Altenburg & Wymenga ECOLOGICAL CONSULTANTS

A&W-report 911

MANAGEMENT OF MEADOW BIRD COMMUNITIES IN FRYSLÂN

Bottlenecks and solutions in the core areas of the Black-tailed Godwit

in association with

RSPB

Environment Agency

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with support of J. van der Linden

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SUMMARY

Finding the optimal conservation strategy for a bird species with its main population breeding on farmland is not an easy task. The Black-tailed Godwit *Limosa l. limosa* is declining rapidly and has a limited distribution worldwide with its stronghold located in the province of Fryslân in The Netherlands. Breeding numbers here have decreased from 50,000 in the 1970s to 20,000 in 1999. This decline has not come to an end yet, and other species of the meadow bird community are in similar trouble. This rapid decrease gives rise to concern. Within that framework policy-makers, farmers and researchers in Fryslân jointly put a lof effort in conservation and working towards optimal management strategies, providing that threequarters of the population breeds on farmland where farmers make a living. With this background, we present in this concise report the results of a long term research framework, investigating where and when the most important limiting factors in the annual cycle of this afro-European migrant occur and how these hurdles can be tackled. This framework - although centred on the Black-tailed Godwit - may act as a blueprint for other threatened species of the agricultural grassland biome in Western Europe.

After breeding, West-European Black-tailed Godwits migrate towards their wintering areas located in the West-African coastal region and floodplains in Mali. The west-European population winters mainly in the rice and mangrove zone from South Senegal to Guinea. A survey carried out in 2005-2006, shows that the distribution is comparable with that in the 1980's, but that numbers have declined, paralleling the decline in the breeding numbers in western Europe. There are no indications that hunting and disturbance are major threats on the wintering grounds, though during arrival conflicts with farmer may occur on sowed rice fields. During spring migration Godwits are concentrated in large groups on a few sites in the rice fields of Portugal (Tejo and Sado estuary) and Spain (Extremadura and Coto Doñana). Here they forage exclusively on rice. At present these rice fields offer sufficient suitable staging habitat, but they are susceptible for future changes.The traditional staging sites in Marais Poitevin (Vendée, France) have lost in importance. Maximum counts show a decrease since the 1980s which can be at least partly attributed to a changer in suitabel habitat. Other important sites in France (Moëze-Oléron and the Basses Vallées Angevines) did not show decreasing numbers. The main threats along the spring migration route are climate change, habitat change and hunting. Habitat change has had negative effects in the past in Morocco and France, and may have contributed to a shift in the use of staging sites. The impact of hunting in France is unknown, and reliable data are lacking. If – as suggested from recent information - a few thousands juvenile Black-tailed Godwits get shot annually, the negative impact of this activity is of significance and should not be ignored.

In the breeding season Godwits receive no habitat protection from EU directives and their habitat (agricultural grasslands) receives insufficient protection in national law and planning. Agricultural grasslands underwent a change in grazing regime and in fertiliser application over time. In some reserves and some grasslands under agri-environment schemes acidification – in combination with a the lack of fertilisation – leads to soil exhaustion and the consecutively a lower biomass of soil invertebrates, the principal component of the diet of adult Godwits. On the other side of the spectrum, agricultural innovations have lead to an earlier onset and higher frequency of mowing, giving clutches and chicks limited and incidentally hardly any survival options. The Godwit is declining throughout its range, but

the strongest declines are observed in areas that always had the lowest densities (marginal areas) and the decline on farmland is twice as steep compared to that in reserves.

Godwits require unobstructed vision in all directions, but their preferred open landscape is gradually transformed in a semi-open landscape. This seems to be associated with higher levels of disturbance and predators. The role that predation plays in the decline of the Godwit is not yet fully understood. Fact is that many predators have increased and at least loccaly can have a significant negative impact. Clear evidence that this is causal to the decline of the Godwit on regional level is absent. Fundamentel are the landscape changes, facillitating those predators that were absent in formerly open landscapes, but have found their way paved now the landscape has changed into a semi-open landscape.

Chicks prefer to hide and feed in tall and diverse vegetation, and this has become scarce in agricultural grasslands. The difference in diet between adults and chicks translates in opposed habitat requirements. In some grassland reserves, conditions for chicks are optimal, but here the low fertiliser load (optimal for botanical diversity and key meadow birds) leads to an underdeveloped soil arthropod community, resulting in a lack of food for adults in early spring. Similar areas of conflict arise around optimal ground water levels.

In the province of Fryslân, the government is acquiring grassland reserves and farmers are financially supported to in agri-environment schemes to manage their land in a 'meadow-bird friendly' manner. They are assisted by a large army of volunteers that help farmers in the protection of nests and chicks. Despite these huge public participation efforts, the population is still decreasing and here we report on a set of actions to improve upon the current conservation efforts. The openness of the countryside should be better protected: important meadow bird areas should receive a protective status which guarantees the conservation of open landscapes and avoids habitat loss through infrastructure and urban developments. Delayed mowing and a mosaic-management are good ways of reducing clutch- and chick-loss. Ditches should have shallow profiles and the ground water level shouldn't fall too low. This type of management can be built in modern farming, but requires a co-operative partnership of government (province, council), farmers, nature reserve managers, volunteers and public.

Nature reserves are often not optimally managed for Godwits, lacking the proper type of fertiliser (raw manure) and fertilisation intensity. Reserve managers should formalise meadow bird targets, which allows evaluation of the effectiveness of their management. The age related differences in diet for Godwits translates into different habitat requirements and management for adults and chicks, and between adult Godwits and other key meadow bird species. To overcome this problem a plethora of management options should be realised in one area, resulting in so-called Mosaic management. The main characteristics are: presence of mowed and grazed areas, early and late mowing dates, permanent low-intensity grazing, annual fertiliser application with raw manure, pH not below 4.5 and the presence of marshy ponds and botanical diversity. Finally, breeding densities and minimum breeding success are given for a set of meadow birds in good habitat.

PREFACE

The typical historic Dutch landscape is characterised by vast open quiet areas of low lying productive grasslands, often in reclaimed areas, dominated by windmills, free ranging Frisian cows and with relatively high densities of typical meadow birds (amongst others Shoveler *Anas clypeata*, Garganey *Anas querquedula,* Black-tailed Godwit *Limosa l. limosa*, Lapwing *Vanellus vanellus*, Redshank *Tringa totanus*, Ruff *Philomachus pugnax*, Snipe *Gallinago gallinago* and Skylark *Alauda arvensis*). Over time this typical Dutch ´polder landscape´ is more easy found on paintings than in reality. The open areas became fragmented, windmills were replaced by large pumping stations, cows are progressively found more often indoors and the numbers of traditional meadow birds have dropped at an alarming rate.

The Black-tailed Godwit is the most charismatic of all Dutch meadow birds. At the same time is has only a very limited distribution worldwide. but with a stronghold in The Netherlands. This species has become therefore - and without reason - the flagship for the open Dutch countryside. Of all European Black-tailed Godwits, around 50% can be found in The Netherlands, and a third of which can be found in the northern province of Fryslân. Research, conservation and habitat management for meadow birds is well developed in The Netherlands, however results are sometimes poorly disseminated or unavailable in languages other than Dutch. Following exchange of management and ecological information, the Royal Society for the Protection of Birds (RSPB) asked Altenburg & Wymenga ecological consultants to translate two of their recent Dutch publications on meadow bird conservation in The Netherlands. In the current publication these reports have been merged to a succint summary of the issues, centred around two main themes: what are the problems and what are the solutions for meadowbirds in The Netherlands?

