Status and population trend of Corncrake *Crex crex* in Germany

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During the last 20 years our knowledge of the Corncrake breeding distribution and trends in numbers in Germany has greatly improved, despite the difficulties in surveying the species. Data from previous (1974-1995) and recent (2005-2009) breeding bird atlas work show the presence of Corncrakes in all major natural regions as well as an overall increase in atlas grid occupancy. The increase was most obvious in the Northern German Plain, whereas in the Southwest occupancy dropped by a factor of 0.56.

Densities of calling males in selected core breeding sites recorded since 1990 showed a significant trend with an increase before and a decrease after 1998. Influx years in 1998-1999, 2002-2003, 2007-2008, and to a lesser extent 2012 led to a high degree of year-to-year variation. In such years much higher numbers are found outside the core breeding areas, too. These fluctuations were also reflected in estimates of national population size regularly produced in the course of national Red List updates.

Key words: Corncrake *Crex crex*, Germany, breeding population, trend, distribution.

1. Introduction

Only 20 years ago, there was considerable uncertainty about occurrence and population trends of the Corncrake in Germany (Hashmi 1991, Stiefel 1991). It was even questioned if the species would still breed there (Flade 1991). Since approximately 1995, a growing interest in this bird and a number of local studies confirmed that Corncrakes regularly breed in various places, and that they were more common than previously thought (Schäffer & Münch 1993, Mammen *et al.* 2005).

Corncrakes can only be surveyed at night, when males are calling. This specific diurnal rhythm, which differs from most other breeding birds, is the main reason why Corncrakes are rarely covered by monitoring activities. Moreover, due to their irregular occurrence, the presence of Corncrakes is probably missed during surveys in many marginal breeding sites. Corncrake populations are usually assumed to be fluctuating on a large scale (e. g. Gedeon *et al.* 2014). While records of calling males are available from a large number of potential breeding sites, reliable information on trends in numbers is only available on a local scale in Germany. Here we present a first analysis of Corncrake trends based on atlas data as well as on monitoring results from core breeding sites.

2. Methods

Atlas data: The breeding distribution and abundance of Corncrakes during 2005-2009 was available from the first national breeding bird atlas for a grid of 10' x 6' (approximately 11 x 11 km) referring to the topographic maps 1:25,000 (Gedeon *et al.* 2014). Breeding distribution in the eastern part of Germany in the period of 1978-1982 was available on the same atlas grid (Nicolai 1993). For the remaining parts of Germany we reconstructed the previous distribution in the period of 1974-1995 (predominantly 1979-1985) on the atlas grid, using data from published regional atlas work (Table 1). Due to the cryptic behaviour of Corncrakes we included all squares with records of possible, probably and confirmed breeding as defined by Hagemeijer & Blair (1997). For the state of Bavaria (Bayern) information on squares with records of possible breeding was unavailable. Changes in grid square occupancy were therefore calculated for all states except Bavaria at the level of major natural regions (Bundesamt für Naturschutz 2012).

Count data: Densities of calling male Corncrakes in selected core breeding sites were obtained from published or unpublished reports as well as directly from coordinators of monitoring schemes and individual observers. Together with information about the size and location of the area monitored this resulted in a database of Corncrake densities from nocturnal counts in 28 core breeding sites. The sites were grouped in three major natural regions (Fig. 1).

In four of these areas males were counted approximately every 10 days throughout the breeding season in selected years (Mammen *et al.* 2005, Pfützke unpubl. reports). We averaged numbers per site and decade over the study period to get insight into seasonal occurrence.

