Oecologia Montana 2024, **33,** 57-61

REPORTS

Ring ouzel (*Turdus torquatus*) – a pilot study on climate and habitat change in the Western Carpathians

S. BUREŠ and S. BRECELJ

Institute of High Mountain Biology, Žilina University, Tatranská Javorina 7, SK-059 56, Slovak Republic; e-mail: stanislav.bures@upol.cz

Abstract. Habitats in Central European mountains change rapidly owing to warming and habitat changes (often as a result of pasture abandonment). The ring ouzel (*Turdus torquatus*) is very sensitive to these changes and decline in their abundance was confirmed in western European mountains. However, at this time, there is little data from the Slovak republic. Thus, the study of factors, which limit occurrence and reproduction of this iconic mountain bird species, is necessary. This study provides pilot data for the long-term monitoring of abundance and describes recent hab- itat, pedological and meteorological characteristics in the study areas of Brankov and Smrekovica in the Western Carpathians of Slovakia, which can contribute to a knowledge base for studies in the future..

Key words: climate change, habitat change, alpine birds, conservation, soil condition

Introduction

Mountain ecosystems, especially above the tree line, are under the continuous influence of human activities, as well as climate change, which has been known to have a disproportionate effect on mountainous environments (Brunetti *et al.* 2009). The main impacts are due to changes in land use, often supported by climate change (Guo *et al.* 2018), and anthropogenic disturbance. Several models and long-term studies predict the severe impact of these changes on populations of mountain bird species, including their shift to higher elevations (Jetz *et al.* 2007; Chen *et al.* 2011; Sim *et al.* 2011; Reif and Flousek 2012; Flousek *et al.* 2015; Lehikoinen *et al.* 2019; Barras *et al.* 2021a; Fumy and Fartmann 2021; Srinivasan and Wilcove 2021).

The ring ouzel (*Turdus torquatus*) is considered a mountain specialist, and therefore is well-suited to studying climate and habitat changes in upland environments. The population trend of the ring ouzel is declining in more countries (Sim *et al.* 2011; Wotton 2016; Barras *et al.* 2021a; Fumy and Fartmann 2021) and breeding areas are gradually moving to higher elevations, with formerly occupied ones at lower altitudes, abandoned (Barras *et al.* 2021a). Field ornithologists in the Slovak Republic, however, have limited detailed data on population trends, with the exception of notes about decreasing population in the Orava region (Karaska *et al.* 2014).

The main food source for nestlings is earthworms (Lumbricidae) (80% by abundance and 90% by biomass) (Barras *et al.* 2021b). Thus, their availability plays an important role for reproduction of the ring ouzel and the peak of their abundance is temporally limited to early spring, when snow is melting (Barras *et al.* 2022). Later, when the soil is too hot or too dry, many earthworms become inactive in a process called aestivation. They move deeper into the soil, curl into a tight ball, secrete protective mucus, and reduce their metabolic rate to reduce water loss. Thus, drought, as an effect of climate change, affects the availability of earthworms to the ring ouzel.

The second factor limiting reproduction of the ring ouzel is habitat change. The overgrowth of former grazing areas by high density grass reduce food availability during breeding, and the ring ouzel abandons such areas.

Unfortunately, traditional sheep and mountain farming is still on the decline in Slovakia. Over the last quarter of a century, Slovakia has lost nine-tenths of the number of sheep that were bred here before 1989. There were approximately three million sheep in Slovakia under socialism, but now there are only about three hundred thousand (Zlatoš 2017).

The ring ouzel is sensitive to climate and habitat changes, as has been confirmed by several studies (Sim *et al.* 2011; Fumy and Fartmann 2021; Barras *et al.* 2021a) and models of spatial distribution and altitudinal shift predict fast decline in abundance and shift into higher elevations (von dem Busche *et al.* 2008; Barras *et al.* 2021a). Therefore, the ring ouzel can be used as a good bioindicator of landscape changes as well as an umbrella species. Thus, the study brings basic data on the environmental conditions in two areas, which were, or still are, used by the ring ouzel for breeding and which can be suitable for long-term study of population trends in dependence on climate and habitat changes. The aim of the study was to create two areas with clear borders, and to provide data on soil, vegetation and temperature characteristics related to date, which can be used for comparison in the future.

