

## Lapwing, *Vanellus vanellus* chick ringing data indicate a region-wide population decline in the Czech Republic

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**A b s t r a c t.** Lapwing (*Vanellus vanellus*) numbers are continually declining in many European countries. In this study we used data on the numbers of lapwings ringed annually as chicks in the Czech Republic, adjusted for ringing effort, to estimate regional population trends. We found a region-wide population decline in the Czech Republic between 1976–2004. The trends from ringing records were supported by data from a standardized national monitoring program. The decline in the number of chicks ringed was significantly correlated with the negative trends of national indices in seven of ten regions. The three remaining regions also showed low but non-significant rates of population decline. We found that the rate of decline was not equal among regions. The rate of population decline was significantly related to a derived index of hunting pressure. Therefore, regions with the most pronounced rates of population decline had relatively more shot birds at both staging and wintering areas. At the same time, we found no evidence for shifts in either mean recovery distances or hunting impact index. This study demonstrates that ringing records are not only a valuable source of data on bird recoveries, but also can be used for population monitoring.

**Key words:** bird ringing, hunting, population trends, wintering sites

### Introduction

During the past two decades the numbers of breeding farmland birds have widely declined in the Czech Republic (Šťátný et al. 2004, Reif et al. 2006), following a pattern recorded in other parts of Europe (BirdLife International 2004). The increasing agricultural intensification is identified as one of the major factors driving these population declines (Donald et al. 2001). However, rigorous estimates of population trends are available only for a short period of time in many European countries. In the Czech Republic such data are available since 1982 through the Breeding Bird Monitoring Program (Šťátný et al. 2004, Reif et al. 2006).

In this study we evaluated the use of regional numbers of lapwing chicks ringed annually as indicators of population changes in the period 1976–2004. The use of annual ringing totals as indicators of population trends has been successfully implemented for a variety of species (e.g. Ginn 1969, Hjort & Lindholm 1978, Österlöf & Stolt 1982, Mason & Hussey 1984, O'Connor & Mead 1984, Rintala et al. 2003). However, despite their promising value, some uncontrolled sources of variation may bias their validity (Ginn 1969, Bibby et al. 2000). The main problem is in estimating the sampling

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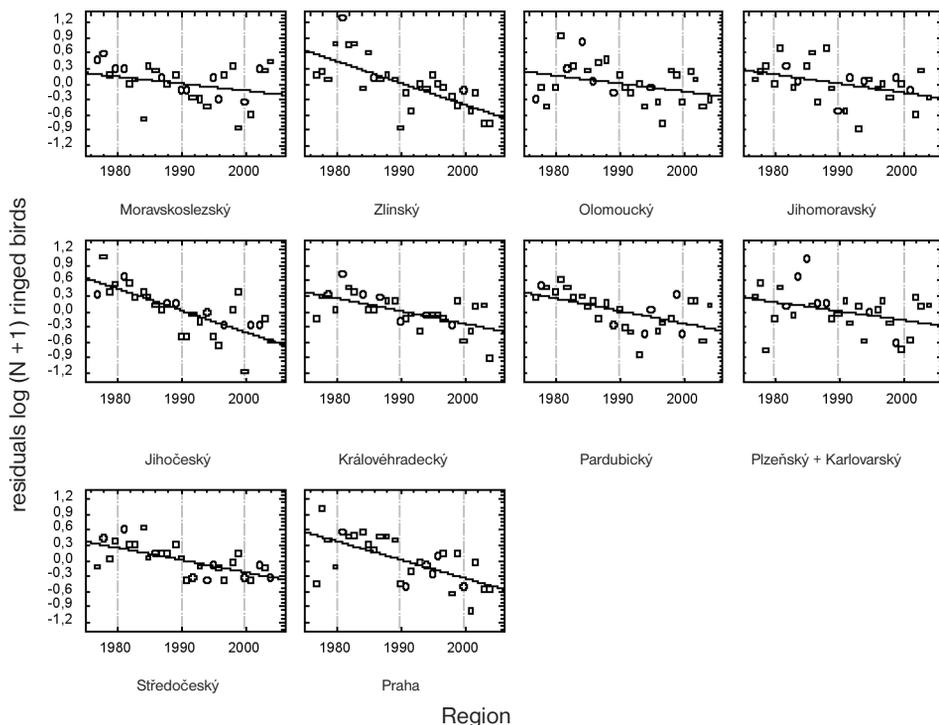
(ringing) effort. For example, data from nonstandardised songbird netting operations are difficult to interpret unless information on length of mist-nets and amount of time spent ringing is available (Bibby et al. 2000). However, many standardised longterm monitoring programmes (e.g. CES, MAPS, MRI Programme) using mist nets provide a very reliable source of data (for an overview see Ralph & Dunn 2004). The advantage of chick ringing data, especially for a ground nesting bird such as the lapwing, is that any possible confounding effects of ringing effort known for example from mist netting grand totals could be easily taken into account by controlling for the number of ringers involved or inter-annual changes in grand totals of ringed birds. Lapwing chicks are easy to find in open agricultural landscape and, therefore, they have been very attractive for many bird ringers. Within a given region, many Czech ringers would always ring as many lapwing chicks as possible making the species ideal for monitoring purposes. In the U.K. the lapwing annual ringing totals were strongly related to standardised estimates of population trends (Mason & Husey 1984). Our study successfully extends this approach to ringing data in the Czech Republic.