The assessment of the problems that the Dutch godwit population is facing is based on a report published in 2001 (Wymenga *et al.* 2001) *'Takomst foar de Skries: bouwstenen voor een beschermingsprogramma voor de Grutto in Fryslân'* literally translated: Future for the Black-tailed Godwit: building blocks for a conservation programme for the Black-tailed Godwit in Fryslân. In addition, we updated part of this information with new findings that came out of a recent studies, as well as a recent survey of the wintering and spring staging sites (Kuijper *et al.* 2006) 'Wintering areas and spring migration of the Black-tailed Godwit', available from our website www.altwym.nl). The sections of this report that deal with management of meadow birds came from a report published in 2004 (Oosterveld & Altenburg 2004) '*Kwaliteitscriteria voor weidevogelgebieden, met toetslijst'* literally translated: Assessing the quality of meadow bird areas, with checklist).

With this publication, initiated and supported by Jeff Kew of the RSPB, we hope to supply managers outside The Netherlands with concrete management information on meadow bird communities in The Netherlands. May be this information proves to be not tailor-made to their reserve or area of interest, but at least it can play a stimulating and steering role in discussions on how to find the optimal management for meadow birds communities.

1. INTRODUCTION

1.1. FRYSLÂN AS CORE BREEDING AREA FOR GODWITS

At least since halfway the 20th century The Netherlands harbours a considerable population of Black-tailed Godwits, breeding in open low-lying grassland areas (Beintema *et al.* 1995a). Despite a recent decline, The Netherlands still harbours the core breeding population of this species in Western Europe (Thorup 2006, data around 2000): up to 85% of the East-Atlantic population and up to 47% of the total continental population (East Atlantic and Central European populations combined). The large majority of this population therefore is breeding The Netherlands, which consequently plays a key role in the international conservation of the species.

The strong and continuous decrease in breeding numbers over the last decades in The Netherlands is alarming (Fig. 1). In 1960 the breeding population was roughly estimated at 125.000 breeding pairs and during the 80's between 85-100,000 pairs (Piersma 1986, SOVON 1987). The most recent estimate of the population, based on a country-wide inventory, amounts to 49-75,000 pairs with an annual loss of about 4% (Teunissen *et al.* 2005, Teunissen & Soldaat 2006, for more information www.grutto.nl). This more precise estimation is higher than earlier recent estimates of 45.000-50.000 pairs (SOVON 2002).

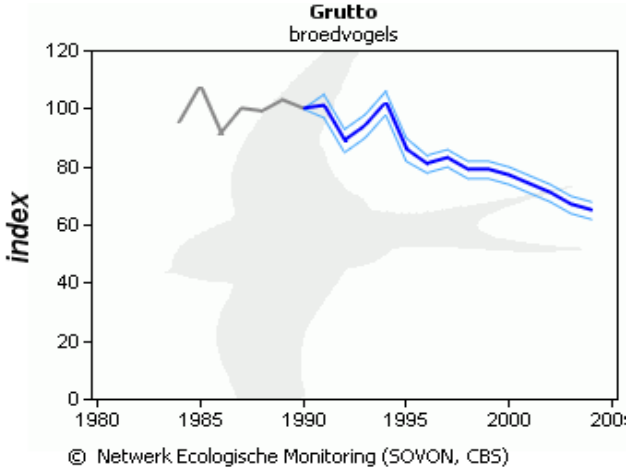


Fig. 1.
Population trend of the Black-tailed Godwit between 1980 and 2005, as produced by the Breeding bird Monitoring Project (BMP) of SOVON. Shown is the yearly population-index en the confidence interval, based on counts in sample areas in The Netherlands. Source: www.sovon.nl.

The decrease mentioned is not restricted to only the Black-tailed Godwit, other typical grassland species have shown similar or even a stronger decrease in numbers since the 1970s (Teunissen & van Paasen 2000, Beintema *et al.* 1995). The onset of the decline coincided with large changes of agricultural practice and extensions of infrastructure in the 1960s. In the province of Fryslân - traditionally the stronghold of the species in The Netherlands - numbers have dropped from more than 50,000 in the 1970s, to 20,000 at the turn of the century (Nijland 1999, Nijland *et al.* 1996). Alarmingly, over the last decade (1990-2000), while protective measurements have come into action, numbers have dropped from 30,000 to 20,000, and this decline has not come to an end yet (Wymenga *et al.* 2001, Teunissen &

Soldaat 2006). When a specific species with a limited distribution worldwide, shows a dramatic drop in numbers even at the core of its distribution range and shares a habitat with other species that also show a decline in numbers, there is profound reason for serious concern.

This report summarizes the problems that the Black-tailed Godwit is facing. Although this report is largely focussed on this species, most of the problems have a strong overlap with those faced by other meadow birds. The general ecological knowledge of the Black tailed Godwit is reasonable well developed (compared to other meadow birds such as skylarks) and we use the general framework developed for this species as a template for other birds that share the same habitat, being aware of the differences in habitat choice. The Black-tailed Godwit share its grassland biome in Fryslân with Oystercatcher, Lapwing, Curlew, Redshank, Snipe, Mallard, Shoveler, Yellow wagtail, Skylark and Meadow pipit and all these species show a decrease in numbers in Dutch agricultural grasslands (Teunissen & Soldaat 2006). But more dramatic, key or critical meadowbirds (species that are very demanding in terms of habitat quality) that used to share their habitats with the Black-tailed Godwit, such as Corncrake, Ruff and Garganey have become locally extinct in most areas, only surviving in fragmented populations (SOVON 2002). This in particular is the case in very wet meadows; Godwits manage to survive also in less wet meadows, providint that enough food is present and exploitable.

1.2. WORKING ON RECOVERY

In especially the Dutch province of Fryslân, a region largely dominated by grasslands, the government, farmers and public nature conservancies are teaming up to stop the decline of the Black-tailed Godwit and meadowbirds in general. Policies and strategies are developed on a national or landscape scale and these are translated into concrete management measures on a parcel level. On a planning level this may give rise to policy contradictions, in the sense that there is a strong drive to conserve meadow birds communities and connected open landscapes while at the same time there is a strong commitment to economic development linked to infrastructural investments and urban development. In the recent draft Regional Planning Scheme Fryslân (2006) a compensation obligation for meadowbirds is incorporated in case of habitat loss.

The (national and regional) government is investing in acquiring grassland nature reserves. Managers of nature reserves (large NGO's) are putting much effort in optimising the management of grassland reserves. Farmers are financially stimulated in the framework of agri-environment schemes to work in a more 'meadow-bird friendly' way. These agri-environment schemes are widely inplemented today, though the overall resultst are still modest (amongst others Verhulst *et al.* 2006). Also there is a strong public interest in meadowbirds, rooted in the very old tradition in Fryslân to collect the first eggs of Lapwings in spring. Though the effects of collection of eggs of lapwings gave and give rise to serious debates, the enthusiastic volunteers are assisting farmers in protecting nests and chicks. These time-consuming efforts imply a strong organisation: the BFVW (founded 1947) or freely translated in Frisian Alliance of Bird Guards. With more than a few thousand active volunteers this is probably one of the larger public bird protection initiatives worldwide.

