# Abundance of Common Buzzard *(Buteo buteo)* in the Central European wintering ground in relation to the weather conditions and food supply

## Vliv počasí a potravní nabídky na hustotu káně lesní *(Buteo buteo)* na zimovišti ve střední Evropě

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ABSTRACT. During 7 winter seasons (November-February) the average density of Common Buzzard in open farmland of Równina Wrocławska (SW Poland) was 2.12 ind./km$^2$. This figure was typical for the Central European wintering grounds of this species. In March the density was lower – 1.34 ind./km$^2$. Strong intra- and interseasonal abundance fluctuations, connected with the weather conditions and food supply, were noted. The density of Common Buzzard was negatively correlated with the air temperature and positively with vole numbers. Distinct fluctuations were noted during the periods of sudden weather change, but these fluctuations were of short duration and more pronounced during the strong temperature drops than during intense snowfalls. I explain these changes by long-distance movements (influx of individuals from North) and local movements (gathering of predators along the busy road). The average density and its increase during the periods of bad weather point to the fact that Lower Silesia should be considered to be the part of main wintering grounds of the Common Buzzard (comprising the central and western part of Europe), rather than one of areas in the migration route of species only.

## INTRODUCTION

The abundance of birds of prey observed on wintering grounds is not stable and is subject to the strong intra- and interseasonal fluctuations. It is accepted that the main reason is food supply (NEWTON 1990), but also other indirect factors like the weather and habitat conditions, part of the winter, migration strategy or behavioural plasticity of predators are of significant importance (SONERUD 1986, MÜLNER 2000, WUCZYŃSKI 2001b). In the case of the Common Buzzard, the wintering area is also important. In Central Europe this species is a partial migrant and the percentage of sedentary birds depends on the weather conditions of given season. In Germany it was estimated that up to 49% of birds are sedentary (MEBS 1964), in Denmark – 57% (CRAMP & SIMMONS 1980), in Czech Republic during mild winters probably most birds do not fly away (P. VOŘÍŠEK, in litt.). There are no such data from Poland.

The migration of Common Buzzards is of „leap-frog" type – the wintering grounds of most northern populations are the farthest to the South of all, whereas the birds from the central part of breeding area move a relatively small distance (GÉNSBØL & THIEDE 1997, FRANSSON & PETTERSSON 2001). Immigrant individuals wintering in Poland nest probably on the western Baltic coast (SAUROLA 1977, KRÓL 1983, WALASZ 2002). The migration records of many birds from northern Poland probably do not go beyond the borders of the country at all (KRÓL 1983). Relatively high abundance of Common Buzzards wintering in western and southern Poland, especially in Lower Silesia (TOMIAŁOJĆ 1990, BEDNORZ et al. 2000), indicates that this area can be the limit of central area of wintering grounds. However, we do not know if the abundance here is comparable with the main wintering grounds of Common Buzzard that are located further away to the West and South.

In comparison with the censuses from the breeding period, the estimations of the abundances of wintering predators are considerably less numerous. More information dates from the seventies and eighties. Thus, the directed research programs were dedicated to the counts of wintering birds in some countries, e. g. in Germany (ROCKENBAUCH 1976), Czech Republic (BEJČEK et al. 1995), Finland (KOSKIMIES & VÄISÄNEN 1991). Unfortunately, data from Poland are not numerous enough (PIELOWSKI 1991, LONTKOWSKI 1994, KITOWSKI 2000, WALASZ et al. 2002, KASPRZYKOWSKI 2002), although methodological recommendations were presented in the 1950s and they were one of the first of this type in Europe (PINOWSKI 1955). The common feature of the most of these works is the number estimation on the basis of merely several counts, while very few of them present the dynamics for the course of the whole winter. This makes the analysis of factors connected with this dynamics difficult.

The aim of the present work is: a) to estimate the abundance of Common Buzzards wintering in Lower Silesia and to compare it with figures obtained in other wintering grounds, b) to analyse the intra- and interseasonal abundance dynamics and its changes under the influence of chosen environmental factors.