In addition to the estimates of regional trends, we used ringing recoveries to test whether regional population trends are associated with hunting pressure on wintering sites.

## Material and Methods

Data on ringed nestlings covering a period from 1976 to 2004 were obtained from the Praha Bird Ringing Centre. In the Czech Republic, scientific bird ringing started in 1910 (Špek & Cepák 2005). Since then, many lapwing chicks have been ringed. However, for our analyses we purposefully selected the period after 1976, because in that year lapwings were ringed for the first time in all regions of the Czech Republic. First, we digitized all records on ringed chicks, and then we divided the national data into 10 regional subsets. The geographical boundaries of these subsets correspond to regions (kraj) except for Plzeňský and Karlovarský region (due to small sample size these two were pooled into one region): 1 – Moravskoslezský, 2 – Zlínský, 3 – Olomoucký, 4 – Jihomoravský, 5 – Jihočeský, 6 – Královéhradecký, 7 – Pardubický, 8 – Plzeňský + Karlovarský, 9 – Středočeský, and 10 – Praha. There are three more regions within the territory of the Czech Republic that we did not include into this study. This was because they are mostly located in unsuitable areas for lapwings and thus giving very low numbers of ringed birds. For each region we identified the annual numbers of chicks ringed. Because ringing numbers are likely to be influenced by the increasing number of active ringers, we standardised the annual chick numbers by regressing the log-numbers of ringed chicks in a given region with log-transformed annual ringing totals for the entire Czech Republic. Annual ringing totals represent the sum of all individuals of all bird species ringed in the Czech Republic. The residuals from these linear regressions were used in further analyses. We also regressed the log-numbers of active ringers on log-numbers of ringed chicks, but since these data showed identical results to analyses with annual ringing totals we omitted them from results. To estimate whether the regional trends correspond with national estimates we correlated the 10 detrended time series with national population estimates. The national population estimates from the Breeding Bird Monitoring Program (Štátný et al. 2004) were available for the period 1982–2004.