Material and Methods

Study area

The two study areas were chosen in 2023. They have similar size, (approximately 0.4 km^2), limestone bedrock is the same, but different pasture history. The borders of the areas are evident in Fig. 1. The first area is around mount Veľký Brankov (1134 m a.s.l., further Brankov) in the western part of the Low Tatra mountains, where the breeding biology of the ring ouzel was studied from 1985-1989 (Janiga and Višňovská 2021). Grazing in this area declined continuously from that time, and the area of shrubs and forest has increased, and the non-grazed meadows altered and overgrown by high grass. The second area is around the Smrekovica mountain hotel (1320 m a.s.l., further Smrekovica) in the Veľká Fatra mountains. Infrequent grazing was discontinued in this area recently.

For description of habitat and soil characteristics we used similar criteria to Barras *et al* (2020). The measurements were done on the 25 April 2023 at the Brankov site and on the 26 April at the Smrekovica site. The points were chosen randomly across the study areas. 24 measurements (Table 1) were taken between the two locations. The centre of the randomly chosen point was bare ground and leaf litter as classified by Barras *et al.* (2020). The selected criteria were as follows: GPS coordinates, soil moisture, soil penetrability and the height of green grass measured as average height of vegetation around the point. A photo was taken at each point (approximately 1 m^2) for detailed analysis (Bureš and Brecelj in prep.).

Additional important characteristics include, the proportion of snow cover of the area, timing of the ring ouzel breeding, the abundance of the ring ouzel and meteorological data (air humidity and temperature) shortly before and during the breeding period (from 1 April to 10 June), which were taken at meteorological stations on mount Krížna (1574 m a.s.l., 15 km far from the Smrekovica area). The data on average temperature and relative humidity were divided into four periods (Table 2): prelaying (1 – 20 April), laying (21 April – 10 May), hatching (11 – 25 May), nestling (26 May – 10 June) in accordance with course of breeding season by Janiga and Višňovská (2021).

The volumetric water content of the soil and soil temperature were measured by multiparameter sensor type WET – 2 (Delta – T Devices Ltd., Cambridge, England). Soil penetrability was measured with a penetrometer of our own construction. This indicates the force (kg/cm^2) needed to insert the tip into the soil to a depth of 6.35 mm, as described by Barras *et al.* (2020).

Results and Discussion

The abundance of singing territorial males was 1-2 at the Brankov and 15 at the Smrekovica in 2023. The abundance of registered families – parents feeding fledglings was 11 at Smrekovica, but none at Brankov. For comparison, the abundance of found nests at Brankov was on average 7/year in 1985-1989 by Janiga and Višňovská (2021). No data are available from the Smrekovica from this period. Recent data on abundance are stated in Bureš and Brecelj (in prep.).

The importance of habitat changes on decline of ring ouzel populations have been documented by Ciach and Mrowiec (2013) in Western Carpathians in Poland, Barras *et al.* (2021) in Swiss Alps, Fumy

