Ornis Hungarica (2009) 17-18: 1-11.

Breeding ecology and population decline of the crested lark *Galerida cristata* in Warsaw, Poland

G. Lesiński

Lesiński, G. 2009. Breeding ecology and population decline of the crested lark *Galerida cristata* in Warsaw, Poland – Ornis Hung. 17-18: 1-11.

Abstract The crested lark *Galerida cristata* inhabited almost exclusively open areas in the outskirts of new settlements of Warsaw in the years 1980-2006. The highest density of the species (0.11 pairs/km^2) in the entire city (494 km^2) was recorded in 1986, and locally (a plot of 2.6 km^2) – 5.7 pairs/km^2 in 1980. Breeding period lasted from April 12th (the first egg) to July 31st (the last fledgeling) with broods most intensively initiated in May. There were usually 4-5 eggs per brood, rarely 3 (mean 4.36±0.60 SD). The mean number of eggs in the first brood was 4.47±0.64 eggs, in the first repeated brood – 4.17±0.98 eggs and in the second brood – 4.09±0.70 eggs. Most pairs (71%) performed the second brood. Reproductive success of the population of 17 pairs studied in 1980 was 3.47 fledgelings leaving the nest per nesting pair (nearly 40% of broods were destroyed). Breeding losses resulted mostly from human activity and intensive rainfalls. Population of *G. cristata* in Warsaw was characterized by a great dynamics. None of the 17 pairs living on the plot of 2.6 km^2 in 1980 remained in 1987 due to the management of new settlements. The species strongly regressed throughout the city: 53 pairs were found in 1986 but only 2 in 2002, one pair in 2003-2005, with a total extinction in 2006. One of probable reasons for this decline could be the development of populations of corvid predators – mainly *Pica pica* (its density has increased near 20 times) and *Corvus cornix* in peripheral Warsaw.

Department of Functional Food and Commodity, Warsaw University of Life Sciences – SGGW, Nowoursynowska 159C, PL-02-787 Warsaw, Poland. e-mail: glesinski@wp.pl

1. Introduction

Specifics of an urban area with its frequent and intensive penetration by people and rapid changes strongly affect biology of synanthropic birds. The crested lark *Galerida cristata* is one of the unique species building its nests on the ground, which has accommodated to living near human settlements. Such species are threatened mostly because of the practices connected with a ground managing, and their habitat selection and reproductive success strongly depend on anthropogenic factors. Breeding ecology of *G. cristata* was the subject of few studies. More attention to this topic was paid in areas, where the species is abundant – in western Europe (Labitte 1957), northern Africa (Heim de Balsac & Mayaud 1962 after Roselaar 1988), and south-western Asia (Hartley 1946, Belskaya 1974, Shkedy & Safriel 1992). In central Europe populations of *G. cristata* were studied in details in Germany (Sudhaus 1966, Witsack 1968, 1969, Krüger 1977, Pätzold 1986, Baumann 1987, Zang & Südbeck 2000, Vökler 2005), Denmark (Møller 1978), southern Sweden (Hultén *et al.* 1989), the Netherlands (Hazevoet *et al.* 1993), Switzerland (Hagelbach *et al.* 2003), Czech Republic (Línek

1999) and Hungary (Orbán 2004). Data on the breeding ecology of this species from Poland, where it lives now near geographic range border, are missing.

This study was aimed to analyse breeding ecology of the species in central Poland and to evaluate the differences in relation to other populations. Having in mind the observed decline of *G. cristata* in many places in Europe (Roselaar 1988, Hazevoet *et al.* 1993, Línek 1999, Zang & Südbeck 2000, Hegelbach *et al.* 2003) and shrinking range of the species, a long-term monitoring was planned and attempts were undertaken to explain possible factors determining population changes.

2. Methods

2. 1. Study area and field methods

Studies were carried out in Warsaw (central Poland) within the administrative borders (20°51' – 21°09' E; 52°06' – 52°20' N) in the area of 494 km^2. Observations started in 1980 in residential areas with buildings 0-15 years old and up to 30 m tall, in northwestern part of the city (plot "Bielany" of an area of 2.6 km^2). Since the beginning of April till the middle of August the area was surveyed every 1-2 days for 2-7 hours a day in various periods of a day. The studies consisted in mapping the records and estimating territories of breeding pairs. Special attention was paid to finding nests and tracing the breeding history. Phenology and the effects of hatching (numbers of hatchlings leaving the nest) were estimated and possible reasons of the brood destruction were recorded. Location of nests (lawns versus barren lands covered with herb vegetation) was noted. Studies near the nests were as short as possible in a way to avoid attracting the attention of people or predators.

