

## Does bib size act as a status badge in territorial Reed Buntings (*Emberiza schoeniclus*)?

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**Abstract** - The hypothesis that bib size acts as a signal of status was tested on territorial Reed Bunting males. In accordance with previous results, we predicted that if males display their status through bib size, a territory invasion by a large badge model would elicit a more aggressive response from the territorial individual. This was tested by presenting two stuffed models with the extremes of badge variation (smallest and largest, as found on 26 museum specimens) to territorial males of unknown badge size and by observing and comparing the responses. A third model, a male in winter plumage, was used as a control. Our hypothesis was not confirmed, but there was a tendency in the predicted direction: territorial males were more aggressive towards the large badge model even if not significantly so. Bib size may then play a minor role in honest signalling in the Reed Bunting, and other cues such as song structure and/or song rate might be more important. It must also be stressed that bib size variability could be involved in individual recognition.

### Introduction

Since Rohwer's (1975) study, plumage variability in winter flocking passerines has attracted much attention (Rohwer 1977, Balph *et al.* 1979, Ketterson 1979, Watt 1986a, b, Møller 1987).

Rohwer (1982) predicted that conspicuous plumage signals may also indicate the variable fighting ability of territorial birds: the advantage of such a status signal would be that individuals of different status competing for limited resources (e. g. territories) can evaluate each other's fighting ability before a contest begins, thus avoiding costs related to overt aggression. A few field studies have verified that plumage *per se* acts as a signal of status during the breeding season, when most Passerines are territorial (Studd and Robertson 1985, Pärt and Qvarnström 1997): they have all found significant correlations between plumage characteristics and aggression or fighting ability, independently of body size or age. In the case of Collared Flycatchers *Ficedula albicollis*, males with a large badge (i. e. white forehead patch) also acquired a female more quickly than others, suggesting that badge size is also implicated in sexual selection (Pärt and Qvarnström 1997).

Male Reed Buntings *Emberiza schoeniclus* have a black bib, partly concealed during winter by light brown feather tips. This variation in black bib size is

not age-related (Svensson 1992). Møller (1987) found that the area of the black bib in male House Sparrows *Passer domesticus* is related to the winter social status, birds with large badge being higher ranking: he found the same to be true during the breeding season.

Our hypothesis was that the black bib of the Reed Bunting acts as a status badge during the breeding season, when it is very conspicuous. Following Studd and Robertson (1985), Rowland (1979), Slagsvold and Saetre (1991) and Huhta and Alatalo (1993), we made a simple specific prediction which we tested by presenting two stuffed models with the extremes of badge variation (smallest and largest) to territorial males of unknown badge size and then observing and comparing the responses: if males display their status through bib size, a territory invasion by a large badge model would elicit a more aggressive response from the territorial individual. A third model, a male in winter plumage showing no badge, was used as a control.

### Materials and Methods

We carried out the tests from 11 to 22 April 1998 in a marsh with extensive reedbeds in northern Italy, the Oasi Palude Brabbia, a Nature Reserve and RAMSAR site which holds a breeding population of Reed

Buntings of the subspecies *schoeniclus*. Six territorial males had previously been located and their territory boundaries marked (Territory Mapping Method, Bibby *et al.* 1992).

In a preliminary analysis on 26 skins at the Natural History Museum of Milano we found considerable variation in bib size, the range being 420 mm<sup>2</sup> to 883 mm<sup>2</sup>. Bib size, measured with dial calipers to the nearest 0.1 mm from the base of the bill, was found to increase lengthwise. Size was calculated as follows:

$$\text{Area (mm}^2\text{)} = 143.00 + 13.08 \text{ Length,}$$

$$F = 13.43, df = 24, 1, P = 0.0012, R^2 = 0.33$$

We prepared two museum mounted specimens, the size of whose bibs were altered with a water-proof black marker and a white marker in order to obtain the extremes of bib variation: on one model bib was reduced to  $\approx 400$  mm<sup>2</sup> and on the other it was enlarged to  $\approx 800$  mm<sup>2</sup>. Only one replicate of each type of model was used, hence we cannot disentangle the effect of badge size from the effect of model. However, the models were chosen and manipulated in a way that they differed only in badge size. Another model, a male in winter plumage with unabraded head feathers, was used as a control. The three models were presented in random order to the selected males at a distance of 3-6 days to minimize the risk of habituation. Testing was conducted before females started laying (Cramp and Perrins 1994): females were still observed wandering around territories after the end of the presentations. To avoid confounding the variable with meteorological conditions and time of day, all presentations were conducted with clear sky and between h 7 - 9 am.

