Phylloscopus collybita* (n = 235), and two trans-Saharan migrants *Sylvia borin* (n = 83) and *Acrocephalus scirpaceus* (n = 112), provided enough data to be considered in this study. The observed stopover site fidelity (F') of each species was defined as F' = r/n, where n is the total number of recoveries of birds ringed during a given phenological period (breeding, wintering, spring migration or autumn migration), and r is the number of retraps made in the same phenological period and at the same ringing place, but during the next or following years (distance between ringing and recovery = 0 km and elapsed time >270 days). This definition was important because it evaluated F' as a ratio over all retraps of controlled, alive birds thus eliminating the influence of mortality on this parameter (see the Jolly-Seber capture-recapture model to count open populations for a similar rationale; Seber 1982). Netting effort and duration of the stay at the stopover site do not affect F' because they alter the absolute scores of both r and n but leave unmodified the ratio r/n. In this way, F' = f (F, M, T, E, HS) was reduced to F' = f (F, HS).

The evaluation of HS scores was difficult in such a wide geographical context. Although differences among species in habitat selection during their migration periods are known to exist (e. g. Bairlein 1983), *Acrocephalus scirpaceus*, a bird usually associated with marshland, was the only species with a rather restricted habitat selection pattern in the dry landscapes of the Iberian Peninsula. This is why our habitat-selection specificity hypothesis was investigated by testing whether the F' scores of *Acrocephalus scirpaceus* during migration periods differed from those of the other warbler species.

The phenological periods were established according to Cantos (1992): wintering period from December to February; spring migration from March to May; breeding period during June and July and autumn migration from August to November. In the case of *S. atricapilla*, however, we chose a more restrictive phenology: wintering period from December to February, spring migration during March and April, breeding period from 15 May to 15 August, and autumn migration from September to November. We also calculated F' after having omitted the data for May, August, November and December. These are intermediate months in which some records of breeding/wintering birds might be assigned to migrant birds. However, the observed scores and seasonal patterns of F' did not differ. Thus, we used the former phenological classification in this study.

Results

Of the warbler species studied, all except *Sylvia borin* showed stopover site fidelity during the spring migration (Table 1). The mean rates observed during the migration periods (mean 0.28, range 0–0.54) were around 50% of

Table 2. Differences between periods in recovery rates (Fisher exact probability test; Sokal and Rohlf 1969). SM: spring migration, AM: autumn migration, BR: breeding, and WI: wintering.

Sylvia borin		
SM vs BR $p<0.001$	SM vs AM $p<0.05$	–
AM vs BR $p<0.02$		–
Sylvia atricapilla		
SM vs BR $p<0.01$	SM vs AM $p<0.1$	SM vs WI $p<0.01$
AM vs BR $p<0.001$		AM vs WI $p<0.001$
Phylloscopus collybita		
–	SM vs AM n.s.	SM vs WI $p<0.01$
–		AM vs WI $p<0.01$
Acrocephalus scirpaceus		
SM vs BR n.s.	SM vs AM n.s.	–
AM vs BR n.s.		–

the ones observed during the breeding or wintering periods (mean 0.51, range 0.41–0.58; Table 1) and differed significantly in all species but *Acrocephalus scirpaceus* (Table 2). This warbler species, with its relatively more restricted habitat preferences, showed higher recovery rates during migration periods than *Sylvia borin* (Fisher exact probability test, $p < 0.005$ and $p < 0.01$ respectively), *Sylvia atricapilla* ($p = 0.05$ and $p < 0.001$) and *Phylloscopus collybita* ($p < 0.05$ and $p < 0.02$), thus confirming the hypothesis that more restricted habitat requirements produce higher rates of stopover site fidelity.

Discussion

Our results support the view that stopover site fidelity is important for warblers during their migrations across the Iberian Peninsula. Fidelity to stopover sites was however lower than to breeding or wintering grounds, although species depending on scarce, patchy habitats for migration stopovers (e.g. *Acrocephalus scirpaceus* in this study) might show a site fidelity similar to the ones observed on the breeding and wintering grounds. These results support the view that some migrant species show an active selection of the more suitable stopover sites during their migrations (Bairlein 1987). Conversely, they contradict the more popular view that night migrating passerines are ubiquitous and non-selective during their resting periods, even able to adapt themselves to less familiar habitats (Gauthreaux 1982). In fact, trans-Saharan migrants that are in poor body condition during their desert crossing tend to select the best foraging places in order to continue their migration (Bairlein 1992). All this evidence seems to support the views of Baker (1978) and Wiltschko and Wiltschko (1978) as to the strategies of migrant birds. These authors postulated that migrants use selected stopover sites along their migration routes, thus travelling along a constant route year after year. This strategy could enhance the migrant's survival, because previous knowledge of a stopover site could allow a more efficient use of its resources, and would eliminate the risks associated with landing in inadequate areas (see Baker 1978, 1984, 1993 for a review of these hypotheses). The finding that some night migrating passerines use but a few stopover sites, raises new conservation challenges. The importance of isolated habitats such as lakes, estuaries and marshlands along the migration pathways for the conservation of some large and popular migrant bird species (e.g. ducks, waders, cranes) has long been recognised (RAMSAR 1971, Hunter et al. 1991). However, the possible constancy of migration routes and stopover sites in small night migrants has only been suspected. Results in this paper support the view that a considerable proportion of birds of such species use the same stopover sites during successive migrations. Hence, they suggest that the potential negative influence of environmental damage to these localities on the survival of the populations involved should be examined. This impact may be especially harmful when it affects species with narrow habitat requeriments, or sites where birds stop to fatten before beginning some major travel. This is probably the case in many areas in the Mediterranean countries, where trans-Saharan species stop to fatten before crossing the desert (Moreau 1961, Lovei 1989, Bairlein 1991 and 1992).

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