

DENSITY AND FLOCK SIZE OF THE RAVEN  
(*Corvus corax*) IN THE ORAWA – NOWY TARG BASIN  
DURING NON-BREEDING SEASON

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ABSTRACT

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During the 2002/2003-2004/2005 non-breeding seasons the density of the Raven in the open habitats of the Orawa – Nowy Targ Basin was studied by line transect method. The results were analysed in four periods (autumn, early winter, winter and early spring). The median density of Ravens did not differ significantly between individual periods and was respectively: 3.5, 3.8, 4.8 and 3.8 indiv. / 10 km. Number of birds during particular controls varied from 1.0 to 24.8 indiv. / 10 km. However, while excluding flocks, the median density of single individuals and pairs of the Raven was considerably lower and in subsequent periods reached respectively: 2.2, 2.4, 2.2 and 1.7 indiv. / 10 km. Flock size did not differ significantly between individual periods. Single individuals and, less often, groups of two birds were recorded mostly. Small (3-5 indiv.) and medium (6-15 indiv.) flocks were recorded rarely and large flocks (16 indiv. and above) – only exceptionally. The high density and strong fluctuations of abundance of Ravens were determined by flocks presence, which was probably linked to irregular occurrence of food resources.

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**Key words:** Common Raven, *Corvus corax*, density, flock size, non-breeding season, Orawa – Nowy Targ Basin, southern Poland, Carpathians.

INTRODUCTION

European population of the Raven is considered to be mainly resident, undertaking short-distance nomadic movements only (Busse 1969). In Poland, the number of breeding pairs and wintering birds has increased for recent decades (Tomiałojć and Stawarczyk 2003). During 1984-1993, number of wintering Ravens in central-eastern Poland increased threefold (Jędrzejewski 2000). Regular use of rubbish-dumps by non-breeding Ravens has occurred recently (Mošanský and

Karaska 2002, Betleja and Meissner 2005). Birds also concentrate close to animal carcasses dumps (Jermaczek *et al.* 1995, Bednorz 2000).

Biology and ecology of the Raven in Poland, especially in non-breeding season, are poorly known (Bednorz 2005). There are shortages of knowledge of Ravens' non-breeding density, inter- and intra-seasonal abundance fluctuation, flock characteristics and food composition. These concern particularly populations from mountainous and foothills terrain. The aim of this paper is to determine the density and flock structure of the Raven during non-breeding season in the mountain valley.

## STUDY AREA

The Orawa – Nowy Targ Basin covers the area of 370 km<sup>2</sup> at 500-600 m a.s.l. and borders with the Beskidy Zachodnie mountain ranges (Kondracki 1998). It is covered by mosaic of diverse biotopes. Numerous afforestation, forests, peat bogs and open farmlands are crossed with streams, routes and built-up areas. The climate of the Orawa – Nowy Targ Basin is harsh. It is noted for being continental and it differs from neighbouring mountain chains (Konček 1974). Observations were conducted in three established transects with a total length of 31.5 km located in open areas between Czarny Dunajec (49°44'N, 19°85'E), Piekienik (49°47'N, 19°76'E) and Ludźmierz (49°46'N, 19°97'E). Details of transects description and full characteristic of study area are given elsewhere (Ciach *et al.* 2006).

## METHODS

Research was carried out from October to March during the 2002/2003-2004/2005 seasons (during the first season – from the end of November). Marked transects were surveyed in the middle and at the end of every month. Birds were counted within the range of vision, which extended from 200 to 1000 m on each side of the transect and was limited by characteristic objects (clump of trees, forests, routes, buildings) and the topography of the terrain. All the transects were surveyed on the same day with the speed of 2-3 km/h. The flock size and presence of other corvids in the flock were recorded. The length of transects was established by using GPS. Bird density was calculated per 10 km of transect.