We applied a generalized additive mixed model (GAMM) to the entire data to estimate a smoothed trend of bird densities as a function of year and region. Site was treated as a random effect, and a first order autoregressive function was

Table 1: Bird atlas and avifauna publications used to reconstruct the distribution in 1974-1995. – *Für die Darstellung der Verbreitung 1974–1995 verwendete Landesatlanten und –avifaunen.*

State – *Bundesland*	Study period – *Kartierzeitraum*	Source – *Quelle*
Schleswig-Holstein	1985-1994	Berndt *et al.* 2003
Mecklenburg-Vorpommern, Brandenburg, Berlin, Sachsen-Anhalt, Sachsen, Thüringen	1978-1982	Nicolai 1993
Niedersachen, Bremen	1981-1985	Heckenroth & Laske 1997
Nordrhein-Westfalen	1975-1983; 1989-1994	Wink 1987; NWO 2002
Hessen	1974-1984	Jürgens 1997
Rheinland-Pfalz	1975-1983; c. 1985	Wink 1987; Rheinwald 1993
Saarland	c. 1985	Rheinwald 1993
Baden-Württemberg	c. 1990-1995	Hölzinger & Boschert 2001
Bayern	1979-1983	Nitsche & Plachter 1987

included to reduce temporal autocorrelation. Models were fitted in R 2.15.0 (R Development Core Team 2012) with the package mgcv (Wood 2006) using thin plate regression splines, a logarithmic link and a quasi-Poisson error distribution. To assess model fit, diagnostic plots of the residuals and observed against fitted values were checked (Zuur *et al.* 2009).

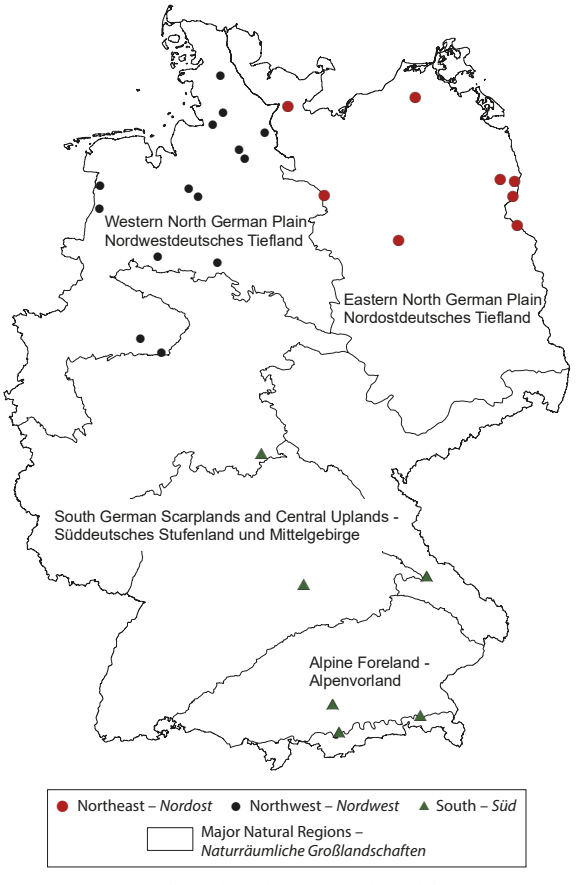


Fig. 1: Location of core breeding sites selected for trend analysis. – *Lage der Brutgebiete, die in der Trendanalyse berücksichtigt wurden.*

3. Results

Distribution

Breeding Corncrakes were present in all German federal states and major natural regions in 1974-1995 (Fig. 2a). With the exception of the North Sea coast, the species was locally and regionally clustered in landscapes dominated by grassland habitats, and rare only in grassland-poor areas dominated by forests or by arable land. In 2005-2009 Corncrakes had occupied a large number of squares where they had been absent before, most of them in the North German Plains, leading to a nearly uninterrupted occurrence especially in the northeast (Fig. 2b). Occupancy of grid squares had increased by a factor of 1.8 in the North German Plains and by 1.2 in the Central Uplands, whereas in the Southwestern part (South German Scarplands and Alpine Foreland) occupancy dropped by a factor of 0.56 (Fig. 3). Within the North German Plains and Central Uplands, the change from 1982-1995 to 2005-2009 was more positive towards the north and east, while Corncrakes regionally disappeared e. g. along the Ems valley and the Dutch border, in the uplands of northern Hesse, and in Saxony (Sachsen).

