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Habitat use by Reed Bunting *Emberiza schoeniclus* in an intensively used farmland in Western Poland

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The habitat use of the Reed Bunting *Emberiza schoeniclus* was studied between 1998–2000 in an intensive cultivated agricultural landscape in western Poland. Birds occupied only wet marginal habitats such as small reedbeds, marshes, meadows and drainage ditches. Reed Buntings located their territories at the edges of these "habitat islands", showing no preferences for their shape and area. Using logistic regression models it was found that Reed Buntings prefer to set territories in areas with a high proportion of reeds, herbaceous vegetation and bulrushes. The percentage of meadows, cattails and oil seed rape had a smaller, positive impact on territory occupancy. Moreover, a small, negative effect of spring cereals on Reed Bunting distribution was found. The results obtained show that protection of wet habitat patches has a key role in the promotion of Reed Buntings in the intensively cultivated farmland.

1. Introduction

The Reed Bunting (*Emberiza schoeniclus*) inhabits farmland in many parts of its European range. The occurrence of the species in an agricultural landscape has been reported from England, Sweden, Germany, Poland and Switzerland (Schifferli 1981, Loman & von Schantz 1991, Glutz von Blotzheim & Bauer 1997, Tryjanowski 1999). Moreover, in some regions farmland holds a significant proportion of the total population. In England, more than half of the population occurs in farmland (Gregory & Baillie 1998). Similarly to typical farmland passerines, the number of Reed Buntings in western Europe has significantly declined during recent years (Chamberlain & Fuller 2000, Fuller *et al.* 2002), e.g. by 58% between 1975 and 1998 in England (Peach *et al.* 1999). One of main causes responsible for such a situation is the loss and degradation of breeding and foraging habitats (Peach *et al.* 1999). Thus, studies on habitat use can play a significant role in conservation of the species. However, unlike other farmland buntings, associations between farmland habitats and Reed Bunting have only been described on a broad scale (Gregory & Baillie 1998, Kosiński & Tryjanowski 2000, Mason & Macdonald 2000).

Polish farmland is especially suitable for sustaining large populations of Reed Bunting. The Farmland Birds Monitoring Program (2002–2003) revealed the presence of this species in 58% of 180 one-square kilometer plots distributed randomly in 6 regions over the whole country (Sachanowicz 2002, 2003). Analyses of habitat preferences of farmland birds is an urgent issue in countries joining the European Union due to marked changes planned in agricultural policy (e.g. Goławski & Dombrowski 2002, Kuitunen *et al.* 2003).

The main aim of the study was to investigate habitat use of Reed Bunting in intensively cultivated farmland. Clear preferences of the species to wetlands (Gregory & Baillie 1998, Kosiński & Tryjanowski 2000, Brickle & Peach in press) suggest, that mid-field patches of these habitats may greatly influence the occupation pattern. On the other hand, some crops may be used as breeding and foraging habitats by Reed Bunting (Surmacki 2001, Gruar *et al.* in prep.). Thus, type of land use might be also expected to modify (also indirectly) the distribution of Reed Bunting in a farmland. Possible conservation actions are discussed on the basis of the results obtained.

2. Material and methods

2.1. Study area

The study was carried out in Western Poland, near Poznań (52°27'N, 16°57'E). The surveyed plot covered 890 ha of farmland where arable fields dominated (89.6%). The structure of cultivation changed between the years 1998 and 2000, but cereals dominated throughout. Other common crops in the study plot were oil seed rape *Brassica napus*, sugar beet *Beta vulgaris* and maize *Zea mays*. Built up areas and roads took up about 5.3% of the area studied. Most of roads (the total length 15 km) are of medium traffic intensity and bordered by poplar *Populus sp.* and fruit trees.

Small marshes, meadows and drainage ditches occupied 5.1% of the area studied. The area of marshes ranged from 0.03 to 9.84 ha, but, 86.7% did not exceed 1 ha. Most of the marshes had centrally located water surfaces throughout the year. Ditches contained water only periodically. The dominant vegetation in marshes and ditch banks were reed (*Phragmites australis*) bordered with a strip of herbaceous vegetation and meadows. Less common emergents were cattails (*Typha latifolia, T. angustifolia*) and bulrushes (*Schoenoplectus lacustris*). Meadows adjacent to ditches and marshes were mowed usually twice a year, in May and June.

