Osnabrücker Naturwissenschaftliche Mitteilungen
Band 32, S. 137 – 143, 2006

Predation on meadowbirds in The Netherlands – results of a four-year study

Wolf Teunissen, Hans Schekkerman & Frank Willems

Zusammenfassung: Die Wiesenvogelpopulationen in den Niederlanden sind in den letzten Jahrzehnten stark unter Druck geraten. In jüngster Zeit wird zunehmend die Prädation als einer der Hauptfaktoren für den zu beobachtenden Bestandsrückgang genannt. Aus diesem Grund ist ein Forschungsprojekt mit dem Titel „Wiesenvögel und Prädation" (2001 – 2005) initiiert worden, das sich zum Ziel gesetzt hat, umfangreiches Datenmaterial als Grundlage für die fachliche Auseinandersetzung mit diesem Thema zu sammeln.

Der erste Schritt beinhaltete eine Auswertung landesweiter Daten zu prädationsbedingten Gelegeverlusten bei Wiesenlimikolen. Die von Freiwilligen erhobenen Daten zeigen, dass überdurchschnittlich hohe Verluste vor allem in halboffenen Landschaften im Norden und Osten der Niederlande auftreten. Allerdings wurden lokal auch höhere Verluste in tiefer gelegenen Marsch- und Niederungsgebieten, den Hauptverbreitungszentren niederländischer Wiesenvogelpopulationen, gefunden. Insgesamt betrachtet hat die Prädation von Gelegen in den vergangenen Jahren zugenommen. Gleiches gilt allerdings auch für landwirtschaftlich bedingte Gelegeverluste in solchen Gebieten, in denen kein aktiver Gelegeschutz betrieben wird. Auf lokaler Ebene zeigten die prädationsbedingten Gelegeverluste starke Schwankungen sowohl zwischen einzelnen Gebieten als auch zwischen aufeinander folgenden Jahren. Zur Identifizierung von Gelegeprädatoren wurden Thermologger und Videokameras eingesetzt. Bei Verlusten von insgesamt bis zu 50 % aller auftretenden Gelege, hielten sich tag- und nachtaktive Räuber als Täter annähernd die Waage. Traten dagegen höhere Gelegeverluste auf, so waren daran in erster Linie nachtaktive Raubsäuger beteiligt. Über die eingesetzte Videotechnik konnten insgesamt 10 verschiedene Gelegeprädatoren (6 Säugetier- und 4 Vogelarten) nachgewiesen werden. Die Kükenverluste bei Kiebitz und Uferschnepfe wurden mittels Radiotelemetrie untersucht. Die Überlebensrate der Küken war insgesamt sehr gering: 60 – 80% der Kükenverluste gingen auf Prädation zurück, 5 - 15 % entfielen auf landwirtschaftliche Einflüsse. Alle übrigen Verlustursachen machten 10 – 15 % der Verluste aus. Mindestens 15 Säugetier- und Vogelarten konnten bislang als Kükenprädatoren nachgewiesen werden, wobei offensichtlich Vögel einen größeren Einfluss hatten (u.a. Mäusebussard: 16%, Graureiher: 7 - 18% aller Verluste) als Raubsäuger. Eine Ausnahme stellt das Hermelin dar, das für ca. 16 % aller Verluste verantwortlich war. Die Rabenkrähe, die immer wieder als Gelege- und Kükenprädator genannt wird, spielte in beiden Bereichen (hier: Gelege- und Kükenprädation) nur eine untergeordnete Rolle. Der Rotfuchs dagegen dominierte in vielen, wenn auch längst nicht allen Gebieten als Gelegeprädator. Die Kombination aller gesammelten Gelege- und Kükendaten ermöglichte eine Abschätzung der Bedeutung einzelner Verlustursachen für den Reproduktionserfolg. Insgesamt betrugen die Prädationsverluste während der Brutperiode ca. 75 % beim Kiebitz und ca. 60 % bei der Uferschnepfe. Die Kükenverluste durch Vögel schlugen dabei in Bezug auf den Bruterfolg am stärksten zu Buche. Allerdings würde selbst eine komplette Eliminierung dieses Verlustfaktors (wenn überhaupt möglich) nicht zu einem ausreichenden Reproduktionserfolg führen. Die vorliegenden Ergebnisse verdeutlichen an, dass die Prädation in Kombination mit anderen, bereits vorhandenen Verlustursachen zu einem wesentlichen Populationsfaktor in verschiedenen Wiesenvogelgebieten geworden ist. Unsere Befunde legen ferner den Schluss nahe, dass in Wiesenvogelgebieten mit „Prädationsproblemen" Lösungen nur vor Ort, also auf lokaler/regionaler Ebene, gefunden werden können.