Numbers

Total population size was repeatedly estimated by summing up estimates for the 16 federal states, or using atlas data. The resulting national total numbers showed an overall increase by c. 100 % during the 1990s, but also considerable variation and uncertainty (Table 2).

The seasonal pattern of occurrence was widely similar among the four study areas, with males present throughout the breeding season (Fig. 4). The Lower Oder Valley showed a pronounced peak during May, which was not found in any other study area.

Population changes 1990-2015

Breeding densities showed a high degree of variation from year to year in all major natural regions with high-

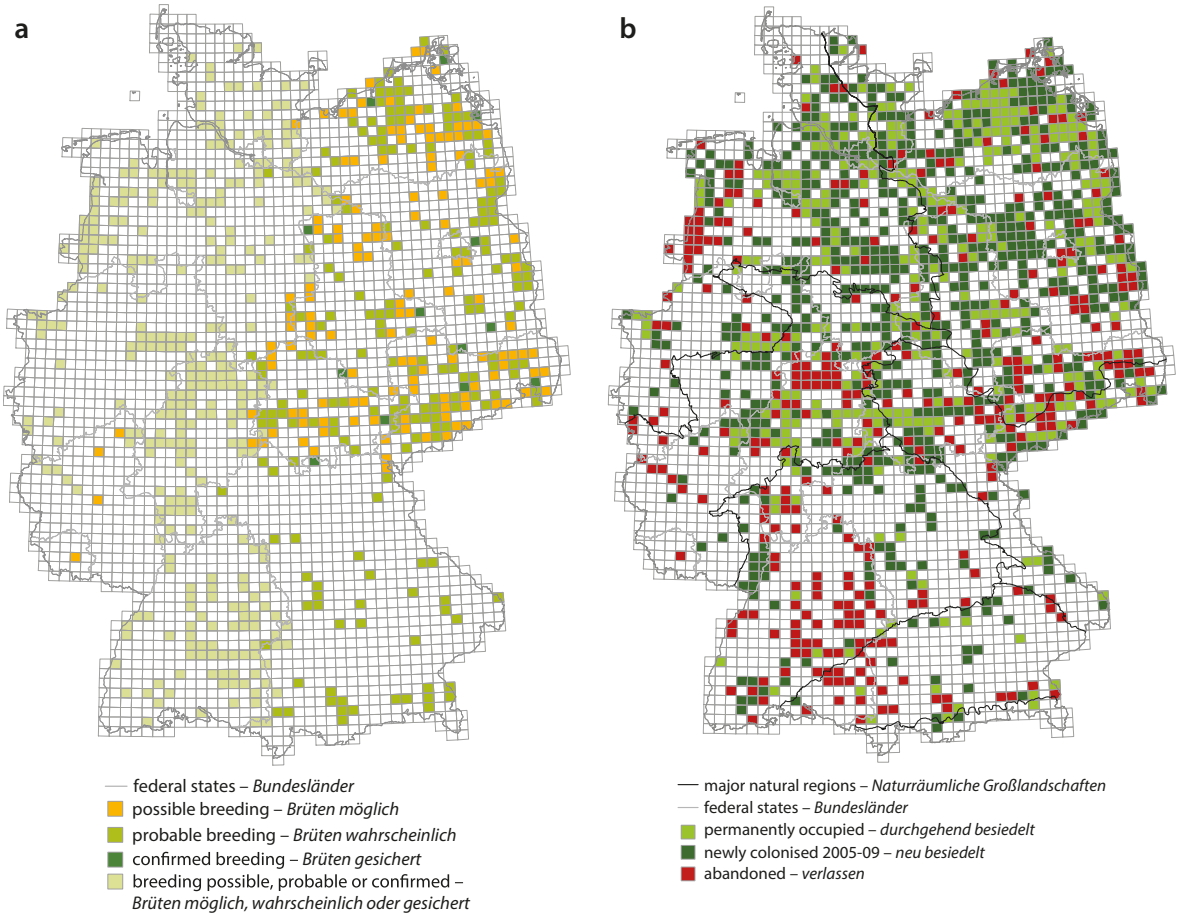


Fig. 2: Reconstructed breeding distribution of the Corncrake 1974-1995 (a), and changes in grid square occupancy to 2005-2009 (b). – *Rekonstruierte Brutverbreitung des Wachtelkönigs in Deutschland 1974–1995 (a) und Veränderung der Giterfeldbesiedlung bis 2005–2009 (b).*