Intensity of the studies carried out in 1980 allows for the supposition that almost 100% of nests containing broods were found (n=57). Some nests abandoned by birds during construction could, however, be overlooked. For broods found at the stage of lying eggs, incubation or feeding the hatchlings, the starting point was estimated assuming that one egg was laid per day, incubation starts with lying the last but one egg and lasts 13 days on average and that hatchlings leave the nest 10 days after hatching (Dementiev & Gladkov 1954, Ferguson-Lees 1962).

More information about the breeding phenology, brood size, reasons of breeding losses or nest location was obtained during long-term monitoring of the numbers of *G. cristata* between 1982 and 2000. Data on 58 broods were collected in that period.

Census of the nesting pairs of *G. cristata* in the entire city was performed in 1986, 1988, 1990, 1993, 1995, 2002, 2003, 2004, 2005 and 2006. Open areas with low herb layer were surveyed, particularly those, where the vegetation was partly destroyed. Old dense housing, parks, forests, fertile meadows, waters with their riparian zones and barren lands densely overgrown with tansy and goldenrod were ignored. Potential colonisation grounds occupied 8-10% of the city area. Census was also performed on two smaller plots (where the process of urbanization has increased): on "Bielany" (described above) in 1980, 1982, 1984, 1985, 1986, 1987 and „Bemowo" (a new residential area and a fragment of grassy airport of an area of 2.5 km^2 in the western part of the city) in 1985, 1986, 1987, 1988, 1990, 1992, 1993, 1995, 1997, 1999, 2000, 2002, 2003, 2004, 2005, 2006.

2. 2. Statistical analyses

Differences between the distributions or proportions were estimated using χ^2 test. Decreasing sizes of the first brood, the first repeated brood (after the first was distroyed) and the second brood (after the first successfull) were tested with one-way ANOVA. Spearman rank correlation coefficient was calculated to show trends in changes in numbers during the study period. In all cases adopted significance level was P=0.05. Statistical analyses were performed using SPSS for Windows.

3. Results

3. 1. Habitat and density

G. cristata in Warsaw inhabited almost exclusively the outskirts of new housings with large open areas. Single pairs were found near railways and in industrial areas but there was always a residential housing at a distance of several hundred meters nearby. Initial stages of building sites resulted in marked destruction of vegetation, later on lawns, paved roads and sidewalks appeared. In peripheries, where land management was delayed, wastelands became overgrown by various plant species. Progressing management of the terrain (replacement of wastelands by lawns, growth of trees and shrubs) made these habitats inappropriate for *G. cristata*.

High local density of breeding pairs was noted near housing on plot "Bemowo" in 1985 and 1986 – 4.0 pairs/km^2, and the highest one on plot "Bielany" in 1980 – 5.7 pairs/km^2. In the whole city, density of this species reached only 0.11 pairs/km^2 (1986) and the colonised area constituted c. 5% of the city.

3. 2. Breeding season

Breeding season of the Warsaw population of *G. cristata* lasted over 3.5 months (Table 1). On April 12th 1990 the first initiated

Table 1. General characteristics of reproductive biology of *G. cristata* in Warsaw

Characteristics	Sample size		Value
	Unit	N	
The earliest term of egg lying	Brood	115	12 April
The latest term of leaving the nest by fledgeling	Brood	115	31 July
Mean number of eggs in a brood	Brood	96	4.36±0.60*
Mean number of eggs in the first brood**	Brood	15	4.47±0.64*
Mean number of eggs in the first repeated brood**	Brood	6	4.17±0.98*
Mean number of eggs in the second brood**	Brood	11	4.09±0.70*
Percent of pairs assuming the second brood**	Pair	17	71
Percent of destroyed broods**	Brood	38	39
Percent of non-fertilised eggs or eggs with dead embryos**	Egg	105	11

* - standard deviation, ** - data from only 1980

brood was recorded. Relatively highest intensity of breeding was noted in May. In the second half of April and in June the number of initiated broods was slightly lower and it was markedly lower in the first half of July (Fig. 1). Detailed observations from 1980 revealed that birds, after loosing the first brood, rapidly initiated the repeated one. About 70% pairs performed the second brood (after a longer break). One certain and one probable case of repeating the second lost brood were recorded.

3. 3. Nest location

Nests were most often placed on barren lands but also there was a relatively high number of nests on lawns (48 out of 118 studied i.e. 40.7%), which constituted 30% territories of *G. cristata* covered with herb vegetation. Nests were often built on lawns between the roadway and the sidewalk (Table 2). The smallest distance between the nest and the sidewalk was c. 2 m.