## STUDY AREA AND PERIOD

The study was conducted during November-March in 1993-2000 on an open area with intense farming, located on Równina Wrocławska, SW of Wrocław. A constant transect was established between the villages Sieniawka and Bielany Wrocławskie, along the busy motorways: national road No. 384 and international road No. E67. Only the short, ca. 6 km long section of transect (Jordanów Śl. – Tyniec – Pustków Wilczk.) ran along the byways. The total route length amounted to ca. 40 km, however the effective counts were conducted on 28 km of open areas. The settled areas and ca. 1 km long forest section were discounted. The birds were always counted on the same side of road within a belt of width of 250-300 m. The belt borders were demarcated along the characteristic terrain elements. The total area of observation amounted to ca. 7.5 km$^2$. Ninety-three percent was covered by the cropland (including 2% of stubble), 3% – by grassland, 2% – fallow, 2% – by small groups of trees, roads and by the peripheries of settlements.

The study area is located in the warmest climatic province of Poland, with high average temperatures in winter, short periods of snow cover, but also with very unstable weather (WOŚ 1999). The studied seasons were of such type, except the more severe winter 1995/96. The periods of weather change connected with snowfall were seldom, of short duration and as a rule they ended in sudden thaws. Table 1 shows the characteristics of chosen parameters of the studied period calculated on the basis of data acquired from the meteorological station in Dzierżoniów. The abundance of Common Vole *(Microtus arvalis)* was estimated by the Plant Protection Inspectorate for the prognostic purposes, by means of the method of counting of re-opened burrows (ROMANKOW-ŻMUDOWSKA 1976). These results refer to an area greater than the study plot itself (some nearest communes) but this area includes the study plot.

**Table 1** – Selected characteristics of studied winter seasons (November-February).
**Tab. 1** – Vybrané charakteristiky jednotlivých zim (listopad-únor).

| Season | Temperature [°C] | Sum of precipitation [mm] | | | Common Vole abundance [number of active burrows/1ha] |
|---|---|---|---|---|---|
| | | Rain | Snow | Total | |
| 1993/94 | 2.2 | 79.3 | 67.1 | 146.4 | 362.0 |
| 1994/95 | 3.7 | 37.6 | 55.9 | 93.5 | 66.6 |
| 1995/96 | -1.6 | 40.0 | 141.4 | 181.4 | 1177.7 |
| 1996/97 | 0.5 | 41.4 | 59.9 | 101.3 | 32.1 |
| 1997/98 | 3.6 | 118.5 | 35.5 | 154.0 | 361.6 |
| 1998/99 | 1.2 | 40.7 | 67.8 | 108.5 | 322.0 |
| 1999/00 | 2.3 | 88.7 | 63.0 | 151.7 | 121.6 |

## MATERIAL AND METHODS

The counts were made from a bus or car with a driver, in the morning (between 8:30 and 10:00 AM), on days with good visibility. The duration of single control was ca. 1 hour. The vehicles moved with the speed of 50-70 km/h non-stop. This method, together with the estimation of degree of accuracy, was more widely described in a separate work (WUCZYŃSKI 2001a). It was proved that the detectability of buzzards amounted to 80-88% and the faulty identification was connected with Rough-legged Buzzard *(B. lagopus)* only. However, it was acknowledged that the bias is insignificant considering the low abundance of this species in Silesia (somewhat less than 1 ind./10 km$^2$, DYRCZ et al. 1991, LONTKOWSKI 1994, own data). For example, during four precise double counts on the same transect only two Rough-legged Buzzards were detected, among 109 buzzards in total (WUCZYŃSKI 2001a).

The material consists of 61 counts, including 21 counts taken in the seasons 1993/94-1996/97 at irregular intervals, and 40 counts taken in the seasons 1997/98-1999/2000 in ten-day cycle. Twelve March-counts outside the real winter season were excluded from most of analyses. The abundance of Common Buzzards recorded on transect was calculated to its area and was expressed as the number of individuals per km$^2$. The results were presented within regular 10-day periods, the data from different years of the same period were averaged. The normality of distribution of correlated variables was tested by Kołgomorov-Smirnov test.

