

EFFECT OF FLOODS ON THE DISTRIBUTION OF MEADOW BIRDS ON LJUBLJANSKO BARJE

Vpliv poplav na gnezditveno razširjenost travniških ptic na Ljubljanskem barju

DAVORIN TOME

National Institute of Biology, Večna pot 111, SI-1000 Ljubljana, Slovenija, e-mail: davorin.tome@uni-lj.si

I investigated the density of meadow birds breeding on Ljubljansko barje as a function of three different flooding regimes. The densities of Common Quail *Coturnix coturnix*, Corn Crake *Crex crex*, Northern Lapwing *Vanellus vanellus*, Sky Lark *Alauda arvensis*, Tree Pipit *Anthus trivialis*, Whinchat *Saxicola rubetra*, Marsh Warbler *Acrocephalus palustris*, Common Whitethroat *Sylvia communis* and Corn Bunting *Miliaria calandra* were significantly higher on regularly flooded than on non-flooded areas. A similar effect was not observed on a Common Stonechat *Saxicola torquata* population. I discuss some reasons for the positive effect of floods on breeding density. Preservation, or even expansion, of areas with extensive agriculture and regular floods is strongly recommend as an essential conservation measure for meadow birds on Ljubljansko barje.

Key words: meadow birds, breeding density, floods, Ljubljansko barje, Slovenia

Ključne besede: travniške ptice, gnezditvena gostota, poplave, Ljubljansko barje, Slovenija

1. Introduction

In Europe, agriculture is one of the most important factors affecting bird populations (TUCKER & EVANS 1997). According to British experience, of all birds, those from farmland suffered the greatest decline in term of population number and distribution (GIBBONS *et al.* 1993, FULLER *et al.* 1995). About 70% of 173 priority bird species from agricultural and grassland habitats in Europe have an unfavourable conservation status (TUCKER & DIXON in: TUCKER & EVANS 1997). A similar situation pertains in North America (HERKERT & KNOPF 1998). It is not easy to define the key causes for these declines, since there are many, but what they all have in common is, what we know as agricultural intensification. Some of the well known causes are increased use of pesticides and fertilisers, creation of large fields without set asides (hedges, etc.), changes in ploughing, harvesting, mowing regime and extensive land drainage (NEWTON 1998), which are often basic to all other causes considered.

In Slovenia there is no hard data on temporal changes in birds populations, but some reports indicate a decline of farmland birds and birds from

wet grasslands (BRAČKO 1986, TOME 1998). There are also some studies where spatial changes in breeding bird densities, caused by different types and levels of land practice, could be used to estimate the influence of agriculture on bird communities. One such is the breeding bird atlas of Ljubljansko barje (SOVINC *et al.* in prep.). The aim of this paper is to present differences in breeding densities of meadow birds on flooded and non-flooded areas of Ljubljansko barje and to evaluate them from the land management point of view.

2. Study area and methods

Ljubljansko barje is 5-10 km wide and about 20 km long, a flat depression south of the city of Ljubljana in central Slovenia. The study area is about 150 km², and lies 287-290 m above sea level. Before agriculture started to become intensified 150 years ago, this was a raised bog. Today, primarily due to drainage and exploitation of peat, only a few raised bog fragments remain (total area about 0.5%), all of which have reached full development in forests of *Pino sylvestris-Betuletum* and *Betulo-Quercetum roboris* type (MARTINČIČ 1987). The remaining areas are

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predominantly corn fields (about 25%), semi-intensive grasslands (about 40%), traditional meadows (about 12%), built-up and industrial areas (about 7%). Other types of land (orchards, ditches area, reed beds, open water, etc.) do not account for more than 1% of the area. (KOTARAC 1999)

In spite of long term efforts at drainage, occasional floods still occur. They are confined roughly to the central part of Ljubljansko barje, on both sides of the Ljubljana river (KOLBEZEN 1984). Floods are most frequent in the autumn and winter, less so in spring and least of all in summer. They usually last from 1 to 7 days.