est densities around 1997-2000 (Fig. 5). Analysing these data with the GAMM resulted in a clear temporal trend with an increase before and a decrease after 1998 (Table 3). Average densities did not significantly differ between the four regions. The highest densities are due to comparatively smaller breeding areas.

4. Discussion

Status of breeding Corncrakes in Germany

Corncrakes breed in all parts of Germany, but most birds are found in the Northern German Plain, especially in the Northeast, were also highest densities were recorded (Gedeon *et al.* 2014). Most birds are found in one of four main habitat types:

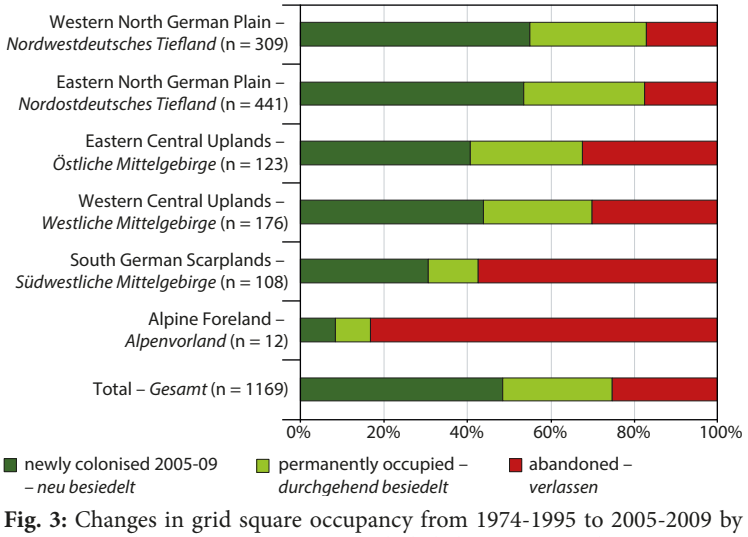


Fig. 3: Changes in grid square occupancy from 1974-1995 to 2005-2009 by major natural region. Bavaria was excluded due to incomplete occupancy information. – *Veränderung der Gitterfeldbesetzung in den Naturräumlichen Großlandschaften zwischen 1974–1995 und 2005–2009. Ohne Quadranten in Bayern wegen unvollständiger Daten.*

Table 2: Estimates of national Corncrake population size and threat status from 1989 until today. – *Bestandsschätzungen und Rote-Liste-Status für den Wachtelkönig für Gesamtdeutschland seit 1989.*

Time period – *Zeitraum*	Approximate population size (number of males) – *Populationsgröße (Männchen)*	Threat status – *Gefährdung*	Source – *Quelle*
1980s	250-1500		Hashmi 1991, Stiefel 1991
1994-1995	740-1340	Critically endangered – *Vom Aussterben bedroht*	Witt *et al.* 1996
(1995-) 1999	2000-3100	Endangered – *Stark gefährdet*	Bauer *et al.* 2002
(2000-) 2005	1300-1900	Endangered – *Stark gefährdet*	Südbeck *et al.* 2007
2005-2009	2300-4100	Endangered – *Stark gefährdet*	Gedeon *et al.* 2014, Grüneberg *et al.* 2015