However, successful conservation of the Black-tailed Godwit is not easy. Despite all the efforts, the progress made over the last ten years is insufficient and the species is still rapidly declining (see before) throughout its Dutch range.

Box 1: Godwit breeding numbers in relation to soil type and management in Fryslân

A systematic survey of breeding meadow birds in Fryslân started in 1996 (coordinated by SOVON; van Dijk 1996). However data do exist from the time period prior to 1996 based on the work of Frisian Alliance of Bird Guards (for details how the BFVW data were transformed in BMP data we refer to Nijland *et al.* 1996). For a detailed analysis of the spatial distribution and decline of the Black-tailed Godwit in Fryslân over the last ten years, the area was divided in seven major soil types (figure 2). The total breeding population declined roughly from 30,000 pair in 1991 to 20,000 in 1999*. The highest densities can be found on clay-on-peat soils (table 1). In general the numbers have been decreasing most rapidly in areas with low densities (marginal habitats). Here Godwits seem to disappear from farmlands and only survive in reserves. Breeding numbers decrease twice as steeply on farmland compared to reserves, resulting in a much higher density in reserves compared to farmland.

*This decline is only partly caused by habitat loss. On estimation 3.5% of suitable habitat has been lost to infrastructure. Since this calculation was done a further decline took place.

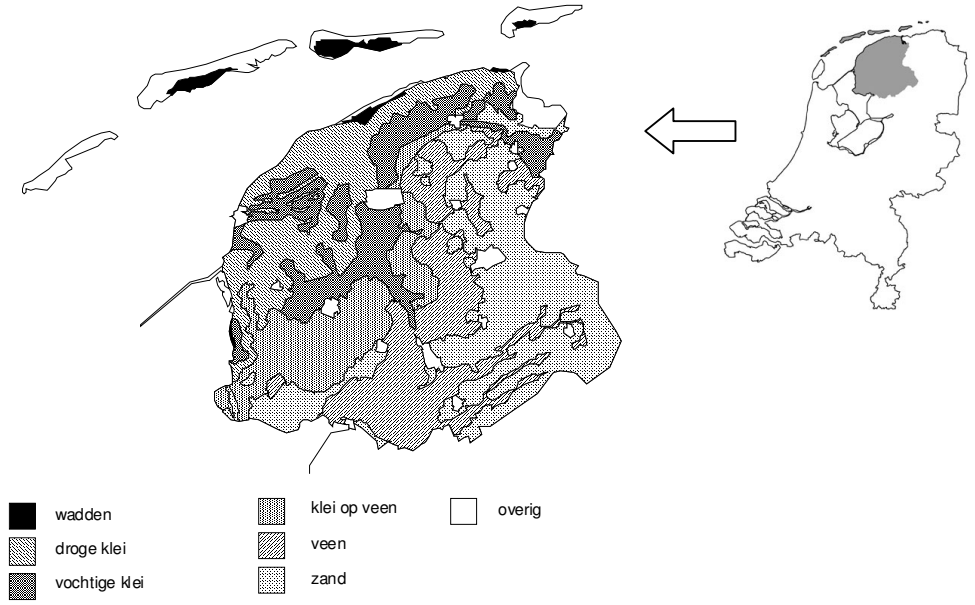


Figure 2. *Distribution of the major soil types in Fryslân.*

Table 1. *Density of breeding Black-tailed Godwits in relation to soil type and management in Fryslân. For each soil type the following parameters are given: surface (in hectares), total number of breeding pairs in 1999 (population size) and the density (pairs per 100ha) broken down by densities on farmland and reserves. Between brackets the decline is given in rounded figures over roughly a ten year time period (by comparing results form 1991 with 1999).*

Area / soil type	Surface (ha)	Population size (pairs)	Breeding density (pairs /100ha)		
			Total	Farmland	Reserves
Wadden Sea Islands (*wadden)*	4200	710	17	15 (-15%)	21 (-)
Light clay (*lichte klei*)	51200	3031	6	5(-30%)	-
Heavy clay (*zware klei*)	40000	4644	12	9 (-40%)	82 (-5%)
Clay-on-peat (*klei op veen*)	31000	7027	23	20 (-20%)	40 (-40%)
Peat (*veen*)	45100	4820	11	6 (-50%)	50 (-10%)
Sandy soils (*open zand*)	13900	533	4	3 (-50%)	-
Total	185400	20765	11		

Note: the Frisian Godwit population dropped below 20,000 pairs (see Nijland 2004)

As a starting point in the conservation process three criteria were formulated:

- All conservation activities should be aimed and contribute to the development of a sustainable Godwit population, serving as key species for other meadow birds. This population should be based on breeding pairs that occupy regular farmland, farmlands under agri-environment scemes and grassland reserves.
- Stimulating initiatives that will result in putting a halt to the decline of the species.
- A long term conservation programme should be based on a continuous process of conservation and management. It should lead to a programme based on scientific understanding, given high priority by the parties involved, and not rigid, but regularly updated, evaluated and revised.

This report summarises the next steps in safeguarding the meadow bird community in Fryslân – and comparable regions – in general and the breeding population of the Black-tailed Godwit in particular. As background information, Chapter 2 gives a sketch of the annual life cycle of the Black-tailed Godwit. In Chapters 3-6 we deal with analysing the main problems in the breeding area, while this information is used in Chapter 7-8 to develop concrete actions and measures aiming at an improvement of breeding habitat.

2. ANNUAL CYCLE OF THE BLACK-TAILED GODWIT

The balance between mortality and reproduction regulates every bird population. For the Black-tailed Godwit mortality occurs throughout the year – but mostly during migration and in winter - while reproduction only takes place in the breeding season on the temperate breeding grounds. The annual cycle can be broken down in four separate phases: migration and wintering (roughly between July and February), arrival and settling as breeder (February-April), nesting and chick rearing (April-June) and a moult and pre-migratory phase (May-July).

2.1. MIGRATION AND WINTERING PHASE

Adult Black-tailed Godwits leave in July towards the African wintering sites. First year birds leave somewhat later, at the end of July and the beginning of August. The bulk of the population flies in a (presumed) non-stop flight to their African wintering sites that are mainly located in the Senegal delta, the coastal region from Senegal to Guinea, and in Mali (see Kuijper *et al.* 2006 for an update). At least thousands of adult and also juveniles are already present in august in the sourthern part of Senegal (Casamance) and Guinea-Bissau, feeding on just sowed rice fields. Recent research reveales that there may be a conflict between farmers in these regions and godwits feeding on the ricefields, being blamed to cause crop damage (van der Kamp *et al.* 2006). Some birds, mainly juveniles and in small numbers, make a stop-over in France or Portugal, probably because they left the temperate zone with insufficient reserves (Wymenga 1997) and are therefore forced to use these suboptimal sites. In general, suitable staging areas are scarce in summer in Southern Europe.