The longer axis of territories of many breeding pairs was situated perpendicularly to the new residential housings. Birds successively penetrated managed and finally formed built-up area on one side and barren lands and areas with devastated vegetation on the other. The nest in such territory was usually located inside the housing or on its outskirts but fledgelings after leaving the nest were fed on grounds located outside. In 1980 such a scheme of breeding adopted 10 out of 17 pairs.

3. 4. Reproductive success

Three to five eggs were found in broods of the studied population of *G. cristata* with prevailing number of 4 and 5 eggs (6 broods

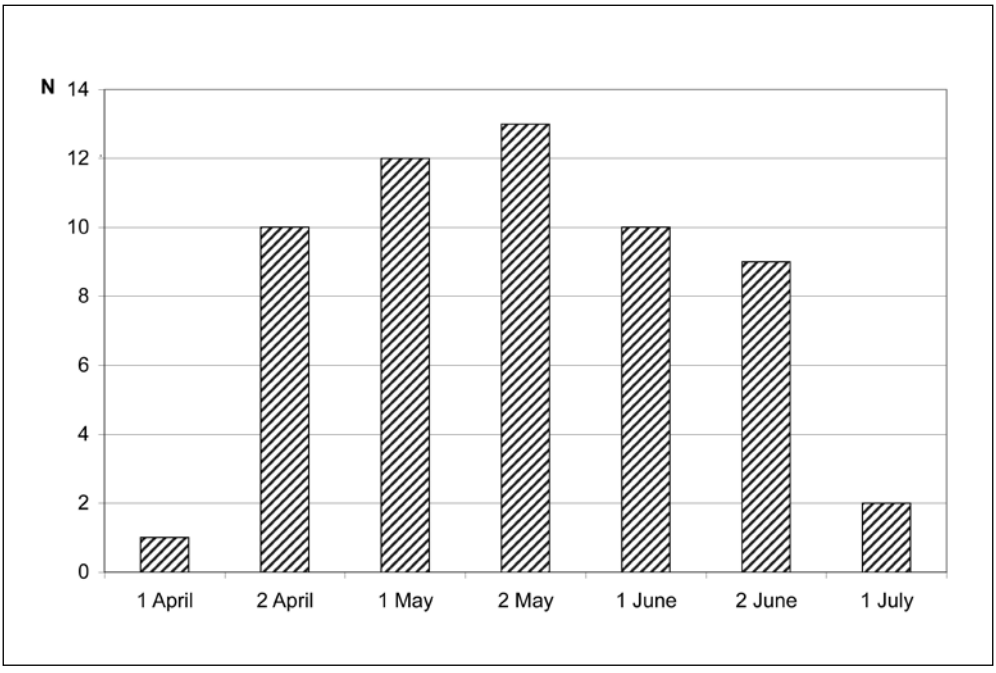

Fig. 1. Intensity of broods (*n*=57) initiated by *G. cristata* in particular halves of the month during the breeding season in 1980

Table 2. Location of nests in the studied population of *G. cristata*

Land use	Location	Fencing the area	
		No	Yes
Barren lands	Between a road and a sidewalk	1	7
	„Hills"*	7	
	Other	53	
Lawns	Between a road and a sidewalk	15	7
	Other	26	
Croplands		2	0

* Terrains termed "hills" were formed by dumping the excess of ground and rubble to a height of 3 m being quickly overgrown by plants.

with 3 eggs, 49 with 4 and 41 with 5). The number of eggs tended to decrease in subsequent broods (first, first repeated, second) (Table 1) but a small number of observations did not allow to confirm this trend ($F = 0.93$, $P = 0.41$). Reproductive success was 3.47 fledgelings leaving the nest per breeding pair. Reproductive success expressed as the number of fledgelings leaving the nest per laid egg and per nest was 0.51 and 2.00 for broods initiated in June-July and respectively 0.31 and 1.29 for the earlier ones (Table 3). The difference in proportion between number of eggs and fledgelings in April-May and June-July appeared to be insignificant $\chi^2=2.7$, $d.f.=1$, $P=0.12$.

A decrease of the reproductive success resulted from the presence of nearly 11% of non-fertilised eggs or eggs with dead embryos and by destruction of almost 40% of broods (Table 1). Main reason for the destruction was human activity including 4 cases of harvesting lawns in May. Intensive rainfall, during which the nests were flooded, was also harmful. Losses caused by corvid birds were assessed upon observations of birds robbing the nests. Two cases of brood destruction by *Pica pica* and one by *Corvus monedula* were recorded. Some nests were left at a stage of egg incubation but it was not estimated for certain whether it was the birds reaction to intensive human penetration (Fig. 2).

