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SHORT REPORT

Biases associated with the use of a playback in stopover ecology studies of Bluethroats *Luscinia svecica*

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Capsule The effects of playback use on number of captures, recaptures, fuel load, and age and sex ratios, and so potential bias in stopover studies in migrant Bluethroats was investigated. Playback promoted biases in the number of captures (although this was site-dependent) and fuel load. We strongly advise against the systematic use of playback to sample Bluethroats at constant effort sites or other type of ringing station, especially if studying fuel loads.

During migration, birds often divide their travel into phases of flight, when energy is consumed and distance is covered, and stopovers, when energy is (normally) stored (Alerstam & Lindström 1990). The majority of migration time is spent at stopover sites, where birds gain energy, rest, and wait before beginning the next flight bout (Hedenström & Alerstam 1997). Studies of the stopover ecology of migrant birds are hence fundamental to a proper understanding of bird migration strategies (Newton 2008, Chernetsov 2012).

The capture of small passerine birds for ringing is of key importance in stopover ecology studies (Newton 2008, Chernetsov 2012). The need to obtain large sample sizes for statistical analysis, either in terms of captures (Arizaga & Barba 2009) or recaptures (Schaub *et al*. 2001), has resulted in the relatively widespread use of playback during sampling ringing sessions (Bolshakov *et al*. 2003, Julliard *et al*. 2006, Arizaga *et al*. 2010, Poulin *et al*. 2010). The effect of playback on the type of data (i.e. on the possible associated-bias) obtained when it is used is, however, poorly understood. Sometimes playback increases the proportion of birds of a particular sex (Lecoq & Catry 2003), or age (Borras & Senar 1986), or alternatively more fuel loaded (Brotons 2000) or less fuel loaded (Figuerola & Gustamante 1995) individuals. Other cases have shown that the use of playback at night can modify migrants' landing decisions, attracting birds which otherwise would not have landed at a particular site (Schaub *et al*. 1999, Ktitorov *et al*. 2010). This generates biases in the interpretation of data relating to the type of migrants which decide to stop over at a site and the use of that stopover area. Such biases in sampling techniques acting directly on migrants' behaviour at stopover sites is likely to be one of the main problems with a number of stopover ecology studies (Figuerola & Gustamante 1995, Schaub *et al*. 1999, Julliard *et al*. 2006).

The aim of this work is to explore the effects of the use of playback on a number of commonly studied aspects related to the stopover ecology of migrant passerines. To test these effects we used Bluethroats *Luscinia svecica* as an avian model. The birds were captured at a number of sampling sites along the coast of the Bay of Biscay. The Bluethroat is a widespread Holarctic songbird breeding from Iberia in Europe to Alaska and Canada, and overwintering in southern Europe, Africa, or Asia (Collar 2005). It is a relatively common

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Table 1. Characteristics of the sampling protocol at each site: sampling period, linear metres of mist nets used at each zone (no playback/playback) within each site, distance between zones without and with playback, and number of captures (in parenthesis: captures with their age and sex determined and body mass and wing length recorded).

Site	Sampling period	No playback (linear m)	Playback (linear m)	Distance (km)	Captures
Gironde	25 Aug–08 Sep (15 days)	120	120	0.5	218 (157)
Txingudi	01 Sep–20 Sep (20 days)	204	72	1	58 (57)
Urdaibai	01 Sep–20 Sep (20 days)	144	120	0.5	36 (35)

passerine along the coast of the Bay of Biscay during the migration period (Grandío & Belzunce 1987, Arizaga *et al.* 2006, 2011, González *et al.* 2007). Together with its abundance, the Bluethroat has the advantage of being easy to age and sex (Svensson 1996), a fact which allowed us to test for the effect of playback on age and sex ratios. Sex determination in the hand has been found to be impossible for other abundant, small passerines caught in the region during the migration period (Mendiburu *et al.* 2009), such as the *Acrocephalus* warblers (Svensson 1996).

Data were collected at three coastal sites situated on the Bay of Biscay, one in France and two in Iberia (Gironde Estuary: 45°29'N 00°49'W, Txingudi: 43°21'N 01°49'W, and Urdaibai: 43°21'N 02°40'W). At each site we tested for the effect of playback by selecting two different sampling zones that contained similar vegetation. Mist nets were placed across two separate reed beds *Phragmites* spp., which had more or less the same proportion of other types of macrophyte vegetation of the genera *Juncus* spp. and *Elymus* spp. The distance between the control zone and the playback zone ranged from 0.5 to 1 km (Table 1). The volume of the playback was low enough to ensure that it could not be detected from the control zone.

The number of mist nets in each zone was kept constant during the entire sampling period (Table 1). Mist nets remained open for a period of 5 h, starting 1 h before dawn. The sampling period lasted for 15 days at the Gironde Estuary and 20 days at Txingudi and Urdaibai, during the autumn migration period (Table 1). In the zones where playback was used, a male song was played (in an MP3 connected to a speaker) during the 5 h sampling period (also starting 1 h before dawn, when the mist nets were open). Exactly the same playback was used at each site. We used a playback for each 36 linear m of mist nets (40 m at Gironde). By applying this protocol we did not affect the migrants' landing decisions and cause more birds to land (Schaub *et al.* 1999). We examined only the likelihood of capturing a higher number of already settled Bluethroats.

