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Breeding success of Black-tailed Godwits *Limosa limosa* under 'mosaic management', an experimental agri-environment scheme in The Netherlands

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Zusammenfassung: Die niederländische Brutpopulation der Uferschnepfe (*Limosa limosa*) verzeichnet über die letzten Jahrzehnte hinweg eine kontinuierliche Abnahme. Diese Bestandsabnahme konnte bislang auch durch Schutzmaßnahmen nicht aufgehalten werden. Deshalb wurde in den Jahren 2003 – 2005 in sechs Grünlandgebieten mit je 200 – 300 ha Fläche eine neue Form des Vertragsnaturschutzes getestet. Dabei haben die in einem Verbund zusammengeschlossenen Landwirte ein vielfältiges Bewirtschaftungsmosaik praktiziert, das unter anderem variable, gestaffelte Mahdtermine (mit Möglichkeit der Verlegung auf einen späteren Termin), eine (frühe) Beweidung, die Anlage von Fluchtstreifen während der Mahd und aktiven Gelegeschutz vorsah. Um die Wirksamkeit des Programms zu überprüfen, wurde der Bruterfolg der Uferschnepfe in den Vertragsgebieten mit angrenzenden Kontrollgebieten vergleichend untersucht. Die Mosaikbewirtschaftung führte in den Testgebieten zu einem höheren Bruterfolg (0.28 vs. 0.16 Küken pro Paar) gegenüber den Kontrollgebieten, allerdings nur infolge der geringeren Gelegeverluste durch die Landwirtschaft. Die Kükenüberlebensrate lag in beiden Gebieten bei 11 %. Entgegen den Erwartungen unterschied sich die Zahl der Aufzuchthabitate (hier: u.a. spät gemähte Wiesen mit hochwüchsiger Vegetation) zwischen den Test- und Kontrollgebieten während der Schlupf- und Aufzuchtphase kaum. Dieses Ergebnis geht weder auf die Landwirte selbst noch auf die beschriebenen Managementbestimmungen zurück, sondern ist vielmehr das Resultat von Niederschlagsereignissen, die auf allen Flächen zu einer verspäteten Mahd führten. Unter Berücksichtigung der Gebietsunterschiede korrelierte die Überlebensrate der Küken positiv mit dem Flächenanteil höherer Gräser (>18 cm). Der für den Bestandserhalt notwendige Bruterfolg zur Kompensation der Adultsterblichkeit (ca. 0.6 Küken/Paar) wurde in nur einem Testgebiet mit Mosaikbewirtschaftung. Im Vergleich mit früheren Studien lag die Kükenüberlebensrate sogar niedriger. Dies legt den Schluss nahe, dass weitere, zusätzliche Verlustursachen an Bedeutung gewonnen haben. In Frage kommen hier ein zunehmendes Prädationsrisiko (50-80 % aller Küken; meistens durch Vögel verursacht) aber auch Veränderungen in der Verfügbarkeit und Eignung spät gemähter Grünländflächen. In Bezug auf die Eignung von Grünlandflächen als Aufzuchthabitate dürften insbesondere der Arthropodendichte und der Dichte der Vegetation Bedeutung zukommen. Die bisherigen Ergebnisse machen deutlich, dass der Umfang der Artenschutzmaßnahmen deutlich gesteigert werden muss, um eine tragfähige Uferschnepfenpopulation langfristig zu erhalten.

Summary: Black-tailed Godwits (*Limosa limosa*) have been declining for decades in The Netherlands and so far this has not been slowed by conservation measures. A new form of agri-environment scheme was tried out in 2003-2005 at 6 sites where a 'grassland mosaic' (200-300 ha) was created by collectives of farmers through a diverse use of fields including postponed and staggered mowing, (early) grazing, creating 'refuge strips' during mowing, and active nest protection. We measured breeding success of godwits in each of the experimental sites and nearby, paired controls. Breeding success was higher (0.28 chicks fledged /pair) in mosaics than in controls, but due to lower agricultural nest losses only. Chick survival was 11 % in both mosaics and controls. The amount of late-mown and other grassland suitable for chicks hardly differed between treatments during the fledging period, mainly due to rainfall delaying postponed mowing in all sites. Chick survival was however positively correlated with site variation in the amount of high grass (>18 cm). Breeding success was high enough to compensate for adult mortality (ca. 0.6) in only one mosaic site. Chick survival was lower than in previous Godwit studies, indicating that additional loss factors have increased. Predation (50-80 % of chicks, mostly by birds) is a candidate, but changes in the suitability of late-mown grassland (insect abundance and sward density in grass monocultures) may also play a role. Consequently a higher management investment is needed to achieve a self-sustaining population.