Summary: Meadowbird populations in The Netherlands are under great pressure. Recently, predation is named increasingly often as one of the key factors in contributing to the declines. A four-year research project (2001-2005) aimed to collect (as yet mostly nonexisting) data to provide a factual basis for this discussion. A country-wide inventory based on data for wader nests found by volunteers who mark nests for their protection from grazing/mowing indicated that above-average predation losses are found predominantly in the half-open landscapes of northern and eastern Netherlands, but also locally in the low-lying open grasslands which are the key areas for meadowbirds. Nest predation has increased in recent years, but the same is true for agricultural losses, at least in areas where no nest-protection takes place.

At a local scale, predation losses vary greatly from area to area and from year to year. Temperature loggers in nest showed that diurnal and nocturnal predators contribute equally in total predation losses up to 50%, but higher predation losses are mainly caused by nocturnal predators. As many as 10 animal species were identified as nest predators on nests under surveillance with video cameras. Chick survival, investigated using radiotelemetry, was very low. About 60-80% were lost by predation, 5-15% by agricultural activities and 10-15% to all kind of other losses. At least 15 predator species were implied, with an apparently larger share taken by birds (notably Buzzard (16%) and Grey Heron (7-18%)) than mammals, with one exception: stoat (16%). Of the most-discussed predator species, Carrion Crows were

remarkably rarely involved in both nest and chick predation, while Red Foxes take a large toll of clutches in some areas, but not in others.

Of all losses during the reproductive cycle about 75% and 60% was due to predation in Lapwing and Black-tailed Godwit respectively. Predation on chicks by birds had the largest effect on total breeding success, but at the same time elimination of this loss factor (if at all possible) alone would not be sufficient to establish a self-sustaining population. Predation seems to have become a factor of importance in some areas, in combination with already existing other losses. Our findings suggest that solutions to predation problems probably have to be found in locally/regionally targeted, specific action on multiple fronts rather than countrywide measures.

Authors:
Wolf Teunissen, SOVON Vogelonderzoek Nederland, Rijksstraatweg 178, 6573 DG Beek-Ubbergen, The Netherlands. E-Mail: wolf.teunissen@sovon.nl
Hans Schekkerman, Alterra, P.O. Box 47, 6700 AA Wageningen, The Netherlands; Dutch Centre for Avian Migration and Demography, P.O.Box 40, 6666 ZG Heteren, The Netherlands. E-Mail: h.schekkerman@nioo.knaw.nl
Frank Willems, SOVON Vogelonderzoek Nederland, Rijksstraatweg 178, 6573 DG Beek-Ubbergen, The Netherlands.

1 Introduction

In The Netherlands, populations of many bird species breeding in agricultural grasslands and arable lands have declined strongly over the past decades. This decline even seems to have accelerated in recent years (Teunissen & Soldaat 2006). In discussions about possible causes, predation is mentioned with increasing frequency, but its perceived importance is usually based on anecdotal evidence rather than systematically collected data. Partly as a result, emotions and folklore play a major role in these discussions.