The area of reedbed varied due to natural and anthropogenic processes. In 1999 the reedbed area increased by approximately 13.6% (compared to 1998) owing to expansion on drainage ditches and small marshes. In the following year a drainage project was carried out in the area which resulted in the destruction of 2.5% of the reed area present in 1999. Moreover, from 1.15 to 6.64% of reeds were burned each year during the autumn or winter preceding the breeding season.

2.2. Bird census

The birds were censused between the years 1998 and 2000. A modified variant of the mapping method was used (Tomiałojć 1980). At least four early morning visits were performed from the middle of April to the end of June each year. The number of visits was lower than in the standard mapping method due to specific local field conditions. In virtually all cases, Reed Buntings bred in small patches of reeds where only a few males sang simultaneously, so their location was easy to determine. During each visit, the edges of ditches, marshes, roads and other marginal habitats were examined. All birds sighted were mapped and their behaviour was coded using symbols used in the mapping method. The breeding territory was defined as an area within a 50 m radius from the midpoint of observations of all territorial and nesting behaviour (mostly song or a pair). This distance was adjusted to the mean foraging distance observed in population studied (Surmacki 2001). For each territory at least two observations between April and May were required. No special effort was made for nest searching. However, in total 7 nests were found accidentally and all of them were located within breeding territories (50 m radius circles).

2.3. Data analysis

In total, the influence of 11 habitat variables on Reed Bunting territory distribution were analyzed. Most of them (n = 7) were defined as the percentage coverage within territory boundaries, i.e. within 50 m radius circle: trees and bushes (TAB), meadows (MEA), herbaceous vegetation (HER), reeds (REE), cattails (CAT), other rushes (OTH) and open water (WAT). Because nearly all Reed Buntings bred on margins, variables connected with crop type (n = 4) were defined as boundary lengths (m): spring cereals boundary (SPR), winter cereals boundary (WIN), oil seed rape boundary (OIL) and root crop boundary (ROO). To determine the effect of marginal habitats and crop composition on breeding territory presence, habitats within breeding and random territories were compared using the logistic regression analysis (Hosmer & Lemeshow 1989). Random territories were located in areas surveyed without Reed Buntings and had the same shape and area as the breeding territories. Their random co-ordinates were generated and accepted only if they fell over the marginal habitat, at least 50 metres from the boundaries of breeding and other random territory. For each year, a separate logistic regression model was calculated with the backward stepwise method. The significance of each variable included in the model was based on the Log Likelihood Ratio. Some ecologically meaningful variables with an individual significance of less than the conventionally accepted P = 0.05 were included in some models (Table 1). Variables expressed in proportions were arcsin transformed prior to analysis.

3. Results

3.1. Territory numbers and densities

In total, 55, 49 and 47 Reed Bunting breeding territories were localized during the consecutively studied seasons. The mean number of Reed Bunting territories in whole study area decreased in consecutive years; 6.18, 5.51 and 5.29 pairs /km^2 respectively. The median values of density on occupied marshes and ditches was 2.94 pairs/ha and 2.10 of pairs/km respectively. The densities of territories on marsh patches and ditches did not vary significantly during the study period (Kruskal-Wallis test, P > 0.05 in both cases).

3.2. Distribution of territories among different types of habitat patches

Reed Buntings bred almost exclusively in wet margin habitats such as marshes with various types of littoral vegetation (63.2%) and drainage ditches (23.7%). On 17 occasions males were located singing in crops; 16 in oil seed rape and 1 in winter cereals. The frequency of observations in each type of crop was significantly different from their percentage in the studied area ($\chi_1^2 = 11.49$, P = 0.001). Because all males were observed once only in the crops and sang close to a marsh or a ditch (median = 30 metres) they were assumed to breed here. The only exception was the male observed throughout the season in 2000 in an oil seed rape field, about 100 metres from the nearest marsh. No territories were recorded in dry marginal habitats, such as roadsides or set-asides. The yearly occupation of marsh patches varied between 42 and 49%. The smallest area of marsh occupied by Reed Buntings was 0.04 ha and the largest 9.84 ha (median = 0.35, n = 29).