The post breeding journey will bring them to the rice fields and floodplains of Guinea-Bissau and Senegal, where they arrive in July - August and stay until January (Altenburg & van der Kamp 1985, Altenburg *et al.* 1985, Beintema & Drost 1986). The west-European population winters mainly in the rice and mangrove zone from South Senegal to Guinea.The central-European population winters mainly in the Inner Niger delta in Mali and in Lake Chad (Kuijper *et al.* 2006). A survey on the wintering grounds in 2005-2006 revealed that currently numbers in the Senegal delta (c. 1800) are significantly lower than in the 1980s (3000-10,000). In the rice and mangrove zone stretching from south Senegal to Guinea, numbers have dropped from approximately 200,000 (1980s) to approximately 100,000. Estimates from this remote region have a low reliability however, as was experienced in the reseach involved (Kuijper *et al.* 2006). There is however no doubt, that numbers have dropped considerable in the winter range, parallel the decline in the breeding population.

Spring migration starts in January when adults leave their West-African wintering grounds to Morocco and Portugal / Spain. Juveniles (now second year birds) do not join adults, but instead spend the entire summer at the wintering sites (Beintema *et al.* 1995a).

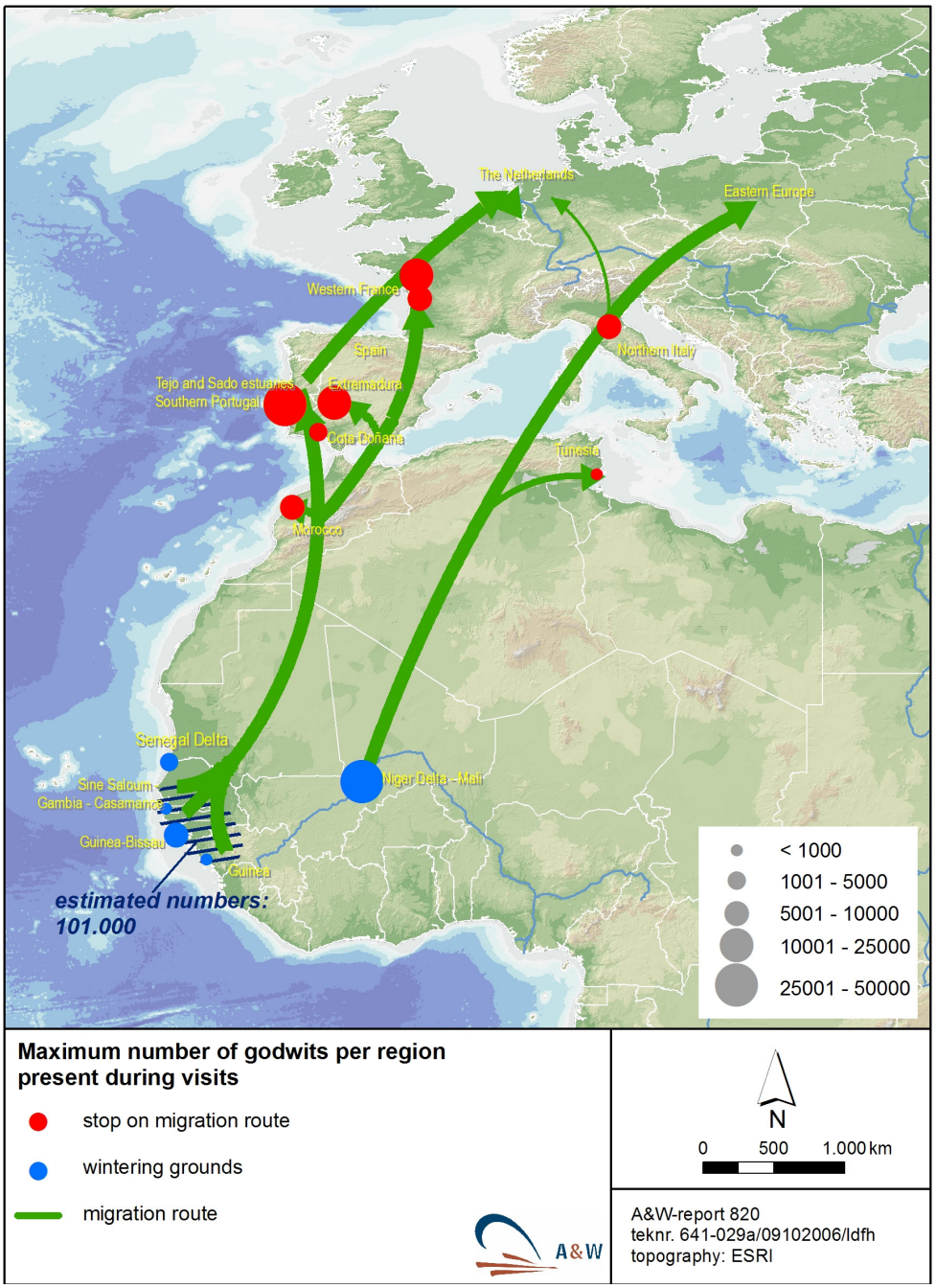


Figure 3. *Black-tailed Godwit wintering sites (red) and wintering areas (blue) and the spring migration route from Kuiper et al. 2006.*

During spring migration Godwits are concentrated in large groups on a few sites in the rice fields of Portugal (Tejo and Sado estuary) and Spain (Extremadura and Coto Doñana). Here they forage exclusively on rice. At present these rice fields offer sufficient suitable staging habitat, but they are very susceptible for future changes.The traditional staging sites in Marais Poitevin (Vendée, France) have lost in importance. Maximum counts show a decrease since the 1980s which can be attributed to a decrease in inundated grasslands.

Other important sites in France (Moëze-Oléron and the Basses Vallées Angevines) did not show decreasing numbers. The main threats along the spring migration route are climate change, habitat change and hunting. Habitat change has had negative effects in the past in Morocco and France, and may have contributed to a shift in the use of staging sites. The impact of hunting in France is unknown and if (as suggested from recent information) a few thousands juvenile Black-tailed Godwits get shot annually, than the negative impact of this activity should not be ignored.

The general conclusion of the study of Kuiper *et al.* (2006) is, that there are no evident large bottlenecks in the winter range, though there are areas of concern (habitat change, conflict with rice farmers). The latter should need more attention (van der Kamp *et al.* 2006). During spring, there seems to have been a shift of the high numbers to the sites in Portugal and Spain.

2.2. ARRIVAL AND SETTLEMENT PHASE

The first Black-tailed Godwits arrive at the end of February in The Netherlands, but the majority arrives at half March (Wymenga 2005). They gather to roosts at night in flooded grassland pools, while during the day they forage in nearby grasslands (Wymenga 2005). At the end of March or the beginning of April they leave these areas to mate and to occupy a breeding territory (Figure 4). Currently there are about 100 wader roosts in Fryslân, 75 of these are used by Godwits and they are mostly located along the west coast and in the centre of the province (Wymenga 2005). There is no indication for limiting factors during this phase of the annual cycle.