This and recent developments in Dutch government policy on wildlife management, led a number of organizations and governmental institutions to commission a research project into the role of predation in the population development of 'meadow birds' (Teunissen et al. 2005). The principal questions of this research project were:

- How frequently does predation of meadow bird eggs and chicks occur?
- Which predator species are involved?
- Which factors affect frequency and impact of predation?
- Is predation a problem for the population development of meadow birds, also in relation to other causes of reproductive failure?

2 Methods

Within the project research activities were conducted in 2001-2005 at multiple spatial scales. At the national level, spatial variation in predation on clutches was analysed from data collected in 2000 and 2004 by volunteers who search and mark nest to protect them from farming losses. In addition, relationships between clutch predation, meadow bird and predator abundance, and landscape characteristics were studied in 17 sites spread throughout The Netherlands. In part of these sites, egg predators were identified by using temperature loggers and video cameras, and chick predators by use of radiotelemetry. By combining these observations, the impact of the various reproductive losses on reproductive output and population development was estimated.

3 Results and Discussion

3.1 How frequent is predation? – Eggs.

Based on 90,000 and 69,000 clutches found by volunteers in 2000 and 2004 respectively, the average probability of predation for a meadow bird clutch in the absence of other causes of failure was 27% and 32% respectively. In practice 52-54% of all clutches hatched, and the main causes of failure were predation (24-27%), agricultural activities and livestock (6-9%), and desertion (5-7%). For nests that are not marked and protected by volunteers, agricultural losses are more important (30-50%).

In both survey years, predation occurred more frequently in the semi-open landscapes on the higher soils in the Eastern parts of The Netherlands than in the low-lying and open wet grassland regions in the North and West, where the highest meadow bird densities occur (Fig. 1). However, also in several meadow bird 'core areas', above-average predation rates were found. There was a slight increase of predation between 2000 and 2004, visible in many regions but notably so in areas bordering on the Western side to those

regions which showed the highest predation in 2000. This seems to indicate an expansion from existing 'predation regions'.

Hatching success in the 17 local study sites showed large variation between sites (range 2-82%), but also between years. Generally, variation between sites was two to three times as large as variation between years, for both total losses and predation losses. This indicates that between-year variation was not synchronous between sites, and suggests that 'random' variation in local presence and activity of individual predators may play a role.

Predation was the most frequent cause of nest failure in the study sites and accounted for 80% of the variation in hatching success. In sites with a high predation rate, the probability of nest desertion tended to be increased as well. Other causes of failure were less important, but in areas without nest protection by volunteers, agricultural losses will be higher than in our study sites.

Two datasets shed some light on long-term changes in predation on meadow bird clutches in The Netherlands. Country-wide data collected by volunteers on nests protected from agricultural losses, and published by Landschapsbeheer Nederland, suggest an increase of predation with 0.5% per year since 1996. A comparison of data collected in sites without nest protection in the late 1980s and in the late 1990s suggests that the probability of clutch predation doubled over this period. However, simultaneously agricultural losses increased even more.

3.2 How frequent is predation? – Chicks.

The survival of chicks of Northern Lapwing *Vanellus vanellus* and Black-tailed Godwit *Limosa limosa* was determined by radio-tagging a total of 665 chicks in 2003-2005. On average, 7% of Black-tailed Godwits and 14% of Lapwings reached the fledging age. There was significant variation between sites and years, with 2005 standing out in a negative sense. In both species,

