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Changes in the fledging success over time with increasing population size in the Northern Lapwing *Vanellus vanellus* on Wangerooge Island (Lower Saxony, Germany)

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Zusammenfassung: Die vorliegende Langzeitstudie beschreibt die Bestandsentwicklung und den Reproduktionserfolg des Kiebitzes (*Vanellus vanellus*) auf der Nordseeinsel Wangerooge (Niedersachsen, Deutschland). In den vergangenen 34 Jahren hat der Kiebitzbestand hier kontinuierlich zugenommen. Diese Entwicklung unterscheidet sich damit deutlich von denen anderer Kiebitzpopulationen in Nord- und Westeuropa. Der Bruterfolg des Kiebitzes auf Wangerooge nahm im gleichen Zeitraum mehr und mehr ab. Er zeigte zudem einen negativen Trend mit steigender Populationsgröße. Leider können beide Effekte aufgrund von Autokorrelation statistisch nicht separiert werden. Der mittlere Bruterfolg ist allerdings keineswegs hoch genug, um die Population selbst zu tragen. Dies ist alarmierend, da die Nordseeinseln und angrenzende Küstengebiete als qualitativ hochwertige Wiesenvogellebensräume gelten. Da nach derzeitigem Kenntnisstand der Bruterfolg des Kiebitzes auf Wangerooge nicht bestandserhaltend ist, kann die Insel auch nicht als „source-Habitat" für diese Limikolenart gelten.

Summary: In this study, we report the results of a long-term investigation on changes in population size and fledging success of Northern Lapwing on Wangerooge, a German Wadden Sea island. This population is increasing over a period of 34 years in contrast to numerous populations in North-western Europe. The reproductive success however declines over time and also with population density. Both effects cannot be considered separately due to autocorrelation. However, it is noted that the population on Wangerooge is not sustained by local recruitment only. This outcome is even more alarming as coastal areas and islands are considered as rare high quality meadow bird habitats. According to the present results Wangerooge cannot be considered as a source habitat for Northern Lapwings in North-western Germany.

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1 Introduction

Most populations of meadow birds in North-western Europe are declining rapidly (Teunissen 2005, Gregory et al. 2004, Nehls et al. 2001, Tucker & Heath 1994). Loss of habitat, increased predation pressure and intensification of agricultural practice are discussed as the most likely causes for the decline (Beintema et al. 1995, Nehls et al. 2001, Donald et al. 2001, Wilson et al. 2004). Despite positive outcome in single studies (Sheldon et al., 2004), conservation efforts often did not yield the expected success (Südbeck & Krüger 2004, Kleijn et al. 2001).

The Northern Lapwing (*Vanellus vanellus*), attributed with the term "robust" to indicate that it can withstand and adjust to the effects of habitat change, is nonetheless declining since the 1980ties (Bijsma et al. 2001, Melter & Welz 2003, Gregory et al. 2004, Wilson et al. 2004). Following the intensification of agriculture and as a consequence thereof the loss of available breeding habitats Lapwings declined dramatically (Melter & Welz 2001, Nehls et al. 2001, Krüger & Südbeck 2004, Melter & Welz 2003). Extensive monitoring programs report reproduction rates that are in the majority of cases not able to maintain local populations (for an overview see: Südbeck & Krüger 2004). The species was up listed in the German Red Lists of Endangered Species from "vulnerable" to "endangered" in 2003.

A population declines because either the mortality of adults is too high or the reproductive success is too low to compensate mortality, if one does not account for immigration and emigration. The knowledge of the development of these two

variables over time is crucial to understand the ultimate factors driving the decline. They are requirements needed for conservation measures and action plans to succeed. Hence we are in need of long-term population data. This applies especially to long-lived species where small decreases in reproductive success are not easily detected but can yet have huge effects on population sizes which become only obvious after several years – often too late for conservation measures to interfere (Südbeck & Krüger 2004).

Here, we investigate a 34 year dataset of breeding Northern Lapwings on the Wadden Sea island Wangerooge (Lower Saxony, Germany). We study the development of fledging success as a proxy for reproduction rate over time and in relation to population size.

2 Methods and Study Area

Wangerooge is the easternmost populated Eastfriesean Wadden Sea island, situated between the island of Spiekeroog and the unpopulated island Minsener Oog in the Jadebusen. It holds two areas suitable for breeding meadow birds, one 37 ha area in the western part and one 87 ha area in the eastern part of the island (Großkopf 1989). The breeding areas are part of the Lower Saxony Wadden Sea National Park and have the highest conservation status which prohibits human activities of any kind during the breeding season. Very low level of grazing by cattle and horses takes place and mowing happens only after the breeding season ended.

The number of breeding Northern Lapwings is counted every year by volunteering bird-rangers since 1935. Methods are standardized since 1994 following the guidelines of Hälterlein et al. (1995). Observations of numbers of fledglings are reported too. The yearly reports on breeding birds usually encompass some extra information which was also analyzed carefully and, if relevant for this work, taken into account.

The first pairs of Northern Lapwing have settled on the island between 1883 and 1905, in 1928 already 10-14 pairs were counted (Großkopf 1989). Onnen & Zang (1995) present a short overview on the development of the Lapwing population on Wangerooge from 1928 to 1984. They report that the population stayed at around 20-40 pairs with the exception of the years 1952-1966, where the population grew up to fivefold. There is no population trend reported as there are huge gaps in the dataset: from1928 to1950 only seven data points are used, and from 1958 to 1970 the dataset is restricted to just 5 years. However, the population seems to increase from around 40 pairs during 1928 and 1954 to 160 pairs in 1958, and then decreases again to the level before 1954. Schroeder et al. (2003) showed a significant increase in breeding pairs on the western site from 1990-2001. A more recent analysis indicated an increase of breeding pairs on both sites (Schroeder et al. in press).