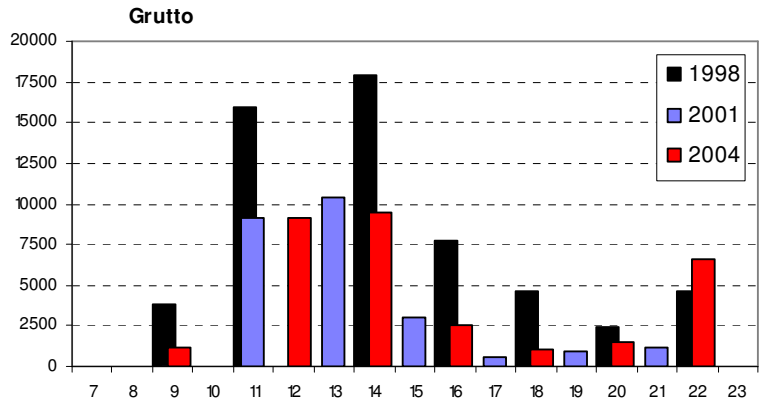


Figure 4.
Number of Godwits counted simulteanously on roosts in Fryslân in spring 1998, 2001 and 2004 (Wymenga 2005). Numbers indicated per week number. Note the increase in week 22-23 indicating pairs which lost chicks or eggs. High numbers early on the roosts are a very good indication of a bad breeding season (Wymenga 1997).

Box 2: Optimal Godwit breeding habitat

Optimal Godwit and meadow bird habitat in The Netherlands is characterised by a grassland area that is at least 170-250 hectares in size and humid, open and not a botanical monoculture. The ground water table is preferably not more than 40-80cm below ground level. Shallow marshy ponds should be present. There is spatial variation in human use of the area, creating a mosaic of patches that vary in timing and intensity of grazing and mowing. At least a large part of the grasslands should be mowed after 8-22 June, to allow Godwitsand other meadowbirds to safely raise chicks. Food availability should be sufficient for both adults (arthropods in the soil) and chicks (arthropods on the vegetation). This implies that the acidity of the soil is not allowed to drop below a pH of 4.8. Fertilising with raw manure (manure straight from the barn) is the best, however liquid manure may in some cases replace raw manure when the latter is unavailable. Long term deprivation of fertiliser will lead to a lower number of soil arthropods and thus to food shortage, however it also leads to more botanical diversity and higher number of arthropods on the vegetation where chicks can feed on. So a mosaic structure should contain both types.*

**There is some debate about the minimum size of an area of optimal Godwit breeding habitat. Most researchers adhere to 150 ha as a rule of thumb, others adhere to an area that should be able to sustain 50 reproducing females. Breeding densities in optimal Godwit habitat are usually between 20 and 30 pairs/100ha. This would result in a minimal area size of 170-250 ha.*

Breeding habitat for Godwits in Western Europe are typically low-lying, very open, grassland areas. By tradition this habitat was submerged during the winter and only became available in April for breeding. These circumstances lasted till halfway the 20th Century. Of the former flooded pastures in Fryslan of 100.000 ha in early 1900 only 2.000 ha is left at present.

In Eastern Europe the Black-tailed Godwit relies more on natural steppe plains. Godwits have a strong preference for open landscapes. With 'open' we mean a two dimensional landscape with unobstructed views in all directions with limited disturbance. Disturbance can influence habitat quality directly (predators, humans) or indirectly (through obstacles in the landscape that might be perceived as hosting predators or humans such as trees, hedges and buildings).

Settlement decisions of Godwits are influenced by factors such as: the openness of the landscape, food availability, growth rate of the grass, density of other breeding waders and probably also by the presence and density of predators (see Teunissen *et al.* 2005, Schekkerman & Teunissen 2006). Furthermore, the settlement choice is thought to be influenced by previous experience: successful pairs have a higher site fidelity compared to unsuccessful pairs (Groen 1993). In Fryslân, Godwits can choose roughly between three different areas: nature reserves, farmland with an adapted management (agri-environment schemes) and regular farmland. Regular farmland - which is used by modern farms for grazing and cutting - is very attractive upon arrival due to the high food availability. Especially in early spring these farmlands may be even more attractive than reserves. The water table is lower on farmland and fertiliser load is higher, creating higher densities of soil invertebrates (especially Earthworms at this time of year).This high food availability early in the year allows Godwits to breed early and this is usually associated with successful breeding (Hegyi & Sasvári 1998, Klomp & Speek 1971). Later in the season, regular farmland becomes far from ideal due to clutch loss caused by mowing and trampling by cattle, unless nest protection is practicised by volunteers. The latter is done in Fryslân intensively and on a wide scale. Although there is a clear positive effect on the nest survival it remains unclear if

this positive effect translates itself in the end of the breeding season in a higher fledging success. This is one of the issues currently investigated in The Netherlands (Landsshapsbeheer Nederland, A. van Paassen).

To return to the issue of the attractiveness of farmland, in fact Godwits on farmland are lured in an ecological trap (Beintema 1986, Schlaepfer *et al.* 2002), there settlement decisions, shaped by centuries of natural selection, are probably primarily tuned to food availability. Food availability for godwits in nature reserves is often suboptimal and underdeveloped compared to intensively used farmland. Many reserves suffer from lack of nutrients and acidification (Brandsma 1999, Wymenga & Alma 1998) and therefore a lower biomass of soil invertebrates. This problem can be overcome by fertilising reserves with raw manure; however this type of fertiliser has become scarce in modern agriculture in Fryslân. Partly this is because straw is not much in use anymore in modern cowsheds. Furthermore, the nutrient deposition laws in The Netherlands forbid the use of manure before the first of February and the method of injecting liquid manure into the soil was promoted. Normally, raw manure was deposited earlier on the grassland during winter, when frost prevented the soil and grass from damage by heavy machinery. Nowadays many farmers cease to use raw manure on grasslands. The general picture is now, that liquid manure is injected in the soil.

Disturbance of the open landscape

Disturbance has increased in virtually all open landscape areas in Fryslân. This varies from more roads and cycle paths (more and more in formerly out-lying areas), better accessibility of out-lying areas through land re-organisation, to the planting of trees around roads and farms. Godwit habitat has decreased over the last decades, in both quantity (direct conversion of grassland habitat) and quality (by disturbance and agricultural intensification, see figure 5 for an example). In addition, many areas that used to be completely dark at night, became disturbed by illumination, leading to disturbance of breeding Godwits (Molenaar *et al.* 1999).

Godwits have a tendency to avoid roads (Reijnen 1995, Reijnen & Foppen 1991), and therefore the number of Godwits that get killed by traffic is limited (Attema *et al.* 2000). This does not apply to power lines that still cause unnecessary deaths among adults each year (Renssen 1977). Black-tailed Godwits have a very strong preference for open habitat, but the availability of this type of habitat is steadily decreasing. For instance in Fryslân roughly 6,500 hectares of grassland habitat have been lost over the last ten years. The area used for growing maize (a habitat that is unsuitable for breeding) has tripled in ten years time and currently amounts to 12,000 hectares (statistics farmland, province of Fryslân). In theory, Godwits can counteract the loss of habitat by moving and breeding elsewhere, but in reality their options are limited. The most suitable habitats become more and more scarce, while habitat quality is limited in the remaining areas. Future research should be focussed on loss of breeding habitat, but also on loss of habitat quality. Habitat quality is continuously under pressure, fuelled by EU agricultural policies and market forces that drive farmers towards producing more efficiently (leading for instance to less, but larger farms).

Shortage of food for adults

Food availability is a decisive factor during settlement. The availability of food – for adults in modern farmland and the larger part of grasslands in spring earthworms and leatherjackets (Zwarts 1993) – depends on the soil, organic fraction and water table (Curry 1998, Auwerswald *et al.* 1996). Flooded areas have low food densities (Ausen *et al.* 2001). The penetrability of the soil, a determinant for the exploitability of soil fauna, is very important and dependent on the soil and water table.

