



Short communication

# Adequacy of winter stubble maintenance for steppe passerine conservation in central Spain

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## Abstract

Maintaining winter stubble for the conservation of steppe passerines is widely implemented under the regional agri-environmental program in Spanish dry lands. The adequacy of such measures was assessed in terms of bird density on different soil cover types in central Spain. Highest bird densities were found in ploughed, sown and fallow plots. Stubble plots were poorly used by wintering passerines compared to other soil cover types. The maintenance of stubble should be therefore reconsidered as an agri-environmental commitment in the Spanish programs.

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## 1. Introduction

Different agri-environmental programs aimed at conserving bird species associated with extensive farmland have been implemented in Spain since the mid-1990s (Oñate et al., 1998). Among other commitments, participant farmers have to maintain stubble after harvest until the end of February (winter stubble), with a view to favour farmland and steppe bird species, for which the Iberian Peninsula is a stronghold in the European Union (Suárez et al., 1997). Stubble has been promoted because: (1) they support vegetation which provides birds with a food resource during winter (Robinson and Sutherland, 1999); (2) they have had a positive effect on most

species in other parts of Europe (Wilson et al., 1996; Wakeham-Dawson and Aebischer, 1998); (3) they used to be a common practice in Spain before the agricultural intensification of the 1970s (Garrabou et al., 1986).

During 1993–1998 some 620,000 ha of cereal farming have entered the programs in Spain, many of which would be ploughed after harvest. However, sown cereal, stubble, ploughed fields and long-term fallows co-exist in the agricultural landscape, resulting in a mosaic associated with diversity and abundance of farmland birds (Martínez and De Juana, 1996).

The adequacy of winter stubble maintenance for the conservation of farmland passerines was assessed in two extensively cultivated areas of central Spain, the hypothesis being that for the measure to be effective, bird density needed to be higher on stubble than on other soil cover types.

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## 2. Materials and methods

The study was carried out in two locations near Madrid (central Spain) at 25 km distance, i.e. Jarama (40°40'N, 3°25'W, 800 m a.s.l.) and Campo Real (40°19'N, 3°18'W, 750 m a.s.l.), respectively, special protection area (SPA, 25,000 ha) and important bird area (IBA, 52,000 ha). Both were flat or gently undulating areas dominated by wheat and barley crops, with an average precipitation of 600–700 mm/year. Average yield reached ca. 2.5 t/ha/year and some 35% of the surface was under traditional fallow.

Bird densities were estimated by line-transects 25 m wide on each side (Järvinen and Väisänen, 1975) in February 2001 (Campo Real:  $n = 7$ ; 92 ha) and 2002 (Jarama:  $n = 4$ ; 224 ha). Transects were placed randomly in each location, and due to the mosaic landscape each transect crossed plots with different types of soil cover. Although average plot size (calculated from digital cartography by means of a vector-based GIS application) differed between study sites (Jarama: 2.66 ha, S.E. = 0.15 ha; Campo Real: 1.28 ha, S.E. = 0.13 ha), it was similar among soil cover types within each locality (each soil cover type compared with every other one by means of Tukey's ANOVA post hoc tests,  $P > 0.05$  in all cases), and thus, the effect of different plot size among soil cover types could be discarded.

Birds detected, distance walked and type of soil cover were recorded for each plot, specific bird density (birds per 10 ha) being calculated for each plot or contiguous plots with the same soil cover type. The following types of soil cover were considered: (1) November sown cereal; (2) winter stubble; (3) ploughed; (4) long-term fallow. Transects were censused once between 9.00 and 11.00 a.m., avoiding windy and rainy conditions. Minimum distance between transects was 0.5 km.

Differences in species densities in relation to soil cover types were evaluated by means of one-way

ANOVAs. To normalise data, density was transformed by means of the equation  $x' = \log_{10}(x + 1)$ , Tukey's post hoc test being used to compare species densities between soil cover types. Data from each location were analysed separately. All analyses were performed using the SPSS 10.0 statistical package (SPSS Inc., 1999).

## 3. Results

A total of 53 bird species were recorded (Jarama, 24 species; Campo Real, 49). Total bird density varied significantly among soil cover types in both locations (ANOVA, Jarama,  $F_{3,148} = 2.768$ ; Campo Real,  $F_{3,77} = 3.391$ ,  $P < 0.05$ ), with highest numbers in Jarama in ploughed and sown cereal covers, where bird density was four and two-fold that found in stubble (Table 1), although paired tests detected significant differences only between stubble and sown cereal (Tukey's test,  $P < 0.05$ ). Long-term fallow and sown cereal yielded the highest densities in Campo Real (Table 1), being in both cases about two-fold those obtained in stubble. Paired comparisons found significant differences between ploughed and sown cereal, and ploughed and long-term fallow (Tukey's test,  $P < 0.05$ ).

