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Brief report

Common Buzzard (*Buteo buteo*) population during winter season in North-Eastern Romania: the influences of density, habitat selection, and weather

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Common Buzzards (*Buteo buteo*) in Eastern Europe are partial migrants, and their numbers in a specific area fluctuate during the winter season. In the cold season of 2010–2011 we carried out 15 car-transect counts, each 40 km in length, during four months (November–February) to study the wintering population of the Common Buzzard in North-Eastern Romania. The counts revealed a density of 0.334–0.539 individuals/km^2 for the winter season. Birds were non-randomly distributed across habitat types: agricultural land and especially areas with natural perches (trees or bushes) were used disproportionately commonly. The density of Common Buzzard varied during the four months, and was influenced by temperature. The numbers of Common Buzzards peaked at transects with complete snow cover and during periods of lower-than-average temperature.

1. Introduction

Birds of prey, being positioned at or near the end of food-chains and at the top of food pyramids, are renowned for being suitable indicators of ecological completeness and environmental health (Voous 1994). Monitoring their numbers is a basic tool in studies on population trends, and for understanding the effect of environmental changes on biodiversity (Nikolov *et al.* 2006). Most monitoring programmes are undertaken during breeding periods and few during cold periods. Winter-season counts are important because many species are limited by their ability to survive over this period (Ralph *et al.* 1995). Winter is critical for many bird species wintering in the temperate region (Cuthill & Houston 1997). A complete understanding of the population ecology and trends requires monitoring programmes in wintering areas. The abundance of birds of prey observed on wintering grounds is not constant and is subject to strong intra- and inter-seasonal fluctuations (Wuczyński 2003).

Common Buzzard (*Buteo buteo*) is one of the most common birds of prey in Europe with a so-called leap-frog migration – the wintering grounds of most northern populations are the farthest south, whereas the birds from the central part of the bree-

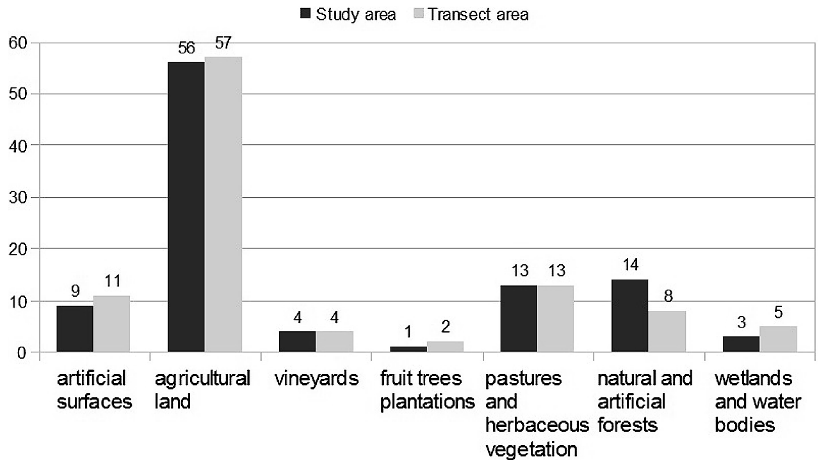

Fig. 1. Proportions of different habitat types along the raptor-census transects, determined from CORINE Land Cover 2006. The study area is the Eastern Moldavian Region. Transect area refers to the area covered by the study transects (see text).

ding area move relatively short distances (Fransson & Pettersson 2001). The mortality rate in the Common Buzzard peaks in winter (Bijlsma 1996). During this season, the species is associated with open areas, and over much of its wintering range, inhabits meadows and agricultural areas with some trees (Melde 1995). Common Buzzard is an open habitat hunter (Cramp & Simmons 1980) and in winter it uses forests most for roosting (E. Ş. Baltag, in prep.). Changes in land use, potentially influencing the distribution and numbers of raptors, are expected in the near future, mainly as a consequence of the agricultural policy of the European community (Boano & Toffoli 2002). Additionally, climate change (IPCC 2007) is supposed to influence many features of Common Buzzard behaviour particularly in the northern part of its distribution (Lehikoinen *et al.* 2009) and on migration (Newson *et al.* 2008). The present and future influence of these changes on wildlife is poorly understood, but severe threats to biodiversity have been predicted for long (e.g., Donald *et al.* 2002).

