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# Grassland bird species in mountain pastures Zaprikraj and Zapleč in the southern Julian Alps, Slovenia

## Travniške gnezdilke na planinah Zaprikraj in Zapleč v južnih Julijskih Alpah

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Grassland birds were surveyed in two mountain pastures (Zaprikraj and Zapleč) in the southern part of the Julian Alps, Slovenia. The survey was carried out during the mornings between 26 and 30 June 2005. Due to the incomplete survey (only one visit, no nocturnal or targeted surveys and late season survey), the surveyed birds' breeding density is only a rough estimate. 167 pairs belonging to 12 species were counted, with Tree (average density of 1.64 p/10 ha) and Water Pipit (average density of 1.60 p / 10 ha) being the most abundant. Both were observed in all altitudinal belts. The highest density in individual altitudinal belt was calculated for Red-backed Shrike *Lanius collurio* (3.78 p/10 ha) and Water Pipit (3.61 p/10 ha). In well preserved grasslands in the study area, most species reached high breeding densities compared to other parts of Slovenia and all were recorded higher than during the 1992 survey, although still mostly within limits of the elevations elsewhere in Slovenia. Breeding density of Skylark *Alauda arvensis* decreased with the elevation. Whinchat *Saxicola rubetra*, Skylark and Red-backed Shrike used significantly gentler slopes, while Pipits showed no preference for particular slopes.

### Introduction

Many physical characteristics of the environment are changing with the elevation (Hodkinson 2005). Along with these changes the bird species composition and richness (Newton 1998) as well as breeding biology of individual species, e.g.: breeding success, start of breeding, the number of replacement and second broods (Gil-Delgado *et al.* 1992; Lessig 2008; Bordjan 2013a; Bordjan 2013b) are also changing. Although species richness rises with the temperature, each species has its own temperature range within which its breeding is optimal (Newton 1998). With increasing elevation, the number of breeding pairs decreases in most bird species, but in some, mainly mountain species, it increases (Mihelič 2019).

The terrain in Slovenia is mostly hilly (Ogrin & Plut 2012) and the altitudinal distribution, especially in breeding birds, is relatively well studied (Mihelič *et al.* 2019). Most data are available for owls (Tome 1996; Božič & Vrezec 2000; Mihelič *et al.* 2000; Ambrožič 2002; Krofel 2008). While the influence of elevation on breeding biology was studied in detail only for Great Tit *Parus major* (Bordjan 2013a; Bordjan 2013b; Bordjan & Tome 2013), the breeding distribution in correlation with elevation was reported for Marsh *Poecile palustris* and Willow Tit *P. montanus* (Vogrin 1992), White-tailed Eagle *Haliaeetus albicilla* (Vrezec *et al.* 2009) Common Kestrel *Falco tinnunculus* (Šumrada & Hanžel 2012), Jackdaw *Corvus monedula* (Božič 2016), Black Kite *Milvus migrans* (Bordjan 2018) and Mallard *Anas platyrhynchos* (Bordjan *in lit*). As part of more general data on elevational distribution gathered for the Atlas of Breeding Birds of Triglav National Park (Jančar 1997), the elevational breeding range for several species in mountain pastures Zaprikraj and Zapleč was reported by Čelik & Polak (1992). On the other hand, studies on breeding bird species richness and density in relation to elevation in Slovenia are few (e.g. Bordjan 2013b). What's more, bird studies in relation to the slope steepness are lacking altogether.

In this paper, I wish to present data on distribution of grassland species in two mountain pastures Zaprikraj and Zapleč in correlation with elevation and slope steepness. I also compare the present data on altitudinal breeding range with those gathered 13 years earlier in the same locality.