Species densities varied among soil cover types and locations (Fig. 1). Skylark (*Alauda arvensis* L.) and common pipit (*Anthus pratensis* L.) densities varied significantly among soil cover types in Jarama ( $F_{3,148} = 3.396$  and  $6.459$ ,  $P < 0.05$  and  $P < 0.001$ ). Skylark density was considerably lower in sown cereal than in long-term fallow (Tukey's test,  $P < 0.05$ ). The differences of common pipit density between sown cereal and stubble, as well as between sown cereal and ploughed, were significant (Tukey's test,  $P < 0.01$ ). The remaining species contacted at Jarama did not differ in density (ANOVA,  $P > 0.05$ ).

Table 1

Mean winter densities (birds per 10 ha) and standard deviation for different soil cover types in two Spanish locations ( $n$ : number of plots censused)

Area	Sown cereal	Stubble	Ploughed	Long-term fallow
Campo Real	51.2 ± 96.5 ( $n = 31$ )	34.9 ± 54.2 ( $n = 31$ )	12.9 ± 18.2 ( $n = 16$ )	63.6 ± 71.4 ( $n = 10$ )
Jarama	50.1 ± 89.0 ( $n = 53$ )	19.7 ± 45.6 ( $n = 62$ )	83.8 ± 168.9 ( $n = 18$ )	38.9 ± 61.1 ( $n = 19$ )