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1 Introduction

The Dutch breeding population of Black-tailed Godwit *Limosa limosa* has been decreasing for several decades (Teunissen & Soldaat 2006). More intensive conservation measures than included in the current agri-environment schemes (Kleijn et al. 2001; Verhulst et al. 2007; Willems et al. 2004) seem necessary to maintain viable populations on farmland (outside reserves), where at the moment still about two thirds of the Dutch population breeds. In answer to this realization, three NGO's in the field of bird and nature conservation protection and agri-environment projects (Vogelbescherming Nederland, Landschapsbeheer Nederland and Natuurlijk Platteland Nederland) initiated the project 'Nederland-Gruttoland'. During 2003-2005, an experimental form of collective 'mosaic management' was put into practice, that was designed to be compatible with modern dairy farming yet yield suitable conditions for reproduction of meadow birds, especially Black-tailed godwits. Aims of the project were (1) to demonstrate that this form of management is economically feasible within the farm practice, and (2) to test whether it is effective for Godwits.

Basic ideas underlying the experimental scheme were (a) safeguarding sufficient suitable grassland with food and cover for Godwit chicks during their entire fledging period, and (b) creating a spatial mixture of differently used fields at the scale of the site (200-400 ha), in which field types that provide different resources for Godwits and other birds are available and within reach in all stages of the breeding season. This is effectuated through a suite of measures including spreading the first cut of grass in time, postponing mowing dates on selected fields to 1, 8, 15 or 23 June, leaving parts of fields uncut as 'refuge strips', early grazing of fields followed by a period of rest, use of farmyard manure, inundating some fields in early spring, and a slower driving speed during mowing (Table 1).

2 Methods

We studied the effectiveness of the experimental management in enhancing Godwit breeding success (Schekkerman et al. 2005). We chose breeding output as the response variable, because this provides a direct measure of the contribution of management to the wider population, while breeding densities respond more slowly in this long-lived species and may be affected by dispersal in addition to local breeding success.

Table 1: Components of 'mosaic management' with rationale and average proportion of area contracted in the six experimental sites.

Management component	Rationale	%
1st cut postponed until 1/8 June	Chick feeding habitat and shelter	11
1st cut postponed until 15/22 June	Chick feeding habitat and shelter	7
Grazing followed by rest until 15 June	Chick feeding habitat in late spring	4
Sequentially mowing out strips to feed to cattle in stable	Diverse sward height within field, suitable for feeding adults and chicks	4
Leaving uncut strips at early-cut fields	Escape havens during mowing; feeding habitat and shelter during brood movements	2
1st cut in May staggered in 3 tranches Separated by >1 week	Allow broods to find unmown grass nearby when of residence is cut	58
Grazing	No specific conservation rationale	13
Flooding grassland 15 Feb – 15 Apr	Early-season resting and bathing habitat for adults	1
Marking and mowing around clutches	Avoid agricultural egg losses	86
Reduced driving speed during mowing	More chicks able to escape machines	86

Godwit breeding success was estimated during one year in each of the six sites with experimental mosaic management and six matched control sites nearby. There were three site pairs in Friesland and three in the western part of The Netherlands. Control sites did not receive mosaic management, though other measures aimed at meadowbird conservation, e.g. nest-protection, did occur to some extent. Breeding output was estimated by combining data on hatching success for the majority of nests in the study areas (14-82 nests per site (total n=620), found and monitored by volunteers to safeguard them from agricultural losses) with chick survival measured in a smaller sample by radio-tracking chicks or their parents (13-55 chicks per site (total n=387) (Schekkerman & Müskens 2000). We failed to obtain a chick survival estimate in one of the control sites. We tested whether agricultural field use and Godwit breeding productivity differed between experimental sites and controls (using analysis of variance with site pair as a blocking factor), and whether enough young fledged to balance adult mortality.