Table 3. Reproductive success of *G. cristata* in relation to the term of brood initiation

Brood started in	Number of laid eggs (A)	Number of fledgelings (B)	Number of initiated broods (C)	Number of fledgelings per laid egg (B/A)	Number of fledgelings per nest (B/C)	Number of fledgelings per breeding pair (B/17 pairs)
April & May	101	31	24	0.31	1.29	1.82
June & July	55	28	14	0.51	2.00	1.65
Total	156	59	38	0.38	1.55	3.47

3. 5. Population changes

Warsaw population of *G. cristata* showed a great dynamics during the study period. Marked and rapid changes in bird numbers were recorded in selected parts of the city and in the whole city (Figs. 3 and 4).

In 1980, 17 pairs of the species occurred on plot "Bielany". In the subsequent years this number rapidly decreased. In 1986 the last nesting pair was found, not recorded next year (Fig. 3). In those years, the area destroyed when building the settlement was intensively managed and trees and shrubs planted afterwards started to grow. Open grounds remained longest near large crossroads and these were the areas left in the latest time by *G. cristata*. The average rate of decreasing bird numbers was 2.2 pairs/year.

The numbers of *G. cristata* was more stable on plot "Bemowo" though decreasing tendency was also observed there. The rate of decreasing was, however, much lower than on plot "Bielany". Initially, there were 9-10 pairs there. During subsequent 10 years the number of pairs varied around 5-8 pairs. The birds changed their distribution with the

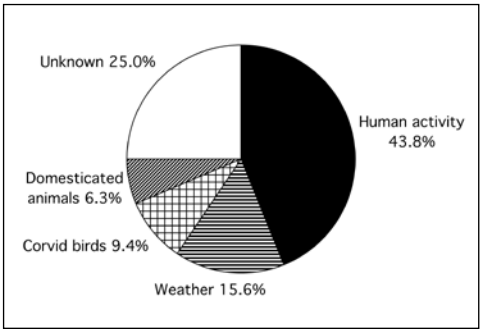

Fig. 2. Reasons of breeding losses (*n*=32) in Warsaw population of *G. cristata* (data from 1980-1988)
"Unknown reasons" involved cases of finding empty or disrupted nests, from which the eggs or fledgelings were taken by predators (dogs, cats, birds but also by rodents observed in the area, weasel *Mustela nivalis* and kestrel *Falco tinnunculus*) or by people.

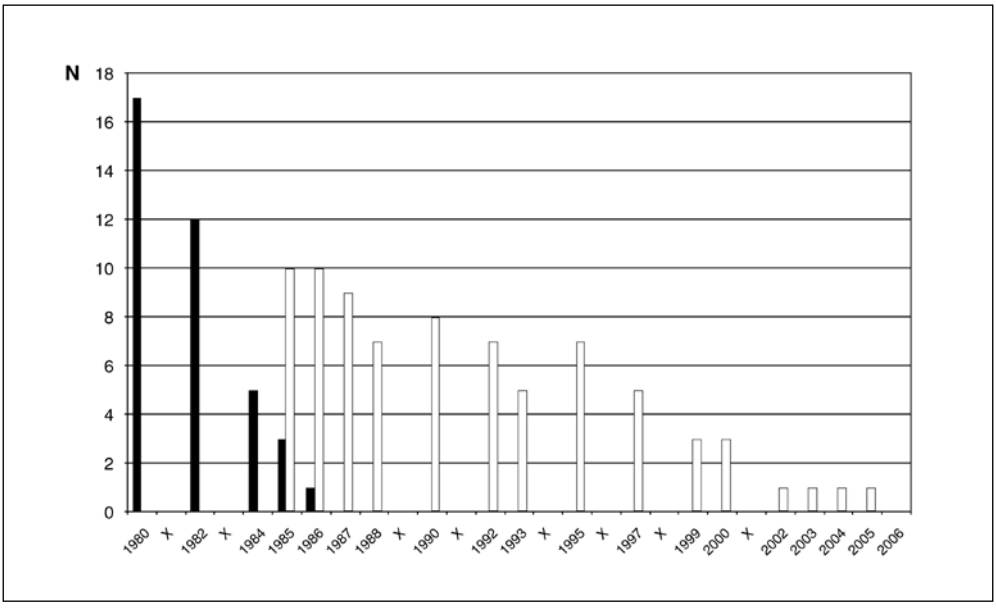

Fig. 3. Long term changes in the number of breeding pairs of *G. cristata* on plots „Bielany" (black) and „Bemowo" (white)
X – no data

