Abundance of raptors and habitat preferences of the common buzzard *Buteo buteo* and the common kestrel *Falco tinnunculus* during the non-breeding season in an agricultural landscape (western Slovakia)

Abundancia dravcov a využívanie a preferencia biotopov myšiakom lesným *Buteo buteo* a sokolom myšiarom *Falco tinnunculus* počas nehniedznej sezóny v poľnohospodárskej krajine (západné Slovensko)

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Abstract: Habitat use and preferences by raptors were studied during three non-breeding seasons (2011–2013) in an agricultural landscape in western Slovakia. The non-breeding season on agricultural land showed high variation and changes in the cover of habitats related to human activities. The most abundant raptor species were the common buzzard *Buteo buteo* (L.) (152 individuals) and the common kestrel *Falco tinnunculus* (L.) (78 individuals). The common buzzard preferred alfalfa and avoided ploughed fields. The common kestrel showed a high habitat preference for alfalfa, corn fields, stubbles and fallow. It also avoided ploughed fields and wheat.

Abstrakt: Počas troch mimohniezdnych sezón (2011–2013) bolo skúmané využívanie a preferencia biotopov dravcami v poľnohospodárskej krajine na západnom Slovensku. Mimohniezdna sezóna v poľnohospodárskej krajine preukázala vysokú variáciu a zmeny v pokrytí biotopov vo vzťahu k ľudským činnostiam. Najpočetnejším druhom dravcov boli myšiak lesný *Buteo buteo* (L.) (152 jedincov) a sokol myšiar *Falco tinnunculus* (L.) (78 jedincov). Myšiak lesný preferoval biotopy s lucernou a vyhýbal sa zoránym poľiam. Sokol myšiar preukázal vysokú biotopovú preferenciu pre lucernu, kukuricu, strniská a úhory. Tiež sa vyhýbal zoránym poľiam a pšenici.

Key words: landscape, agricultural land

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Acknowledgments: This study was supported by the international project Conservation of Raptors and Owls – Slovakia – Austria CORO-SKAT according to European Regional Development Fund within the Cross-Border Cooperation Programme Slovakia – Austria 2007–2013. I would like to thank Raptor Protection of Slovakia for the opportunity to work on this project.

Introduction

During the non-breeding season raptors often have different habitat and environment requirements than they have during the breeding season. Limitations in this period are food resources and habitats where prey is available (MacArthur & Pianka 1966, Newton 1998).

A number of studies were carried out during the winter months involving the counting of wintering raptors and recognizing their habitat use (Ševčík 1995, Wuczynski 2003, Nikolov et al. 2006, Schindler et al. 2012, Baltag et al. 2013). Habitats in agricultural land rapidly change during autumn and winter, because fields are ploughed and also cropped. The agricultural landscape is composed of important foraging habitats for raptors hunting in open areas.

The common buzzard is the most abundant bird of prey in the Western Palearctic (Cramp & Simmons

1980). It breeds on trees and cliffs (Sergio et al. 2002). This species inhabits a great variety of landscapes but mainly mosaics of woodland and agricultural areas (Bijlsma 1997). It is a typical perch-hunting predator. Its main prey consists of small mammals, lagomorphs, birds, reptiles and worms (Mebs 1964, Graham et al. 1995, Kenward et al. 2001, Sergio et al. 2002, Šotnár & Obuch 2009). The population of the common buzzard in the non-breeding period is formed of birds wintering in Central Europe (Northern populations) and of the local non-migrating population (Cepák et al. 2008). During winter the species is strongly connected to open habitats (Danko et al. 2002).

The common kestrel is also a common species in Europe (Village 2010). It nests in trees, on buildings and close to pastures, grasslands, agricultural land and in built-up areas (O'Connor 1982, Aviles et al. 2001). The

dominant prey of this species is composed of small mammals, insects and birds (Korpimäki 1985, Darolová 1989, Van Zyl 1994, Gil-Delgado et al. 1995, Valkama et al. 1995, Romanowski 1996, Piattella et al. 1999, Sándor 1999, Salvati 2002, Souttou et al. 2006, Noga & Kečkéšová 2008).