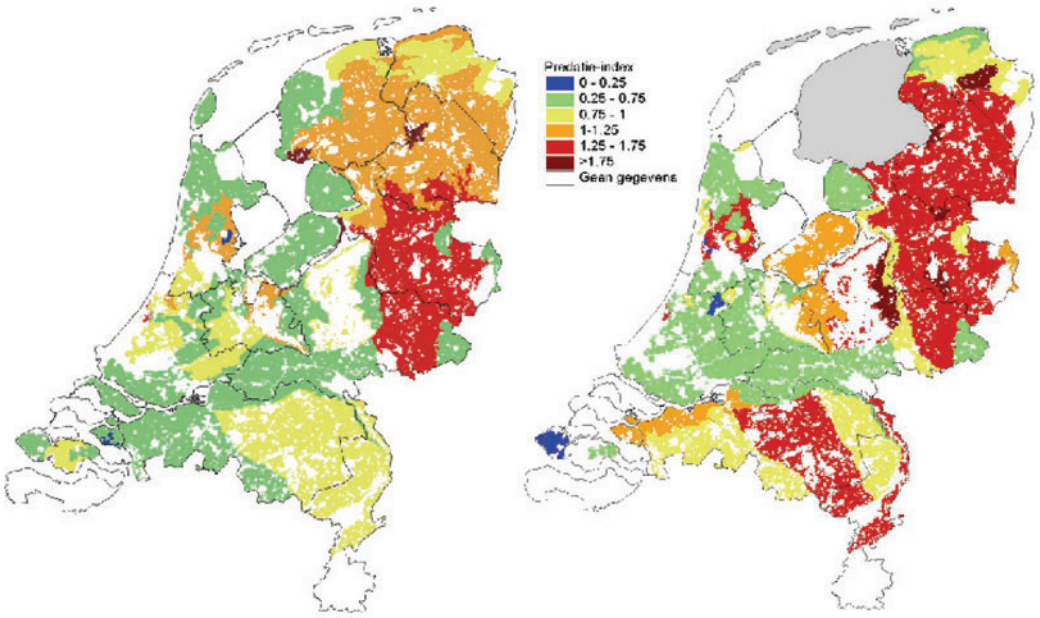

Fig. 1: Predation on meadow shorebird clutches in 2000 (left) and 2004 (right). Predation losses were calculated for a total of 200 regions and indexed against the nationwide average predation loss in that year. Red and orange colours denote above-average, green and blue below-average predation rates. Nest data from Landschapsbeheer Nederland, Bond van Friese Vogelbeschermingswachten, Agrarische Natuurverenigingen and Vanellus vanellus. No data were available for the province of Friesland in 2004.

daily mortality was highest among very young chicks, and then stabilized with a further decline after the fledging age. Taking into account that a significant proportion of chicks ending up as 'missing' in our observations were probably preyed upon or killed by mowing, we estimate that some 60-80% of all lost (including 'missing') chicks was eaten by predators, 5-15% was killed by agricultural activities and 10-15% died by other causes. The probability that a chick was preyed upon before fledging was therefore 50-70%. However, our 'predation' numbers may include an unknown amount of scavenging of chicks that had already died by other causes.

Mortality by agricultural causes (notably mowing of grassland) was significantly more frequent in Godwits than in Lapwings. Mowing losses were probably somewhat underestimated in this study. 75% of chicks lost to mowing were less than 10 days old; the oldest was 23 days old. Drowning in canals or being trapped in ditches caused the death of 6% of all lost chicks. Both Godwits and Lapwings drowned; only Lapwings got trapped in dry ditches. Modifying the height and shape of ditch-sides may thus reduce chick mortality.

In sites where both clutch survival and chick survival were measured, variation in predation losses was much larger in the nest phase, and uncorrelated with predation losses in the chick phase. The latter may be explained by the fact that mammals seem to be the major predators of clutches, while birds take more chicks.

There are no data on long-term changes in the frequency of predation on chicks. In the past decades however, several chick predators have (re)colonised or increased in the 'meadow bird landscape', so that an increase seems probably. As in the case of clutches, it is likely that agricultural losses have also increased during the same period.