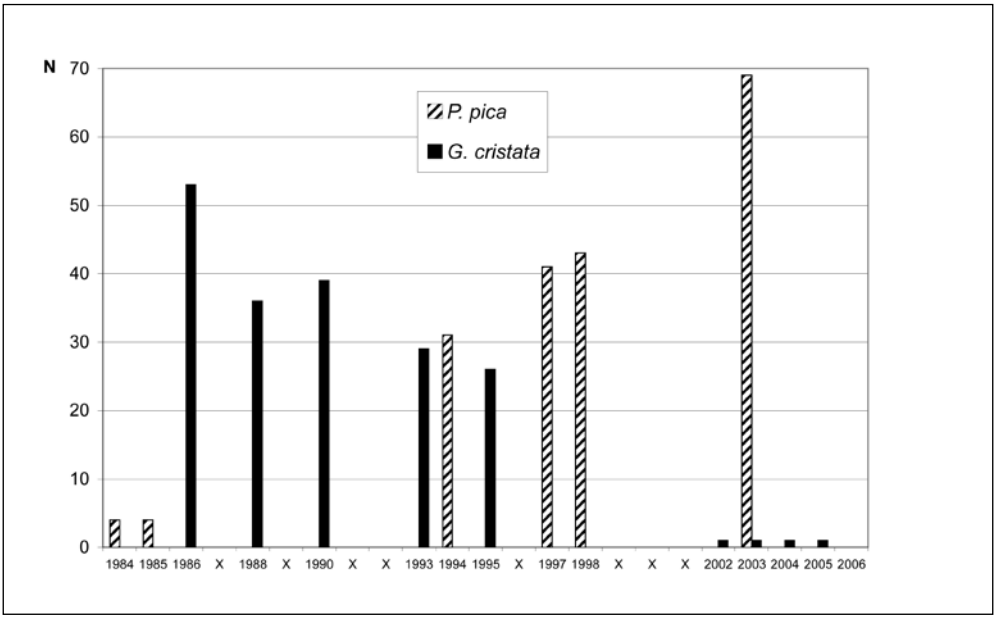

Fig. 4. Decline of Warsaw population of *G. cristata* (pairs – this study) against the increasing numbers of *P. pica* (pairs) in peripheral Warsaw – 75 ha (acc. to Lesiński 1998 and author's unpublished data for 2003)
X – no data

development of residential housing on the former airport and kept closer to outskirts of the settlement. Then the numbers declined more rapidly to leave only 1 pair in the area in 2002-2005, and no pairs in 2006 (Fig. 3). The average rate of decreasing the numbers of birds was 0.6 pairs/year.

The regress of population was observed in the whole city. Since 1986 its rate was similar during the whole study period until a total extinction of the population in 2006. Only at the end of the 1980s the decline was restricted for a short period (Fig. 4). One of the last two pairs initiated brooding in the first half of May and the brood (eggs) was destroyed for unknown reason. No birds were seen in the area afterwards. The second pair survived in the vicinity of the supermarket complex on grounds almost totally devoid of trees. The numbers of birds decreased in the whole city at an average rate of 2.9 pairs/year.

4. Discussion

In most studied populations of *G. cristata* broods are composed of 4-5 eggs. In Poland they are slightly larger than those of Germany and northern Africa but smaller than in the Middle East or Turkmenia (Table 4). The beginning of the breeding season in Warsaw (the earliest brood on April 12th) took place later than in Germany (March 26th – Krüger 1977, March 30th – Abs 1963), France (March 27th – Labitte 1957), or Turkmenia (first half of March – Belskaya 1974), which is a result of earlier springs on those areas.

There are no details on how large part of a population initiates subsequent broods. Two broods were reported from Germany (Abs 1963, Krüger 1977), and 3 from France (Labitte 1957). The fact that not all pairs in Warsaw initiated the second brood might

Table 4. Clutch size in various populations of *G. cristata*

Geographic region (sample size)	Clutch size							Differences (compared to Central Poland)	Source of data
	2	3	4	5	6	7	Mean		
Central Poland (96)	0	6	49	41	0	0	4.36	–	This study
Germany (146)	8	25	77	34	2	0	3.98	χ^2=19.0, *d.f.*=4, *P*<0.001	Krüger 1977, Baumann 1987
Turkmenia (24)	0	1	9	10	3	1	4.75	χ^2=16.9, *d.f.*=4, *P*<0.05	Belskaya 1974
Middle East (37)	0	0	17	18	2	0	4.59	χ^2=7.9, *d.f.*=3, *P*<0.05	Hartley 1946, Shkedy, Safriel 1992
North Africa (115)	0	20	81	14	0	0	3.90	χ^2=27.2, *d.f.*=2, *P*<0.001	Heim de Balsac, Mayaud 1962 after Roselaar 1988

suggest a possibility of decreasing number of broods in European populations in the east and north direction.