The primary aim of the present study was to reconsider the relationships between raptors and agricultural habitats during the non-breeding season. I tested the hypothesis that raptors use habitats in the agricultural landscape in proportion to the habitat coverage.

Material and methods

Study area

The study was carried out in an open, agricultural area of the Podunajská pahorkatina Hills (17° 31' 00" E, 48° 16' 26" N). The area covers 18.7 km², and the average altitude is between 125–140 m. The major habitat is arable land with windbreaks (Table 1). Habitats change during the year in the area. The study area is a part of the special protection area (SPA) Ulanska mokrad (NATURA 2000), which protects raptor species, such as the saker falcon (*Falco cherrug*), the Montagu's harrier (*Circus pygargus*), the black kite (*Milvus migrans*) and the red-footed falcon (*Falco vespertinus*).

Habitats availability

Habitat categories were recorded with a GPS unit (Garmin eTrex 10) and a camera during the counting of the number of raptors. For each counting habitats were recorded by making photo documentation from the counting points. These were translated into GIS layers. Eight habitat categories were classified in the monitoring area – alfalfa, corn, fallow, wheat, beet & rape,

sunflowers, ploughed fields and stubbles. Beet and rape were merged into a single category because of the very small area of beet. The highest habitat diversity was recorded in September (Shannon index = 1.57). In autumn, the landscape was more diverse due to the higher cover of stubbles and fallow. The lowest values were recorded during the winter months. Winter habitats were predominantly formed of ploughed fields and wheat. The size of field parts ranged from 0.3 to 143.6 ha.

Data collection

The raptor counting was performed during the non-breeding season from 2011 to 2013 (twice in November and December of 2011, four times in January, September, November and December of 2012 and once in March of 2013). The field work was carried out between September and March. Each counting started at 10 a. m. and only when the weather conditions were with no snow cover, fog, rainfall or strong wind (over 10 m/s). The visibility was often low in the early mornings because of the fog. It often lasted until 10 a. m. The temperature did not fall below 0°C. The field method used was the point transect (Gibbons and Gregory 2006). A total of 7 counting points were established. Points were located 700–1300 m apart and with the good view of the area. A binocular (10×42) was used to search for raptors and a monocular (30×65) for identifying raptors. Raptors were recorded within two kilometres. The habitat category was added only when I was sure where the raptor was hunting. The average distance between the counting points was 800 m. Each point was sampled for 20 minutes. Only hunting birds of prey were selected for the study. I identified hunting birds as birds perched on trees or on the ground, hunting with

Tab. 1. The cover of the habitats in the study area [%]. A – average, H' – Shannon diversity index.

Tab. 1. Pokryvnosť biotopov v skúmanej oblasti [%]. A – priemer, H' – Shannonov index diverzity.

habitat type	2011			2012			2013	
	XI	XII	I	IX	XI	XII	III	A
alfalfa	4.2	3.2	3.2	6.6	8.8	8.8	8.8	6.2
corn	0.0	0.0	0.0	12.0	0.0	0.0	0.0	1.7
rape and beet	9.8	7.4	7.4	0.0	3.36	3.4	3.4	5.0
wheat	42.9	42.9	42.9	0.0	35.2	35.1	35.1	33.4
ploughed field	22.3	43.6	46.2	41.2	51.6	51.6	51.6	44.0
stubbles	20.1	2.6	0.0	19.0	0.8	0.8	0.8	6.3
fallow	0.4	0.0	0.0	14.3	0.0	0.0	0.0	2.1
sunflower	0.0	0.0	0.0	6.6	0.0	0.0	0.0	0.9
H'	1.41	1.12	1.02	1.57	1.08	1.08	1.08	

a hovering flight or circling, gliding with a prey attack. Other types of flight (circling, gliding, direct flight without an attack) were not considered as hunting. I assigned a category to the habitat where each individual raptor was hunting. In the case of a flying raptor, I assigned the category of the habitat over which it was flying. All individual birds were recorded only once when they were observed for the first time. Birds perched on trees between two habitats were assigned to the habitat being monitored by the raptor.