During radio-tracking we also recorded the location of each radio-tagged brood and the availability of 10 different habitat types (arable and grassland in different phases of the mowing or grazing cycles). Chick condition was monitored by recapturing and weighing radio-tagged chicks every 4-7 days.

In two site pairs, the return rates of 35 adult Godwits colour-ringed in 2003 were studied in 2004-2005. On average, 80 % returned to the breeding site in the next spring (Roodbergen et al., ms). This confirms that earlier observations of breeding site tenacity also apply to present-day intensive farmland, and that an estimate of required breeding productivity based on older estimates of adult annual survival (ca. 0.6 fledged young per pair, based on Beintema & Drost (1986) and Groen & Hemerik (2002)) is still valid.

3 Results and Discussion

3.1 Experimental results

We failed to obtain a chick survival estimate in one of the control sites. Reproductive success of Black-tailed godwits was higher in the experimental mosaic sites (mean: 0.28 fledged young/breeding pair, range: 0.0-0.72, n = 6) than in controls (mean: 0.16, range: 0.0-0.35, n = 5; p = 0.059), but this was entirely caused by a higher hatching success of clutches (50 (18-87) % vs. 33 (14-73) %, p = 0.002), due to lower agricultural nest losses (6 % vs. 29 %, p = 0.052). The larger scale and intensity of nest protection by volunteers played a role in this, possibly combined with a higher alertness and experience of farmers in avoiding

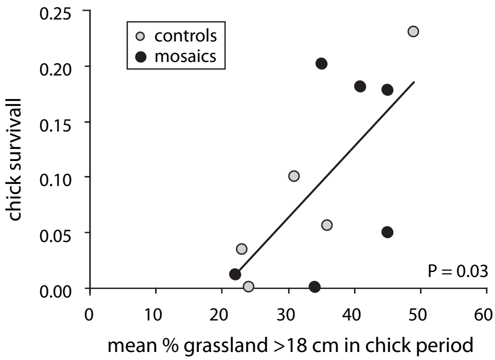

Fig 1: Survival of Black-tailed godwit chicks in 11 sites in relation to the area of grasslands with a sward >15-20 cm (mostly not yet cut or grazed, partly refuge strips and regrowing fields) in the main chick period ($F_{1,10} = 6.91$, $p = 0.027$).

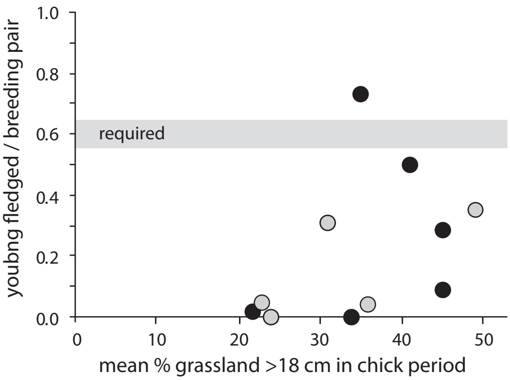

Fig. 2: Breeding success of Black-tailed godwits in 11 sites in relation to the area of grasslands with a sward >15-20 cm in the main chick period ($F_{1,10} = 2.02$, $p = 0.19$). The grey bar denotes the breeding output that is needed to balance mortality of full-grown birds and maintain a stable population.

destroying clutches during field activities. Predation losses did not differ between the two groups of sites (32 % vs. 37 %, $p = 0.48$).

Survival of Godwit chicks to fledging did not differ between experimental sites and controls (both 11 %, range: 0-23 %, $p = 0.81$), and neither did their condition, as observed during recaptures of radio-tagged chicks. However, chick survival did show a positive correlation with variation between study sites in the average availability of (mostly unmown) fields with a tall (>18 cm) grass sward during the main chick period (Fig. 1), irrespective of the sites' status as a mosaic or control site. A primary goal of the prescribed management, a higher availability of late-mown grassland suitable for chicks than in the controls, was not achieved in practice. The proportion of unmown fields and of 'chick-grass' (unmown fields plus refuge strips and regrown swards that had been cut earlier), was not significantly larger in experimental sites than in controls during the main period of chicks' presence (chick grass, 37.0 vs. 33.4 %, $p = 0.43$). The lack of a difference in land use was not caused by farmers ignoring management prescriptions. Rather, the mosaic management was somewhat 'diluted' by some fields owned by non-participants being interspersed between experimental grasslands, and field use in a few control sites was relatively low-intensity, although in only few cases it clearly differed from 'typical' modern farmland. Most importantly in all three study years rainy periods in May forced farmers to postpone mowing in both experimental and control sites.