3.3 Which predators are involved?

By placing automated temperature loggers in 545 meadow bird nests, the timing of predation events could be determined. There was large variation in both total predation losses and the proportion of nests preyed upon during the day (by birds or diurnal mammals) and during the night (by nocturnal mammals). This was true between sites, between years and even between Godwits and Lapwings within the same site. In predation losses up to 50% both birds and mammals could be involved, but losses exceeding 50% were caused mainly by mammals (Fig. 2).

Continuous recording with time-lapse video cameras was applied at six sites, of which in four Red Foxes were suspected to be active. In a total of 145 nest predations, six to seven predators were identified: (Fox, Stoat, Beech Marten, Polecat, Hedgehog, Domestic Dog and possibly Weasel) and four species of bird (Carrion Crow, Marsh Harrier, Goshawk and Oystercatcher). At the sites with the highest clutch losses Foxes were the main predators, but in one site Stoats took most eggs while in another site no single species pre-

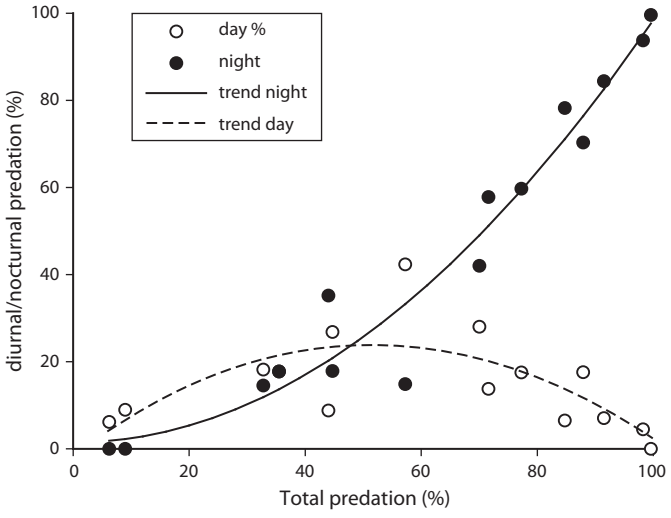

Fig. 2: Relationship between total predation losses of clutches of Northern Lapwing and Black-tailed Godwit in areas with nest surveillance by video cameras or temperature loggers, and the proportion of predation losses occurring by night or during the day. High predation losses (>50%) are predominantly caused by nocturnal predation.

