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Survival, phenology and philopatry of the Melodious Warbler *Hippolais polyglotta* in North eastern Italy

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Abstract - Survival rates of adult Melodious Warblers were estimated by capture-mark-recapture data, analyzing capture - histories of 169 individuals with the program SURGE. The annual adult survival rate was estimated at 54,1%. Breeding density in the study area was 16-18 pairs/8 ha in the 1992-95 period, whereas decreased to 13 pairs in 1996. Philopatry, phenology of migration and of reproduction are also discussed.

Introduction

The Melodious Warbler is a common breeding species throughout south - western Europe and north - western Africa, wintering south of the Sahara Desert in western Africa from Gambia to Camerun (Moreau, 1972; Zink 1973).
In Italy the species is distribuited all over the country but is expecially abundant in the Apennines regions. Although the species is expanding its northern european range (Cramp, 1992), data collected on the Po plain suggested a decline of the local population (Brichetti and Cambi, 1981-82; Ceccarelli in Meschini *et. al.*, 1993; Cerato in Nisoria 1994; Mezzavilla, 1989) attribuited mainly to the loss of suitable habitats due to human activity.
Studies on demographic aspects of this species, such a survival rate estimation and breeding biology are, thus particularly importants.
Several authors have investigated survival rates of small migratory passerines (Boano and Cucco, 1991; Boddy, 1993; Boddy, 1994; Peach *et. al*, 1991; Pratt and Peach, 1991), but to our knowledges, no data are available for Melodious Warbler. Paewskij, (1987) reported survival rates of the close related Icterine Warbler *Hippolais icterina* in western USSR. The Icterine Warbler and the Melodious Warbler may be found in sympatry in some areas of their distribution (Landenbergue *et. al.*, 1982). However, comparison of demographic parameters between these two species has never been done because of the lack of information.

The aim of this paper is to summarize a 5 years study on a breeding population of Melodious Warbler in Northern eastern Italy, at the north eastern boundary of the breeding range (Brichetti, 1985; Ceccarelli in Meschini *et. al.*,1993; Cramp, 1992) and modelling survival to investigate a possible difference between males and females using statistical method for analysis of capture-recapture data (Lebreton *et. al.*, 1992).

Study Area

The study area is located near S. Martino Buonalbergo -Verona, N-E Italy 45°26' N; 11°06' E, on a hill side of approximately 8 ha. The altitude vary between 50 and 95 m s.l.m. The site consist in a untidy cherry-orchard colonised by hedges 3 - 4 m spaced, prevalently made up of *Crataegus* spp., *Ligustrum vulgare*, *Fraxinus ornus*, *Quercus pubescens* and by submediterranean species as *Cotinus coggygria*, *Paliurus spina - christi*, *Phillyrea* spp., *Pistacia terebinthus*. The micro-climate dry and warm confer to study area the typical appearance of the "Xerothermic Prealpine Oasis" (Magistretti and Ruffo, 1959).
This xerothermic climat makes the area particularly suitable for the species. Indeed the Melodious Warbler breeds at highest density recorded in Europe (Pollo *et. al.*1995).
Despite this high breeding density the population suffer of a recent decline. The area is surrounded by unsuitable or low quality habitats prevalently woody or intensive cultivated lands; then the studied popula-

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tion is partly isolated. Indeed the few bird found outside the studied area were breeding in isolated territories.
In the surroundings the Melodious Warbler breeds at very low density or with isolated pairs.