The presentation of models was associated with a standard playback of the *schoeniclus* subspecies, recorded in the same area in a previous year: there are indications that song varies between Reed Bunting subspecies (Matessi *et al.* 1997). Unfortunately no work has been done on possible age/badge correspondences with song difference, but the taped song was of the pre-mating type (G. Matessi, pers. comm., Nemeth 1996). One song strophe every 10 sec was broadcasted. Each presentation lasted 5 min, during

which the response of the territorial males were verbally described onto a tape recorder (see Hill 1989). It was also noted if the male was observed on the territory before the beginning of the presentation. The models were presented on a post in a conspicuous position within each male's territory, always in the same position, marked with small flags on the reeds. The response was scored according to three aspects of aggressive behaviour: minimum distance attained, movement rate, and vocalizations: after an evaluation of the responses across all presentations and preliminary observations, a 0-5 scale was developed for each of these behaviours (Table 1). Since the scores for each category were all highly positively correlated (all correlations  $P < 0.01$ ), a total response score (TRS) was calculated as the sum of the scores for each category of behaviour. All tests were two-tailed, except those on TRS, where we had an a-priori prediction.

## Results

All but 2 of the 18 presentations to the six males were successful, i. e. the males were observed during the 5 minutes of the presentation in 16 cases: the 2 failed presentations (TRS = 0) (both to control model) were excluded from the analysis, as the male probably was not on the territory (see Dixon *et al.* 1994 for a brief description of territorial behaviour). Male Reed Buntings were not particularly aggressive towards the models: in none of our presentations did an attack on the model occur, and TRS ranged from 3 to 13. We found a significant decrease in aggression with date of presentation (linear regression:  $y = -2.65x + 12.11$ ,  $F = 8.05$ ,  $df = 14$ ,  $P = 0.013$ ,  $R^2 = 0.36$ ), so in the following calculations we use residuals of the regression of TRS on date. The decrease in aggression with date may have been caused by habituation to the experimental setup. However, this is unlikely as we followed the same procedure as Studd and Robertson (1985): furthermore, the use of TRS residuals allowed us to carry out comparisons, as we were able to eliminate the effect of date. There was no time of day effect (h 7-9, Kruskal-Wallis Anova,  $H = 1.99$ ,  $df = 2$ ,

Table 1. Categories of behaviour and response score for each category.

score	minimum distance	score	movements	score	vocalizations
0	not observed	0	not observed	0	no vocalizations
1	>20 m	1	no movement	1	regular song
2	11-20 m	2	some distant movements (>20 m)	2	irregular, excited song
3	6-10 m	3	some close movements (<20 m)	3	some alarm calls
4	3-5 m	4	slow movements around the model	4	song phrases and alarm calls
5	1-2 m	5	excited movements around the model	5	continuous alarm calls



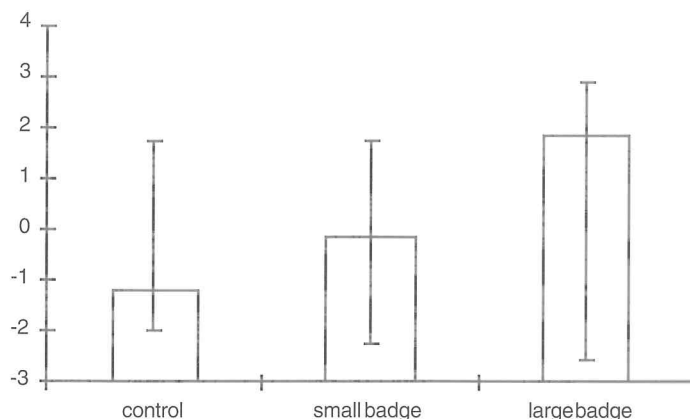


Figure 1. Residuals Total Response Score (TRS): bars are median and 25<sup>th</sup> and 75<sup>th</sup> percentiles. The correlation between model (control-small badge-large badge) and residuals TRS is  $r_s=0.19$ ,  $N=16$ , one-tailed  $P=0.23$ .