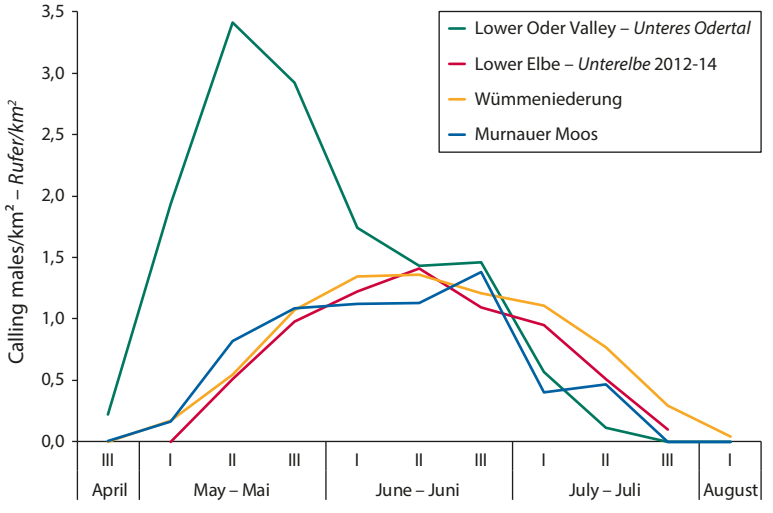
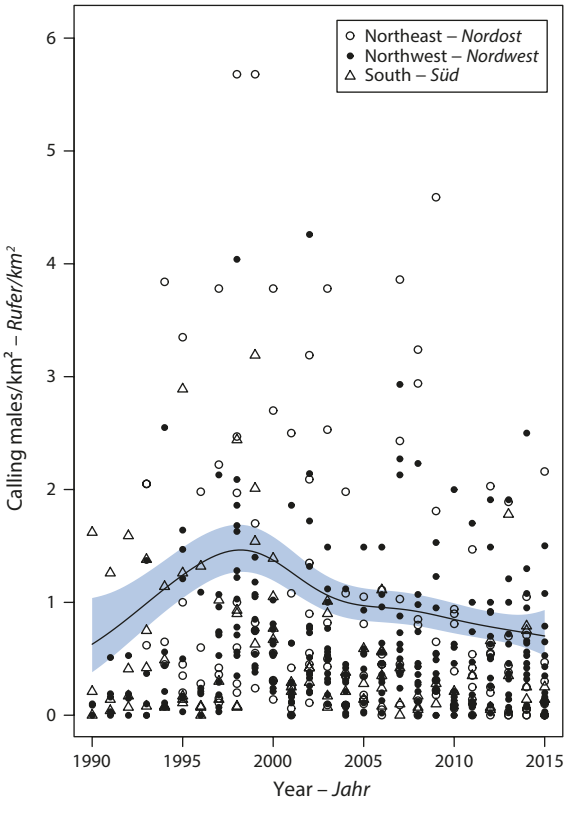


Fig. 4: Seasonal occurrence of calling male Corncrakes in selected study areas. Study period 1998-2000 if not stated otherwise. – *Jahreszeitliches Auftreten rufender Wachtelkönige in ausgewählten Gebieten. Untersuchungszeitraum 1998-2000, wenn nicht anders angegeben.*



1. Wet grasslands in lowland river valleys and mires, mainly used for hay-making or being recently abandoned. This is the typical habitat in most breeding areas in northern Germany.
2. Wet meadows in mires of the Alpine Foreland, e. g. the Murnauer Moos (Schäffer & Münch 1993, Mammen *et al.* 2005), Loisach-Kochelsee-Moore, Chiemseemoore in Bavaria
3. Various types of mostly low-intensity meadows in the uplands of southern and south-eastern Germany e. g. in the Ore mountains and Rhön (Kolb 1997). A preference for wet fallow land was found in the Inner Bavarian Forest (Schlemmer 2001).
4. Arable land is a main habitat only locally in the Hellwegbörde, western Germany, where Corncrakes are known to occur since the late 1960s (Prünte & Raus 1970), and in the Rheiderland close to the Netherlands (Joest & Koffijberg 2016).