## RESULTS

On average, 15.9 individuals were recorded on the studied transect in the period November – February and the range was from 3 (05.01.2000 and 27.02.2000) to 37 individuals (02.02.1998). The average density reached 2.12 ind./km$^2$ (N = 49 counts, Table 2). The densities in March were lower – 1.34 ind./km$^2$ on average (N = 12 counts). The abundance of Common Buzzards was subject to significant fluctuations, both the intra- and the interseasonal ones (Fig. 1). In three winters when the highest number of counts was made (1997/98-1999/2000), the average densities for the period November-February were successively decreasing (2.8, 2.2 and 1.5 ind./km$^2$). The highest densities were recorded in the winter 1993/94 and in relatively warm and rainy season 1997/98. Buzzard abundance did not increase during rodents

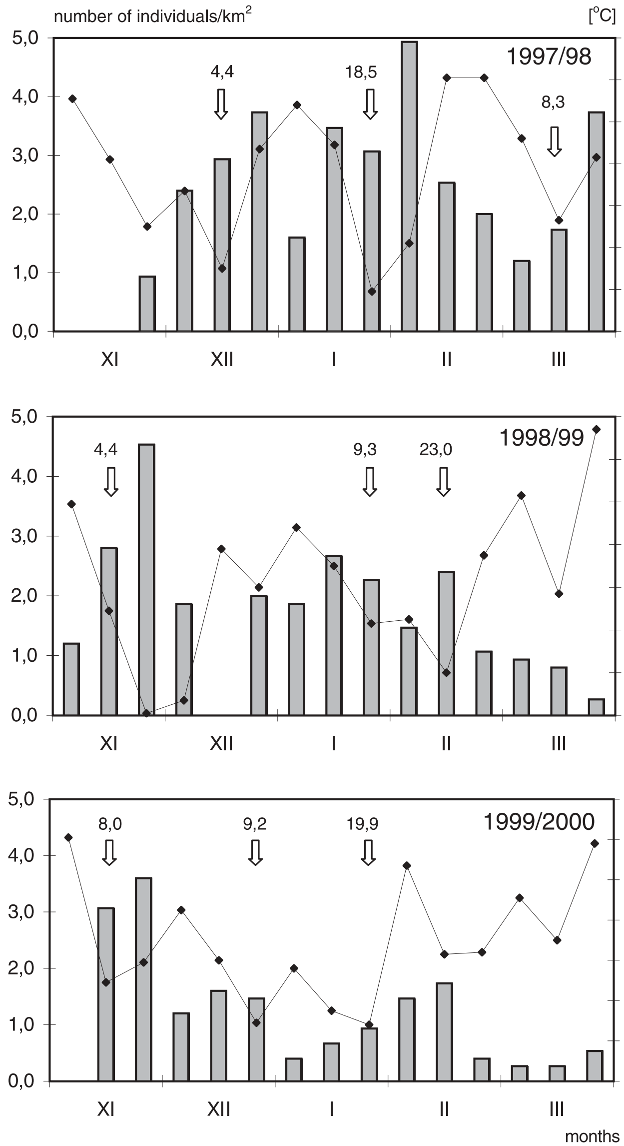


**Fig. 1** – Changes of the abundance of Common Buzzard on the studied transect (columns, number of individuals per $km^2$), the course of average temperatures in 10-day periods (curve) and the main weather collapses (arrows) in three winter seasons. The figures over the arrows are the snow precipitation [mm]. In the periods without columns the counts were not made.

**Obr. 1** – Změny v početnosti káně lesní na sledovaném transektu v jednotlivých dekádách (sloupce, počet ex. /$km^2$), průběh průměrných teplot v jednotlivých dekádách (křivka) a významná zhoršení počasí (šipky) ve třech zimách. Hodnoty nad šipkou vyjadřují výšku sněhové pokrývky v mm. Prázdná místa v grafu znamenají, že sčítání nebylo prováděno.

gradation peak in winter 1995/96, although the lowest densities coincided with food depletion (1994/95, 1996/97, 1999/00). The relationship between the numbers of raptors and vole abundance was significant (Spearman's $r_S = 0.79$, $N = 7$, $P = 0.036$) (Tabs. 1 and 2).