Once caught, Bluethroats were ringed (or the ring was read if the bird had been ringed before) and their sex and age were determined. Birds were aged as either first-year birds (birds with some juvenile feathers in the greater coverts and/or tertials) or adults (older birds, with no juvenile flight feathers or coverts) (Jenni & Winkler 1994). We then measured wing length (0.5 mm accuracy, method III by Svensson 1996) and body mass (0.1 g accuracy).

Our object parameters were standardized number of captures (captures/100 linear m of mist nets and day), age and sex, residual body mass (i.e. body mass controlled for body size), and proportion of recaptures. The standardized number of captures was log-transformed in order to obtain a variable that fitted the normal distribution (Kolmogorov–Smirnoff (K–S) test, $P > 0.05$). The age and sex categories were combined to obtain a single sex–age variable with four possible values: first-year male, first-year female, adult male, and adult female. To obtain a variable assessing body condition we regressed body mass on wing length at each site (Gironde Estuary: $r^2 = 0.28$, $P < 0.001$, $n = 157$; Txingudi: $r^2 = 0.30$, $P < 0.001$, $n = 57$; Urdaibai: $r^2 = 0.32$, $P < 0.001$, $n = 35$). The residual values of such regressions were used as a body condition index (Schulte-Hostedde *et al.* 2005). This variable fitted to a normal distribution (K–S test, $P > 0.05$). The proportion of recaptures refers to Bluethroats recaptured once or more within each sampling zone (playback/no playback) at each site during the period in which the study was carried out.

We ran generalized linear models (GLMs) with three of these dependent variables: standardized number of captures (log-transformed), residual body mass, and sex–age. Concerning the standardized number of captures, we considered the sampling day as a 'subject' at each site, the zone (playback/no playback) as a repeated measures variable and the site as a factor. Regarding the rest of the dependent variables, we considered playback and site as control fixed factors. The variable sex–age was also included in the models of residual body mass (Table 2). For the residual body

Table 2. Generalized linear mixed models run to see the effect of playback on residual body mass, recaptures, age, and sex of Bluethroats caught during the autumn migration period at three coastal sites within the Bay of Biscay.

Models	*F*	df	*P*
Dependent variable: log-standardized captures. Link function: Linear			
Playback	7.2	1	0.01
Site	20.6	2	<0.001
Playback × Site	8.5	2	<0.001
Dependent variable: residual body mass. Link function: Linear			
Playback	4.7	1	0.03
Site	2.6	2	0.07
Age–Sex	4.2	3	0.01
Playback × Site	0.9	2	0.42
Playback × Age–Sex	1.9	3	0.13
Site × Age–Sex	4.6	6	<0.001
Dependent variable: sex–age. Link function: Logistic multinomial			
Playback	0.5	1	0.72
Site	1.1	2	0.37
Playback × Site	0.6	2	0.71

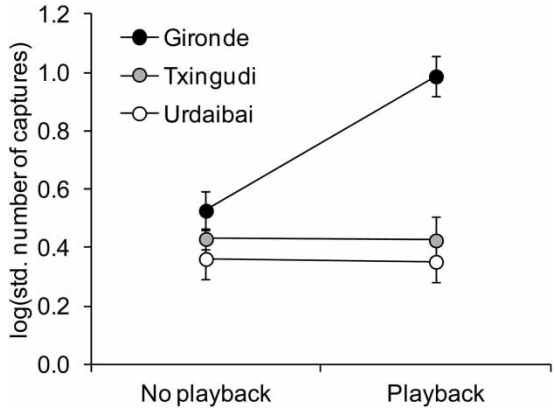

Figure 1. Mean (± se) of the log-catching effort-standardized number of captures per day of Bluethroats between zones without and with playback at the three study sites. Days without captures in either zone have not been considered here. Sample size: Gironde, *n* = 15 days; Txingudi, *n* = 15 days; and Urdaibai, *n* = 11 days.

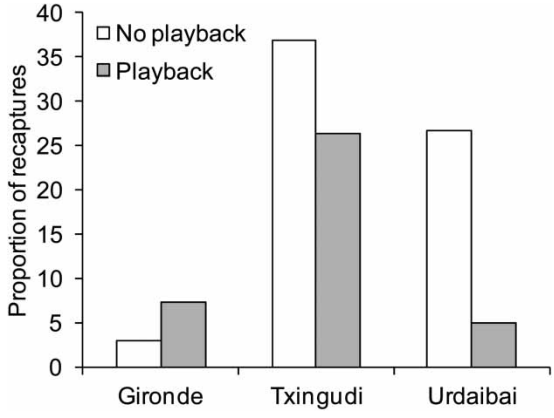

Figure 2. Proportion (%) of Bluethroats recaptured within each sampling zone (playback/no playback) at each site.

mass and age–sex analyses, each bird was considered only once. Depending on the nature of each variable we used different link functions (for details see Table 2). All the possible two-way interactions were considered in all the models. We were particularly interested in the site × playback interaction in order to know whether the effects of playback on a particular variable were observed across all sites or were site-dependent.

