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Short research contribution

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## EFFECT OF WEATHER CHANGE ON FLOCK SIZE OF THE SNOW BUNTING (*PLECTROPHENAX NIVALIS* L.) WINTERING IN SOUTH-WESTERN POLAND

**ABSTRACT:** In winter 2004/2005 some exceptionally large (on the Central European scale) concentrations of Snow Bunting (*Plectrophenax nivalis*), up to 1600 individuals, were recorded in Lower Silesia (south-western Poland). The Snow Bunting flock size was positively correlated with the mean daily air temperature ( $P = 0.002$ ). The average flock size during snowless days was 11 times higher than in the snowy period ( $P = 0.0017$ ). One of the factors encouraging the more abundant wintering of Snow Bunting in Central Europe may be the milder climatic conditions, especially higher temperature and lack of snow cover. During the last four decades the rise of mean temperatures and shrinking of the snow cover period in winter months (December-February) have been observed in Lower Silesia.

**KEY WORDS:** Snow Bunting, *Plectrophenax nivalis*, wintering range, climate change, weather factors, Central Europe

The climate transformation currently occurring in the colder areas of the northern hemisphere (Houghton 1995, Hurrell 1995, data for Poland compiled in Kożuchowski and Degirmendžić 2005) brings about a series of changes in phenology and behaviour of many animal species, including birds (Berthold 1991, Žalakevičius

2001, Hubalek 2004). In central Europe the climate warming is reflected, among others, in the shorter winter period (Kożuchowski and Degirmendžić 2005) and the increase of its average temperatures (Houghton 1995, Hurrell 1995), which induces changes in the bird migration patterns and encourages the short-distance migrants to stay closer to the breeding grounds (Berthold 1991, Raudonikis 2001, Graham and Rehfish 2005, Mills 2006). In the winter period many passerine species tend to form flocks and the main factors affecting the winter bird concentrations include weather conditions (mainly the thickness of snow cover and air temperature) and predator pressure (e.g. Morrison *et al.* 1987; see also references herein). The advancing climate change may therefore be causing some modifications in winter bird concentrations, which, however, can be hard to detect and even misinterpreted, due to the far-reaching anthropogenic transformations of many habitats (Žalakevičius 2001).

The Snow Bunting *Plectrophenax nivalis* L. 1758 breeds in the open Arctic tundra regions of Europe and Asia. The main wintering areas of the species are the western European coasts of the North Sea (Cramp 1998).

The abundance of the population wintering on the coasts of Denmark, Holland and Germany is estimated at 10000–16000 birds (Dierschke 2001). In recent years, due to the transformations of the seaside halophyte associations, a drop in the number of Snow Buntings wintering on the coasts has been noted (Dierschke and Bairlein 2002, 2004). In Central Europe, including Poland, the Snow Bunting winters irregularly and in varying numbers, the flock size usually not exceeding 100 individuals (Cramp 1998; Dierschke 2001, Tomiałojć and Stawarczyk 2003). The abundance of the population wintering in Poland is estimated at over 3000 individuals (Tomiałojć after Dierschke 2001).

In winter 2004/2005 on the uncovered, stony bottom of the Mietkowski Reservoir (16°62' E, 50°96' N; Lower Silesia Province, south-western Poland) some exceptionally large (on the Central European scale) concentrations of the Snow Buntings were observed. The aim of the present study is to establish the relation between the number of wintering Snow Buntings and the weather conditions present in Lower Silesia during the period of the species' high abundance. The paper deals also with winter weather conditions of the last 45 years, that can be the cause of the change of the species' wintering range and intensity in Central Europe.

From the beginning of November 2004 till the end of March 2005 a total of 30 Snow Buntings censuses in 1–14 day intervals were made on the reservoir. The Mietkowski Reservoir was built in 1987 on Bystrzyca river (left tributary of Odra). Its surface reaches 980 ha at the maximum capacity. The reservoir lacks the littoral vegetation and its bottom is formed by muddy sediments and uniform gravel expanses. Every year, between November and February, a large part of the stored water is released, causing the exposure of up to 40–50% of the bottom. Due to the difficulties with bird counting in very mobile flocks, the video recording was used to assess the abundance of the largest concentrations. The field observations were carried out with the help of spotting scopes (20–60×80 mm and 22–66×102 mm). In order to establish the relationship between the weather conditions and the Snow Bunting flock size,