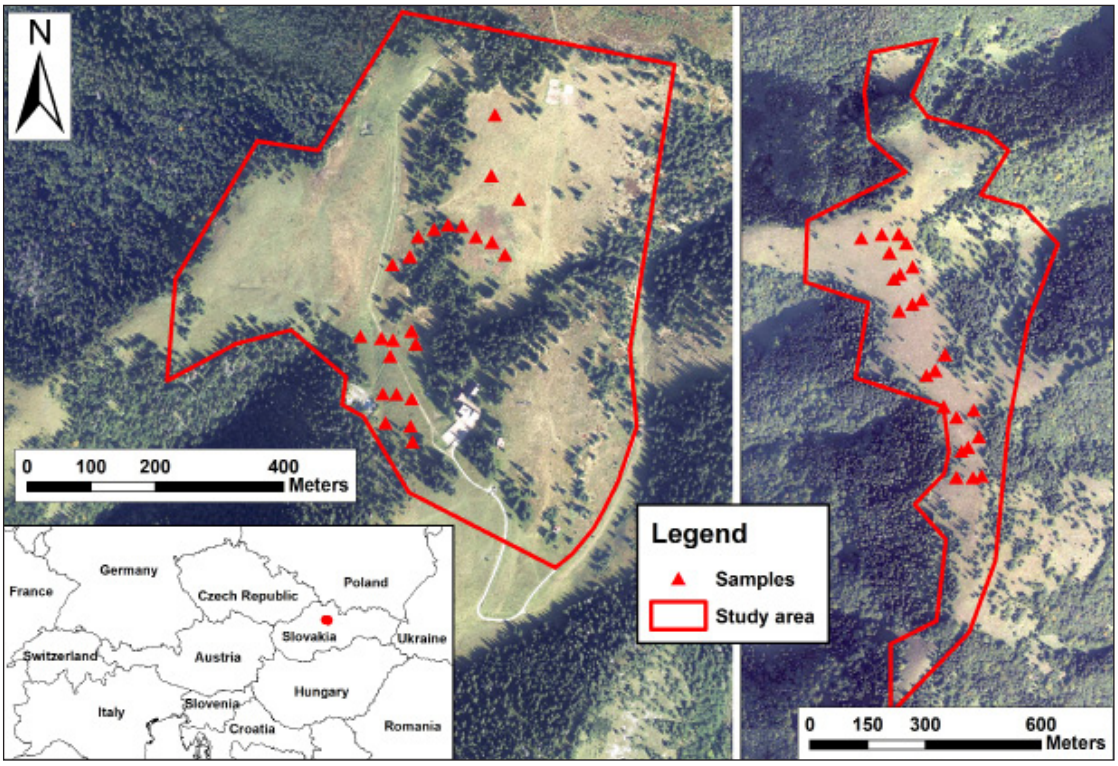

Fig. 1. Study area of Smrekovica (left side) and Brankov (right side) (Image from Mapy.CZ).

Coordinates Brankov	Grass (cm)	Pressure (kg/cm²)	Humidity (%)	Coordinates Smrekovica	Grass (cm)	Pressure (kg/cm²)	Humidity (%)
N 48.98867667 E 19.31431567	20	1.2	39.3	N 48.99086472 E 19.19893972	4	2.0	41.5
N 48.98873400 E 19.31462683	19	2.6	44.7	N 48.99084611 E 19.19947556	8	1.4	48.3
N 48.98865550 E 19.31372367	20	1.7	43.8	N 48.99063167 19.19954083	7	1.4	64.9
N 48.98927717 E 19.31384683	16	2.8	39.4	N 48.99123000 E 19.19945694	7	2.4	44.2
N 48.98937783 E 19.31405917	22	1.5	43.6	N 48.99127778 19.19912500	8	1.2	44.3
N 48.98964367 E 19.31442150	20	2.4	39.9	N 48.99127111 E 19.19883667	9	2.5	47.0
N 48.99005650 E 19.31357367	25	1.5	45.2	N 48.99180611 E 19.19893528	7	2.0	41.8
N 48.99024783 E 19.31416533	20	2.3	35.0	N 48.99199778 E 19.19945889	7	1.8	31.7
N 48.99028733 E 19.31309483	19	2.2	49.8	N 48.99217917 E 19.19934250	7	1.6	50.8
N 48.99110933 E 19.31269900	20	2.3	52.5	N 48.99202889 E 19.19896389	6	2.2	45.0
N 48.99098783 E 19.31240450	20	1.9	34.5	N 48.99204750 E 19.19872333	6	3.4	34.7
N 48.99149917 E 19.31300717	20	2.2	35.9	N 48.99205083 E 19.19826611	8	3.2	42.8
N 48.99261433 E 19.31172317	14	3.3	33.1	N 48.99308333 E 19.19883361	10	4.0	27.2
N 48.99274800 E 19.31206017	22	2.7	52.7	N 48.99322083 E 19.19919417	7	0.5	56.6
N 48.99243133 E 19.31127283	20	3.0	43.4	N 48.99350611 E 19.19933833	10	0.6	76.8
N 48.99329083 E 19.31120783	19	2.3	23.7	N 48.99362083 E 19.19966167	9	0.5	81.2
N 48.99348733 E 19.31163917	23	3.4	34.6	N 48.99369806 E 19.19995694	10	0.8	68.2
N 48.99317883 E 19.31099850	20	1.7	32.5	N 48.99369972 E 19.20025444	9	2.2	45.1
N 48.98945150 E 19.30618967	19	4.1	42.0	N 48.99356111 E 19.20057056	10	4.0	47.8
N 48.99377600 E 19.31078317	22	2.3	36.1	N 48.99350333 E 19.20091611	10	2.4	46.0
N 48.99402467 E 19.31135567	25	1.9	33.6	N 48.99334139 E 19.20120972	11	1.6	44.2
N 48.99422767 E 19.31105633	24	4.4	37.0	N 48.99412722 E 19.20142056	8	4.0	23.4
N 48.99419111 E 19.31046278	19	2.9	27.5	N 48.99443361 E 19.20079472	14	3.0	24.8
N 48.99407222 19.30974139	16	2.6	39.9	N 48.99528139 E 19.20077611	6	4.0	27.6

Table 1. Habitat characteristics of the study areas (Brankov on 25 April, Smrekovica on 26 April 2023).

and Fartmann (2021) in Black Forest in Germany. The gradual abandoning of former mountain pastures and their overgrowth with high grass, bushes and forests, reduce breeding possibilities of the ring ouzel, mainly due to decreased availability of food.