Methods

The study was carried out from late April to early August for five consecutive years (1992-1996).
Animals were caught on mist nets (9-12 m long; 4 shelves; 16 mm mesh) and ringed with I.N.F.S. metal rings.
Within each study period, one netting session for week was made for a whole of 8 - 10 visit for breeding season. We analysed capture - recapture data of 268 ringed birds.
Age was determined using plumage wear and presence of dark spots on the tongue (Svensson, 1992); sex was determined by examining the cloacal protuberance and brood patch. Bimodality in adult wing length was also used as an aid to determine the sex of the bird (Svensson, 1992).
Estimates of the number of Melodious Warbler pairs breeding in the study area during 1992 - 1996 were obtained by means the comparison of the results of the mapping method (IBCC, 1969) with the number of adult females with a brood-patch showing evidence of egg - laying or incubation of eggs.
Annual survival rates and probability of recapture of adult Melodious Warbler were estimated by the maximum likelihood approach (Lebreton *et. al.*, 1992) using Cormack - Jolly Seber and related models. Analysis were done using program SURGE 4.2 (Clobert *et al.* 1987; Pradel and Lebreton, 1993).
Test were made for sex and time dependence in survival rates (Phi, t) and recapture probabilities (p, t) by fitting a series of models and using likelihood ratio tests to select the simplest model providing an adequate description of the data. Likelihood - ratio statistics are the difference between deviances and are distribuited as χ^2 with degrees of freedom equal to the difference between the number of identifiable parameters of the compared models.
To select the appropriate model we also utilised Akaike Information Criterion (A.I.C.) (Akaike, 1973). One selects the model where A.I.C. is smallest. One consider the results of LRT when the differences between two A.I.C. are equals to, or lower of two. The basic assumptions of the Cormack-Jolly-Seber model are discussed by Seber (1982), the most important being:
1) every bird present in the population at the time of sampling in period *i* has the same probability of being captured;
2) every marked bird present in the population immediately after sampling period *i* has the same probability of surviving until period *i* + 1;
3) marks are not lost;
4) all emigration is permanent;
5) the sample is istantaneous (i.e. the sampling time is negligible in relation to the intersample period).
Biased estimates of the survival rate may result from any violation from the above assumptions; for this reason we restrict the analysis only to the capture histories of 169 adult Melodious Warblers. If a significant part of the population, althoug alive, does not return to the sampling site in subsequent sampling times, then survival estimates will be negatively biased because the complement of survival probability estimates (1 - Phi) includes both mortality and permanent emigration. Thus bird species know to be strongly philopatric like the Melodious Warbler (Pollo and Bombieri,1997) are more suitable for investigation by capture-recapture method. In any case the estimates derived from our study will be considered as "minimal survival rates" as suggested by Boano and Cucco,1991 and Boano *et al.*,1993.
To satisfy assumption "5" we restrict the sampling period as much as possible (from May to July) in relation to the intersample period.

Results

Phenology, Breeding density, Return rates of youngs

First arrivals were at late April (the earliest being 24 April 1995) and most of the population settled down by the second decade of May. Nest-building start immediately; first eggs were laid from the end of May (a nest with one egg being found 28 May 93). The first fledged young were captured at the middle of the June. Adult Melodious Warblers left the area in early August, whilst migration of the youngs protract until late August. The breeding density of Melodious Warbler in the study area was 16 -18 pairs /8 ha in the 1992-1995 period, whereas decreased to 13 pairs/8 ha in 1996.
5% (5/100) of birds ringed as juveniles were recaptured in the study area in subsequent years; from which four were males and one only was female.

Survival rates of adults

We analysed capture histories of 169 birds of which 98 were males.
The process of model selection using program SURGE is summarized in table 1.

Table 1. Modelling the survival rates of adult Melodious Warblears captured between 1992-1996.

Model	n.p	deviance	L.R.T - χ^2	d.f.	P	A.I.C.
(1) Phi_{s*t}, p_{s*t}	14	235,21				263,21
(2) Phi_t, p_t	7	239,92	(2) - (1) = 4,71	7	0,6948	253,92
(3) Phi_t, p	5	240,04	(3) - (2) = 0,12	2	0,9445	250,04
(4) Phi, p_t	5	239,95	(4) - (2) = 0,03	2	0,9872	249,95
(5) Phi, p	2	241,60	(5) - (4) = 1,65	3	0,6477	245,60
(6) Phi, p_s	3	241,59	(6) - (5) = 0,01	1	0,9050	247,59
(7) Phi_s, p	3	241,50	(7) - (5) = 0,10	1	0,7530	247,50

Phi represents survival and p capture probability (Lebreton *et al.*, 1992). Subscript indicates time (t) and sex (s) dependence within a model; n.p. = the number of identificable parameters; df = degrees of freedom). A.I.C. = Akaike Information Criterion = deviance + 2 *np*. L.R.T. = Likelihood Ratio Test.