## Study area and methods

The study was carried out between 26 and 30 June 2005 in mountain pastures Zaprikraj and Zapleč above Drežniške Ravne (W Slovenia). Altitudinal distribution of breeding bird species in the area had already been surveyed 13 years earlier and a more detailed overview of habitat was given (Čelik & Polak 1992). The study area (176.6 ha) comprises mostly meadows and pastures and lies between 1,200 in 1,870 metres above sea level. The area also includes a small patch of young beech stand *Fagus sylvatica* (it was excluded from the survey plot) and scree. Abandonment of grazing is common in most areas of the Julian Alps (Perko & Oražen Adamič 1998) and this is also evident in parts of the study area. Although both mountain pastures are active, there are some signs of early stages of overgrowth. Both mountain pastures were visited only once. Breeding grassland bird species were counted by walking on predetermined path that approached every point of the area to around 50 m. The visits took place in the mornings between 6 and 11 am. Weather was mostly sunny with temperatures of 11.7 to 22°C and average daily wind speed from 0 to 2.3 m/s at a weather station 15 km away (ARSO 2020). All birds were mapped on orto-photo of the area at the scale of 1:5000. Due to only one visit to the area, I calculated only rough breeding density for the area and for separate 100m altitudinal belts for each recorded species (Figure 1). When calculating the surface area, the slope was taken into consideration. I corrected the calculated surface area for each elevation belt. I multiplied surface with quotient between square root of sum of squared average width and height of the belt's elevation and average width. The steeper belts thus had larger surface areas then measured from above. Even if the species moved between the belts, we mapped

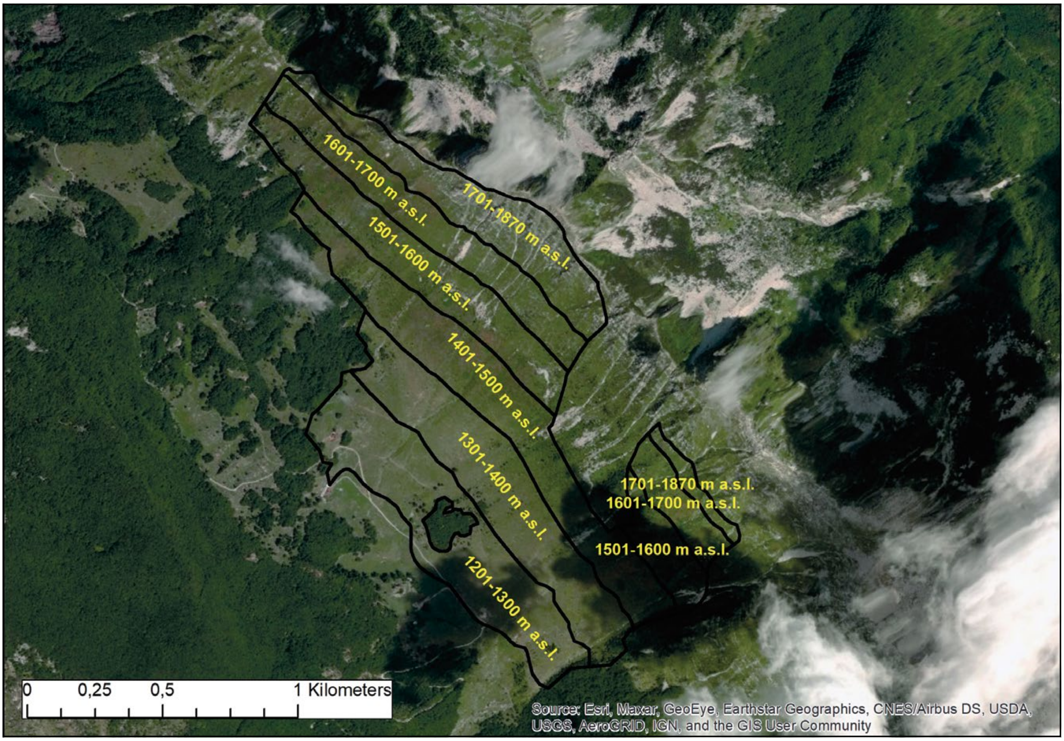


**Figure 1:** Study area with 100m altitudinal belts

**Slika 1:** Območje raziskave in višinski pasovi (100 m).

only the first sighting of an individual. While this may show a distorted picture for individual pair, I considered the error for each belt and slope to be the same and hence comparable. For spatial analyses I used the ArcMap (ESRI 2015) program. Due to the small size of the upper belt (1801–1870 m a.s.l.), I combined it with the one below at 1701–1870 m a.s.l. I calculated average slope of individual altitudinal belts from tangent between width and height (100m) of elevation belt. For every mapped pair, I determined altitude and slope. I calculated the slope for each breeding pair from the height (the number of contours) in 50m in both directions (up and down) from the mapped location. I used the non-parametric Spearman's correlation to study the correlation between altitude and distribution of species. I used the Wilcoxon test to compare random slope of the area and slope of individual species. For both tests I used the R (R Core Team 2017) program. I tested for statistical significance only for species with more than the suggested minimum of 10 records (Fay & Gerow 2018).