In Romania, studies on Common Buzzard are lacking and for South-Eastern Europe they are rare (e.g., Nikolov *et al.* 2006). The aim of our study is to estimate the density and habitat selection of Common Buzzards in Eastern Romania, but also to determine how the wintering population of this species is affected by weather conditions. Daily temperature affects the number of Common Buzzards during winter in south-western Poland (Wuczyński 2003). We focus not only on daily temperature but also on potential effects of air pressure, snow cover, snow depth, and habitat type. No such data have previously been available on Common Buzzards wintering in South-Eastern Europe.

2. Material and methods

2.1. Study area

The study area is located in North-Eastern Romania (46° 58' 0 N, 27° 25' 0 E), between the Siret and Prut rivers, and consists of a large hilly plain in the north and a fragmented plateau in the centre. Elevation varies from 50 to 200 m a.s.l., with peaks not exceeding 700 m (Jarvis *et al.* 2008). This area is a mosaic of artificial and natural habitats (CORINE Land Cover 2006; Fig. 1). Agricultural land is mainly cultivated with grain, potato and in the last years, with rape. Forests are fragmented, with few larger tracts in the central and western parts. Most of the pastures at this area are grazed by domestic animals.

2.2. Data collection

A vehicle road survey, i.e., driving a car at slow speed, is a common method to count diurnal raptors, especially in open areas and in winter months (Boano & Toffoli 2002, Pandolfi *et al.* 2005, Wuczyński, 2005). We surveyed 15 transects per month of around 40 km length each, during November 2010–February 2011. We repeated these counts once in a month, during the last two weeks of each month, covering a total of 600 km/month. The counts were made by driving 30–40 km/h between 10.00 AM and 16.00 PM. The research team consisted of a driver and a minimum of two observers (one per side).

For each Common Buzzard individual we recorded the perpendicular distance from the transect, the habitat where the raptor was observed for the first time, and age if possible. The distance was obtained using laser telemetry binoculars (Nikon Laser 1200S) with precision ±0.5 m and a range of 10–1,100 m. The distance of less than 10 m was paced or estimated visually. For each bird we recorded the GPS position on the road, and by using the perpendicular distance we obtained the location using ARCGIS 9.3 software (ESRI, Redlands, CA). To determine habitat type we used direct observations and, when the land was covered by snow or the bird was too far, we cross-checked direct observations in ArcGIS using CORINE land-cover maps (1:100,000). We identified habitat types using the most detailed level of CORINE land-cover classification (Bossard *et al.* 2000). The only exceptions were agricultural land, from which we excluded pastures, vineyards and fruit orchards, and forest and semi-natural areas from which we excluded scrub and/or herbaceous vegetation. We combined pastures with scrub and/or herbaceous vegetation into a distinct habitat type named "pastures and herbaceous vegetation associations". We also combined wetlands and water bodies into a single class. After these modifications we had a total of seven habitat types in the analysis (Fig. 1).

To account for habitat-related variation in raptor detection, we recorded birds that were within 500 m from a transect in open areas, within 50 m in forested areas, and within 100 m in human-settlement areas, but kept the surveyed area by a given transect constant. In total, we made 60 counts (15 transects per month, over four months), which equates to 2,400 km. The area surveyed covered 500 km^2 per month, which equates to 2,000 km^2 for the whole period.

2.3. Estimates of density and habitat selection

Our density-estimate method using Distance 6.0 software intends to account for undetected (but presumably present) individuals. In practice, it is necessary to ascertain that as few as possible present individuals remain undetected. To satisfy this condition, we ran all counts only on calm and clear days with high visibility (Wuczyński 2001).