Ciach and Mrowiec (2013) found that the ring ouzel in the Western Carpathians preferred higher altitudes and proximity of clear-cuts and avoided small mountain meadows covered dense layers of vegetation on former mountain pastures, in accordance with our results (Brankov). The shift to higher altitudes and decline in abundance at breeding areas is a recent phenomenon, rarely documented (Karaska *et al.* 2014; Křenek and Ševčíková 2019), but often registered by field ornithologists both in the Czech and Slovak Republics.

Year	Pre-laying		Laying		Hatching		Nestling		Total	
	˚C	%	˚C	%	˚C	%	˚C	%	˚C	%
1986	0.0	79.1	7.3	85.7	8.5	86.1	5.5	92.5	5.1	85.5
1987	-1.5	86.8	2.6	81.3	2.7	92.6	6.0	85.6	2.4	86.2
1988	-0.7	82.8	2.7	83.2	6.3	89.2	8.2	91.3	3.7	85.8
1989	2.3	85.7	2.7	88.7	7.2	75.3	6.9	87.0	4.5	84.6
2023	-2.4	99.4	2.2	92.6	6.9	95.7	9.4	91.2	3.5	94.8
2024	4.6	63.8	4.7	66.2	7.6	67.2	10.1	72.8	6.5	67.2

Table 2. Daily average temperature in ˚C and relative humidity in % during study periods in 1986-1989 and 2023 - 2024.

The pastures in alpine meadows have been abandoned recently in Slovakia. In the Veľká Fatra mountains, only one area is grazed, under the mount of Čierny kameň, but 9 former pastures were abandoned. In the Malá Fatra mountains, there is no pasture on the alpine meadows. The sheep and cows only graze in meadows in valleys. Thus, the ring ouzel can suffer from warming and low snow cover at lower altitudes and by changing habitat use and overgrowing former pastures on alpine meadows. This unpleasant scenario in the Brankov area can be widespread in the Slovakian mountains and an altitudinal shift in occurrence of the ring ouzel to higher elevations during breeding season is very probable. This translates into a reduction of breeding areas and a decline in abundance of the ring ouzel.

Evaluating the influence of climate change in addition to habitat change is necessary to consider when we explain decline in abundance of the ring ouzel in an area. This article shows recent basic environmental characteristics of the study areas which can be useful for further studies in the future.

Acknowledgements

We thank SHMU and HZS Slovakia for providing meteorological data, A. Romanová for field assistance and J. Solár for calculation of meteorological data.

References

Barras, A.G., Braunisch, V. and Arlettaz, R. 2021a: Predictive models of distribution and abundance of a threatened mountain species show that impacts of climate change overrule those of land use change. *Divers. Distrib.*, **27**: 989–1004. https://doi.org/10.1111/ddi.13247

Barras, A.G., Candolfi, I. and Arlettaz, R. 2022: Spatiotemporal patterns of earthworm abundance suggest time-limited food availability for a subalpine bird species. *Pedobiologia*, **93**: 150826. https://doi.org/10.1016/j.pedobi.2022.150826

Barras, A.G., Marti, S., Ettlin, S., Vignali, S., Resano-Mayor, J., Braunisch, V. and Arlettaz, R. 2020: The importance of seasonal environmental factors in the foraging habitat selection of Alpine ring ouzels *Turdus torquatus alpestris*. *Ibis*, **162**: 505–519. https://doi.org/10.1111/ibi.12764

Barras, A.G., Niffenegger, C.A., Candolfi, I., Hunziker, Y. A. and Arlettaz, R. 2021b: Nestling diet and parental food provisioning in a declining mountain passerine reveal high sensibility to climate change. *J. Avian Biol.*, **52**: e02649. https://doi.org/10.1111/jav.02649

Brunetti, M., Lentini, G., Maugeri, M., Nanni, T., Auer, I., Bohm, R. and Schoner, W. 2009: Climate variability and change in the Greater Alpine Region over the last two centuries based on multi-variable analysis. *Int. J. Climatol.*, **29**: 2197–2225. https://doi.org/10.1002/joc.1857

Bureš, S. and Brecelj, S. (in prep.): Influence of climate and habitat changes on the ring ouzel (*Turdus torquatus*) populations in the Western Carpathians.