Assumptions of the Cormack - Jolly - Seber model were checked using program RELEASE (Burnham *et. al.*, 1987). Program RELEASE fits model Phi_{s*t}, p_{s*t}; a goodness of fit test of the data (test 2) suggest that the basic assumptions of the Jolly - Seber model are met : $\chi^2 = 5.96$; d.f. = 5; P = 0.3098. No age-dependent models are considered.

Homogeneity of parameters between sexes was verified by "test 1": $\chi^2 = 4.57$; d.f. = 7 ; P = 0.713 and comparison of models (Phi_{s*t}, p_{s*t}) and (Phi_t, p_t): χ^2 = 4,713; d.f. = 7; P = 0.69.

Model (Phi_{s*t},p_{s*t}) does not provide a better fit to the data than model (Phi_t, p_t) . In consequence of the principle of parsimony, the model with fewer parameters (Phi_t, p_t) was preferred. A further improvement was obtained by considering that probability of capture remains constant across capture session (model Phi_t, p). The likelihood ratio test statistic was obtained from (Phi_t, p_t) vs (Phi_t, p): $\chi^2 = 0.12$; d.f. = 2; P = 0,944. Model (Phi_t, p) was preferred. Beside we selected the model with constant survival probabilities and year - dependent capture probabilities (model Phi, p_t).

The L.R.T. test was obtained from model (Phi_t, p_t) vs. model (Phi, p_t): $\chi^2 = 0.026$; d.f. = 2; P = 0.99.

Model (Phi , p_t) was preferred. We thus selected model with both Phi and p constant across capture sessions (model Phi, p). Model (Phi, p_t) vs (Phi, p): χ^2 = 1,65; d.f.= 3; P = 0.65. Model (Phi, p), was preferred, suggesting both constant catching effort and constant adult survival rates across years.

At this point we retested the hypotesis of a sex effect on the survival or on recapture probability. It was considered the model with constant survival probabilities and sex-dependent capture probabilities: model (Phi, p_s) vs model (Phi, p): $\chi^2 = 0.01$; d.f. = 1; P = 0.905; A.I.C. = 247.59. We tested for an effect of sex on survival probabilities: model (Phi_s, p) vs model (Phi, p): $\chi^2 = 0.10$; d.f. = 1; P = 0.753; A.I.C. = 247.50.

We considered Akaike's Information Criterion for the models involved. This criterion also supports the use of the model (Phi, p) with the lowest value of A.I.C. = 245.60.

Sex effect on survival was not significant, but model (Phi_s, p) had a A.I.C. value similar to model (Phi, p).

The estimate of annual adult survival rate (Phi) derived from model (Phi, p) is 54,1% (38,4 - 69%, 95% confidence limits) for the years 1992/93 to 1995/96. Recapture probability (p) is 33,9% (20 - 51,1%, 95% confidence limits).

Discussion

The survival rate of adult Melodious Warblers found in this study is compared in table 2 with the estimates of four other species of *Sylviidae* with similar phenology of migration, based on ringing recaptures and computed with the programs SURGE or JOLLY.

We do not know of any other explicit survival estimates for the Melodious Warbler; the only estimate on the genus *Hippolais* is the mortality in a breeding population of the Icterine Warbler in Western U.R.S.S (Paewskij, 1987).

The mean estimate of adult survival (0.35) of the Icterine Warbler, derived from the complement of the mortality (1 - 0.65), is much more lower than that found for the Melodious Warbler . It is likely that this difference is due to a different method in estimating survival rather than of biological or environmental reasons. Indeed, in the study above, recapture probability is not taken into account and could lead to a underestimation of survival parameter. We believe that the survival of Melodious Warbler at our study area is fairly high.

Indeed our estimate should be considered a "minimal" survival rate for the fact that in capture - recapture

Table 2. Annual adult survival rates of *Sylviidae* species.