$P=0.36$ ) and males on the territory before the beginning of the presentation were not more aggressive than those not observed on the territory (Mann-Whitney U Test,  $U=13$ ,  $N_1=12$ ,  $N_2=4$ ,  $P=0.18$ ). We did not find any consistent variation in aggression towards the three different models in any of the six territorial males (residuals of TRS for the 4 males who responded to all three presentations: Friedman two-way Anova,  $\chi^2=3.5$ ,  $df=2$ ,  $P=0.17$ ). However, the correlation between model (control - small badge - large badge) and TRS residuals was positive but not significant ( $r_s=0.19$ ,  $N=16$ , one-tailed  $P=0.23$ ) (Figure 1). Controlling for date, there was also a positive but non-significant correlation between TRS and model ( $r_{\text{partial}}=0.28$ ,  $df=13$ , one-tailed  $P=0.15$ ).

## Discussion

Our hypothesis that bib size acts as a signal of status was not confirmed, although territorial males tended to be slightly more aggressive towards the large badge model. Bib size may then play a minor role in status signalling in the Reed Bunting, with other cues such as song structure and/or song rate possibly being more important (e.g. Grafen 1990, Hoi-Leitner *et al.* 1995, Hiebert *et al.* 1989): this is strongly suggested by the similar aggression level displayed towards the control. In addition to this, during ringing operations in the study area we found little variability in bib size: coefficient of variation for our study population was 6.6 ( $N=18$  males), while for museum skins was 20.2 ( $N=26$  males) (A. Boto and D. Rubolini, unpubl. data). The variability we found on museum skins may also be of geographical origin, as the specimens we analysed were collected in various parts of Italy. It must also be

stressed that bib size variability could be involved in individual recognition (Shields 1977). Another possible explanation is that in the sexually dichromatic *Emberizinae*, where females are extremely similar, conspicuous male colouration (i.e. head and breast pattern) may have evolved for interspecific male recognition rather than intraspecific recognition, and so head and breast pattern may have little or no social significance (but see Saetre *et al.* 1997). In conclusion, our hypothesis was not confirmed, nor was it strongly confuted. Maybe a larger sample of tests in other parts of the species' distribution might help in clarifying the role of bib in honest signalling in the Reed Bunting.

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**Riassunto** - Abbiamo verificato sperimentalmente se la dimensione del bavaglino nero dei maschi territoriali di Migliarino di palude abbia la funzione di segnale di status sociale. In accordo con altri studi, abbiamo ipotizzato che i maschi territoriali avrebbero risposto in modo più aggressivo alla simulazione di un'invasione territoriale da parte di un modello impagliato con bavaglino grande rispetto a un modello con bavaglino piccolo (le dimensioni massima e minima del bavaglino sono state ricavate dall'analisi di 26 animali in pelle e le dimensioni del bavaglino dei modelli sono state manipolate artificialmente, in modo da ottenere le dimensioni massime e minime). Un terzo modello, un maschio in piumaggio invernale, è stato usato come controllo. Le indicazioni emerse non permettono di trarre alcuna conclusione definitiva riguardo al ruolo delle dimensioni del bavaglino come segnale di status, ma tuttavia c'è una debole tendenza nella direzione attesa: probabilmente il ruolo del bava-

golino come segnale di status nel Migliarino di palude è limitato, e altre caratteristiche potrebbero essere più importanti, ad esempio la frequenza o il tipo di canto. Deve inoltre essere sottolineato come le dimensioni del bavaglino potrebbero essere implicate nel riconoscimento individuale.

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