The relationship between body mass and some weather variables in Blackcaps *Sylvia atricapilla* wintering in orange groves in south-eastern Spain

I.G. PEIRÓ

The body mass and fat score of Blackcaps Sylvia atricapilla *wintering in suburban orange groves in south-eastern Spain was studied in relation to some environmental factors (temperature, precipitation and photoperiod) using stepwise multiple regressions. Analyses were carried out on average values for the different individuals trapped within the same day to avoid pseudo-replication. The variation in body mass was significantly predicted by mean temperature on day of capture, mean temperature five days before capture and minimum temperature two days before capture ($R^2 = 0.980$; $p = 0.001$). Fat score was significantly related to maximum temperature on day of capture ($R^2 = 0.822$; $p = 0.002$). Temperature seems to play an important role as a proximate or short-term factor in the regulation of body mass of Blackcaps wintering in SE Spain.*

Key words: Blackcap, *Sylvia atricapilla*, body mass, weather, temperature, south-eastern Spain.

Ignacio García Peiró. Departamento de Ecología e Hidrología. Facultad de Biología. Universidad de Murcia. E-30100 Espinardo. Murcia. E-mail: peiro7@hotmail.com
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INTRODUCTION

Body mass of passerines is subject to temporal changes as a response to variations in their metabolic demands in order to face important stages in their life cycles (e.g. migration, moult, breeding, Dawson *et al.* 1983, Gosler 1991, 1994), and it also depends on variations in the environmental conditions (Dawson & Marsh 1986, Gosler 1996).

The body mass of passerines has been related to environmental parameters such as temperature (Jenni & Jenni-Eiermann 1987, Peach *et al.* 1992, Robson 1996), day-length amplitude (Rogers

& Rogers 1990, Gosler 1996), wind (Bakken 1990, Peach *et al.* 1992), sun radiation (Bakken 1980, Walsberg 1986) and precipitation (Blem & Shelor 1986).

It is also known that the daily and seasonal variation in body mass may be a response to photoperiod or temperature, or both (e.g. Haftorn 1976). Both of these variables might act as either proximate (short-term) or ultimate (long-term) factors as determinants of body-mass levels (e.g. Evans 1969).

Although earlier studies in some areas of northern Europe found strong relationships between temperature and body condition in wintering passerines (e.g. Brambling *Fringilla montifringilla*, Jenni & Jenni-Eiermann 1987; Starling *Sturnus vulgaris*, Peach *et al.* 1992), few studies have been carried out in order to assess such relationships in Blackcaps *Sylvia atricapilla*, particularly those wintering in Mediterranean areas (e.g Herrera 1998). Nevertheless, some authors postulate that temperature fluctuations seem to affect fat storage of Blackcaps wintering in such areas (Cuadrado *et al.* 1989).

This paper examines the nature of body mass of a population of Blackcaps *Sylvia atricapilla* wintering in an area in the south-eastern Mediterranean zone in relation with the environmental factors prevailing in this area, testing the hypothesis that body mass levels reflect the predictability of the bird's environment.

STUDY AREA AND METHODS

The study area is situated in a suburban zone of Elche, Alicante province, south-eastern Spain (38°16'N 00°41'W). The locality is situated in the thermo-mediterranean climatic region (Rivas-Martínez 1983). Mean temperatures at the locality span from 10°C in December to 28°C in August, and the total annual precipitation is usually less than 200 mm (Navarro 1988).

The site is an orange grove of 3,083 ha that comprises a mosaic of mixed groves with *Phoenix dactylifera* palms and Lemon *Citrus lemmon* and Orange *Citrus aurantum* trees.

From 1 January to 30 March 1996, altogether 166 Blackcaps were captured, using a variable number of mist-nets (mean length = 46,75 m; SD = 9,14) on each trapping day (n = 12). Blackcaps were assumed to be wintering based on recaptures on subsequent visits.

All Blackcaps trapped (n = 166) were ringed or recorded as individual recaptures (14%; n = 23). Birds were trapped on a trapping effort of 163 minutes on each visit, mostly in the evening hours. For each bird body mass was measured to the nearest 0.1 g and fat-class was recorded according a conventional six-degree scale (Helms & Drury 1960). Birds recaptured some days after ringing (n = 23) were excluded from the analysis in order to avoid pseudoreplication in the samples.

In order to assess the relationships between mean body mass and local ambient conditions (prior to and on the day of capture), the following variables were taken from a weather station 500 m from the area of the nets: mean, maximum and minimum 24-hour temperature on each day and 1, 2, 3, 4, 5 and 6 days before capture; and total rainfall 1 and 2 days before capture. The response of body mass and amount of fat to day-length (photoperiod) was calculated for each trapping day, based on the time between sunrise and sunset. Stepwise regressions between mean body mass and visible fat score as dependent variables and average environmental parameters as independent variables were used to detect associations between weather variables and body mass. The

values of body mass and fat score for the different individuals trapped within the same day were averaged, and analyses were carried out on these values. All statistical analyses were performed using the *Statistix* computer programme (Analytical Software 1986).