Data on numbers of breeding bird populations were collected by several field workers between 1989 and 1996 during a systematic survey of the area for an atlas of breeding birds in a 1x1 km grid (detailed description of data collection methods see in SOVINČ *et al.* 1993). In the present work I took into consideration only squares with at least 75% non-forested, non built-up area. These squares were designated as "open squares". According to data from KOLBEZEN (1984), selected open squares were separated into three types: (1) regularly flooded squares - entirely flooded almost every year; (2)

occasionally flooded squares - flooded only partially and, in some years, not flooded at all; (3) non-flooded squares - normally not flooded.

Meadow birds were defined as all non-aquatic species nesting directly on the ground among herbaceous plants and as birds building nests low over the ground on annual plants. Densities of birds were compared between all three types of squares, using Kruskal-Wallis ANOVA test. Differences were significant to $p < 0.05$. The calculations were done only for birds found on at least 50 open squares, to minimise inaccuracy caused by small sample size.

In 1997, all squares were surveyed in summer and scored visually to the nearest 10% for the presence of forest, fields, meadows and, to the nearest 100 m length, of hedgerows ("mejice" in Slovene language).

3. Results

Of 111 squares considered in this research, 47 (42%) were regarded as non-flooded, 24 (22%) as occasionally-flooded and 40 (36%) as regularly flooded, indicating that a little over half the open area on Ljubljansko barje is, at least occasionally, exposed to high waters.

Table 1: Proportion of occupied squares and density of singing males on nonflooded (NF) areas, semiflooded (SF) areas and flooded (FL) areas

Tabela 1: Delež zasedenih kvadratov in gostota pojočih samcev v nepoplavljenih (NF), delno poplavljenih (SF) in poplavljenih (FL) območjih

	Occupied squares/ Zasedeni kvadrati			Density of singing males/km ² (avg, std), number of occupied squares (N) / Gostota pojočih samcev/km ² (avg, std), število zasednih kvadratov (N)									Kruskal-Wallis ANOVA	
	NF	SF	FL	NF			SF			FL			H	p
	%	%	%	avg	std	N	avg	std	N	avg	std	N		
<i>Coturnix coturnix</i>	53	63	78	1.6	2.56	25	2.9	3.42	15	4.2	4.87	31	9.9	0.00720
<i>Crex crex</i>	23	67	83	0.3	0.60	11	1.2	1.10	16	4.6	3.99	33	42.0	0.00000
<i>Vanellus vanellus</i>	28	50	60	2.0	4.45	13	4.4	5.72	12	3.5	4.21	24	11.2	0.00360
<i>Alauda arvensis</i>	77	100	100	8.4	8.49	36	16.3	11.57	24	16.4	13.09	40	17.2	0.00020
<i>Anthus trivialis</i>	79	100	100	9.9	7.64	37	14.8	6.15	24	22.8	10.52	40	32.7	0.00000
<i>Saxicola rubetra</i>	81	96	100	9.4	7.95	38	17.8	8.63	23	22.8	10.21	40	34.5	0.00000
<i>Saxicola torquata</i>	72	88	70	2.5	2.45	34	2.4	1.82	21	1.5	1.54	28	3.1	0.21050
<i>Acrocephalus palustris</i>	77	100	100	9.2	9.36	36	14.2	9.03	24	21.9	12.42	40	32.0	0.00000
<i>Sylvia communis</i>	87	100	100	4.9	4.12	41	8.2	5.64	24	12.3	6.73	40	34.1	0.00000
<i>Miliaria calandra</i>	30	63	50	0.4	0.69	14	1.3	1.71	15	1.7	2.53	20	8.3	0.01600
No. of squares/ Število kvadratov	47	24	40											

Among meadow birds, 10 species breed on Ljubljansko barje in a defined distribution threshold (over 50 occupied squares). They are as follows (with number of occupied squares and estimated mean population size in brackets; SOVINČ *et al.* in prep.): Common Quail *Coturnix coturnix* (79, 330), Corn Crake *Crex crex* (73, 260), Northern Lapwing *Vanellus vanellus* (52, 340), Sky Lark *Alauda arvensis* (113, 1480), Tree Pipit *Anthus trivialis* (127, 1970), Whinchat *Saxicola rubetra* (123, 1860), Common Stonechat *Saxicola torquata* (102, 290), Marsh Warbler *Acrocephalus palustris* (127, 2060), Common Whitethroat *Sylvia communis* (129, 1030) and Corn Bunting *Miliaria calandra* (53, 125). In all species except the Common Stonechat, there were significantly different densities between non, occasionally and regularly flooded squares (Table 1). Population sizes of Common Quail, Corn Crake, Tree Pipit, Whinchat, Marsh Warbler, Common Whitethroat and Corn Bunting increased more or less steadily from non, through occasionally, to regularly flooded areas, while populations of Northern Lapwing and Sky Lark increased significantly from non to occasionally flooded areas, but remained unchanged on regularly flooded areas.