the weather records from the Meteorological Station of the Agricultural University of Wrocław (Wrocław–Swojec, 17°12' E, 51°12' N, 40 km away from the study area) were used. The following values were used in the analysis: mean daily air temperature ( $T_{\text{mean}}$ ), minimal daily air temperature 5 cm above the ground ( $T_{\text{min}+5\text{ cm}}$ ), maximal daily air temperature ( $T_{\text{max}}$ ), minimal daily soil temperature ( $T_{\text{soil}}$ ) and the thickness of snow cover (cm). The relationships between the Snow Bunting flock size and the current air temperatures were determined with the Pearson's correlation coefficient. The analysed temperatures and the Snow Bunting abundance had a normal distribution (in Kolmogorov-Smirnov test  $P > 0.20$ ). The differences in the mean flock size during days with / without snow cover were determined with the Mann-Whitney test. Only the results with probability  $P \leq 0.05$  were assumed as statistically significant. The statistical analysis was conducted with the help of Excel and Statistica 5 software. The long-term fluctuations of the mean temperatures (for seasons 1961/1962–2004/2005) and the length of the snow cover period (for seasons 1962/1963–2004/2005) were calculated jointly for all three winter months (December, January, February) based on the above mentioned unpublished meteorological records.

In the winter season 2004/2005 the Snow Buntings were recorded on the Mietkowski Reservoir between 4 November and 17 March (Fig. 1). The highest abundance was noted between 4 December and 17 January. In this period between 420 and 1610 birds (average  $\pm$  SD =  $908 \pm 307$  individuals) were seen. The largest concentration of 1610 birds was found on 29 December (Fig. 1). The Snow Bunting flock size ( $n = 24$ ) was positively correlated with  $T_{\text{mean}}$  ( $r = 0.61$ ,  $P = 0.002$ ; Fig. 2),  $T_{\text{mean}+5\text{ cm}}$  ( $r = 0.52$ ,  $P = 0.009$ ),  $T_{\text{max}}$  ( $r = 0.61$ ,  $P = 0.002$ ) and  $T_{\text{soil}}$  ( $r = 0.48$ ,  $P = 0.017$ ). The appearance of a thin snow cover (in Wrocław the first snow cover, 5 cm thick, was recorded on 23 January) caused a clear drop in the Snow Bunting numbers. In total, there were 27 days with snow cover (max. 18 cm in the last week of February) from December until the end of February. The average flock size ( $\pm$  SD) during snowless days ( $803 \pm 385$  individuals) was 11 times higher compared to the snowy

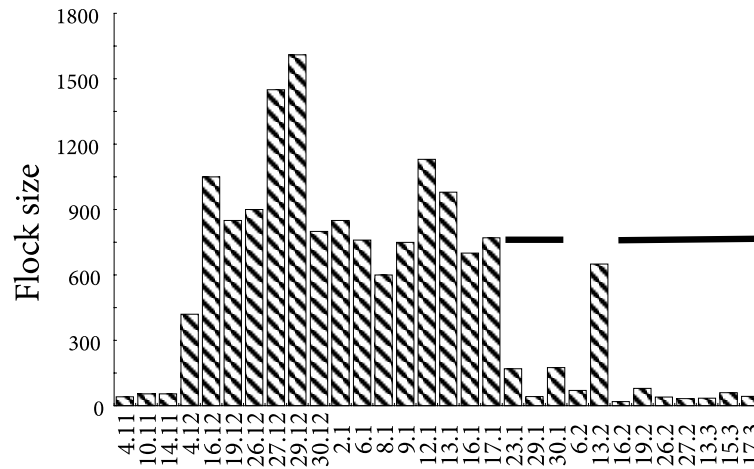


Fig. 1. The abundance (N = 15203) of the Snow Bunting in Mietkowski Reservoir (Lower Silesia, SW Poland; total surface 980 ha) during the consecutive censuses in winter 2004/2005. Black line indicates the presence of snow cover.

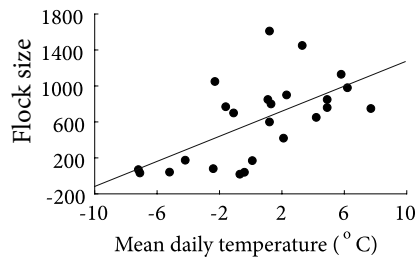


Fig. 2. Relationship between the mean daily temperature (in December and February) and the Snow Bunting flock size (n = 24) on Mietkowski Reservoir (SW Poland; 980 ha) in winter 2004/2005;  $y = 579.8 + 69.7x$ .