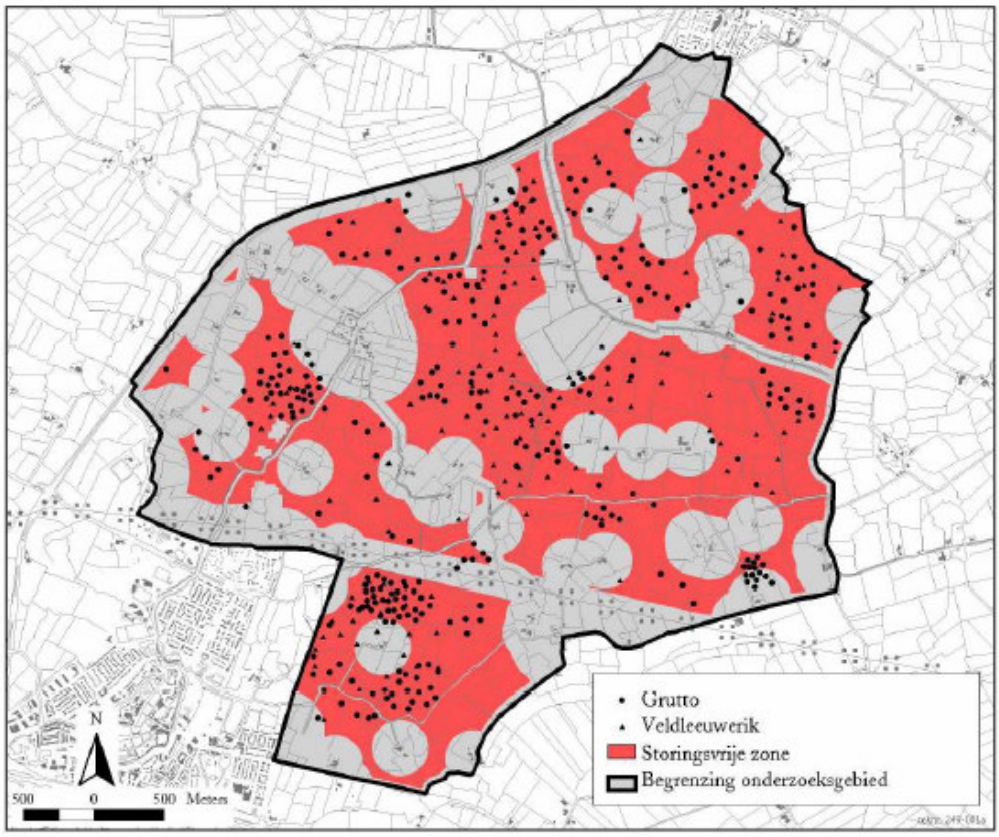


Figure 5. *Distribution of Godwits (dots) and Skylarks (triangles) in a rural area in Fryslân. Areas marked red are areas which are unaffected by disturbance. The grey areas represent disturbed areas. Note the clear match between high breeding densities and undisturbed areas.*

In many nature reserves food availability in spring is insufficient for high densities of meadowbirds (insufficient = earthworms < 50 grams freshweight per square meter). These areas suffer from acidification of the soil in combination with a nowadays much less intensive fertilising regime, all factors that reduce soil arthropod availability (Brandsma 1999, Wymenga & Alma 1998). This applies in particular to reserves which have a problematic hydrological position; in seepage circumstances the seepage of mineral-rich groundwater avoids acidificaiton. Therefore, the hydrological circumstances need always attention, for botanical reasons but also for the meadow birds.

This problem of acidification and low nutrinet content is not apparent on agricultural grasslands. Although liquid manure has accidental negative effects on the soil fauna (earthworms), these do not seem to effect sufficient food intake (Oosterveld *et al.* in prep.) Densities of earthworms may easily reach 100 gram fresh weight per square meter, which is often correlated with high densities of meadowbirds. Important to note, that we have no information on treshold densities of the required food density. The amounts of fresh weights mentioned are indications.

Cattle grazing is important for maintaining Godwit habitat in good shape. It creates microstructures and thus more habitat variability, furthermore it enhances the penetrability of the soil (important for Godwits foraging on soil arthropods).

2.3. NESTING AND CHICK REARING PERIOD

Black-tailed Godwits start laying around mid April. They lay 3-4 eggs that are incubated for 24 days. After clutch loss they can make a replacement clutch (and after subsequent loss even a second replacement clutch can be produced). Clutch loss occurring before May 20th can result in a replacement clutch, but not after this time period (van Balen 1959, Schekkerman & Müskens 2001).

Clutch and chick loss caused by mowing
For Godwits it is of utmost importance to have their eggs hatched before the first mowing event. In Fryslân this is nowadays around the first week of May (peak of mowing, weather dependent), though often already in the end of April first mowing starts. Some 10-15 years ago mowing peaked in the second half of May (see Wymenga 1997). The earlier the clutch is laid, the bigger the hatching chance. However, the repercussions for early laying is that in cold springs chicks need to be brooded by the parents and both – chicks and parents - lose precious foraging time with these brooding events (Beintema *et al.* 1995a, Beintema 1991, see also Schekkerman 1997). Most clutches hatch around mid May but there is considerable inter-annual variation. Chicks are able to fly in the second week of June. Nowadays mowing starts much earlier. Various factors contribute to this, such as fertiliser application and lowering of ground water tables, which allows the grass to grow faster.

In addition new mowing techniques and broader machines introduced in the early nineties contributed to a shift in mowing time. With this technique the grass is cut and bruised during the mowing which means that the swath dries much more quickly (easy evaporation because of the bruising) and can be ensiled within two days. With traditional mowing it took the swath a couple of days to dry and farmers had to rely on a prolonged period of sunny weather, which is more common later in the season. With the modern equipment farmers start mowing as soon as the grass is high enough and 2-3 days of sunny weather is forecasted. The result is, that mowing takes place massively and much more earlier in spring (Wymenga 1997); in some years 70-80% of the modern farmland in Fryslân and other parts in The Netherlands is mowed within a week (own observations). In such years there is hardly any reproduction in modern farmland.

Godwits have responded to the changing selection pressure. In the course of the last century, Godwits have advanced laying by as much as three weeks (Beintema *et al.* 1995b). It is unknown whether they can even further advance their laying date. Several factors might constrain a further advancement, such as food availability and cold stress for chicks. In addition, the options for a further advancement of laying are restricted early in the season by other agricultural activities that are carried out to improve the grasslands such as equalizing the grassland and liquid manure injection.

Clutch and chick loss caused by predation
As in each ecosystem, eggs and chicks of Godwits and other meadowbirds are lost to predators such as Common Gull, Carrion Crow, Grey Heron, Herring Gull, Fox, Weasel, Stoat, Mink, Goshawk (predates adults), Marsh harrier and Buzzard (Teunissen *et al.* 2005). An extensive study on predation by Teunissen *et al.* (2005) revealed an array of predators, being 'captured' by camera's. Surprising predator was the Hedgehog.

Predation is an important factor determining the breeding success of Godwits and other meadow birds (for instance Beintema & Müskens 1987). A large part of eggs (24-27%) and chicks (60-75%) fall victim to a variety of predators (Teunissen *et al.* 2005b, Schekkerman & Teunissen 2006). Even though it is common that many eggs and chicks are preyed upon, changes in the landscape, such as the planting of trees in open landscapes, may increase the abundance of predators and hence the predation risk. A lower habitat quality may result also in a lower condition of the chicks which can make them more vulnerable for predation.