The Ravens groups characteristic is based on single-species groups only. Relative values were used to show fluctuation of abundance, they were calculated by using formula:

$$L_r = \frac{N}{N_{mn}} \cdot 100\%$$

where:

- $L_r$  – relative value of abundance,
- $N$  – number of birds recorded in a given control,
- $N_{mn}$  – mean abundance in a given season.

Controls were classified into four periods (Table 1), divided based on meteorological data (Konček 1974). Weather conditions recorded in subsequent study seasons were similar to each other and corresponded to given periods.

Table 1  
Characteristic differences in periods according to Konček (1974)  
and the numbers of surveys.

Period	Autumn	Early winter	Winter	Early spring
Dates	25 Sep.-22 Nov.	23 Nov.-25 Dec.	26 Dec.-18 Mar.	19 Mar.-12 Apr.
Number of days	59	33	84	24
Temperature	0°-10°C	< 0°C	< 0°C	0°-5°C
Extended snow cover	none	none	26 Dec.-18 Mar.	none
Number of controls	7	6	17	4

## RESULTS

Median density of Ravens in the Orawa – Nowy Targ Basin did not differ significantly between periods (Kruskal-Wallis test:  $H = 1.05$ ,  $p = 0.79$ ; Fig. 1). However, range of density in each period was considerable. Number of birds between subsequent surveys considerably fluctuated (Fig. 2). Median density in autumn was 3.5 indiv. / 10 km (1.0 to 16.2 indiv. / 10 km), in early winter – 3.8 indiv. / 10 km (1.0 to 12.7 indiv. / 10 km), in winter – 4.8 indiv. / 10 km (1.0 indiv. / 10 km to 24.8 indiv. / 10 km) and in early spring – 3.8 indiv. / 10 km (2.2 to 15.2 indiv. / 10 km). High density of the species was strongly determined by the presence of flocks of three and above individuals. Density of single individuals and groups of two birds only was signifi-

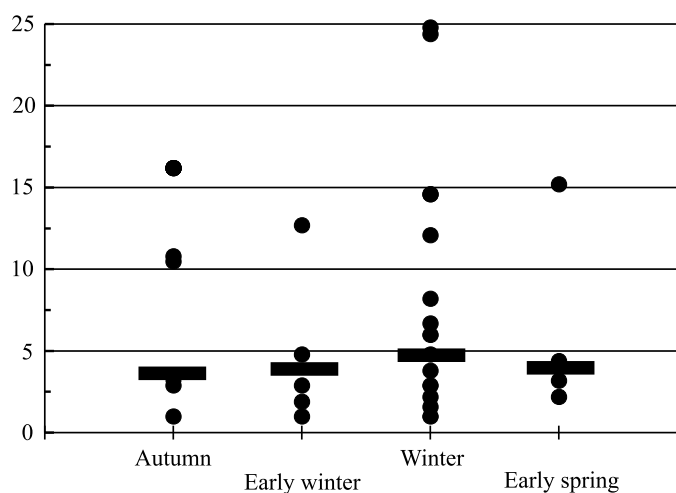


Fig. 1. Density (indiv. / 10 km) of Ravens within subsequent periods in the Orawa – Nowy Targ Basin during 2002/2003-2004/2005 non-breeding seasons. Medians are given as horizontal bars.