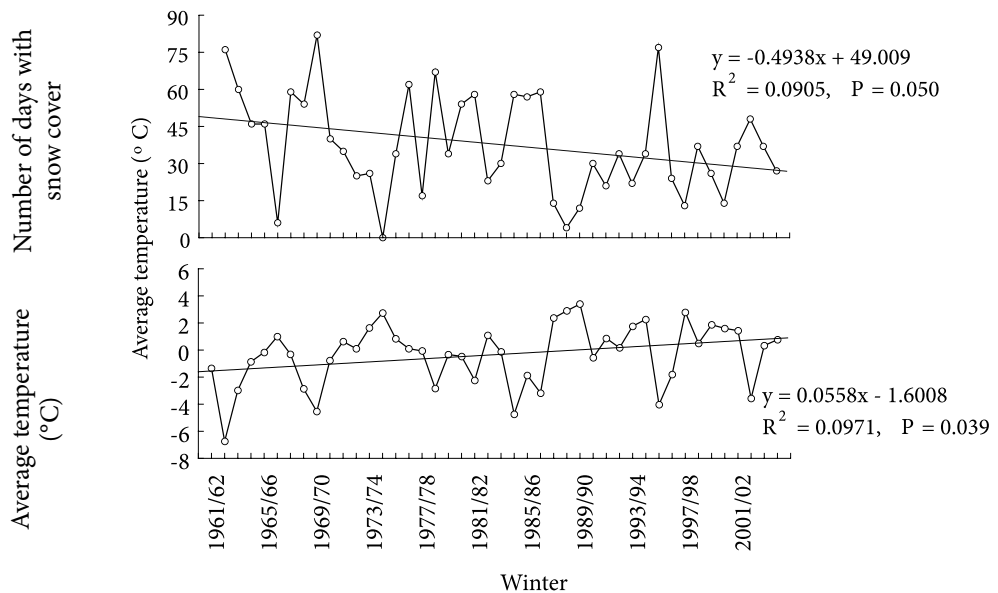


Fig. 3. Trend in average temperature and the total number of days with snow cover in the three winter months (December, January and February) in Wrocław for the period 1961/1962–2004/2005. The charts were made with the use of the unpublished long-term meteorological records from the meteorological station of the Wrocław Agricultural University in Wrocław–Swojec (17°12'E, 51°12'N).

period ( $73 \pm 53$  individuals). The difference was statistically significant (Mann-Whitney test,  $U = 7.0$ ,  $Z = 3.13$ ,  $P = 0.0017$ ).

The results of the present study suggest that the mean daily air temperature had the biggest influence on the Snow Bunting abundance in the Mietkowski Reservoir on the turn of December 2004. The positive correlation between the air temperature and the flock size could be the result of a temporary concentration of the migrating birds. The migration in this species has a nomadic character and can draw on until the beginning of January, while its wintering range spreads much further to the south-west (Tomiałojć 1990, Cramp 1998, Dierschke 2001). The large fluctuations of Snow Bunting abundance recorded during the consecutive controls carried out in a few day intervals (see Fig. 1) may result from the movements of some birds into the surrounding arable fields. The results of censuses of highly mobile Snow Bunting flocks may also not be accurate; it seems though that these methodological shortcomings are unlikely to affect seriously the relations detected between the flock size and the weather conditions. The long-lasting high temperatures coupled with the lack of snow cover on the turn of December 2004 undoubtedly encouraged the foraging efficiency on the vast open areas of the reservoir. The appearance of snow cover in the last decade of January caused a sudden fall of abundance, most likely due to the remarkable reduction of food availability. In the North Sea wintering areas the Snow Buntings fed usually along the driftline, only during the high snow cover venturing into the higher vegetation (Dierschke and Bairlein 2004). Winter diet of the Snow Bunting consists mainly of seeds of grasses and many other plant species, including weeds, that are picked from the ground (Cramp 1998). It seems however, that the seed abundance on the bottom of the studied reservoir, filled with water for the most part of the year, are very limited. The tendency of wintering birds to aggregate with the increase of temperature was described earlier e.g. in House Sparrow *Passer domesticus* (Barnard 1980), although Caraco and Bayham (1982) found a completely contrary relationship in this species. Similarly in Willow Tit *Parus montanus* in Scandinavia the drop of

temperature caused the increase of the flock size (Hogstad 1988).

The recently published studies on the influence of the climate change on birdlife dealt e.g. with the ever earlier spring arrivals (Tryjanowski *et al.* 2002, Hubalek 2004), earlier commencement of breeding (Møller 2002), increased reproduction success (Skinner *et al.* 1998), expanding of the breeding areas as well as changes in the wintering ranges (Tomiałojć and Stawarczyk 2003, Graham and Rehfishch 2005, Mills 2006). The analysis of the meteorological records from Lower Silesia shows a clear rise in the average winter temperatures coupled with the reduction of the snow cover period (Fig. 3) during the last 45 years (see also Kożuchowski and Degirmendžić 2005). The changes in the climatic conditions are certainly also reflected in the changing quality of the wintering grounds (increasingly milder weather encouraging wintering of some species, e.g. Graham and Rehfishch 2005). In the case of the Snow Bunting this can spell the shift of wintering range from the mild climate of the North Sea coasts towards the interior of the European continent (where, as it has been proved for Wrocław area, the winter temperatures are rising steadily). This can, to some extent, explain the fall of wintering Snow Bunting abundance on the current main wintering grounds (Dierschke and Bairlein 2002). Some observations from Poland also hint at a certain increase of frequency of winter encounters with this species in the last two decades (Chylarecki 2000).

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