We calculated the density estimate for each month and for the entire season using Distance 6.0 software with Conventional Distance Sampling analysis engine. We selected the best model based on the minimum value of Akaike's Information Criterion (AIC). To obtain estimates of density we placed the transects so that they covered different habitat types in proportions similar to the overall study area. Only for natural and artificial forest were the surveyed proportions smaller than those within the study area as a whole. However, given the habitat favoured by Common Buzzards (see Results) and the small difference between percentages surveyed and those present, we believe that this did not significantly influence our results.

To evaluate habitat use by the Common Buzzard we applied Manly's standardized habitat-selection index *w* for constant resources:

$$w_i = u_i/a_i \quad (1)$$

where u_i is the observed proportion of birds in habitat *i*, and a_i is the proportion of habitat *i* available within the transect (Manly *et al.* 1993). A w_i value larger than 1 indicates a positive selection for the resource and a value less than 1 indicates avoidance; a value around 1 indicates that the resource was used in proportion to its availability, implying no resource selection.

To test if individuals selected the studied habitat types randomly, we applied *g* test (H_0: random selection). We ran the calculations with the extension adehabitat in R (Ihaka & Gentleman 1996, Calenge & Dufour 2006). To detect possible differences in the relative abundance among months and transects, we used Friedman's repeated-measures analysis of variance (F_r) in Rstudio (www.rstudio.com) statistical software.

2.4. Weather conditions

We analysed the influence of weather conditions (temperature and air pressure), snow cover, snow depth, and habitat type on Common Buzzard density. Pressure was included because it could influence the Common Buzzard population indirectly; it was applied as a prediction index for atmospheric changes, as low pressure is generally associated with cold and wet weather. We obtained weather data from the weather observation network of the Romanian National Meteorological Agency, from the OMM international weather-data stream (Hydro-meteorological Centre of Russia 2011). For each transect we used the value observed at the nearest weather station during the bird-count day. We estimated snow depth (in cm) and snow cover (percentage, calculated from photos) in the beginning, middle and end parts of each transect and applied averages of these measurements for depth and cover. For habitat data we used the percentage of each habitat type within each 1-km transect segment with observed individuals.

Cold periods dominated the study winter, with a minimum temperature of –20°C at the beginning of January, but we also encountered occasional warm periods, with maximum temperature 10°C at the beginning of February. Daily temperatures differed significantly between the four study months (ANOVA, $F_{3,902} = 23.93$, $P < 0.0001$).

We used a generalized linear model (GLM) to determine the influence of daily temperature, pressure, snow cover, snow depth, and habitat type on the Common Buzzard observation data. Prior to the analysis, we examined the distributions of temperature, pressure, snow cover, snow depth and habitat types data with the Newman-Keuls *post hoc* test ($P < 0.01$; Sokal & Rohlf 2001). We ran these calculations in the Rstudio software.

3. Results

Common Buzzard numbers varied over the four winter months ($F_r = 12.021$, df = 3, $P = 0.007$). We encountered the lowest numbers in November, and observed nearly twice as many in December as in November. After that, the numbers declined again and stabilized in January and February (Table 1).

The effect of habitat type on Common Buzzard numbers was statistically significant (Table 2). Most birds were recorded in agricultural land (73.60% of individuals), the dominating habitat type within the study area. The least used habitat

Table 1. Density (individuals per km^2) of Common Buzzards for each month over the wintering season 2010/2011.

Month	Density	SE	95% CI
November	0.366	0.077	0.238–0.563
December	0.699	0.154	0.442–1.105
January	0.403	0.088	0.255–0.637
February	0.433	0.083	0.293–0.640
Winter Season	0.425	0.051	0.334–0.539

Table 2. Habitat types used by Common Buzzards during four winter months, based on habitat proportions along census transects.

Habitat type	Records (%)	Habitat (%)	w_i
Artificial surfaces	3.16	11.33	0.278
Agricultural land	73.60	57.65	1.276
Vineyards	2	4.53	0.443
Fruit orchards	1.29	1.78	0.724
Pastures and herbaceous vegetation	12.92	12.53	1.030
Natural and plantation forests	5.60	7.48	0.747
Wetlands and water bodies	1.43	4.70	0.305
G test (df = 6)			102.03 (P < 0.0001)

Table 3. Generalized Linear Model results for the observed numbers of Common Buzzards. Model factors consist of weather-related variables and habitat types (see text for details).