Reproductive success in particularly studied populations of *G. cristata* was very differentiated. Hatching and leaving the nests by young birds from 62.5% of laid eggs (*n*=48 eggs) were reported in Turkmenia (Belskaya 1974). It is much more than in Polish population (38% – see Table 3). Similar results were, however, obtained by Witsack (1968) – 38.8% and Baumann (1987) – 34.3% in Germany. Lower values were given for other German populations (Krüger 1977 – 26.8%, Pätzold 1986 – c. 30%) and for the Israel one (Shkedy & Safriel 1992 – 23.8%), in which losses resulted mainly from predation.

Breeding success of birds in open nests built in the beginning of the breeding season is often smaller than in nests built later, the effect recorded e.g. in *Turdus merula*, *Columba palumbus* (Snow 1958, Cramp 1972). Similar phenomenon was probable in the studied population of *G. cristata* (too small sample size did not allow to show it). In species, which build their nests on trees and shrubs the relationship is an effect of different nest sheltering from predators. Plant growth makes the nest more and more difficult to be found. The influence of plant development on the breeding success of *G. cristata* was probably less important. Greater losses in early broods originated mostly from human activity. In the second half of May lawns on the studied area were harvested, which made up to 10% of all breeding losses. Predation was also higher in this period, which should be associated with higher food requirements in avian predators to maintain their own broods.

Density of Warsaw population was relatively low compared to other countries. Even the highest local value (5.7 pairs/km^2)

is lower than occurred in bordering country – Slovakia – up to 10-16 pairs/km^2 (Krištín 2002). In the city of Prague in years 1985-1989 the density of *G. cristata* was about twice higher (Línek 1999) than in Warsaw in 1986.

Observed rapid changes in numbers of *G. cristata* have probably many reasons. Decline of the subpopulation on plot "Bielany" should be explained by habitat changes, mainly by the vegetation growth and increasing density of buildings, which is unfavourable for the species. Reproductive success (almost 3.5 hatchlings leaving the nest per breeding pair – Table 3) probably was not small enough to cause the decline. In the years preceding the study period (1960-1979) the species occurred also in central city districts, which it left soon after building up the open grounds (Lesiński 1988).

G. cristata in Warsaw appeared to be closely associated with a definite and ephemeral habitat (residential settlements during and shortly after their building), which resulted in the short-term appearance and retreat of subpopulations. Similar pattern was also described for other European cities (Hazevoet *et al.* 1993, Línek 1999). The loose of nesting sites on the ground in Warsaw cannot be substituted by using other sites, e.g. building roofs (typical for some populations – Chytil 1991, Orbán 2004), because the crested lark in this part of its range did not show such behaviour. Populations inhabiting areas of winters milder that those in central Poland (e.g. in France, Germany or western Poland) use to select a wider spectrum of open grounds: outskirts of villages, dunes, railway wastelands, industrial areas (Labitte 1957, Abs 1963, Baumann 1987, Jermaczek *et al*. 1995, Bednorz *et al.* 2000). The difference probably consist in the winter dependence of studied population on anthropogenic food available in large amounts in the city settlements. Flocks of up to 12 individuals were observed in Warsaw to forage on wastes (mainly on bread) and penetrating deeper into built-up areas (Unpubl. data). A decline of *G. cristata* out of cities has also been noted recently in Germany (Scherner 1996, Zang & Südbeck 2000).

Changes observed in the whole city of Warsaw during 20 years and a total extinction of the population of *G. cristata* have probably a different origin. There were a lot of habitats appropriate for the species at the end of the study. This phenomenon is a part of the general process of extinction, especially maked in eastern half of Poland (Biaduń 2004, Janiszewski *et al.* 2004, Misiuna 2006).

One of important reasons of the population decline could be the changes in bird communities that had occurred in urban areas of central Poland. An intensive development of corvid birds, especially *Pica pica* and *Corvus cornix* was observed in Warsaw in the last years (Lesiński 1998, Luniak *et al.* 2001). This would certainly increase predation, particularly on *G. cristata*. In the 1980s, when the density of *P. pica* in peripheral Warsaw was c. 5 pairs/km^2 (near 20 times less than the present over 90 pairs/km^2 – Fig. 4) the species was responsible for at least 6% of destroyed broods of *G. cristata*. Densities of the two species showed opposite trends (for *G. cristata*: r_s=–0.97, n=9, P<0.05; *P. pica*: r_s=0.99, n=6, P<0.05 – Fig. 4). Predation in urban areas is an important factor limiting the occurrence of birds, which build open nests (Tomiałojć 1980). It is especially true for birds nesting on the ground, in particular for those, which build nests poorly sheltered by vegetation (Jokimäki & Huhta 2000), and *G. cristata* is such a species. Predation by crows and pet

cats as an important reason for the decline of *G. cristata* in Sweden was reported by Hultén *et al*. (1989).