Overall, the proportion of recaptures was not sufficiently high to run meaningful GLMs. In this case, then, we ran a chi-square test to see if the proportion of recaptures varied between zones without or with playback (sites pooled). This test was run for each site and corrected using a Bonferroni correction. We used the software SPSS 21.0 for the statistical procedures.

Overall, we caught 312 Bluethroats (Table 1). The log-standardized number of captures varied between zones without or with playback, but with a site–effect interaction (Table 2). The observed positive effect of playback was only recorded at one site out of three (Fig. 1).

Residual body mass varied between zones without or with playback (Table 2). Bluethroats caught at playback zones had lower residual mass values (mean ± sd: no playback, +0.20 ± 1.22, *n* = 87; playback, −0.11 ± 1.11, *n* = 162). The site × playback interaction was non-significant.

The effect of the playback on the age and sex of the Bluethroats caught at each site was non-significant (Table 2). Overall, we caught 48.6% first-year males, 32.2% first-year females, 14.8% adult males, and 4.4% adult females.

The proportion of Bluethroats recaptured once or more did not vary between zones without and with playback for any site (Gironde Estuary: $\chi^2 = 0.9$, df = 1, $P = 0.46$; Txingudi: $\chi^2 = 0.6$, df = 1, $P = 0.56$; Urdaibai: $\chi^2 = 3.3$, df = 1, $P = 0.14$; Fig. 2).

The use of a playback (a male breeding song) for Bluethroat capture during mist-netting ringing sessions, at three coastal sites in the Bay of Biscay during the autumn migration period, did not increase the number of captures at all sites. There was, however, an increase at one site. This result highlights that the effect of a playback is (or can be) site-dependent, and its use cannot be guaranteed to increase captures (Poulin *et al.* 2010).

The reason why Bluethroats were attracted by the playback at the Gironde Estuary but not at the other two sites located further south (Txingudi and Urdaibai) remains unknown to us. In contrast to Txingudi and Urdaibai, where there are no breeders, the Gironde Estuary has a breeding population. It is also a target moulting site for Bluethroats prior to the autumn migration period (R. Musseau unpubl. data). Moulting birds are not found at Txingudi or Urdaibai (J. Arizaga unpubl. data). Thus, the status of a bird (i.e. breeding, moulting, or migrating) is likely to have a significant effect on its response to a playback.

Bluethroats in the playback zones had lower fuel loads than those caught in control zones. This result demonstrates that the use of a playback promotes biases in the physical condition of birds: those with relatively low fuel loads were more attracted by the playback than birds that were carrying more fuel. This result has been obtained previously, both in passerines and shorebirds (Borras & Senar 1986, Figuerola & Gustamante 1995). In other cases, however, playback attracted birds with higher fuel loads (Brotons 2000). Thus, the impact of the playback can also differ between species; hence species-specific studies should be carried out before its use in a particular case. Fuel load analyses are of key importance in several stopover studies (Newton 2008, Chernetsov 2012), hence the use of playback during sampling sessions must be re-considered, owing to its impact on the condition of the birds caught. The combination of field data collected over sites using/not using playback must be considered with caution.

Adult males are often the social category most sensitive to playback (Lecoq & Catry 2003). The analysis of sex and age ratios is of high importance in determining several features of avian migration patterns, including differential migration (Cristol *et al.* 1999), and yearly associated variations in survival between age classes (Guillemain *et al.* 2010). Methodological biases in the population structure associated with the use of a playback, therefore, may generate idiosyncratic results. In our case the playback did not bias the age and sex ratios of the sample. Although it seemed that the proportion of adult males tended to increase with the use of a playback tape, which would confirm previous studies with other passerine birds (Lecoq & Catry 2003), the difference was not significant in our study, possibly due to the lack of statistical power.

Overall, the proportion of recaptures was not affected by the use of playback. If we assume the same capture rate between zones with and without playback (Lebreton *et al.* 1992), it can be concluded that the use of playback did not increase the number of recaptures at each site. Unfortunately, our relatively low sample sizes did not allow us to run more sophisticated models (e.g. Cormack–Jolly–Seber models) to estimate the recapture and survival probabilities independently (Lebreton *et al.* 1992).

In conclusion, the use of playback to sample Bluethroats during the autumn migration period, at three independent sites along the coast of the Bay of Biscay, promoted biases in the number of captures (although this was site-dependent) and fuel load. This last variable, was the only one that varied significantly with the factor 'playback', both consistently among sites and in the predicted direction. We strongly advise against the systematic use of playback to sample migrants during ringing campaigns at constant effort sites, or other types of ringing stations, unless its use is clearly advantageous. Researchers, or ringers in general, must take into account the fact that data obtained in this way will be limited in terms of their value for comparison with other sites.

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