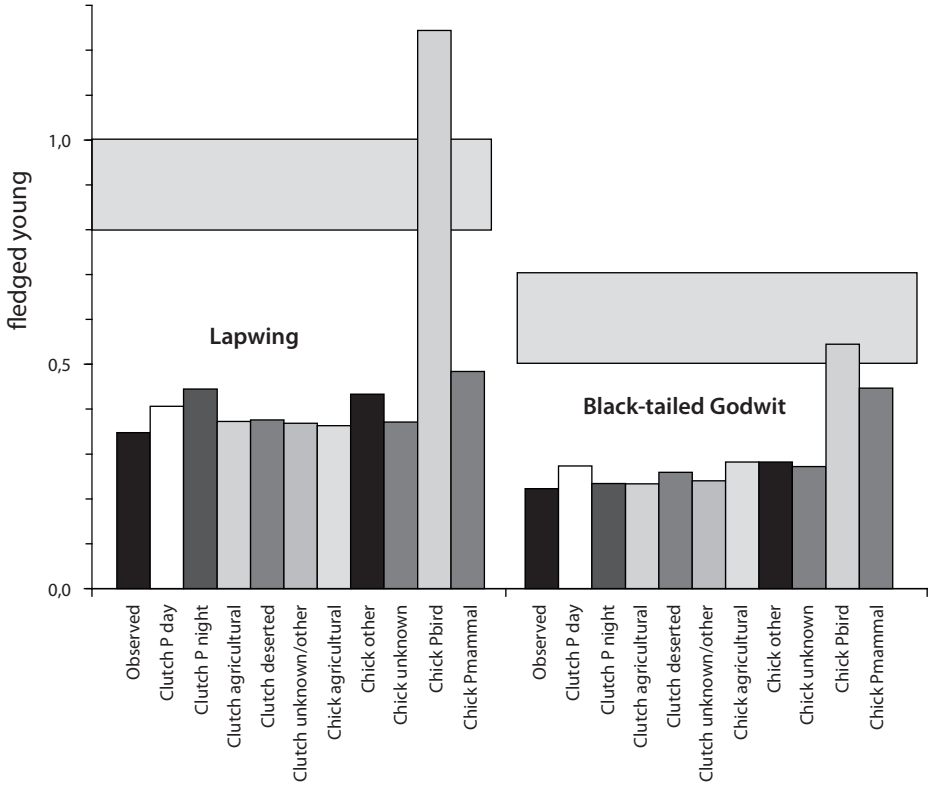

Fig. 3: Overview of effects of eliminating a loss factor during the nest or chick phase on total breeding success (fledged young per breeding pair) of Northern Lapwing and Black-tailed Godwit. The black bars illustrate the average breeding output that was observed in the field; the horizontal bars denote the output needed to compensate for annual mortality of full-grown birds. In most cases eliminating a loss factor hardly results in any improvement of breeding success because several factors operate synchronously and substitute each other's effects. In many areas this result also accounts for the factor "predation by birds", although the averages presented here do show a clear effect.

dominated. Because sites were few and not randomly selected, the observed frequencies cannot be viewed as representative for the whole of The Netherlands, but they do give an indication of the range in species involved and their approximate relative importance.

We recorded only one case in which the breeding adult (Lapwing) was killed by a predator (Red Fox).

In total 15 species were identified as predators of meadow bird chicks; 11 birds and 4 mammals. Based on numbers of recovered radio tags, predation by birds occurred two to four times as often as predation by mammals (but the latter may have been somewhat underestimated). No single predator species accounted for more than 20% of all chick losses with a known cause, but three species were involved more than others: Common Buzzard (16%), Grey Heron (7-18%) and Stoat (16%). Carrion Crow was slightly less important with 6%; other species made up no more than a few percent.

Lapwing chicks were relatively often taken by Grey Herons, Godwit chicks more often by Buzzards and Stoats. This reflects habitat preference of the species involved. In short, open grassland

swards preferred by Lapwings, 80% of the predation was done by birds; mammals (Stoats) mainly took chicks in higher swards that are preferred by Godwit chicks.

In both clutch and chick predation, Carrion Crows played a far smaller role than is often supposed; in none of the study sites was this species the main predator. This was different for the other most-discussed predator species, the Red Fox, but only with respect to clutch predation. Though predation by Foxes on chicks could have been somewhat underestimated, this species did not seem to be an important chick predator in most sites.

3.4 Which factors affect the frequency of predation?

Large variation in the presence and/or activity of predators at the local scale possibly explains why in an analysis of the nationwide clutch data, only few clear correlations were found between predation rate and a number of landscape characteristics, and the abundance of several species of (avian) predators. The analysis did confirm that clutch predation occurs more frequently on sandy soils than on peat and clay soils. Although this is probably mediated by different soil types carrying different landscapes that mediate the occurrence of different predator species, the effect of soil type could not be linked to one or a few specific landscape features. Also among the 17 intensive study sites, only few straightforward relationships were found between landscape characteristics on the one hand and the occurrence of predators and meadow birds on the other, but in general meadow birds were more abundant in open areas with many ditches. Predation pressure on clutches decreased with increasing openness of the landscape.

There seems to be no simple proportional relationship between predator abundance and predation pressure. However, the abundance of some predators, notably mammals, is difficult to quantify.

Hatching probability of meadow bird clutches was highest in the early part of the breeding season, until early May. Thereafter clutch survival decreased, especially in June. This effect was mainly caused by predation which increased notably in June, especially at night. We found no indications that the risk of nest predation is elevated in the last days of the incubation period; hence the story that predators find clutches by the calls of chicks peeping inside the eggs seems untrue.