Chen, I.C., Hill, J.K., Ohlemuller, F., Roy, D.B. and Thomas, C.D. 2007: Rapid range shifts of species associated with high levels of climate warming. *Science*, **333**: 1024–1026. https://doi.org/10.1126/science.120643

Ciach, M. and Mrowiec, W. 2013: Habitat selection of the ring ouzel *Turdus torquatus* in the Western Carpathians: the role of the landscape mosaic. *Bird Study*, **60**: 22–34. https://doi.org/10.1080/00063657.2012.745463

Flousek J., Telenský T., Hanzelka J. and Reif J. 2015: Population trends of Central European montane birds provide evidence for adverse impact of climate change om high-altitude species. *Plos ONE*, **10**: e0139465. https://doi.org/10.1371/journal.pone.0139465

Fumy, F. and Fartmann, T. 2021: Climate and land-use change drive habitat loss in a mountain bird species. *Ibis*, **163**: 1189–1206. https://doi.org/10.1111/ibi.12954

Guo, Q., Fei, S., Shen, Z., Iannone, III B.V., Knott, J. and Chown, S.L. 2018: A global analysis of elevational distribution of non-native versus native plants. *J. Biogeogr.*, **45**: 793–803. https://doi.org/10.1111/jbi.13145

Janiga, M. and Višňovská, Z. 2021: Breeding biology of ring ouzel (*Turdus torquatus*) in the West Carpathians, Slovakia. *Oecologia Montana*, **30**: 50–58.

Jetz, W., Wilcove, D.S. and Dobson, A.P. 2007: Projected impacts of climate change and land-use change on the global diversity of birds. PLOS Biology, **5**: 1211–1219. https://doi.org/10.1371/journal.pbio.0050157

Karaska, D., Cichocki, W. and Kocian, L. 2014: Hniezdne rozšírenie vtáctva Oravy. SOS/Birdlife Slovensko, Bratislava.

Křenek, and Ševčíková, K. 2019: Kos horský (*Turdus torquatus*) v CHKO Beskydy v letech 1975-2019. *Acrocephalus*, **34**: 38–46.

Lehikoinen, A., Brotons, L., Calladine, J., Campedelli, T., Escandell, V., Flousek, J., Grueneberg, Ch., Haas, F., Harris, S., Herrando, S., Husby, M., Jiguet, F., Kalas, J.A., Lindstrom, A., Lorrilliere, R., Molina, B., Pladevall, C., Calvi, G., Sattler, T., Schmid, H., Sirkia, P.M., Teufelbauer, N. and Trautmann, S. 2019: Declining population trends of European mountain birds. *Glob. Change Biol.*, **25**: 577–588. https://doi.org/10.1111/gcb.14522

Reif, J. and Flousek, J. 2012: The role of species´ ecological traits in climate driven altitudinal range shifts of central European birds. *Oikos*, **121**: 1053–1060. https://doi.org/10.1111/j.1600-0706.2011.20008.x

Sim, I.M.W., Rebecca G.W., Ludwig, S.C., Grant, M.C. and Raid, J.M. 2011: Characterizing demographic variation and contributions to population growth rate in a declining population. *J. Anim. Ecol.*, **80**: 159–170. https://doi.org/10.1111/j.1365-2656.2010.01750.x

Srinivasan, U. and Wilcove, D.S. 2021: Interactive impact of climate change and land-use change on the demography of montane birds. *Ecology*, **102**: e03223. https://doi.org/10.1002/ecy.3223

von dem Bussche J., Spaar R., Schmid H. and Schroder B. 2008: Modelling the recent and potential future spatial distribution of the ring ouzel (*Turdus torquatus*) and blackbird (*T. merula*) in Switzerland. *J. Ornithol.*, **149**: 529–544. https://doi.org/10.1007/s10336-008-0295-9

Wotton, S.R., Stanbury, A.J., Douse, A. and Eaton, M.A. 2016: The status of the ring ouzel *Turdus torquatus* in the UK in 2012. *Bird Study*, **63**: 155–164. https://doi.org/10.1080/00063657.2016.1159180

Zlatoš, Š. 2017: Úpadok slovenského ovčiarstva treba zastaviť. Online: https://snn.sk/news/upadok-slovenskeho-ovciarstva-treba-zastavit/ (retrieved: 15 March 2024).

Received 20 April 2024; accepted 30 May 2024.