## Results

We counted 167 pairs belonging to 12 species. The highest overall number of pairs was counted for Tree Pipit *Anthus trivialis* (with average density of 1.64 p/10 ha) and Water Pipit *A. spinoletta* (with average density of 1.60 p/10 ha) (Table 2). The highest density in individual altitudinal belt was calculated for Red-backed Shrike *Lanius collurio* (3.78 p/10 ha; 1201–1300 m a.s.l.) and Water Pipit (3.61 p/10 ha; 1701–1870 m a.s.l.). Slope was steeper with higher elevation, while the density of species did not change (Table 1). Only Tree and Water Pipits were observed in all altitudinal belts, whereas Skylark *Alauda arvensis* and Whinchat *Saxicola rubetra* were recorded in five and Quail *Coturnix coturnix*, Common Rock Thrush *Monticola saxatilis* and Red-backed Shrike were recorded in four belts. With higher elevation, the breeding density was higher for both Pipits and smaller for Red-backed Shrike, Skylark and Whinchat, but this was significant only for Water Pipit and Skylark (Table 3). Whinchat, Skylark and Red-backed Shrike used gentler slopes within the area (Table 3), while the slope of both Pipits was similar.

## Discussion

The biggest drawback to this survey is the method used. To cover all present species and to register most territories up to ten visits are expected in a season, two in the night (Bibby *et al.* 2000). Since only one visit was made to the area, the resulting number of pairs gives only a very rough estimate of a breeding population. Although breeding season in the Alps is much shorter than lower down, several visit would still be needed. Additional problem is the lateness of the survey season. At the end of June, most species in temporal zones of

**Table 1:** Separate altitudinal belts with size, average slope, number of species and density of breeding pairs of birds

**Tabela 1:** Posamezni višinski pasovi in njihova površina, povprečen naklon, število vrst in gostota gnezdečih parov ptic

| Altitudinal belt (m. a. s. l) | Area (Ha)* | Average slope (°) | No. of species per 10 ha | Density of pairs per 10 ha |
|---|---|---|---|---|
| 1200–1300 | 34.4 | 21.2 | 2.0 | 8.4 |
| 1301–1400 | 34.6 | 26.1 | 2.0 | 7.2 |
| 1401–1500 | 37.2 | 29.0 | 2.4 | 8.6 |
| 1501–1600 | 35.3 | 32.5 | 2.5 | 7.9 |
| 1601–1700 | 32.6 | 38.0 | 2.5 | 8.0 |
| 1701–1870 | 38.8 | 42.5 | 1.3 | 7.0 |
| 1200–1870 | 213.0 | 33.2 | 0.6 | 7.8 |

* - surface accounting for a slope

Europe are already at the end of breeding season (Billerman *et al.* 2020). With the exception of Buntings and Skylarks that start to nest earlier in the season and have already finished with their first nesting attempt, all studied species start to nest in May and, considering the average nesting period of approximately month and a half (Billerman *et al.* 2020), most were probably in

**Table 2:** Number of pairs, altitudinal range, breeding density and slope for individual species recorded in mountain pastures Zaprikraj and Zapleč in 2005

**Tabela 2:** Število parov, višinski razpon, gnezditvena gostota in naklon posamezne vrste zabeležene na travnikih planin Zaprikraj in Zapleč v letu 2005.