The proportion of fields and meadows correlated significantly with the flooding regime, with fields occupying almost twice as large an area in non-flooded as in flooded squares ($H=9.74$, $p=0.0077$), and a considerably higher proportion of meadows on flooded as opposed to non-flooded areas ($H=10.27$,

$p=0.006$; Figure 1). The proportion of forests ($H=0.18$, $p=NS$) and length of the tree lines ($H=3.77$, $p=NS$) did not differ between areas with different flooding regimes, probably due to eliminating squares with more than 1/4 of the area covered with trees.

4. Discussion

Common Stonechat was the only one of ten species with a lower density on flooded compare to non-flooded areas, which came as no surprise. In Europe, dry plains and hillsides are the most frequent type of breeding habitat of this species (CRAMP 1998). Apart from this, the results indicate the great importance of floods for meadow birds (Table 1) - nine out of ten species nested in greater densities on flooded than on non-flooded areas. More than 70% of their total population, and over 90% of all calling male Corn Crakes being present on regularly and occasionally flooded areas combined (57% of the open squares). If breeding success would be considered, the value of regularly flooded, traditional meadows for birds would probably be even greater.

Population sizes of the nine meadow species ranged from 10% (Tree Pipit) to about 50% (Corn Crake, and Marsh Warbler) of the total Slovenian population (TRONTELJ 2001, SOVINČ *et al.* in prep.). Considering that Ljubljansko barje is less than 1% of the total area of Slovenia, the importance for birds of floods must be considered on the national scale. Four of the species, Common Quail, Corn Crake, Sky Lark and

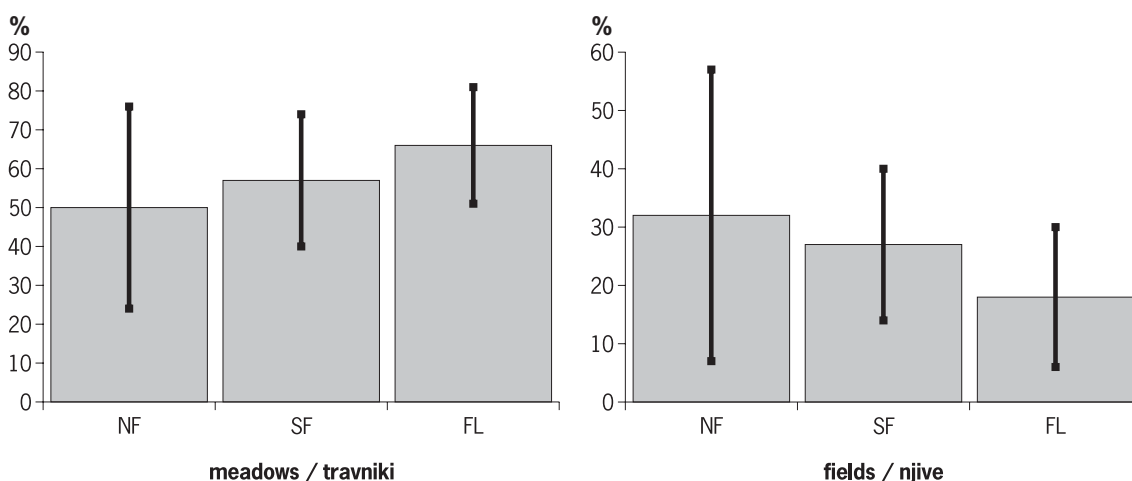


Figure 1: Proportion of meadows and fields according to flooding regime in 1 x 1 km squares on Ljubljansko barje (NF=non-flooded, SF=semi-flooded, FL=flooded, bars=average, lines = standard deviation)

Slika 1: Delež travnikov in njiv glede na poplavni režim v 1 x 1 km kvadratih na Ljubljanskem barju (NF=nepoplavni, SF=delno poplavni, FL=poplavni, bars=povprečje, črte=standardni odklon)

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Corn Bunting are also listed as endangered breeding birds (BRAČKO *et al.* 1994), with Northern Lapwing, Whinchat and Common Whitethroat being on a new proposal of endangered breeding birds in Slovenia (DOPPS unpubl.).