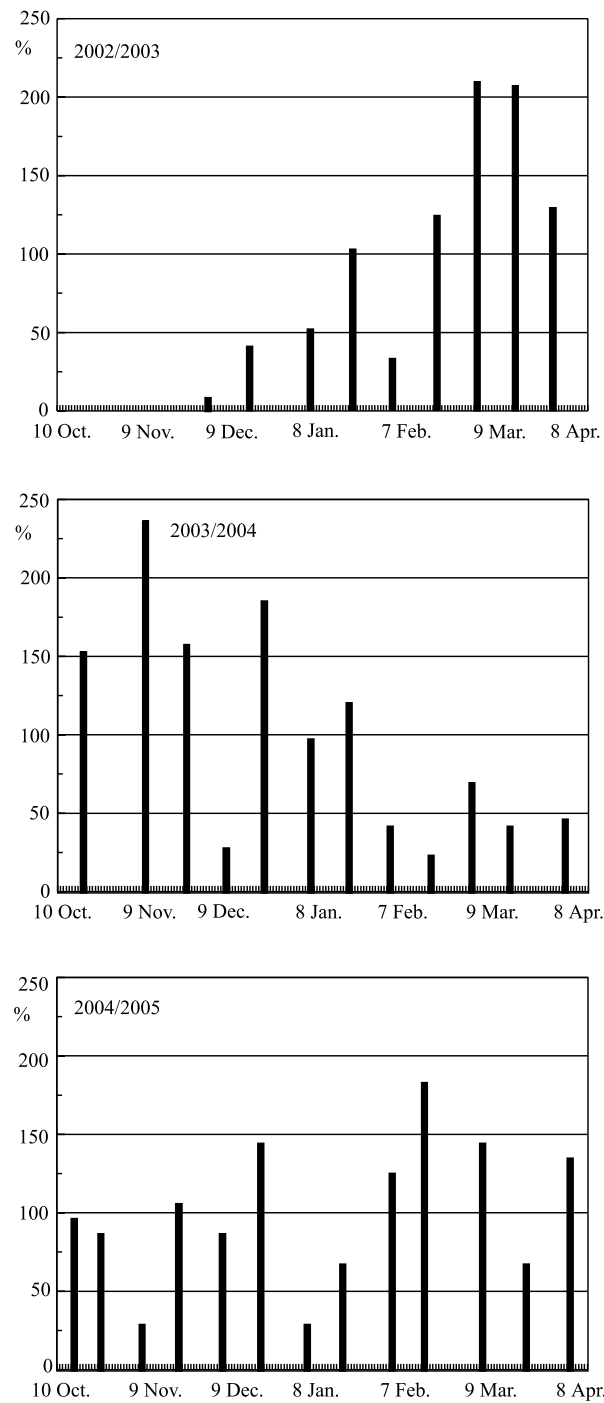


Fig. 2. Abundance fluctuations of the Raven in the Orawa – Nowy Targ Basin during non-breeding seasons of 2002/2003-2004/2005 (relative values of bird numbers shown as percentages of mean abundance in a given season)

cantly lower than density of all recorded types of groups (Wilcoxon test:  $Z = 4.46$ ,  $p < 0.001$ ). It was stable (Kruskal-Wallis test:  $H = 1.63$ ,  $p = 0.65$ ) and in subsequent periods its median value was respectively: 2.2, 2.4, 2.2 and 1.7 indiv. / 10 km (Fig. 3). In subsequent seasons a decrease in median density was recorded (Kruskal-Wallis test:  $H = 7.73$ ,  $p < 0.05$ ). In 2002/2003 season the median density was 12.1 indiv. / 10 km, in 2003/2004 – 5.7 indiv. / 10 km and in 2004/2005 – 2.9 indiv. / 10 km.

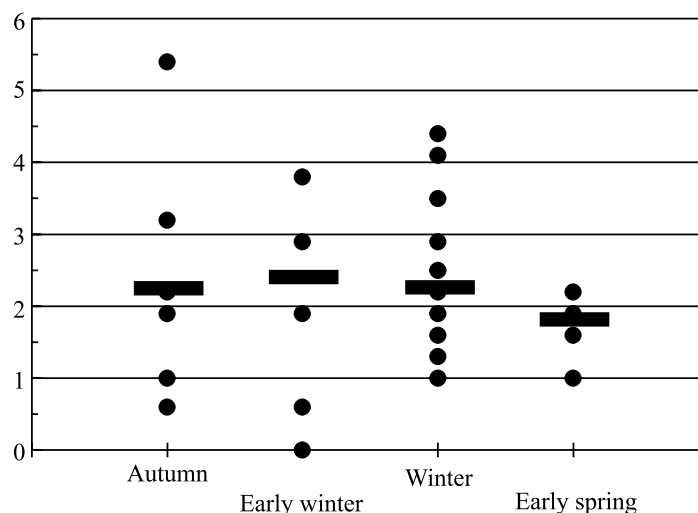


Fig. 3. Density (indiv. / 10 km) of single individuals and pairs of the Raven within subsequent periods in the Orawa – Nowy Targ Basin during 2002/2003-2004/2005 non-breeding seasons. Medians are given as horizontal bars.