| | | Altitude (m) | | | Density | | | | Slope | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Bird species | No. of pairs | Min | Average | Max | Average | Highest | Elevation belt (m) with highest density | No. of belts | Min | Average | Max |
| *Coturnix coturnix* | 7 | 1340 | 1460 | 1680 | 0.33 | 0.87 | 1301–1400 | 4 | 22 | 27 | 39 |
| *Alectoris graeca* | 5 | 1640 | 1675 | 1740 | 0.23 | 1.23 | 1601–1700 | 2 | 35 | 37 | 39 |
| *Crex crex* | 7 | 1370 | 1580 | 1487 | 0.33 | 0.85 | 1501–1600 | 3 | 24 | 31 | 39 |
| *Lanius collurio* | 27 | 1200 | 1325 | 1620 | 1.27 | 3.78 | 1201–1300 | 4 | 11 | 26 | 39 |
| *Alauda arvensis* | 12 | 1220 | 1383 | 1630 | 0.56 | 1.16 | 1201–1300 | 5 | 19 | 26 | 35 |
| *Monticola saxatilis* | 5 | 1420 | 1620 | 1750 | 0.23 | 0.52 | 1701–1900 | 4 | 27 | 29 | 31 |
| *Saxicola rubetra* | 27 | 1200 | 1424 | 1690 | 1.27 | 2.96 | 1401–1500 | 5 | 11 | 27 | 39 |
| *Oenanthe oenathe* | 6 | 1200 | 1607 | 1860 | 0.28 | 0.77 | 1701–1870 | 3 | 6 | 29 | 45 |
| *Anthus trivialis* | 35 | 1220 | 1521 | 1860 | 1.64 | 2.27 | 1701–1870 | 6 | 22 | 33 | 45 |
| *Anthus spinoletta* | 34 | 1280 | 1630 | 1850 | 1.60 | 3.61 | 1701–1870 | 6 | 22 | 35 | 48 |
| *Emberiza cia* | 1 | | 1470 | | 0.05 | 0.27 | | 1 | | 31 | |
| *Emberiza citrinella* | 1 | | 1215 | | 0.05 | 0.29 | | 1 | | 6 | |

**Table 3:** Statistical significance of correlation between elevation and breeding density and the relation between slope steepness and breeding densities of grassland birds surveyed in mountain pastures Zaprikraj in Zapleč in 2005.

**Tabela 3:** Statistična značilnost korelacije med nadmorsko višino in gnezditveno gostoto in relacija med naklonom in gnezditveno gostoto travniških ptic, raziskovanih na travnikih planin Zaprikraj in Zapleč v letu 2005

| | Elevation | | Slope | |
|---|---|---|---|---|
| Bird species | Spearman's R | p | Wilcox U | p |
| *Lanius collurio* | −0.78 | 0.066 | **467** | **0.001** |
| *Alauda arvensis* | **−0.88** | **0.033** | **194** | **0.011** |
| *Saxicola rubetra* | −0.37 | 0.497 | **407** | **0.023** |
| *Anthus trivialis* | 0.6 | 0.242 | 384 | 0.786 |
| *Anthus spinoletta* | **1** | **0.003** | 323 | 0.560 |

the last stages of breeding and some may have already finished. Also, in the early summer birds are most active in the early hours, so at the end of survey (at 11 am), the activity would be rather low. Method of the survey underestimates nocturnal (Corncrake *Crex crex*, Quail) and cryptic species (Rock Partridge *Alectoris graeca*) that would need additional nocturnal visits or targeted visits with eliciting responses (Bibby *et al.* 2000). While more numerous visits eliminate possible migrants or stragglers in the area, most other drawbacks (single survey, no night surveys, late season and late end of daily survey) underestimate the size of a population. Considering this, I only discuss density of species with relatively high densities compared to other areas.

Nevertheless, some conclusions may be drawn from the present survey. The breeding density lowers with the elevation for lowland species like Skylark. They also tend to stay in areas with gentler slope. On the other hand, the species of high mountain biome like Water Pipit, the breeding density increases with altitude and they show no preference for a gentler slope.

In general, the number of bird species decreases with the altitude (Newton 1998). The lowest number of species in this study was indeed recorded in the highest altitudinal belt, but overall trend does not support the general rule. This may be a result of low altitude difference in this study of only 700m that just reaches a tree line at higher elevations. To get a clearer picture we should expand the altitudinal range of survey to at least above the treeline. Since the number of species remained similar up to 1700 m a.s.l. and then dropped substantially, there may be additional reasons besides elevation. Lower heterogeneity of vegetation structure in upper altitudinal belts may be one reason. This would explain the absence of Red-backed Shrike and Whinchat that both can nest at higher elevations and both need higher plants for hunting (Collar & Garcia 2020; Yosef *et al.* 2020). The other reason may be a much steeper slope in upper altitudinal belts, which would explain the absence of Skylark, Whinchat, Red-backed Shrike, Quail and Corncrake that are more common in less steeper terrain (Billerman *et al.* 2020).