Reproductive success of Godwits is not sufficient to counterbalance mortality and this is visible throughout the country. Godwits are only able to raise sufficient numbers of offspring when all conditions are optimal. A further decrease in breeding success, being caused by either early mowing, predation or sever weather will result in a further drop in breeding numbers. Surely, predators do play a role, but it's not the one-and-only factor. For instance Godwits on the Wadden Sea islands, where ground predators are absent, and those occupying nature reserves in areas that are not inhabited by foxes, show similar patterns of poor reproductive success (see for instance Scharrenburg 1998). Recent research has shown interactions between grassland management and predation risk (Schekkerman *et al.* 2005).

Box 3: Are Godwits breeding in low densities less successful in deterring predators?

Godwits can reach high densities in optimal habitat, and here they are very capable of deterring avian predators (Green et al. 1990). By breeding in loose colonies, they can share the burden of chasing aerial predators even in association with other meadowbirds (Lapwing!). During fieldwork in which we monitored alarming adults, we experienced that in areas with low breeding densities birds not always responded to predators, while in areas with high densities each individual predator was escorted by alarming breeders. It is possible that the steep decline in marginal habitats is in part attributable to single pairs (in contrast to groups of pairs) being unable to deter all predators. If this hypothesis is true, then many pairs in marginal areas are in a downward spiral of inverse density dependence (e.g. reproductive success is decreasing with a decrease in local population size). This so called Allee-effect can pose a real threat to recovery of the species. Areas where the Godwit disappears may loose the ability for re-population in the future, even when habitat quality is improved.

Shortage of food for chicks

Godwit chicks need 25-30 days to fledging (Beintema *et al.* 1995a). Mowing and predation during this phase are decisive factors. In addition requirements of the chick play an important role and weather conditions and arthropod availability are important factors (Beintema 1991, Beintema & Visser 1989). Chicks feed on arthropods that live on the vegetation and therefore have to rely on semi-long and not to dense grasslands (Schekkerman *et al.* 1998). Areas without mowing are not optimal, here the grass becomes too long, the density of stems becomes too high, and senescence of the vegetation sets in, making it suboptimal for herbivorous insects. This probably plays an important role in grasslands with a high fertiliser load. In less intensively fertilised grassland this is probably of lesser influence because of a different plant community and vegetation structure. Nevertheless, for optimal feeding conditions for chicks it is important to have vegetation in different stages of growing (short, middle and long), which is realised by variation in grazing and mowing (see Chapter 5).

Already a few days after hatching families can move considerable distances in search for suitable patches (Schekkerman *et al.* 1998). Survival of chicks is generally low. The survival

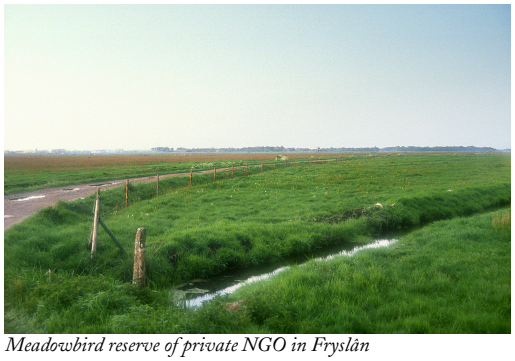
rate of chicks that reach fledging varies between 0.09-0.34 and this leads to a breeding success varying between 0.16-0.91 chicks per pair (Schekkerman & Műskens 2001). It was estimated that for a stable population pairs at least a breeding success of 0,6-0,7 is required. These figures give rise to pessimism, over the last years these high values have rarely been reached, and the Godwits in The Netherlands are not producing enough youngsters to replace themselves. It must be stressed however, that sound and long-term data on mortality and recruitment in The Netherlands are lacking (except for some areas), and it is of utmost importance to gather these type of data (see Kuiper *et al.* 2006, Both *et al.* 2006).

2.4. MOULT AND PRE-MIGRATORY PHASE

Godwits congregate at roosting sites after the breeding season. A general unsuccesful breeding season is apparent in the timing of arrival on the roosts; high numbers on roosts as early as mid May are indicators of a failed breeding season (Wymenga 1997, Kleefstra 2006). Adults start their primary moult in this period and leave for Africa in the course of June. Successful pairs arrive with their offspring on the roosts in the second half of June (Piersma 1983, own observations). Adults leave first to the wintering grounds and the youngsters follow at a later stage, therefore juvenile percentage increases on roosts in the course of summer (Wymenga 1997). Towards the end of the breeding season Godwits can be found on grasslands with a high abundance of Leatherjackets (Tipulid larvae) (Zwarts 1993). Earthworms have become progressively less important as food items since they tend to hide deeper in the soil in summer. In addition, the upper soil layer becomes harder to penetrate with the bill in summer (Schekkerman 1997). Godwits also move in this period to wetlands where they forage on chironomid (mosquito) larvae (Zwarts 1993).

The decline of the Frisian Godwit population is also apparent in the roost counts, numbers show a steady decline since the mid 1970s (Wymenga *et al.* 2001). Especially in July, when these roosts were traditionally 'full' with juveniles. The drop in numbers on the roosting sites makes the previous conclusions painfully clear. The Godwit population is producing an insufficient number of young.

Very open landschape in Northern NL



Meadowbird reserve of private NGO in Fryslân

Meadowbird reserve in seepage polder, > 20 years reserve

Farmland under agri-environment scheme along Frisian coast

Similar landscapes in western part of Holland

wet spots in meadow bird grassland, attractive in spring

modern grassland

Typical flooded pasture, home to Ruff, Garganey and Corncrake

Impression of open landscapes in the Northern part of the Netherlands.

3. CONSERVATION OF OPEN LANDSCAPES

The gradual loss of openness of the agricultural landscape is a point of serious concern. Government plans devoted to spatial planning highlight the important role for openness on the agricultural country side. Often this statement remains a good intention on paper, but is not turned into action. In practice, little of it is found in regional plans. It is difficult to convince people that an 'open' area has intrinsic value itself and is important for animals that prefer these. It would be desirable to investigate the impact of these landschape changes on the meadow bird community. Up to now these impact studies have been restricted to areas that are designated by the EU Birds Directive or part of the Dutch Ecological Main Structure (EMS, a network of interconnected reserves and buffer zones). The Godwits' main stronghold is in areas that are neither part of the EMS nor are EU Birds directive areas, but farmland, with agricultural production as its main function. Not only should the focus be on preventing the loss of openness, but also on restoring the openness (for instance by removing trees along lanes in core meadow bird areas).

The loss of openness of the landscape is not only apparent during the day. At night these areas were historically dark, but nowadays many areas are illuminated for safety reasons, leading to disturbance of breeding Godwits (Molenaar *et al.* 1999). This is an example of disturbance that could have been prevented in part if meadow bird experts had been consulted at the planning stage. For instance street lights can be adapted so that they only illuminate the road, with less light scatter into the surroundings.

Recently, new cycle paths have been constructed in off-lying areas that were previously the sole territory of meadow birds. Careful planning of new cycle paths in the future, combining knowledge of various disciplines, might easily lead to solutions where both recreational use and meadow bird conservation can be optimised. For cycle paths already built through core meadow bird areas, one should consider closing these during the most sensitive period. This applies also to new boat trails along canals and new nature developments (for instance forests).