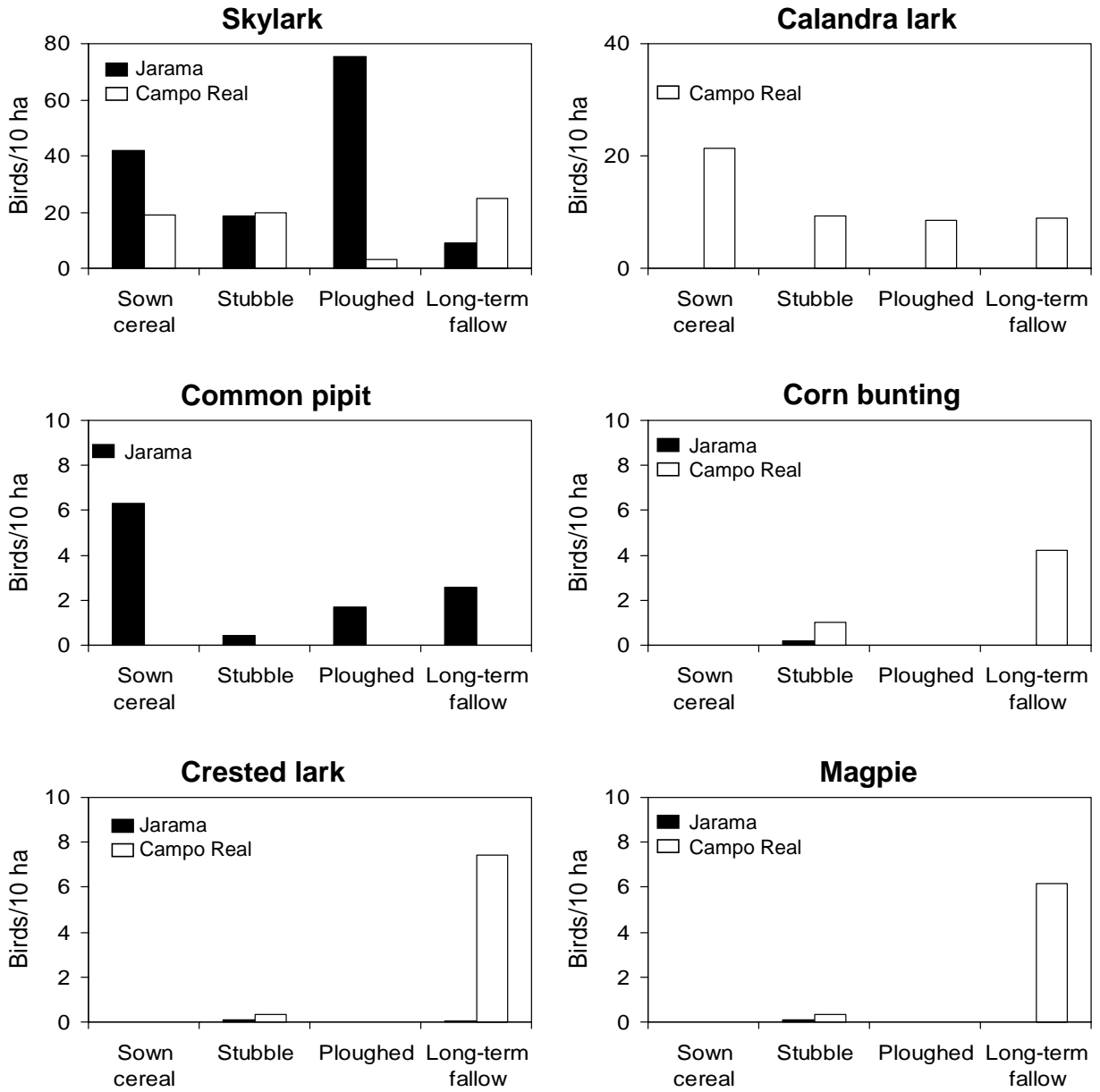


Fig. 1. Mean winter densities (birds per 10 ha) of species most abundant or showing significant differences among soil cover types in two Spanish locations.

The only species showing significant differences between soil cover types in Campo Real were crested lark (*Galerida cristata* L.) and black-billed magpie (*Pica pica* L.;  $F_{3,77} = 6.029$  and  $3.573$ ,  $P < 0.01$  and  $0.05$ , respectively), both reaching their great-

est abundance in long-term fallow (Fig. 1, Tukey's test,  $P < 0.05$ ). Calandra lark (*Melanocorypha calandra* L.) and corn bunting (*Miliaria calandra* L.) densities were always lower in stubble than in any other soil cover type (Fig. 1), al-

though differences were not significant (Tukey's test,  $P > 0.1$ ).

#### 4. Discussion

Stubble and long-term fallow are known to hold greater richness and densities of passerine species than other agrarian soil cover types in UK and central Europe (Robinson and Sutherland, 1999). The present results showed that: (1) stubble were not favourable to wintering passerines in central Spain; (2) species composition of wintering communities and their corresponding pattern of habitat use varied considerably between locations.

The first result was related to differences in landscape structure in terms of soil cover available to farmland birds and stubble management. Diversity of agrarian substrates during winter was generally low in UK and most of central and northern Europe, winter cereal being highly dominant with an almost complete absence of non-cultivated plots (O'Connor and Shrubbs, 1986; Robinson and Sutherland, 2002). In the studied areas, however, even though winter cereal was the dominant crop, large areas were occupied by traditional fallow, up to ca. 35% of the total farmland surface. As a consequence, birds wintering in Iberian farmland have much greater access to non-cultivated plots than in the British or central European countryside, and may use all soil cover types in addition to stubble.

Winter stubble maintenance was included as a compulsory commitment under the Spanish agri-environmental programs "Traditional Fallow Improvement" (five regional programs) and "Extensification Systems for Flora and Wildlife Protection" (three). In contrary to UK programs for environmentally sensitive areas, where the use of herbicides on stubble is limited (Wakeham-Dawson and Aebischer, 1998), herbicides were not explicitly included in Spanish programs, which just required that products belong to the lowest eco-toxicity category established by Spanish regulations. Winter stubble in Jarama and Campo Real were widely treated with herbicides during the study years, reducing weed cover and thus, the attractiveness of soil cover to birds.

Maintaining winter stubble without restrictions on herbicides dosage makes programs quite attractive for

farmers. Since no limits are put on the number of beneficiaries, there is a risk for reduced soil cover diversity and habitat quality. The programs' commitment is thus not adequate for farmland birds, whose diversity and abundance are correlated to the availability of a mosaic of different soil cover types (Díaz and Tellería, 1994).

The second result is relevant to the implementation of the program, which imposes equivalent conditions in terms of habitat characteristics over the whole eligible area. As birds in different locations did not equally prefer stubble, the program implementation should be redefined to take the local realities into account.

Both results are relevant with regard to the controversy about the evaluation of the effectiveness of agri-environmental schemes (Kleijn et al., 2001; Carey, 2001; Primdahl et al., 2003). Spatially non-targeted programs are expected to deliver less significant results in terms of bird densities, since they may have different effects among locations in the implementation area. This possibility should be taken into account in the evaluation procedure. Also, an evaluation based on the comparison of bird species densities between plots under and not under agreement (Kleijn et al., 2001) may be difficult in cases where most plots are under agreement. In such situations, the immediate effect on agricultural practices could be used as indicator, instead of amendments based on the ultimate impact on the environment (Oñate et al., 2000).

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