For most studied species, the highest recorded elevations are similar to those reported for our ornithological atlas (Mihelič *et al.* 2019), with the exception of Quail. Highest elevation of Quails' territorial calls was recorded in the mountain pasture Zaprikraj, at Breginjski stol and Planja, but in a lower altitudinal belt 1400–1600m a.s.l. (Trilar & Šumrada 2019). On the other hand, all studied species were recorded at higher elevations then in the 1992 survey (Čelik & Polak 1992). The reasons behind this are not very clear. The overall habitat remained roughly the same with only some overgrowth at the middle and upper elevations, although the availability of hunting structures higher up may explain presence of Tree Pipit, Whinchat and Red-backed Shrike. In both surveys, the methods have not been suitable for nocturnal species, so higher elevation of Quail may be due to chance. Many species move up the mountains due to climate change (Scridel *et al.* 2018), but this may not be the main reason in this case, since all species have been recorded breeding at higher elevations in other parts of the Alps (Luder *et al.* 1998). Climate change may partly explain higher elevation in at least three species, Tree Pipit, Corncrake and Quail, that were recorded higher than during the census of the entire Triglav National Park (Jančar 1997). The biggest difference between the 1992 and 2005 surveys concern Rock Partridge and Rock Thrush. In 1992, they were recorded considerably lower than in 2005 (Rock Partridge: below 1460; Rock Thrush below 1400 m a.s.l.). This is interesting since the optimal habitat for both species, i.e. rocky open meadows (Collar & Bonan 2020; McGowan & Kirwan 2020) at a site in 2005 started above 1400 m a.s.l.. It is possible that due to more grazing in 1992, the suitable habitat was also present below 1400m a.s.l. and both species were overlooked higher up.

The results indicate that in well preserved grasslands in the study area most recorded species seem to reach high breeding densities compared to other parts of Slovenia (Mihelič *et al.* 2019). For Corncrake (Božič 2019), Rock Partridge (Mihelič 2019) and Water Pipit (Polak 2019), the recorded densities are among the highest in Slovenia. Breeding densities of Whinchat are similar to average densities in Slovenia and comparable to those at Ljubljansko barje (Tome 2019).

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## Povzetek

Med 26. in 30. junijem 2005 smo na dveh planinah (Zaprikraj in Zapleč) v južnem delu Julijskih Alp, Slovenija, popisovali travniške ptice. Zaradi nepopolnega popisa (samo en obisk ploskve pozno v sezoni in brez nočnih popisov) je zabeležena gnezditvena gostota le groba ocena. Skupaj smo tako zabeležili 167 parov 12 vrst. Najštevilčnejši gnezdilki sta bili drevesna cipa *Anthus trivialis* (povprečna gostota 1,64 p/10 ha) in vriskarica *A. spinoletta* (1,60 /10 ha). Obe vrsti sta bili zabeleženi v vseh šestih višinskih pasovih. Najvišjo gnezditveno gostoto v posameznem višinskem pasu smo zabeležili pri rjavem srakoperju *Lanius collurio* (3,78 p/10 ha) in vriskarici (3,61 p/10 ha). Gnezditvena gostota večine vrst je bila na dobro ohranjenih traviščih omenjenih planin visoka v primerjavi z gostotami drugod po Sloveniji. Vse vrste so bile zabeležene na višjih nadmorskih višinah kot leta 1992 na istem območju, vendar še vedno v mejah višin drugod po Sloveniji. Gnezditvena gostota poljskega škrjanca *Alauda arvensis* se je nižala z nadmorsko višino. Medtem ko so bili repaljščica *Saxicola rubetra*, poljski škrjanec in rjavi srakoper pogostejši na bolj položnih pobočjih, sta obe vrsti cip izbirali različne strmine enako pogosto.

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