To estimate whether the observed regional population trends were associated with hunting pressure, we used all ringing recoveries of shot lapwings that were ringed as chicks between 1976 and 1997. The recoveries were divided into 10 regional subsets and each bird was assigned to a given region based on its original ringing location. The ringing location



**Fig. 1.** Regional trends in number of lapwing chicks ringed annually in the Czech Republic, 1976–2004.

represents the natal area since we used data on birds ringed as chicks. Thus our dataset contained information on both number of chicks ringed and the number of recoveries from hunting for each of the 10 regions. The recoveries covered period from August to March with 57% of them falling between December and March. Thus it is possible that some of the birds were shot while migrating to their wintering sites. Therefore our data include hunting pressure combined for both migration and wintering areas. We regressed the regional log-numbers of both ringed and recovered birds and took the regression residuals as estimates of hunting pressure. Positive regression residuals would indicate that for a given region and for a given number of ringed birds, high numbers of birds were shot. These residuals, used as a proxy of hunting pressure, were related to the slopes (b) of regional population trends.

To control for possible confounding effects of climatic conditions on shifts in wintering areas, we calculated annual mean recovery distances of shot birds. We selected only shot recoveries that were reported between November – February. For each winter we calculated mean recovery distances and these were tested for any temporal changes (Fiedler et al. 2004). Similarly, the hunting pressure might have changed during the period over which the study was conducted. Therefore, for each year we calculated the hunting impact index of McCulloch et al. (1992) and tested whether the index showed any temporal trend.

## Results

The number of chicks ringed showed a consistent decline in all 10 studied regions between 1976 and 2004 (Fig. 1). In seven of the 10 regions there was a significant decline in lapwing

**Table 1.** Regional trends in the numbers of lapwing chicks ringed annually in the Czech Republic between 1976–2004. “n” denotes sample sizes for each region. P values < 0.5 in bold type.

Region	$R^2$	$P$	Equation	n
Moravskoslezský	0.097	0.107	$y = 27.6689 - 0.0139*x$	536
Zlínský	0.479	<b>&lt;0.001</b>	$y = 84.4365 - 0.04242*x$	804
Olomoucký	0.112	0.0821	$y = 31.1688 - 0.01566*x$	560
Jihomoravský	0.156	<b>0.0377</b>	$y = 35.5132 - 0.01784*x$	555
Jihočeský	0.534	<b>&lt;0.001</b>	$y = 85.1429 - 0.04277*x$	2516
Královéhradecký	0.377	<b>0.0005</b>	$y = 50.1193 - 0.02518*x$	2067
Pardubický	0.294	<b>0.0029</b>	$y = 49.0074 - 0.02462*x$	1635
Plzeňský + Karlovarský	0.120	0.0707	$y = 35.0685 - 0.01762*x$	453
Středočeský	0.422	<b>0.0002</b>	$y = 48.2510 - 0.02424*x$	1162
Praha	0.402	<b>0.0003</b>	$y = 72.2844 - 0.03631*x$	1312

numbers. The most pronounced declines were found for Southern Bohemia (Jihočeský), Eastern Moravia (Zlínský), Central Bohemia (Středočeský), and the Prague (Praha) region (Table 1). Some regions i.e. North-eastern Moravia (Moravskoslezský), Central Moravia (Olomoucký), and Western Bohemia (Plzeňský + Karlovarský) showed insignificant negative trends. This suggests rather a uniform pattern of regional population declines.

The national population estimates from the Breeding Bird Monitoring Program significantly correlated in 7 cases with the regional ringing trends (Table 2). Similarly, the ringing trends for the whole Czech Republic significantly correlated with the Breeding Bird Monitoring Program ( $r = 0.822$ ,  $P < 0.001$ ).

**Table 2.** Correlations between regional population trends in ringed chicks and the national population estimates from the Breeding Bird Monitoring Program in the Czech Republic for the period 1982–2004. Regions: 1 – Moravskoslezský, 2 – Zlínský, 3 – Olomoucký, 4 – Jihomoravský, 5 – Jihočeský, 6 – Královéhradecký, 7 – Pardubický, 8 – Plzeňský + Karlovarský, 9 – Středočeský, and 10 – Praha. P values < 0.5 in bold type.