Fig. 5: Densities of Corncrakes counted in core breeding sites in three major natural regions and estimated smoothing curve with 95 % confidence interval. – *Dichte rufender Wachtelkönige in ausgewählten Brutgebieten in drei naturräumlichen Regionen und 95 %-Konfidenzintervall.*

Tall vegetation providing sufficient cover in spring is the most important common feature of these habitats, whereas soil moisture varies from very wet in mires to dry on arable land. This explains local habitat preferences, from wet meadows and fallow land in lowlands (Mammen *et al.* 2005) and in mountain regions (Kolb 1997) to winter wheat on arable land. A lack of cover due to early mowing and grazing explains the lower densities or absence on high-intensity grassland. The broad range of agricultural habitats and the specific requirements for the vegetation structure explain the wide range as well as the mostly local or regional distribution within Germany.

Table 3: GAMM results for Corncrake density in core breeding areas. – *Ergebnis des GAMM für Wachtelkönigdichten in ausgewählten Brutgebieten.*

	Estimate – *Wert*			*p*
Coefficients – *Koeffizienten*		SE	*t*	
Intercept – *y-Achsenabschnitt*	-0.49	0.25	-1.94	0.05
Region Northeast – *Nordost*	0			
Northwest – *Nordwest*	-0.18	0.31	-0.57	0.59
South – *Süd*	-0.08	0.38	-0.21	0.83
Smooth term – *Glättungsfunktion*		df	*F*	
Year – *Jahr*		4.25	7.92	< 0.001

Seasonal patterns of occurrence in the four study areas show that most males are present long enough to start two broods. Remarkably higher densities in May in the Lower Oder Valley are probably caused by early development of tall vegetation (Mammen *et al.* 2005).

Quality of population estimates

Until 2005, national population sizes were derived from numbers reported by regional coordinators, with highly variable quality. Despite these uncertainties, these estimates reflect the trend in the monitored key sites. The total number for 2005-2009, in contrast, is based on the national breeding bird atlas (Gedeon *et al.* 2014). The distinctly higher number probably reflects the invasion observed in 2007 and 2008, unless it is an overestimate for methodological reasons as suggested by Gedeon *et al.* (2014).

Trends in numbers and distribution

Corncrake populations in large parts of continental Europe are known for strong between-year fluctuations, involving short-term influxes at a regional level (Koffijberg *et al.* 2016). Such fluctuations were visible in Germany, too, with influx years 1998-1999, 2002-2003, 2007-2008, and to a lesser extent 2012. The trend model revealed an underlying increase in the 1990s and a subsequent decline. This trend, which was also observed in several other European regions (Koffijberg *et al.* 2016), was largely obscured by the short-term fluctuations.

Fluctuation in occurrence is also visible in the small proportion of atlas squares occupied in both atlas periods. For this reason monitoring results from more or less permanently occupied core breeding sites will not necessarily show a complete picture of population trends. During influx years, numbers of males were higher in many, but not all, core breeding sites. In these years, many more birds were also recorded outside the regular breeding areas (e. g. Schröder *et al.* 2007). This pattern of occurrence makes it difficult to estimate and monitor total numbers on a larger scale. As a consequence, we lack reliable estimates for Corncrake populations in most federal states and on the national level. Developing the German Rare Breeding Bird Survey towards a site-based monitoring will improve the future trend and population estimates.

The atlas data showed that breeding occupancy nearly doubled in the North German Plains between 1982-1995 and 2005-2009. Compared to the first study period, a regional increase in observation effort as well as in the use of tape lures has probably led to a more complete recording of the species during 2005-2009 in the entire country. At the same time the major influx of Corncrakes to western Europe in 2007-2008 will have affected the results of this atlas and contributed to the increase in occupancy especially in the Northeast.

The current concentration of Corncrakes in the northeast, and also the comparatively early arrival in the Oder Valley directly at the border, suggest that the majority of the German population is connected to the very large Corncrake population in Poland (BirdLife International 2015). Also, influxes of Corncrakes are likely caused by birds from eastern Europe (Koffijberg *et al.* 2016). Within-season movements of ringed males between eastern Germany and the Czech mountains prove another link to the Czech breeding population (Cépak *et al.* 2008, Jiří Vlček pers. comm.).