Data analysis

The monitoring area and size of the habitats were calculated using the Quantum GIS program (version 1.8.0.) (QGIS Development Team 2013). The LibreOffice program (The Document Foundation 2013) was used for the data. Tables with the recorded birds, types of habitats and graphs were created in this software. The type of habitat was identified and recorded using the Geographic Information System (GIS) from photos taken during the counting. The statistical analysis was performed in InStat+ v. 3.37 (Statistical Services Centre 2012). Habitat preferences were tested with the Chi-square test for goodness-of-fit with $\alpha = 0.01$. The α level was corrected with Bonferroni correction for two tests ($\alpha = 0.01/2$ tests). In each habitat I expected numbers of birds according to the ratio of habitat cover in the area. The sum of expected birds was the sum of recorded birds during the counting. I counted birds which were recorded in each habitat category and compared them with the numbers of expected birds in each habitat. The Chi-square test method was used for the

Tab. 2. Abundance of raptors in the study area. NI – numbers of individuals in the area for all counts, NIA – average number of individuals/count, DIA – average density of individuals/10 km².

Tab. 2. Abundancia dravcov v skúmanej oblasti. NI – celkový počet jedincov zaznamenaných v oblasti, NIA – priemerný počet jedincov/sčítanie, DIA – priemerná hustota jedincov/10 km².

species	NI	NIA	DIA
<i>Aquila heliaca</i>	8	1.1	0.6
<i>Buteo buteo</i>	152	21.7	11.6
<i>Buteo lagopus</i>	9	1.3	0.7
<i>Buteo rufinus</i>	1	0.1	0.1
<i>Circus aeruginosus</i>	6	0.9	0.5
<i>Circus cyaneus</i>	14	2.0	1.1
<i>Falco tinnunculus</i>	78	11.1	6.0
<i>Falco vespertinus</i>	1	0.1	0.1
Σ	269		

habitat preference of the common buzzard and of the common kestrel. These species were the most common raptors in this area. Data were analysed independently for each species because of the slightly different habitat requirements of each species (Butet et al. 2010). Habitat diversity was calculated with the Shannon Diversity Index.

Results

Abundance of hunting raptors

A total of 269 observations of 8 raptor species were made during three non-breeding seasons (2011–2013). Habitat preference was not tested for all raptors species because of a lack of data. The total abundance of hunting raptors showed the highest number of the common

Fig. 1. Hunting habitat preference of (a) the common buzzard (*Buteo buteo*) and (b) the common kestrel (*Falco tinnunculus*). Number of recorded (black columns) and expected (grey columns) individuals on the habitat types are presented.

Obr. 1. Preferencia biotopov (a) myšiakov lesným (*Buteo buteo*) a (b) sokolom myšiakov (*Falco tinnunculus*). Zobrazené sú počty zaznamenaných (čierné stĺpce) a odhadovaných (sivé stĺpce) jedincov v typoch biotopov.

buzzard (Table 2). The population of this species was stable, with the highest number occurring in September (41 individual birds). The common kestrel was the second most common species, and the highest number of this species (49 individual birds) was also recorded in September. During the rest of winter, the population of this species was stable, but low in number. Other raptors were relatively rare.

Habitat preference

Habitat preference was significant for the common buzzard ($\chi^2 = 76.5$, $DF = 7$, $p < 0.005$): it preferred the alfalfa habitat (Fig. 1a). A lower number of this species was recorded in ploughed fields. Other categories had similar recorded and expected numbers. The common kestrel was recorded with a high habitat preference for alfalfa, corn fields, stubbles and fallow land ($\chi^2 = 186$, $DF = 7$, $p < 0.005$) (Fig. 1b). A large difference between recorded and expected numbers of this species was also observed in ploughed fields and wheat. All categories showed some degree of positive or negative preferences. The common kestrel used more alfalfa and fallow habitats and fewer wheat and ploughed fields in comparison with the common buzzard.