Increased predatory pressure resulted probably in very low reproduction in population of *G. cristata* in the 1990s. Strong specialization in habitat selection (mainly outskirts of cities) was the reason why losses in reproduction of the Warsaw population could not be compensated by dispersal of birds from habitats of low predatory pressure by corvid birds e.g. from agricultural lands, which typically had lower densities of *P. pica* – less than 1 pair/km^2 (Dombrowski 1997). At the end of the study period no rural *G. cristata* were observed within the radius of 100 km from Warsaw (Unpubl. data).

The phenomenon of building nests inside or at the outskirts of residential settlements and carrying hatchlings outside was probably caused by predation by corvid species. *C. cornix* and *P. pica* living in Warsaw in the 1980s were afraid of men and did not nest inside the settlements. Building nests by *G. cristata* near roads or attended sidewalks was a distinct anti-predatory behaviour. Location of nests of this species far from places intensively penetrated by predators was also described by Baumann (1978).

Negative effect on the numbers of the *G. cristata* population could be exerted, apart from predation, by other not analysed factors like the use of pesticides in agriculture or soil pollution near roads (Heyne 1992, Hazevoet *et al.* 1993, Zang & Südbeck 2000, Hegelbach *et al.* 2003), where the species often foraged. In the past the rural pairs of this species lost the important food source after disappearance of a horse transport (Hazevoet *et al.* 1993). It is also probable that the number of adult birds decreased after severe winters – data from Germany (Witsack 1969) and Denmark (Møller 1978) report of up to 30% reduction in such cases. Most of these factors could be important for a Warsaw population of *G. cristata*.

Acknowledgements. I am grateful to dr Dariusz Bukaciński for critical comments to the preliminary version of the manuscript.

References

Abs, M. 1963. Vergleichende Untersuchungen an Haubenlerche (*Galerida cristata* (L.)) und Theklalerche (*Galerida theklae* A. E. Brehm). – Bonn. Zool. Beitr. 14: 1–128.

Baumann, C. 1987. Zur Brutbiologie der Haubenlerche *Galerida cristata* in Braunschweig. – Braunschw. Naturk. Schr. 2: 725–750.

Bednorz, J., Kupczyk, M., Kuźniak, S. & Winiecki, A. 2000. Birds of the Wielkopolska Region. Faunistic monography. Bogucki Wydawnictwo Naukowe S. C., Poznań. (In Polish, with English summary).

Belskaya, G. S. 1974. K ekologii hohlatogo zhavoronka v Turkmenii. – Fauna i ekologia ptits Turkmenii 1: 18–33.

Biaduń W. 2004. Birds of Lublin. Akademia Medyczna, Lublin. (In Polish, with English summary).

Chytil, J. 1991. Crested Larks nesting on roofs. – Brit. Birds 84: 62–64.

Cramp, S. 1972. The breeding of urban Woodpigeons. – Ibis 114: 163–171.

Dementiev, G. P. & Gladkov, N. A.1954. Hohlatyj zhavoronok *Galerida cristata* L. In: Ptitsy Sovetskogo Sojuza 5: 540–549.

Dombrowski, A. 1997. The abundance of breeding populations of Magpies *Pica pica* in various types of agricultural landscape in Poland. – Acta Orn. 32: 25–32.

Ferguson-Lees, I. J. 1962. Studies of less familiar birds 116. Crested Lark. – Bird Study 50: 37–42.

Hegelbach, J., Güntert, M. & Winkler, R. 2003. Die Haubenlerche *Galerida cristata* – mit dem 20. Jahrhundert aus der Schweiz verschwunden. – Ornitholog. Beob. 100: 261–279.

Hartley, P. H. T. 1946. Notes on the breeding biology of the crested lark. – Brit. Birds 39: 142–144.

Hazevoet, K., Vlek, R. & Vogelzang, F. 1993. The 1901 Housing Law and the Crested Lark *Galerida cristata* as a breeding bird in Amsterdam. – Limosa 66: 145–152. (In Dutch with English summary).

Heyne, K.-H. 1992. Ehemalige Vorkommen der Haubenlerche (*Galerida cristata*) im Trierer Raum. – Dendrocopos 19: 26–30.

Hultén, O., Grandin, B., Gustafsson, M. & Jönsson, Å. 1989. The Crested Lark *Galerida cristata* in Malmö. – Anser 28: 229–234.

Janiszewski, T., Wojciechowski, Z. & Pędziwilk, A. 2004. Distribution and abundance of the Crested Lark *Galerida cristata* and Stonechat *Saxicola torquata* in Łódź in 1994-2002. – Not. Orn. 45: 49–53. (In Polish with English summary).