The distribution of territories in ditches (36 territories), marshes smaller or equal to 1 ha (55 territories) and marshes larger than 1 ha (60 territories) was not proportional to their total area (24.0, 34.3 and 70.6 ha respectively). Significantly more Reed Buntings bred in ditches and small marshes than in large marshes ($\chi_2^2 = 7.07$, P < 0.05). However, the distribution of territories was proportional to the total length of boundaries of these three habitat types (27.5, 27.5 and 16.7 km respectively, $\chi_2^2 = 5.43$, P > 0.05).

3.3. The effect of habitat composition and boundary type on territory distribution

The mean area of habitats and length of field ecotones in breeding territories did not change markedly through the study seasons (Kruskal-Wallis test, P > 0.05 in all cases). The dominant habitats were reeds, composing on average 22.2% ± 23.1 (mean ± SD, all years included) of the territory, followed by herbaceous vegetation (12.7% ± 17.2) and meadows (8.8% ± 16.2). The length of crop ecotone (m) was the longest in the case of winter cereals (34.9 ± 53) and the shortest for root crops (23.7 ± 46.3).

The logistic regression analysis showed that in every year 3 to 4 habitat variables significantly affected Reed Bunting distribution (1998: $\chi_3^2 = 43.2$, P < 0.001, 1999: $\chi_4^2 = 58.1$, P < 0.001, 2000: $\chi_4^2 = 25.0$, P < 0.001, Table 1). In total, 7 of the 11 variables significantly affected Reed Bunting distribution in an least one year (Table 1). Most of variables which entered logistic regression models

Table 1. Logistic regression models for the individual years. Negative coefficient is indicated with –. Measurements of habitats surveyed in breeding and random territories (mean ± SD) are given. Significance of coefficient abbreviation is based on Log Likelihood Ratio (LogLR, ** P < 0.01, * P < 0.05, ° P < 0.10). For variable abbreviations see Methods.

	1998			1999			2000		
	Breeding	Random	Log LR	Breeding	Random	Log LR	Breeding	Random	Log LR
TAB	2.0 ± 3.1	1.5 ± 2.4		2.6 ± 6.5	1.7 ± 2.9		3.5 ± 1.8	2.1 ± 3.1	
MEA	8.7 ± 16.6	2.7 ± 9.3		8.2 ± 14.4	3.8 ± 12.4		9.5 ± 17.6	3.3 ± 9.8	*
HER	9.8 ± 13.1	6.9 ± 8.4		14.7 ± 18.8	6.9 ± 9.9	**	14.0 ± 0.9	8.0 ± 8.3	**
REE	24.1 ± 25.6	3.9 ± 6.3	**	23.5 ± 18.7	4.0 ± 6.5	**	19.8 ± 0.8	5.7 ± 15.2	**
CAT	0.4 ± 1.7	0.8 ± 3.6		0.8 ± 4.4	0.2 ± 0.8	*	0.3 ± 1.6	0.8 ± 2.2	
OTH	1.4 ± 5.8	0.5 ± 1.4	°	1.7 ± 5.3	0.1 ± 0.5	**	1.4 ± 5.1	0.5 ± 1.7	
WAT	3.9 ± 6.8	1.1 ± 3.1		3.9 ± 6.3	1.5 ± 3.8		3.9 ± 7.1	2.9 ± 6.7	
SPR	44.3 ± 56.9	91.6 ± 73.6	(–)*	31.5 ± 55.8	58.1 ± 61.1		27.8 ± 46.3	78.7 ± 69.2	
WIN	51.0 ± 61.4	45.6 ± 54.3		32.2 ± 58.4	52.8 ± 56.1		63.6 ± 80.1	47.4 ± 59.2	
OIL	28.8 ± 48.6	41.6 ± 57.1		56.9 ± 76.6	57.9 ± 73.4		37.3 ± 57.0	36.4 ± 62.1	°
ROO	20.8 ± 40.7	16.8 ± 43.0		28.5 ± 47.0	21.7 ± 36.0		22.2 ± 52.0	26.9 ± 52.7	