Single Ravens and, less often, groups of two predominated (Table 2). Only during winter both were recorded with similar frequency. Together they constituted 74-82% of recorded groups in individual periods. In all meteorological periods the presence of small (3-5 birds) and medium (6-15 birds) flocks were recorded. Larger flocks were recorded exceptionally. No differences in flock size between individual periods were recorded (Kruskal-Wallis test:  $H = 1.36$ ,  $ns$ ). Mixed flocks of corvids including Ravens were recorded twice. On 16 February 2003, the flock of 35 Ravens and 8 Hooded Crows (*Corvus cornix*) and on 15 March 2003, the flock of 180 Jackdaws (*Corvus monedula*), 60 Ravens and 10 Rooks (*Corvus frugilegus*) were recorded. The latter was the biggest concentration of Ravens ever recorded during present study.

## DISCUSSION

Mean density of Ravens recorded in this study was relatively high in comparison with densities recorded elsewhere. However, it was characterized by strong changes within individual period. During winter the mean density of the Raven in central-

eastern Poland was 1.08 indiv. / 10 km (Jędrzejewski 2000) and in the Bieszczady mountains 10.7-13.8 indiv. / 10 km (Zbrożek 2001).

Table 2  
Flock size of the Raven during subsequent periods in the Orawa – Nowy Targ Basin  
in the 2002/2003-2004/2005 non-breeding seasons (*N* – number of groups)

Group size	Autumn		Early winter		Winter		Early spring	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
1	22	44.0	18	52.9	42	38.9	9	45.0
2	15	30.0	10	29.4	43	39.8	6	30.0
3-5	8	16.0	3	8.8	16	14.8	2	10.0
6-15	4	8.0	2	5.9	5	4.6	2	10.0
16-50	1	2.0	1	2.9	2	1.9	1	5.0
Total	50	100	34	100	108	100	20	100
Mean flock size	3.0		2.5		2.9		4.0	

Despite numerous occurrence of other corvids in the Orawa – Nowy Targ Basin (Ciach *et al.* 2006), their mixed flocks with Ravens were recorded exceptionally. Records of single Ravens or groups of two birds, probably family pairs, dominated. Records of flocks were considerably less frequent, however they include major number of birds present in a given area. Density of single individuals and groups of two birds was twofold lower than mean density of all recorded types of groups and was characterized by minor fluctuations. Probably it was similar to breeding density of Ravens in a given area.

Influx of nomadic birds from neighbouring grounds probably strongly affects non-breeding density of the Raven in the Orawa – Nowy Targ Basin. It results from the presence of carrion, which is the basic food of Ravens during non-breeding season (Zawadzka 1996). Its irregular and temporal accessibility (in the form of preys of large carnivores, animals dead due to harsh weather conditions, as well as animal carcasses dumps) led to the occurrence of local concentration of Ravens, which influenced considerably the abundance fluctuations. Frequency of foraging on carrion and size of flocks increase in winter (Rösner *et al.* 2005). Changes in food supply within the Orawa – Nowy Targ Basin probably contribute to nomadic movements of local population as well as to influxes of birds from neighbouring areas. Birds in search for food may cover a few thousand kilometres (Heinrich *et al.* 1994). It has been shown for the Bieszczady mountains (SE Poland) that in the areas abundant in carrion, higher density of Ravens occurred (Zbrożek 2001). It is possibly linked to the presence of wolves (*Canis lupus*) and actually of their prey remains in this region. Accessibility of carrion led to natural, local and short-term foraging concentration, which caused an increase of mean density.

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