	1	2	3	4	5	6	7	8	9	10
$r$	0.043	0.639	0.569	0.253	0.593	0.610	0.389	0.450	0.663	0.638
$P$	0.846	<b>0.001</b>	<b>0.005</b>	0.243	<b>0.003</b>	<b>0.002</b>	0.066	<b>0.031</b>	<b>0.001</b>	<b>0.001</b>

In total, 141 ringing recoveries were reported for birds ringed as chicks during 1976–1997. Of these, 113 (80%) birds were reported as being shot. The birds were mostly shot in France ( $n = 89$ ) and fewer in Italy ( $n = 13$ ), Spain ( $n = 8$ ), and Portugal ( $n = 3$ ). We found a positive relationship between the regional population trends and the hunting pressure ( $R^2 = 0.43$ ,  $F_{1,9} = 5.99$ ,  $P = 0.040$ ). During the same period we did not find evidence for changes in either the mean recovery distances ( $r = -0.020$ ,  $P = 0.932$ ) or hunting impact index ( $r = -0.140$ ,  $P = 0.503$ ).

## Discussion

In this study we demonstrated a region-wide population decline of lapwings in the Czech Republic. The trends from ringing data are supported by the standardized national Breeding Bird Monitoring Program. Seven of 10 regions positively correlated with the national indices. The three uncorrelated regions exhibited low rates of population decline. Our data highlight

the fact that lapwing numbers showed declines in all studied regions. However, the rate of decline was not equal among all 10 regions, with some showing steep declines, while others only moderate ones. When the rate of population decline was related to the derived index of hunting pressure, we found a positive relationship. In other words, those regions that had the most pronounced rate of population decline had relatively higher numbers of shot birds at both staging and wintering areas. The correlative nature of these results does not necessarily imply a causal relationship between hunting related mortality at wintering sites and the declining regional populations (A e b i s c h e r et al. 1999). Possible role of climatic changes at wintering sites is unlikely to explain the observed trends, since we did not find evidence for shift in mean recovery distances at wintering sites (but see F i e d l e r et al. 2004). Similarly, we did not find evidence for a temporal trend in the hunting index. In recent decades, the hunting pressure on birds has declined all over Europe (M c C u l l o c h et al. 1992, B a r b o s a 2001). However, lapwing is still hunted in many European countries and as our study shows there is no trend toward a decline in hunting pressure for this species. Similar finding was reported for several species of waders (including lapwing) hunted in Spain (B a r b o s a 2001).

At present, we do not have survival estimates for Czech lapwings and therefore we can not rule out both the effects of hunting at wintering sites or changes at breeding sites. P e a c h et al. (1994) did not find evidence for any long-term trends in lapwing survival rates; instead, they suggested that low productivity might be the main factor behind the declining British numbers. However, the proportion of shot British lapwings from all recoveries is ca 50% less than for the Czech population. We believe that high brood losses are, among others, likely to contribute to negative population trends in the Czech Republic. Unfortunately, we do not have any estimates of breeding productivity at our sites. The only available study by Š á l e k (1992) suggests that nest failure rates in southern Bohemia did not deviate much from other European studies. In a different study, Š á l e k & Š m i l a u e r (2002) found that breeding density was negatively related to predation risk. Given the fact that the breeding densities have declined in the entire country it is quite possible that nowadays lapwings might be under much stronger predation pressure than before.

Agricultural intensification is frequently cited as the cause for the declining numbers of farmland birds (D o n a l d et al. 2001, 2006). Interestingly, after the collapse of Czech agriculture in 1989, lowered agricultural productivity did not slow the decline in lapwing numbers. A comparison of population estimates between 1989 and early 2000s shows a 70% decline in breeding pairs (Š t a s t n ý et al. 2006). It is very likely that factors at both breeding and wintering sites are responsible for the observed drop in Czech lapwing population. However, without information on long-term trends in breeding productivity, the relationship between hunting pressure and population trends described in this study is, at this moment, the only available explanation for the long-term decline in lapwings, at least in the Czech Republic.

#### A c k n o w l e d g e m e n t s

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