Variable	No. individuals	*P*
Temperature	–2.750	0.008
Pressure	–0.995	0.344
Snow cover	0.677	0.501
Snow depth	–0.825	0.413
Artificial surfaces	1.567	0.123
Agricultural land	–0.593	0.555
Vineyards	0.238	0.812
Fruit orchards	0.553	0.583
Pastures and herbaceous vegetation	1.001	0.321
Natural and plantation forests	0.769	0.445
Wetlands and water bodies	–0.003	0.997

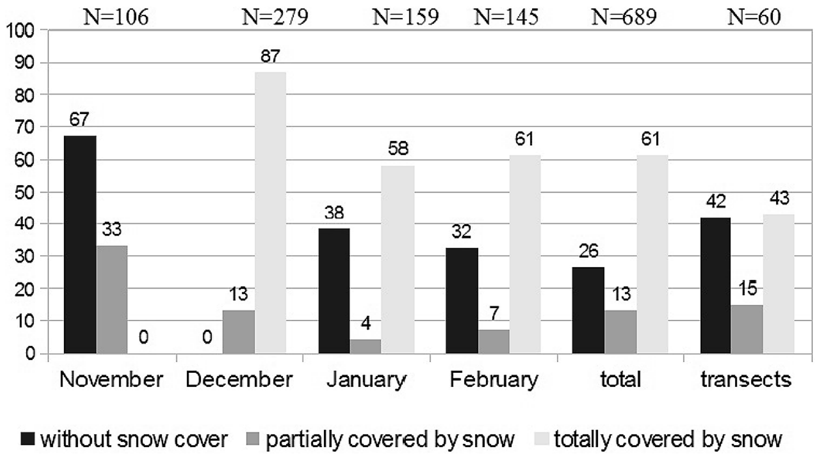

Fig. 2. Percentages of Common Buzzards and proportions of total transect length on transects without snow cover, and those partially or totally covered by snow.

was represented by artificial surfaces, wetland and water bodies, and vineyards (w_i = 0.278, 0.305 and 0.443, respectively; Table 2). This apparent habitat selection resulted in substantial variations in Common Buzzard abundance across transects positioned through different habitat types (F_r = 27.486, df = 14, P = 0.017).

The numbers of Common Buzzards also depended on temperature (Table 3). Lower temperatures were associated with higher number of observed individuals. However, air pressure, snow cover, snow depth, or habitat type did not significantly influence the numbers of Common Buzzards (Table 3).

During the winter season, most precipitation was snow, but this melted during warm days and accumulated during colder periods. The study season included five periods with 100% snow cover over the entire Moldavian Region: 5–8 December, 12–23 December, 28 December–10 January, 23 January–2 February, and 15 February–10 March. Even though we counted more individuals during these periods of 100% snow cover (61.54%, 689 individuals) than during periods of partial or no snow cover (38.46% 689 individuals; Fig. 2), the GLM for all variables did not reveal snow cover to have a significant effect on numbers.

4. Discussion

The wintering population of the Common Buzzard varied considerably during the winter months, which can be linked to bird behaviour. Common Buzzards usually arrive in their Romanian wintering grounds in November, after which so-called wintering movements begin (Strandberg *et al.* 2009). As our Common Buzzard density records in November were considerably lower than in December (0.366 versus 0.699 individuals/km^2), they apparently completed these movements in early December. Another explanation for the peak density in December could be simultaneous low temperature in central and northern Europe.