**Table 2** – Mean densities (number of individuals per km$^2$) of the Common Buzzards wintering in the Równina Wrocławska.
**Tab. 2** – Průměrné zimní denzity (počet ex. /km$^2$) káně lesní v oblasti Równina Wrocławska.

| winter | November-February | | March | |
|---|---|---|---|---|
| | mean density | number of counts | mean density | number of counts |
| 1993/94 | 3.33 | 5 | | |
| 1994/95 | 1.33 | 3 | | |
| 1995/96 | 1.98 | 6 | 2.13 | 3 |
| 1996/97 | 1.11 | 3 (November only) | | |
| 1997/98 | 2.76 | 10 | 2.22 | 3 |
| 1998/99 | 2.19 | 11 | 0.67 | 3 |
| 1999/00 | 1.50 | 11 | 0.36 | 3 |
| Total | 2.12 | 49 | 1.34 | 12 |

In spite of the strong variability of buzzard densities within particular seasons, the average multiyear data show some weak regularities (Fig. 2): low values at the beginning of November distinctly increased in the 2$^{nd}$ and 3$^{rd}$ 10-day periods of this month (seasons 1998/99 and 1999/00). Next the numbers of birds stabilised, the short decrease in abundance was recorded in 1$^{st}$ 10-day periods of January and next the distinct and durable decrease at the end of February and in March. The difference between buzzards' numbers in December-February and in March was close to significant (Tukey HSD test, $P = 0.069$), but between December-February and November it was not ($P = 0.87$). The peak of abundance was recorded at the beginning of February. Between the half of November untill the end of February there persisted the moderately stable density at the level of 1.7 to ca. 2.5 ind./km$^2$ (Fig. 2).

Negative dependence was found on the abundance of Common Buzzard upon the air temperature (the density increased with the low temperatures). The number recorded on a given day was correlated with five temperature averages (Table 3): twenty-four hours', 10-day periods and with the average of 3, 5 and 10 days preceding the control (including the day of control). Dependence was statistically significant in the case of twenty-four hours' average temperature on the day of control ($P = 0.027$) only. The distinct increase of density was recorded immediately after the periods of temperature decrease. The reverse dependence of density and temperature is visible in the diagrams illustrating the winters separately (e.g. the following 10-day periods: 1$^{st}$ and 3$^{rd}$ of January 1997/98, 2$^{nd}$ and 3$^{rd}$ of November 1998/99, 1$^{st}$ of December 1999/00, Fig. 1) as well as in the diagram of averaged many years' data (Fig. 2).

During the last three winter seasons there were nine short-term periods of relatively intense snowfalls (three per season, Fig. 1), which could also affect buzzards numbers. However, the influence of snow and temperature seemed not to be the same: the strong temperature drops (below -10°C) in the periods of bad weather almost always caused an increase in the birds abundance, irrespective of attendant precipitations (e. g. December 1997, January and November/December 1998). On the other hand snowfall could have had a similar influence (January and March 1998, November 1998 and 1999, Fig. 1) but this was not the rule and even after the exceptionally abundant snowfalls in February 1999 and in January 2000 no distinct changes in buzzard numbers were observed. The dependence of snowfall and birds abundance was not statistically confirmed (Table 3), partly because the number of days with snowfall was too small for reliable analysis.

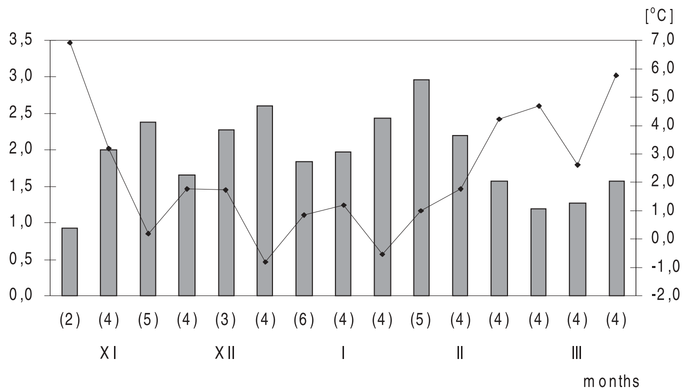


**Fig. 2** – Mean density of the Common Buzzard on the studied transect (number of individuals per km2, N = 61 counts) and the course of average decadal temperatures (curve) in the winter seasons 1993/94-1999/2000. The values in brackets – number of counts in particular 10-day periods in different years.

**Obr. 2** – Průměrná denzita káně lesní na sledovaném transektu (počet ex. /km2, N = 61 kontrol) a průběh průměrné teploty (křivka) v jednotlivých dekádách v zimách 1993/1994-1999/2000. Hodnoty v závorce – počet kontrol v každém desetidenním období.

**Table 3** – The values of Pearson's r and Spearman's $r_S$ correlation coefficients between the number of Common Buzzards on the transect, the average air temperatures and the sum of precipitation.