The most striking change in density was in Corn Crake, a globally endangered species (TUCKER & HEATH 1994). On frequently flooded areas there was about 10 times greater density than on non-flooded ones. These results confirm findings (GROBELNIK 2000) that, on Ljubljansko barje, traditional meadows are by far the most important habitat type for this species, and agree with conclusions of WILLI (1985), that Corn Crake is among the most sensitive birds when drainage of the habitat is in question. Although the population size of this species is not significant on the international scale, representing less than 0.01%, it is one of the greatest in southern Europe (SCHÄFFER & GREEN 2000) – and, we should not forget, concentrated on a very small area!

Northern Lapwings and Sky Larks differ from other species whose populations increase more or less steadily from non, through occasionally, to regularly flooded areas, in having average densities that are similar on occasionally and regularly flooded squares. In spite of differences in ecology of these species, they both prefer to nest in short vegetation or, if not available, on fields (WILLI 1985, BEINTEMA & MUSKENS 1987, CHAMBERLAIN & GREGORY 1999). On Ljubljansko barje many regularly flooded areas stay unmown (personal observations). In spring they are covered with a dense, tall layer of dead annual vegetation stalks (predominantly *Filipendula ulmaria*), which makes them less appropriate for the two species, hence reducing their average density in flooded squares. Sky Larks also prefer dry to wet nesting places (WILLI 1985). My estimate is, that the importance of floods for these two species is to some degree lower (but not insignificant!) than for the other seven.

Since all the birds considered are terrestrial, water from floods could not have a direct influence on their distribution. What probably shapes their settling patterns are land management, vegetation structure and food. On Ljubljansko barje, frequently flooded areas are not as suitable for agricultural practice as others (personal communication with farmers) and traditional, seldom fertilised, late mowed meadows predominate. A late mowing date in particular is known to increase reproductive success in meadow birds (BEINTEMA & MUSKENS 1987), and consequently, the breeding density. Corn fields and semi-intensive meadows, which are less friendly to

birds, are more common in non-flooded areas (Figure 1), resulting in low breeding densities. On the other hand, high water table and frequent floods make a structure of vegetation more suitable for many of the meadow birds, and moist land also increases the quantity and/or quality of available food (BEINTEMA 1988). So floods on Ljubljansko barje have a direct impact on agriculture practice and on some important ecological features of the meadows, all in turn influencing the distribution and population size of the birds. If the nationally important breeding populations of meadow birds on Ljubljansko barje are to be conserved, it is of vital importance to preserve or even expand areas with traditional agriculture and regular floods.

5. Povzetek

Na Ljubljanskem barju sem raziskoval gostoto travniških gnezdilcev na treh območjih, ki se med seboj razlikujejo glede na režim poplavljanja. Ugotovil sem, da so gostote prepelice *Coturnix coturnix*, kosca *Crex crex*, pribe *Vanellus vanellus*, poljskega škrjanca *Alauda arvensis*, drevesne cipe *Anthus trivialis*, repaljščice *Saxicola rubetra*, močvirske trstnice *Acrocephalus palustris*, rjave penice *Sylvia communis* in velikega strnada *Miliaria calandra* značilno večje na vsakoletno poplavljenih površinah kot na površinah, kjer poplav ni ali pa so zelo redke. Gnezditvena gostota prosnika *Saxicola torquata* ni bila odvisna od poplavnega režima. Predstavljam nekaj vzrokov za tako ugoden vpliv poplav na ptice. Kot nujen naravovarstveni ukrep za ohranitev nacionalno pomembnih populacij travniških ptic na barju predlagam ohranitev ali celo razširitev poplavnih površin in ekstenzivnega kmetovanja.

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