were significantly inter-correlated with each other (Rank Spearman correlation test, P < 0.05). However, correlation coefficients (r_s) were low and did not exceed the level of 0.286, except in one case when it reached 0.350. Considering this, it was assumed that the effect of inter-correlations on the final regression models is small and might be neglected. In all years, territories of Reed Bunting contained a higher proportion of reeds (REE) compared to unoccupied areas (Table 1). A similar effect was found for herbaceous vegetation (HER) and other emergent vegetation (OTH) in 1999–2000 and 1998–1999, respectively. In single years the following habitats significantly influenced territory occupation: cattails (CAT), meadows (MEA), oil seed rape (OSR) and spring cereals (SPR, negatively). Variables that did not enter the models in any season were: tree and bushes (TAB) and open water (WAT).

4. Discussion

The density of breeding pairs of Reed Bunting in the farmland study area was one of the highest in Europe (mean for three years is 5.66 pairs /km^2). Previous studies conducted on large plots of farmland (> 1 km^2) in Europe indicated densities at least 50% lower i.e. 2.4, 3.0 and 1.5 pairs / km^2 (Górski 1988, Gregory & Baillie 1998, Tryjanowski 1999). The most probable explanation for this pattern is the relatively large area of midfield marsh, which, as shown in this study, constitutes the almost exclusive breeding habitats of the Reed Bunting. Earlier studies have shown that locally, the species may occupy drier habitats such as hedgerows (Gordon 1972) or even crops (Berndt 1995, Watson & Rae 1998, Burton *et al.* 1999). The shift from primary to drier habitats was usually followed by rise in the number of breeding pairs (Bell 1969). High densities of Reed Bunting noted in the studied area theoretically should lead to a higher occupation rate in the drier, less suitable habitats. On the other hand, wet habitats in the studied farmland were abundant enough to hold a large and balanced Reed Bunting population. Another explanation is the type of cultivation in Wielkopolska. The use of mechanical and chemical means of cultivation is very intensive in the region (Tryjanowski 1999) what reduces quality of alternative breeding habitats e.g. borders between fields, meadows and crops.

The most important vegetation type positively influencing Reed Bunting presence throughout the years of the study was the area of reeds. Reed Buntings often choose nest site in the vicinity of reeds (Magerl 1984, van der Hut 1986, Okulewicz 1989). However, they seldom locate their nests within this habitat (Okulewicz 1989). Reeds serve males as a song post and are an important feature of a territory (Okulewicz 1989). At the beginning of the breeding season, when other vegetation is lacking, the area of old reed stems may be also used as a shelter. The role of bulrushes and cattails in Reed bunting territories is probably similar to that of reeds. However, they are less appropriate because of their lesser height and smaller density. Cattails are especially prone to break during winter which may significantly reduce their attractiveness as song post. The most typical nest site for Reed Buntings is dense herbaceous vegetation, which allows sufficient concealment (Blümel 1982, Okulewicz 1989, Cramp 1998, A. Surmacki in prep.). This strategy of nest location may explain the markedly high proportion of herbs in Reed Bunting territories found during this study. Areas with meadows were chosen less frequently, mainly due to the higher risk of nest destruction. Mowing practices have been shown to be a common cause of breeding failure in many birds which breed in meadows (Kruk *et al.* 1997).