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5. Zusammenfassung

Bellebaum, J., C. Grüneberg & J. Karthäuser 2016: Status und Bestandstrend des Wachtelkönigs *Crex crex* in Deutschland. Vogelwelt 136: 113 – 119.

Noch vor 20 Jahren war über Brutverbreitung und Bestandstrends des Wachtelkönigs in Deutschland sehr wenig bekannt. Trotz der aufwendigen Erfassung der versteckt lebenden Art haben sich seither die Kenntnisse erheblich verbessert. Für einen Vergleich der Ergebnisse der ersten Brutvogel-Atlaswerke in den Bundesländern aus dem Zeitraum 1974-1995 mit dem Atlas Deutscher Brutvogelarten (2005-2009) wurde das ehemalige Verbreitungsgebiet des Wachtelkönigs für den Zeitraum 1974-1995 (hauptsächlich 1980-1990) auf Basis der Topografischen Karten 1:25.000 (TK25) aufgearbeitet. Wachtelkönige kommen in allen naturräumlichen Großlandschaften Deutschlands in unterschiedlichen Lebensräumen vor. Die wichtigsten Lebensraumtypen zeichnen sich durch hohe, Deckung bietende Grasvegetation aus:

1. Feuchtgrünland(-Brachen) in den Flussniederungen und Niedermooren im Norddeutschen Tiefland
2. Feuchtgrünland in den Mooren des Alpenvorlands
3. Extensivgrünland und feuchte Brachen in den Mittelgebirgen
4. Ackerflächen in der Hellwegbörde (Nordrhein-Westfalen) und im Rheiderland (Niedersachsen)

Der Vergleich der früheren und aktuellen Verbreitung zeigte eine hohe Fluktuation in der Besetzung der Vorkommen: nur knapp ein Viertel der TK25 war in beiden Zeiträumen besetzt. Insgesamt nahm die Zahl besiedelter TK25-Blätter seit den 1980er Jahren deutlich zu: bundesweit (wegen unvollständiger Atlasdaten ohne Bayern) wurden 25 % ehemals besiedelte Kartenblätter aufgegeben, jedoch mit 49 % nahezu doppelt so viele Kartenblätter neu besiedelt. Die Ausbreitung fand besonders im Norddeutschen Tiefland statt, in den Südwestdeutschen Mittelgebirgen mit Alpenvorland ging die Rasterbesetzung dagegen um den Faktor 0,56 zurück.

Dichten rufender Wachtelkönige in ausgewählten, regelmäßig kartierten Brutgebieten zeigten seit 1990 einen deutlichen Bestandstrend mit einem deutlichen Anstieg bis 1998 und einem nachfolgenden langsamen Rückgang. Auffällige Einflüge in den Jahren 1998-1999, 2002-2003, 2007-2008 und weniger deutlich um 2012 führten zu einer starken Schwankung der Dichten von Jahr zu Jahr. Zudem treten in Einflugjahren mehr Wachtelkönige auch außerhalb regelmäßig besetzter Brutplätze auf. Die bundesweiten Bestandsschätzungen für die Roten Listen spiegelten den Langzeittrend und die Einflüge ebenfalls wider.

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Corncrake habitat: floodplain meadows in the Lower Oder Valley National Park, Germany. – *Wachtelköniglebensraum: Auenwiesen im Nationalpark Unteres Odertal.* Photo: J. Bellebaum

Corncrake habitat: meadows in the Borgfelder Wümmewiesen, Germany. – *Wachtelkönigebensraum Borgfelder Wümmewiesen.*
Photo: S. Pfützke

Corncrake habitat: floodplain meadows at the Lower Elbe river in Nordkehdingen, Germany. – *Wachtelkönigebensraum an der Unterelbe in Nordkehdingen.*
Photo: S. Pfützke