**Tab. 3** – Zhodnocení vlivu průměrné teploty a souhrnu srážek na zimní početnost káně lesní na sledovaném transektu (Pearsonův a Spearmanův korelační koeficient).

| Average temperature or sum of precipitation > 4 mm | Temperature | | | Precipitation | | |
|---|---|---|---|---|---|---|
| | r | P | N | $r_S$ | P | N |
| twenty-four hours' on the day of control | **-0.32** | **0.027** | **49** | 0.60 | 0.400 | 4 |
| of 10-day period with the control | -0.18 | 0.209 | 49 | 0.21 | 0.518 | 12 |
| of 3 days preceding the control | -0.23 | 0.115 | 49 | -0.05 | 0.910 | 8 |
| of 5 days preceding the control | -0.21 | 0.146 | 49 | -0.02 | 0.947 | 10 |
| of 10 days preceding the control | -0.10 | 0.514 | 48 | 0.19 | 0.581 | 11 |

## DISCUSSION

The densities of wintering Common Buzzards recorded in Europe are of wide range when comparing the different regions as well as the years of study. According to ŠÁLEK'S (1988) estimation the average density for the open areas of Central Europe ranges from 0.17-1.25 ind./km$^2$. GAMAUF (1987) shifted this range to 0.9-2.3 ind./km$^2$. The densities from the dozen plots in the Czech Republic were of more wide range: 0.17-5.1 ind./km$^2$ (BEJČEK et al. 1995, KREN 2000) and BEJČEK et al. (1995) reported a density of 0.8 ind./km$^2$ to be the real average for the Czech Republic. However, most authors emphasise that comparisons are difficult considering the big differences in the size of controlled plots and in the methods of study.

With reference to these review figures the density in Równina Wrocławska (with the average of 2.12 ind./km$^2$) seems to be high. It exceeded also the other results from Silesia – in 1988-1991 in mid December the average densities on 13-23 plots (size 5.5-31 km$^2$) amounted to 0.7-1.6 ind./km$^2$ (LONTKOWSKI 1994). But comparison with other plots of similarly small area does not show any significant differences. For example several years' regular controls of the plot of 7 km$^2$ near Hamburg revealed the density of 0.65-2.3 ind./km$^2$ (GLAUBRECHT 1981). Taking only the data collected by means of line method into account, the densities of Common Buzzard amounted to:

- 1.50-2.80 (on the average 1.97) ind./km$^2$, 5 different plots within the range 10-20 km$^2$ in the vicinity of Lake Constance (MÜLLER et al. 1979),
- 0.5-3.0 ind./km$^2$, plot of 16.7 km$^2$ in Mecklenburg (EICHSTÄDT & EICHSTÄDT 1991),
- 1.5-3.2 ind./km$^2$, plot of 10 km$^2$ in Czech Republic (VOŘÍŠEK 1991),
- 2.4-5.1 (on the average 3.6) ind./km$^2$, plot of 4.2 km$^2$ with great part of stubble fields in western Czech Republic (SCHRÖPFER 1997).

In comparison with the results from similar areas and using similar methods, the numbers of Common Buzzards wintering on Równina Wrocławska was found to be average. The features of the region – warm climate and great availability of fertile, lowland soils, support it. In the areas with severe conditions, esp. mountainous ones, the Buzzard's winter densities were generally low (ROCKENBAUCH 1975, MÜLNER 2000). These facts suggest that Lower Silesia should be considered to be a part of the main wintering grounds of Common Buzzard comprising the central and western part of Europe, rather than one of areas in the migration route of the species only.

It is confirmed also by the observed dependence of the numbers of Common Buzzard and the weather conditions. The density was negatively correlated with the temperature and increased with the sudden weather deterioration. Such dependence should be expected just on the main wintering grounds and it can result from the influx of a great number of birds from North and East (so-called winter migrants) (MÜLLER et al. 1979, ŠÁLEK 1988, VOŘÍŠEK 1991). The abundance fluctuations connected with the weather changes including large areas of Poland and Europe (December 1997, November 1998) were probably of such character.