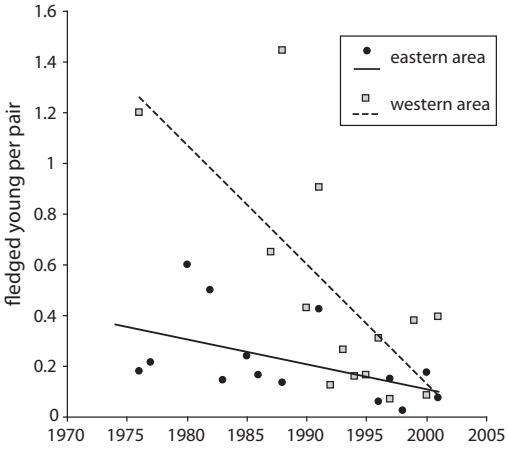

Fig. 1: Decrease of fledging success in Northern Lapwing over time on Wangerooge Island. Trend lines: east: y = 19.65 - 0. 01x , west: y = 94.5 - 0.05x.

Here, we analyze data on fledging success from 1972-2002 of both areas. Due to the nature of the dataset, with big gaps over some time spans distributed unevenly between both areas, we use nonparametric Spearman rank order correlation to test for a relation of fledging success with time. To test for a relationship of fledging success with population size, we use Pearson correlation. Statistics are calculated with Statistica 7.0.

3 Results

Observations of fledglings are available for the eastern part of Wangerooge from 13 years between 1978 and 1999. In this area, the breeding success averaged 0.216 ± 0.178 fledglings per pair and year, with a maximum of 0.6 in 1978 and a minimum of 0.02 in 1996. In the western area only 2 years are without any reports on fledglings in the period 1986-2000. However, additional data exists from the years 1972, 1975, 1977 and 1982.

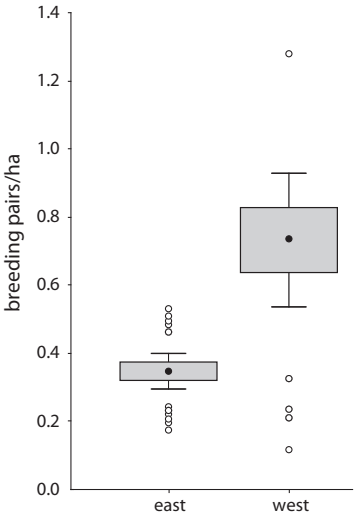

Fig. 2: Population density (breeding pairs/ha) of Northern Lapwing breeding in the west and eastern area on Wangerooge Island between 1972 and 2002. Filled circle: mean, box: mean ± SE, whiskers: mean ± 95 % CI, open circles: outliers. ANOVA: $F(1, 63) = 16.97$, $p < 0.001$.

The average breeding success amounted 0.636 ± 0.57 fledglings per pair and year, with a maximum of 2 in 1972 and a minimum of 0.07 in 1996. Thus the breeding success was significantly higher in the western part of the island (independent samples t-test: $t = 2.569$, $p = 0.0158$, $df = 28$).

The breeding success of the Lapwing is declining with time (Fig. 1). In the western area, Lapwings produce 0.05 fledglings per pair less every year (Spearman rank correlation: $R = -0.64$, $p = 0.015$), whereas in the east it is only 0.01 fledgling per pair per year that is produced less as time moves on (Spearman rank correlation: $R = -0.62$, $p = 0.019$). When plotted against population size, a similar trend is recognizable: With increasing population size, fledging success decreases in the east (Pearson correlation: $R^2 = 0.22$, $p = 0.11$) and, more pronounced, also in the western study site (Pearson correlation $R^2 = 0.27$, $p = 0.059$). However, in both cases the statistical results are not yet significant.

4 Discussion

We note a discrepancy between the breeding success in the east and in the west, with values in the west being on average 0.4 fledged young per pair and year higher than in the east. We can think of different causes underlying this result: First, it might be a consequence of a systematical observer error, with the eastern area being bigger and therefore less good to observe than the western study site. In line, the western study site possesses different observation facilities (e.g. platform) lacking at the eastern site. Since the island airport of Wangerooge is located next to the eastern study site, we can additionally not exclude that the presumably higher predation risk here is mediated by disturbances of starting and landing airplanes.

A decrease in breeding success was found with time as well as with population size. As the habitat of the population did not change in size over time (Großkopf 1989), the latter result can be seen as a negative effect of breeding density. In theory, density dependence of reproductive success is only expected at high densities. The area in the west harbors significantly higher densities of breeding Lapwings (Fig. 2), which therefore might explain the slightly different results for both study sites. However, due to autocorrelation (population growth over time), it is not possible to tear apart the effects of time and density.

The decreasing reproductive success of the Lapwing on Wangerooge island over time is alarming. Hötker et. al (2007) report declining reproduction rates for Godwits and Lapwings all over Germany during the last decades. The same holds true for The Netherlands (Schekkerman et al. 2005). In our study the reproductive success was not sufficient to keep the Lapwing population on Wangerooge island stable (see also Schroeder et. al. 2003), let alone the reproductive success from only the last decade. This is of major concern, because the islands and coastal areas are the only areas in Germany where stable or growing meadow bird populations are observed, while all other regions show more or less negative trends (Hötker et al. 2007, Rasmussen et al. 2000). It would be desirable if these habitats could act as a source, - but our study suggests the opposite. This study shows that a mere increase in breeding numbers does not necessarily reflect a sufficient reproductive success. However, the dataset relies primarily on unsystematic observations of many volunteers. We therefore like to stress the importance of a more thorough and methodologically constant long-term study on the reproductive success of Lapwings on Wangerooge island.

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