The correlation between chick survival and the availability of tall grass indicates that the basic concept that mowing fields later is beneficial to chicks does apply, and suggests that a difference in chick survival between experimental sites and controls would have been found, had the difference in land use been larger. The results, however, also show that the experimental management overlaps in intensity with the between-year variation in 'ordinary' agricultural land use, and this should be improved for it to be effective in all years.

On the whole, chick survival in this study was poor to very poor in comparison with earlier measurements in Dutch Black-tailed godwits. Combined with a relatively low hatching success of nests, this led to low numbers of chicks fledged per pair. Just one of the estimates from experimental areas (0.72) exceeded the value required of ca. 0.6 fledged young per pair (Fig. 2). In one other experimental site, productivity fell not much below the threshold, but all other estimates (including controls) fell below 0.3 fledged young per pair. Thus breeding success was insufficient for a self-sustaining population in both mosaics and control areas.

Fig. 3: 'Refuge strip', part of the field is skipped during mowing to preserve feeding habitat and shelter for meadow bird chicks.
Photo: H. Schekkerman

3.2 Results in a wider perspective

In combination with earlier studies these data suggest that breeding success of Dutch Black-tailed godwits has decreased considerably in recent decades, even in areas where the availability of 'chick-grass' would have been considered sufficient on the basis of existing insights. Factors other than mowing dates may have further reduced chick survival; obvious candidates are other aspects of agricultural intensification, and an increase in predation of chicks.

Predation was the prevailing cause of death of chicks (50-80 %), followed by agricultural losses (mowing: 7 %) and drowning in ditches (5 %). However, 'predation' may include an unknown amount of scavenging of chicks that died by other causes. Fifteen predator species were identified, with Common buzzard (*Buteo buteo*) and Stoat (*Mustela erminea*) as the most frequent (though not strictly dominant) species. We did find indications for interactions between (mowing) management and predation. Chicks ran a higher risk of predation (especially by birds) in recently mown or other fields with a short sward (<18 cm), and in earlier-mown fields with a regrowing sward (>18 cm), than in fields that had not yet been cut (sward >18 cm). Possibly, predation risk is also higher in high grass occurring in strips than in completely unmown fields.

The development of body condition of chicks up to 12 days old lagged behind the expected growth rates based on measurements made in the 1980's (Beintema & Visser 1989). Older chicks often showed a somewhat better condition, possibly as a result of condition-biased mortality. Chicks with suboptimal condition ran a higher risk to 'disappear', due to unknown causes. It is not clear whether the reduced average condition was caused by relatively unfavourable weather in the study years, or by a structural shortage of insect prey in modern agricultural grasslands. This calls for further study.

3.3 Scope for improvements

The relationship between chick survival and availability of unmown grassland, data on habitat preferences of Godwit broods and predation risks in different field types all point to increasing the proportion of late-mown grassland as the best way to improve the effectiveness of management mosaics for Godwits. Refuge strips and regrowing grass on early-mown fields do not seem to provide equivalent alternatives (see Fig. 3), but must be seen as additional instruments that may help in alleviating spatial (strips) or temporal (regrowth) bottlenecks. Further studies are required into the role of variation in the quality (insect abundance, vegetation structure) of late-mown grassland.

The current results do not allow a precise estimate of the proportion late-mown grassland that will lead to a sufficiently high breeding success. This will also depend on external preconditions that vary in time and space. It is however clear that the quality of the mosaic needs to be improved. A crucial question is whether these improvements will be feasible within the economic and practical constraints of modern agriculture. Further experiments with mosaic management are thus called for (and are currently being carried out in The Netherlands), but with more intensive management prescriptions. If these experiments do not lead to viable breeding productivity levels, conservation effort would better be directed at a selection of areas with good external preconditions (landscape, water levels, lack of disturbance) where nature conservation is given priority over agriculture and further intensification of measures is possible.

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