Discussion

Abundance

Results showed a high abundance of the common buzzard and the common kestrel in comparison with other raptor species. These two species have been recorded as the most abundant birds of prey in many studies in Europe (Ševčík 1995, Mülner 2000, Boano & Toffoli 2002). The abundance during winter was similar to results in the Czech Republic and Poland. The common buzzard was more abundant in November, and its population was relative stable until January. Then the population slowly decreased (Ševčík 2005, Wuczynski 2003). The present study contained a small sample size (7 counts) and started in September, when the abundance of the common buzzard and common kestrel was at its highest.

Habitat use and preference

Many holes and paths of rodents were observed in the alfalfa. I assumed that alfalfa fields attract the common buzzard and the common kestrel because of their stable environment. This did not change during autumn and winter. Habitat selection by predators of small mammals is in relation to the density of these species and to

the height of the vegetation. Raptors prefer lower vegetation height because of the easier search for prey (Sheffield et al. 2001, Aschwanden et al. 2005). A study in western France specifically identified negative associations between the lower abundance of two raptor species (the common buzzard and the common kestrel) and agricultural intensification in a plot with the highest cover of crop areas (Butet et al. 2010). These species have slightly different requirements for the landscape. The common kestrel is able to nest in more fragmented landscapes and is better adapted to exploit less abundant but more widespread small mammal prey species within a cultivated matrix (Butet et al. 2010).

Common buzzard

Alfalfa covered a small area, but the number of birds was higher than expected. Results showed a high preference for this kind of habitat. A negative preference was recorded in ploughed fields. Overall, the species distribution in the non-breeding season is strongly affected by food availability (Newton 1998). The common buzzard preferred a habitat with a rich dietary base (alfalfa) (Heroldová et al. 2007). The use of wheat and ploughed fields by this species could be because of searching for carcasses and worms in these habitats. This is probably reflected in the easy foraging for invertebrates in freshly ploughed fields (Dare 1957).

Results did not show any preference for stubbles, as was stated in the article from Poland (Wuczynski 2005). In Poland, permanent papilionaceous crops, along with cereal stubbles, margin habitats, meadows and maize stubbles were preferentially used, whereas bare tillage (ploughed fields) and winter cereals were avoided (Wuczynski 2005). In south-western Poland the common buzzard most often used cereal stubbles (Orlowski 2006). During winter, stubbles were ploughed in the study area, and only a small part of them remained. In the area with a high proportion of grassland (48.6%), the common buzzard especially used the grassland (more than 75%) and very few birds used fallow (lower than 2%) (Mülner 2000). I can consider that the common buzzard uses available habitats during the non-breeding season but prefers habitats with abundant small mammals.

Common kestrel

The habitat preference of the common kestrel was different. The abundance of this species was not proportional to habitats in the area. It preferred habitats with a smaller area but a higher diversity and an abundance of small mammals (fallow, alfalfa and stubbles) (Heroldová et al.

2007). Ploughed fields and wheat were less important for this species. The numbers of recorded birds were lower than the expected numbers. These habitats were also used, but less than I assumed. Different habitat use was recorded in Poland (Orlowski 2006). In the study from Wrocław, the common kestrel used habitats proportional to their availability. More than 50% of the study area was formed of old fallow fields, which were used intensively (Orlowski 2006). A preference for grassland was found in Italy (Casagrande et al. 2008), and high usage of grassland was also recorded in Austria (Mülner 2000). The small mammal density was not the highest in grassland, but prey was the most available there. Shrubb (1980) found results similar to those of the present study. The common kestrel especially used the clover ley and grassland. Stubbles and cereals were also more used during the non-breeding season. However, cereals covered most of the checked area.

Conclusion

The results of the present study showed a high abundance of the common buzzard and the common kestrel in agricultural land during the non-breeding season. They indicated a raptor preference for certain habitat categories. Different habitat use and preferences were recorded between the species. The alfalfa habitat was preferred by both species.

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