Despite their strong dependence on marshes, Reed Buntings used only the fringes of those habitats. The distribution of territories along marsh edges was equal, while their interior remained unoccupied. Such an occupation pattern reflects the distribution of the most important nesting habitats of Reed Bunting (herbaceous vegetation) which occurred at the edges of marshes and ditches. Moreover, territories located on the edges of marshes are also closer to arable fields, in which adults foraged to provision young (Surmacki 2001, see Dale 2000). In the population studied, adult birds foraged most frequently on oil seed rape while spring cereals were utilized in least extent (Surmacki 2001). Thus, preferences or avoidance of these particular crops in a territory may be connected with food resources. On the other hand, a Reed Bunting may forage far from its nest, even up to hundreds of metres (Dyrcz *at al.* 1972, Blümel 1982, Okulewicz 1998) so immediate presence of a favored crop type is not likely to be an important factor limiting territory occurrence. Oil seed rape is similar in its structure to that of reeds and may act as an extension of Reed Bunting territory and serve such important functions as song post and cover against predators (see Results, Watson & Rae 1998, Burton *et al.* 1999). Similar functions are less applicable to cereals due to their simplified structure. Previous studies have provided some evidence for a greater preference among Reed Buntings for oil seed rape rather than cereal crops. Ziesemer (1996) showed that Reed Buntings increased in number on mid-field marshes after changes of crops from cereals to oil seed rape. Reed Buntings also breed less frequently in cereals than in oil seed rape (Berndt 1995).

The present study shows that Reed Bunting presence depends mainly on wet marginal habitats with tall and dense herbaceous vegetation which may provide both nest site and male song posts. Although most territories were situated near the edges of arable fields, the influence of crop type on territorial distribution was relatively low. The Reed Bunting is not very demanding in terms of habitat choice. It may utilize even the smallest reed beds, artificial structures (ditches) and temporary drying marshes. Small, natural marshes like potholes are still common in western and northern Poland including Wielkopolska region (Choiński 1999). However, the Polish mid-field marsh patches are particularly sensitive to destruction and need special protection (Juszczak & Kędziora 2003). Further, more detailed studies on Reed Bunting biology and ecology in farmland are needed to fully understand the importance of particular habitat components. Moreover, the habitat requirements of the species may vary across the regions due to the different cultivation method used.

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Pajusirkun habitaatinvalinnasta Länsi-Puolan maatalousalueella

Pajusirkku esiintyy levinneisyysalueellaan yleisesti maatalousalueilla. Pajusirkun, kuten monen muunkin maatalousympäristössä esiintyvän lintulajin määrä on vähentynyt viime vuosina. Yhdeksi tärkeimmistä vähenemisen syistä on esitetty sopivien pesimä- ja ruokailualueiden vähenemistä. Artikkelin kirjoittaja tutki pajusirkun habitaatinvalintaa Länsi-Puolan maatalousalueella vuosina 1998–2000.

Pajusirkkujen reviirit paikannettiin kartoitusmenetelmällä. Reviireiltä määritettiin kasvillisuuden peittävyys ja reuna-alueiden määrä. Tutkimuksessa vertailtiin reviirien ja pajusirkuttomien satunnaispisteiden kasvillisuuden koostumusta. Eri vuosina tutkimusalueella oli 55, 49 ja 47 pajusirkkureviiriä. Alueen pajusirkkutiheys oli Euroopan mittakaavassa varsin korkea: 5,2–6,2 paria/km^2. Pajusirkkuja esiintyi vain kosteilla habitaateilla, kuten pienillä ruovikoilla, soilla, niityillä ja ojikoilla. Pajusirkkujen reviirit sijaitsivat yleensä näiden habitaattien reunoilla.

Tutkimuksessa havaittiin pajusirkun suosivat alueita, joilla oli paljon järviruokoa, järvikaislaa ja aluskasvillisuutta. Osmankäämin ja rapsin peittävyydellä oli edellisiä tekijöitä pienempi, mutta silti positiivinen vaikutus lajin esiintymiseen. Myös niittyjen esiintyminen vaikutti positiivisesti pajusirkkujen esiintymiseen. Lisäksi tutkimuksessa havaittiin kevätviljojen vaikuttavan negatiivisesti pajusirkun esiintymiseen. Artikkelin kirjoittaja päättelee, että kosteiden habitaattilaikkujen säilyttäminen on oleellista pajusirkkujen menestymiselle voimaperäisesti viljellyillä alueilla.

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