Jermaczek, A., Czwałga, T., Jermaczek, D., Krzyśków, T., Rudawski, W. & Stańko, R. 1995. Birds of the Lubusian Region. Faunistic monography. LKP, Świebodzin. (In Polish with English summary).

Jokimäki, J. & Huhta, E. 2000. Artificial nest predation and abundance of birds along an urban gradient. – Condor 102: 838–847.

Krištín, A. 2002. The crested lark (*Galerida cristata*). In: Birds distribution in Slovakia. Š. Danko, A. Darolová, A. Krištín (eds), Veda, Bratislava: 417–419. (In Slovak with English summary).

Krüger, S. 1977. Die Lerchen (Alaudidae) in der Oberlausitz. – Abh. Ber. Naturkunde, Görlitz 51 (8): 1–9.

Labitte, A. 1957. Contribution a l'etude de la biologie de l'Alouette huppee en pays drouais (E.-et-L.). – Oiseau 27: 143–149.

Lesiński, G. 1988. Distribution and numbers of the crested lark (*Galerida cristata*) in Warsaw. – Not. Orn. 3-4: 222–227. (In Polish with English summary).

Lesiński, G. 1998. Population increase of Magpie *Pica pica* in peripheral and suburban built-up area of Warsaw in 1983-1998. – Kulon 3: 185–193 (In Polish with English summary)

Línek, V. 1999. Occurrence and numbers of Crested Lark (*Galerida cristata*) in the city of Prague. – Sylvia 35: 69–81. (In Czech with English summary).

Luniak, M., Kozłowski, P., Nowicki, W. & Plit, J. 2001. Birds of Warsaw 1962-2000. – IGiPZ PAN, Warszawa. (In Polish with English summary).

Misiuna, Ł. 2006. Decline of the Crested Lark *Galerida cristata* breeding population in Kielce in 1986-2005. – Not. Orn. 47: 134–138. (In Polish with English summary).

Møller, A. P. 1978. Population size and changes of Crested Larks *Galerida cristata* in North Jutland, with remarks on population regulation. – Dansk Orn. Foren. Tidsskr. 72: 189–196. (In Danish with English summary).

Orbán, Z. 2004. Nest construction and roosting behaviour of a Crested Lark *Galerida cristata* population nesting on flat roofs in Hungary. – Ornis Hung. 14: 1–13.

Pätzold, R. 1986. Heidelerche und Haubenlerche *Lullula arborea* und *Galerida cristata*. – Wittenberg Lutherstadt, Ziemsen Verlag.

Roselaar, C. S. 1988. *Galerida cristata* Crested Lark. In: Handbook of the birds of Europe, the Middle East and North Africa. The birds of the Western Palearctic, vol. 5 (S. Cramp ed.): 145–163.

Scherner, E. R. 1996. Die Bedeutung sozioökonomischer Verhältnisse für den Artenschutz am Beispiel der Haubenlerche (*Galerida cristata*) in Nordwestdeutschland. – Ökologie der Vögel 18: 1–44.

Shkedy, Y. & Safriel, U. N. 1992. Nest predation and nestling growth rate of two lark species in the Negev Desert, Israel. – Ibis 134: 268–272.

Snow, D. 1958. The breeding of the Blackbird *Turdus merula* at Oxford. – Ibis 100: 1–30.

Sudhaus, W. 1966. Über Verbreitung, Bestand und Ökologie der Haubenlerche, *Galerida c. cristata* (L.), in Schleswig-Holstein. – Corax 1 (17): 129–144.

Tomiałojć, L. 1980. The impact of predation on urban and rural woodpigeon (*Columba palumbus* L.) populations. – Pol. Ecol. Stud. 5: 141–220.

Vökler, F. 2005. Der Brutbestand der Haubenlerche *Galerida cristata* im Landkreis Bad Doberan im Jahre 2004. – Ornit. Mitt. 57: 268–273.

Witsack, W. 1968. Beiträge zur Biologie der Haubenlerche (*Galerida cristata* L.) I. Zur Fortpflanzungsperiode. – Naturkdl. Jahresber. Mus. Heineanum 3: 47–66.

Witsack, W. 1969. Beiträge zur Biologie der Haubenlerche (*Galerida cristata* L.) II. Zur Spätsommer-, Herbst- und Winterperiode. III. Zur Ökologie der Haubenlerche. – Naturkdl. Jahresber. Mus. Heineanum 4: 61–75.

Zang, H. & Südbeck, P. 2000. Zur Situation der Haubenlerche *Galerida cristata* im Niedersachsen. – Vogelwelt 121: 173–181.