However, changes in numbers resulted from the local movements too. The studied transect over most of its length was situated along the busy motorway. Attention to the phenomenon of gathering of birds of prey along communication routes as well as along river valleys, on the peripheries of cities and the like was drawn long ago (ROCKENBAUCH 1976, VINUELA 1997). This phenomenon intensifies just under the influence of deteriorating weather conditions. The birds from the surrounding areas, not necessarily very distant ones, move closer to the roads considering the potentially greater food accessibility (chiefly carrion and wounded animals). For example, in Lublin province (E Poland) 74% of buzzards observed in the vicinity of roads were recorded after the abundant snowfalls preceding the count by 1-3 days (KITOWSKI 2000). Wide and properly developed roadsides situated in a scanty agricultural landscape can even fulfil essential function in protection of birds of prey in winter (MEUNIER et al. 2000).

In the present study not only the distinct time convergence of number fluctuations with the temperature drops was characteristic, but also their short duration. As a rule just in the next period after the end of weather deterioration, the abundance of Common Buzzard returned to the level recorded before the cold period. If we assume that the changes of numbers were caused by the winter migrations and the influx of waves of great numbers of individuals from the North and East, it would be difficult to make clear their later fast disappearance. It is unlikely that the birds return to the previously occupied, distant wintering grounds just after the end of cold. Moreover, the increase in abundance should be expected with some delay (flight time). Meanwhile, the values of correlation coefficient (Table 3) pointed to the strongest connection with the temperature of a given twenty-four hours, but not the connection with the average temperature of previous days. The local and short-term movements to the area of the bird counting from the directly adjoining areas seem to be therefore more likely. Whereas the great-area changes of abundance can intensify this process but as a rule they refer to the beginning and end of winter. These changes were also observed on the Równina Wrocławska: together with the first temperature drops in November there was recorded the last wave of autumn migration of Common Buzzard and the persistent occupation of wintering grounds. A marked decrease in numbers at the end of February and in March was connected with the leaving of wintering grounds and beginning of the breeding season.

The correlation between prey density and raptor abundance in winter is well documented (SONERUD 1986, GAMAUF 1987, NEWTON 1990, MÜLNER 2000) and it was recorded also in this study. Buzzard densities followed the vole oscillations, although in the season of exceptionally high rodent numbers, the density did not exceed the mean level. In fact, the winter 1995/96 was relatively severe, with long-lasting low temperatures and snow cover (Table 1), which could have been responsible for low prey availability. In turn, Buzzards responded consistently to decreasing vole density and the lowest abundance was noted during three winters when prey were scarce. This may suggest, that the bottom level of wintering raptor densities is maintained chiefly by food supply, while the top level depends on a complex of factors.

ACKNOWLEDGEMENTS. I am very grateful to Prof. Ludwik Tomiałojć and to two anonymous referees for important comments on the manuscript.

## SOUHRN

V průběhu zim 1993/94-1999/00 (listopad – únor) byla v oblasti Dolního Slezska (Polsko) sledována početnost zimující káně lesní (*Buteo buteo*). Ve čtyřech posledních zimách byla zjišťována denzita i v březnu. Ke zjištění zimní početnosti byla použita metoda sčítání z jedoucího automobilu, celkem bylo uskutečněno 61 kontrol. Většina kontrol (41) spadá do posledních třech zim a proto byly vnitrosezónní rozdíly v početnosti hodnoceny pouze v tomto období. Denzity zimujících kání byly v období zimy vyšší (listopad-únor: 2,12 ex./km$^2$, březen: 1,34 ex./km$^2$). Zjištěné výsledky souhlasí s ostatními prameny z centrální Evropy. Denzity kolísaly výrazně jak v rámci jedné zimy, tak i mezi jednotlivými roky a byly signifikantně pozitivně korelovány s počtem zjištěných aktivních nor hraboše a negativně s denní

teplotou vzduchu. Teplota v období před kontrolou, stejně jako srážky, neměla na kolísání denzit signifikantní vliv. Vyšší početnost při zhoršení počasí autor vysvětluje dálkovou imigrací jedinců ze severních oblastí a lokální imigrací do okolí silnic v zimním období. Druhá zmíněná imigrace souvisí s vyšší potenciální nabídkou v okolí komunikací – hlavně mršiny a zvířata zraněná automobilovou dopravou. Minimální denzity v rámci let jsou pravděpodobně způsobeny potravní nabídkou, zatímco maximální komplexem faktorů. Dolní Slezsko je podle stávajících výsledků spíše zimovištěm druhu, než jen součástí migračního koridoru.

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(Received 16.2. 2003, accepted 24.4. 2003)