We used variation in apparent daily survival rates measured over intervals of different length between nest visits to investigate possible effects of these visits on predation probability, and found that survival is decreased by 10% on average by each visit to a nest. The effect was twice as large in sites with a low hatching success than in sites with hatching success >50%. The mechanism involved (scent or visible marks) is not clear, but it seems to last for about two days. Effects of nest visits deserve further research in view of the widespread activities of volunteers protecting meadow bird nests in The Netherlands. While protected (and marked and visited) nests have been shown to enjoy a higher hatching success due to reduced agricultural losses, the effectiveness of the protection could be further increased by minimising nest visits, and nests should not be protected on fields where they are not threatened by agricultural activities.

Survival of Black-tailed Godwit chicks was associated with the type of field that they stayed in, indicating a link between local grassland management and predation rate. The risk of predation (especially by birds) was higher in recently mown or grazed grasslands with a short sward (<18 cm), or in earlier-mown fields with a re-growing sward, than in uncut fields with tall vegetation (15-30 cm). This result points to a clear interaction effect between grassland management and predation risk. In Lapwing chicks, no relationship was found between predation risk and field type.

3.5 Is predation a problem for meadow bird populations?

In Northern Lapwings, about half of the total reproductive losses occurred in the nest phase and the other in the chick phase. In Black-tailed Godwits these proportions were 35% and 65% respectively. Predation accounted for 60% of all reproductive losses in Godwits and 75% in Lapwings. Agricultural losses were limited however in all study areas because of the occurrence of nest protection by volunteers.

The effect of various loss factors on the total reproductive success of Lapwings and Godwits was explored by virtually excluding them one by

one, recalculating reproductive success and comparing this with the observed values. In most sites predation on chicks (especially by birds) turned out to be the most influential factor. The effect of nest predation was usually smaller and comparable to that of other causes (Fig. 3). Effects of various causes of failure on population development were estimated with a simple population model. Based on measured values for nest success and measurements or assumptions for chick survival in several studies, a population decline is calculated in most cases, for both Black-tailed Godwit and Northern Lapwing. Virtually excluding all predation in the chick phase was the factor that could reverse this decline most often, but in only a minority of cases the decline could be reversed by excluding a single factor. In the other cases, several factors had to be excluded simultaneously to stabilise the population. In some cases, eliminating all losses other than predation also led to a stable or growing population.

3.6 Relevance for policy and management

Formulating recommendations for specific policy and management measures was not a goal of this study; this was to supply data that provide discussions about predation in The Netherlands with a scientific basis. A first important point relevant to this discussion is the observation that predation can be a problem for meadow bird populations, but usually only in combination with other causes of reproductive failure. The frequency of (clutch) predation, while showing a consistent spatial pattern on the national scale, varies greatly between sites and years. The same is true for the contribution of each of the many predator species involved. The only generalisation possible is that in areas with more than 50% predation losses of clutches, mammals -notably Foxes- seem to play the major role, though even this rule has exceptions. In view of this heterogeneity in predation pressure and the wide range of species involved, an area-specific approach based on sound knowledge of the local situation will probably be more effective than general, country-wide measures. The model simulations showed that excluding a single loss factor –even if at all possible- will often not suffice to reverse a local population decline. In addition, the loss factor that proved most influential in many sites, predation on chicks, will probably not be easily reduced in practice. This provides strong arguments for an approach targeting several locally limiting factors simultaneously instead of focusing on predation only.

References

Teunissen, W., Schekkerman, H., & Willems, F. (2005): Predatie bij weidevogels., Rep. No. 2005/11. - Beek-Ubbergen.

Teunissen, W.A. & Soldaat, L.L. (2006): Recente aantalsontwikkeling van weidevogels in Nederland. - De Levende Natuur 107: 70-74.