Comparisons of Common Buzzard densities among European countries are difficult because the size of inventoried areas and study methods vary remarkably. For example, in Bulgaria the wintering population of the Common Buzzard was studied using point-transect sampling, but the points were placed along roads (Nikolov *et al.* 2006), and in Poland, counts were conducted using a car – as was done in the present study – but the study areas were very small and the car speed was much higher (50–70 km/h; Wuczyński 2003). Bearing these caveats in mind, our study suggests a density similar to the Bulgarian study (0.34 individuals/km^2; Nikolov *et al.* 2006), but lower than that recorded in the Polish study (0.7–2.12 individuals/km^2; Wuczyński 2003).

The Common Buzzard prefers meadows for hunting in the winter season (Wuczyński 2005, Wikar *et al.* 2008), but due to the lack of meadows in our study area, and in eastern Romania in general, we most frequently encountered individuals at agricultural land (73.60%, N = 697). The agricultural land in our study area predominantly consisted of small fields (1–3 ha) owned privately, and only some areas hosted larger fields (10–20 ha). The preferential selection of agricultural habitat by wintering Common Buzzards has also been reported in South-Western Poland (Wuczyński 2005). As agriculture represents 57% of land use in this eastern Moldavian Region, and most of it is extensive, this habitat selection appears logical. The structure of the Moldavian agricultural landscapes with mostly small plots of farmland may actually be favourable to Common Buzzards due to the presumably high diversity of prey. Open areas are particularly important in winter months, but during the breeding season Common Buzzards often hunt in patches adjacent to forests where the nests are (Sim *et al*. 2001).

We showed that Common Buzzards wintering in Eastern Moldavia were strongly influenced by daily temperature during winter months, supporting previous studies (Cramp & Simmons 1980, Wuczyński 2003, Wikar *et al.* 2008). In Central Europe, Common Buzzards are partial migrants and the number of individuals that winter on breeding grounds depends to a significant extent on atmospheric conditions (Cramp & Simmons 1980, Wuczyński 2003). Considering the observed temperature fluctuations (cold periods with snow cover alternating with warm periods with melting snow), it may appear highly important to study the relationship between temperature and raptor numbers over longer periods in order to determine more general responses of the wintering population of Common Buzzard.

Birds are highly sensitive to changes in air pressure especially during migration (Gill 2007), as the pressure is generally linked with temperature and moisture. However, according to the present analysis, this may not be the case for Common Buzzards in winter. We found that snow cover or snow depth had no significant influences on Common Buzzard numbers, even if more than half of the individuals were seen during transects with 100% snow cover. Similarly, the lack of influence of snow depth seems to hold for other European *Buteo* species (Kasprzykowski & Cieśluk 2011). However, these results could be influenced by the small number (3) of transects with snow deeper than 15 cm.

In conclusion, the East Romanian wintering population of Common Buzzard – studied here – was negatively affected by temperature and utilized agricultural land over other types of habitat. To maintain the suitability of this area for the wintering population of Common Buzzards, we need to sustain the present agriculture management and encourage local stakeholders to continue the application of traditional farming techniques.

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Koillis-Romanian talvehtiva hiirihaukkapopulaatio: kannantiheyden, elinympäristön valinnan ja sään vaikutukset

Itäisen Euroopan hiirihaukat (*Buteo buteo*) ovat osittaismuuttajia, joiden määrät tietyllä paikalla vaihtelevat vuodesta toiseen. Talvella 2010–11 tehtiin autolla 15 linjalaskentaa, jokainen pituudeltaan 40 km, neljän kuukauden aikana. Tarkoitus oli tutkia Koillis-Romanian talvehtivaa hiirihaukkapopulaatiota. Laskentojen mukaan talvikauden tiheys oli 0,334–0,539 yksilöä/km^2. Yksilöt eivät jakautuneet satunnaisesti eri ympäristötyyppeihin, vaan hiirihaukat suosivat viljelymaita etenkin puustoisia ja pensaikkoisia, enemmän kuin oletettiin näiden ympäristöjen yleisyyden perusteella. Hiirihaukkatiheys vaihteli tutkimuskuukausien välillä ja oli yhteydessä lämpötilaan. Korkeimmat yksilömäärät tavattiin lumen peittäessä maanpinnan kokonaan sekä keskimääräistä alempien lämpötilojen vallitessa.

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