RESULTS

The results of the stepwise regression for body mass (Table 1) indicate that there was a significant inverse relationship with the mean local temperature on the day of capture, with a reduction of 0.68 g/ °C ($p < 0.001$) and minimum temperature two days before capture, involving a reduction of 0.174 g / °C ($p = 0.009$). On the other hand, there was positive relationship with mean temperature 5 days before capture, with increases of 0.803 g/ °C ($p = 0.001$). The results of stepwise regression of fat showed that there was an inverse relationship with maximum temperature on the day of capture.

Total precipitation on the days before capture and day-length amplitude did not have significant effects when entered in the model (Table 1). Some authors postulate that temperatures and photoperiod are usually intercorrelated and that body

	a	SE	t	P
A) Body mass				
CONSTANT	20.027	0.682	29.353	0.000
MED	–0.681	0.059	–11.547	0.000
MED5	0.803	0.093	8.639	0.001
MIN2	–0.174	0.037	–4.756	0.009
R^2	0.980			
F	64.294			0.001
B) Fat				
CONSTANT	8.112	0.934	8.682	0.000
MAX	–0.285	0.054	–5.257	0.002
R^2	0.822			
F	27.634			0.002

Table 1. Results of stepwise regressions of body mass (A) and fat (B) on prevailing variables. a = regression coefficient; R^2 = Determination coefficient for the regression; SE = Standard error; t = Student's test; P = Significant value. F = ANOVA's value of the model; MED= Mean temperature on day of capture; MED5 = Mean temperature five days before capture; MIN2 = Minimum temperature two days before capture; MAX = Maximum 24 h temperature on day of capture. Sample size is 12 days (averaging body mass and fat for the different individuals trapped within the same day).

Taula 1. Resultats de la regressió múltiple automàtica, pas a pas, de la massa corporal (A) i greix (B) sobre les variables significatives. a = coeficient de regressió; R^2 = Coeficient determinant per a la regressió; SE = Error estàndard; t = test d'Student; P = Valor de significació. F = Valor de l'ANOVA del model; MED= Temperatura mitjana del dia de captura; MED5 = Temperatura mitjana cinc dies abans de la captura; MIN2 = Temperatura mínima dos dies abans de la captura; MAX = Temperatura màxima del dia de captura. El conjunt de la mostra és de 12 dies (mitjana de la massa corporal i greix dels diferents individus capturats dins del mateix dia).

mass is affected by this trend (S. Haftorn, pers. com). In order to test whether the effect of temperature might be due to seasonal variation, simple regressions between photoperiod and average maximum and minimum temperatures were used. The results indicates that, although maximum temperatures were significantly intercorrelated with photoperiod (r_7 = 0.78; p = 0.01), body mass was not related with the latter variable (r_7 = 0.48; p = 0.20).

DISCUSSION

Temperature is one of the most important factor affecting the fattening of birds (Blem & Shelor 1986). Short-term changes in the ambient temperature can act as a proximate factor in the control of energetic reserves as is argued for some passerine birds (Robson 1996, Gosler 1996), and the long-term ambient temperature can result in an ultimate factor controlling the body reserves (Evans 1969). The results obtained in this study indicate that short-term temperature may be a proximate factor playing an important role in the regulation of body mass in Blackcaps, suggesting a physiological response of Blackcaps to temperature variation. Short-term precipitation had no detected effect in the regulation of body mass, as has also been found in other passerines (e.g. White-Throated Sparrow *Zonotrichia albicollis*, Blem & Shelor 1986).

Importantly, an effect of temperature on fat score was also found, which indicates that variation in body mass is probably the result of adjusting fat reserves through the winter.

In Bramblings *Fringilla montifringilla* wintering in Switzerland, it has been shown that there is a critical temperature of 0°C, over which significant decreases of body mass occur (Jenni & Jenni-Eiermann 1987), minimum body mass being higher than for birds wintering in colder climates (Robson 1996). In Blackcaps wintering in areas with warner climates and more stable weather conditions, critical temperature could climb to higher values as was found this study.•

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RESUM

Relació entre la massa corporal i algunes variables meteorològiques en els Tallarols de Casquet** Sylvia atricapilla **hivernants als tarongerars del sud-est d'Espanya

Es va estudiar la massa corporal i l'acumulació de greix dels Tallarols de Casquet Sylvia atricapilla *que hivernaven en uns tarongerars suburbans del sud-est d'Espanya en relació a diverses variables ambientals (temperatura, precipitació i fotoperíode) utilitzant una regressió múltiple automàtica pas a pas. De cara a evitar la pseudo-replicació, les anàlisis es van realitzar sobre els valors mitjans dels diferents individus capturats dins del mateix dia. La variació en la massa corporal es va poder predir significativament per la temperatura mitjana del dia de captura, temperatura mitjana cinc dies abans de la captura i la temperatura mínima dos dies abans de la captura (R^2 = 0.980; p = 0.001). La puntuació de greix va estar significativament relacionada amb la temperatura màxima del dia de captura (R^2 = 0.822; p = 0.002). Sembla que la temperatura té un paper important com a factor immediat o a curt*

termini en la regulació de la massa corporal dels Tallarols de Casquet que hivernen al sud-est d'Espanya.

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