Species	Phi - (S.E./ asymmetric 95% confidence limits)	method	locality	Reference
Marsh Warbler *Acrocephalus palustris*	0.56 (0.07)	JOLLY	Italy	Boano and Cucco, 1991
Whitethroath *Sylvia communis*	0.55 (0.35 - 0.73) *	SURGE	Britain	Boddy, 1993
Melodious Warbler *Hippolais polyglotta*	0.54 (0.38 - 0.69)	SURGE	Italy	This study
Willow Warbler *Phylloscopus trochilus*	0.47 (0.40 - 0.55)	SURGE	Britain	Pratt and Peach, 1991
Lesser Whitethroath *Sylvia curruca*	0.44 (0.35 - 0.53)	SURGE	Britain	Boddy, 1994

(*) Mean annual survival rate during 1984-85 to 1988-89.

studies, permanent emigration is confounded with mortality. The model (Phi_s, p) emphasized a slight sex difference in survival rate, however difference was not significant. Small differences in sex-related parameters are difficult to detect. In passerines monogamous birds, a difference between males and females survival is likely to correspond to a difference in philopatry or site tenacity rather than mortality. In birds, females have in general an higer probability to disper than males (Greenwood 1980, Greenwood and Harvey, 1982).

Our results support these general outcomes. Indeed, although the difference is not significant, adult females survival from model Phi_s, P is lower than the one estimated for males, likely due to permanent emigration. A second finding that supports a females - biased dispersion is that among the five birds ringed as fledlings and recaptured as adult in the study area, only one was female. These data are in line with findings reported for juvenile Whitethroats (Da Prato and Da Prato, 1983), for adult Whitethroats (Boddy, 1993), for Lesser Withethroats (Boddy,1994), and also for many other passerines (Greenwood 1980, Greenwood and Harvey 1982, Davies 1992).

The return rate of birds ringed as juveniles is much lower than adults. This finding should make to think of a low natal philopatry.

On the contrary, in considering that:

a) first - year birds as a rule have a much high mortality than adults;

b) the capture probability in our study was low (0.34); we believe that the nathal philopatry is fairly good.

Actually, return rate of the first - year Melodious Warbler at our study area is comparable to ones of other species of *Sylviidae* with similar phenology of migration (see table 3).

Table 3. Return rates of juveniles of *Sylviidae* species.

Species	Return rate	Reference
Garden Warbler *Sylvia borin*	**0%**	Solonen, 1979
Lesser Whitethroat *Sylvia curruca*	**0.8%** **3.5%**	Norman, 1992 Boddy, 1994
Whitethroat *Sylvia communis*	**2.9%** **5.7%**	Da Prato and da Prato, 1983 Boddy, 1993
Melodious Warbler *Hippolais polyglotta*	**5%**	This study
Blackcap *Sylvia atricapilla*	**7.6%**	Bairlein, 1978
Willow Warbler *Phylloscopus trochilus*	**6.9%** **9.6%**	Norman, 1994 Pratt and Peach, 1991
Sedge Warbler *Acrocephalus schoenobaenus*	**17,7%**	Norman, 1984

The breeding population of the Melodious Warbler in the study area was enough stable during 1992 - 1995. We believe that the decrease observed in 1996 was due at the habitat loss. An extension of about 2 ha of shrubs and spontaneous hedges in the eastern side of the study site were removed in winter 1995-96.

From our study, it is difficult to drawn general conclusions on the decline of Melodious Warbler in the studied area.

Habitat loss seemed not to increase adult permanent emigration.

If it was so, survival may have changed in time, decreasing during the study period. In contrast, habitat loss may decrease recruitement probability. Long - term studies are needed to asses the effect of habitat loss and future works should focussed on demographic parameters in low quality or degradated habitats.

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Riassunto - Vengono riportati e discussi dati sulla sopravvivenza, fenologia, densità riproduttiva e filopatria di una popolazione di Canapino nidificante in un'area di 8 ha, controllata nel quinquennio 1992 - 1996. Sono state analizzate le storie di cattura di 268 Canapini, di cui 169 adulti. La sopravvivenza annuale degli adulti, calcolata con il programma SURGE è risultata di 54.1%. Non sono emerse differenze significative nei tassi di sopravvivenza tra maschi e femmine. La popolazione nidificante si è mantenuta costante nei primi quattro anni di studio (16 - 18 coppie) mentre è risultata in declino nell'ultimo anno (13 coppie), a causa di modificazioni ambientali. La filopatria negli adulti è elevata; nei giovani è dello stesso ordine di grandezza di quella di altre specie di Silvidi con fenologia migratoria similare.

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