Power lines still cause unnecessary deaths among adult Godwits each year (Renssen 1977). This mortality is unnecessary, since with relative cheap measures such as visibility markings around the power lines, one is able to reduce this type of mortality by 90%. Furthermore there is strong public support for paying more for electricity if this is generated and distributed in an environmentally friendly way ('green electricity'). The knowledge, the tools, and the finances are already at hand!

Grassland habitat is being lost continuous to new infrastructure development, especially around cities. These new infrastructures consume a lot of space; it is desirable to restrain the urban new development and, if this is not a realistic option, minimize the spatial requirements. Development of new infrastructures in the countryside should be done with similar levels of efficiency, targeted at economic development without compromising the open countryside. Compensation for lost meadow bird habitat is very rare in Fryslân and is not required by law yet. However, in the draft Regional Planning Scheme (2006), obligatory compensation of habitat loss of meadow birds areas (with a focus on 'open and quiet' areas) is incorporated. This is an important step forward in policy-making for farmland birds on a regional planning level.

Compensation does not necessarily need to be in terms of hectares (surface area); on the contrary, the compensation for habitat loss on one side could also be counterbalanced by improving the quality of other areas. There are many creative ways to achieve this; for instance companies (occupying what was previously grassland) could adopt a meadow bird area elsewhere and (financially) support this to allow long term habitat improvement.

Territorial fighting

Protecting nests from trampling (action volunteers)

Godwit-cluth with aberrant egg

Breeding female godwit sticks to its nest

Ringing a juvenile godwit

Post-breeding roosting godwits

Impression of godwit – experciences during the breeding seaon. A&W and Benny Klazenga.

4. ENHANCING NEST AND CHICK SURVIVAL

4.1. VOLUNTEERS ASSISTING IN NEST AND CHICK PROTECTION

Tremendous efforts have been made by volunteers to enhance breeding success of meadow birds in the province of Fryslân. Volunteers seek nests and mark them, so the farmers can avoid damage during field activities as mowing and grazing (amongst others van Paasen 2006). Nest protection is mainly aimed at Lapwing, Black-tailed Godwit Oystercatcher and Redshank. Without this type of care (called 'nest protection', but it also involves protective measures during the chick phase) the breeding productivity of Godwits on farmland was much worse than it is today. Nest protection is coordinated by regional groups that are all members of the Frisian Union for Bird Protection (BFVW). On an annual basis this group is active over an area of 125,000 hectares involving several thousands of volunteers. Nest protection yields twice as many chicks as a situation without nest protection (Teunissen 1999, 2000). But without protection of chicks it is not enough. Here we address suggestions for further improvement of this conservation measure. The conservation output can be improved by an extension of the area where conservation takes place, but also and more importantly, by better coordination of the current efforts.

The quality of the care can be improved if (on a regional level) it is known how the current efforts are distributed in time and space. A regional 'work plan' is an important tool. Important questions can be addressed in this work plan related for instance to the location of Godwit areas – as key indicator of the better meadowbird areas - where conservation efforts are lacking, or the locations of high densities of Godwits where conservation effort is insufficient. One could also think of a better distribution of volunteers over the area in time and space, for instance by taking into account the skills of the volunteers with regard to general experience, local knowledge and communication skills with local farmers. However, one should not lose track of the fact that these people are doing this on a voluntarily basis. Well aimed steering of volunteers needs intensive communication. Furthermore, it would be very beneficial that the care is also continued after the chicks hatch, but this is not an easy task given that the broods move around, sometimes great distances. Volunteers can discuss measures with farmers, and can propose alternatives, for instance in relation to mowing (see below). They can assist farmers by temporarily chasing Godwit families away from the areas before mowing takes place by placing poles with plastic flags (Kruk *et al.* 1989, information Landschapsbeheer Nederland). Farmers and other operators of mowing machines need to become aware of their responsibility, jointly they are partly responsible for the survival of 9,000 to 14,000 Godwit fledglings.

4.2. REDUCING PREDATION OF NESTS AND CHICKS

Predation of clutches and chicks is a serious problem (Baines 1990, Beintema *et al.* 1995a, Galbraith 1988, Groen & Buker 1991, Teunissen *et al.* 2005). However, measures to prevent predation should be based on reliable and systematically collected evidence (Beintema & Müskens 1987). There is currently a lack of sound information, and a lot of discussion is based on preconceptions and opinions. In 2004, on average 24% of clutches on Dutch grassland are predated (Teunissen *et al.* 2005). The increase of the number of predators is

tightly linked to the changes that have taken place in the landscape (from open to semi-open) and to the population developments in the core areas of some predator species (e.g. increase of Common Buzzard, Goshawk and Fox: see for instance Teunissen *et al*. 2005, SOVON 2002). Measures aimed at reducing predation should be tailored to the local situation for example by restoring the openness of the landscape. Predation by Foxes is an especially difficult subject (Brandsma 2002). The management regarding the predation problem requires local insight, local measures and pragmatic solutions that must fit within the law. Communication and education are important tools to prevent unjustified persecution of predators. For instance, we must ensure that a threatened species such as Marsh Harrier is not persecuted for the sake of another species. Priority lies in all cases in safeguarding and restoring the orirginal open and wet landscapes.

5. OPTIMAL FEEDING GROUNDS FOR ADULTS AND CHICKS

5.1. GODWIT HABITAT IN GENERAL

Good Godwit and meadow bird habitat on farmland should produce at least 0.6 chicks per pair as a minimum level of productivity (see below). However, in reserves and on farmland under agri-environment schemes productivity ought to be higher, since these areas should function as a source to stock traditional farmland. In this paragraph we report on the measures that should be taken in order to improve the quality of the breeding areas. We put extra emphasis on improvement of regular farmland, since this is the type of breeding habitat where 85% of all Godwits in The Netherlands can be found.

Optimal habitat for the complete meadow bird commuity is usually characterised by a ground water level at, or just below (-20 cm) ground level, and with some marshy areas scattered around (for instance Beintema et al. 1995a, Guldenmond *et al.* 1995). Good Godwit habitat usually has a water level of 20 to 80 cm below ground level (Oosterveld *et al.* 2006, Oosterveld 2006). During the spring (March – May) water levels should not be allowed to drop below 50 to 60 cm below ground level (for instance Beintema et al. 1995a). These guidelines were developed in the 1970s, and were based on studies that could not specifically tease apart the separate roles of vegetation management and ground water manipulation. Often high water table are associated with a extensive use of the grasslands with late mowing dates, which leads to higher meadow bird densities. The independent role of water itself lies essentially in providing a humid environment for invertebrates (not drown them!) and at the same time a sufficient penetrability for probing wader species during foraging. There are indications that Redshank and Black-tailed Godwit can cope with water levels 80-100cm below ground level, but this applies to soils which have a humid topsoil like clay-on-peat (Oosterveld *et al.* 2006). Key species such as Corncrake, Ruff, Snipe, Garganey and Shoveler prefer ground water levels at or very close to the surface.

Ground water levels and soil characteristics directly affect the abundance of soil invertebrates and water content is an important determinant of the abundance of earthworms (Auwerswald *et al.* 1996, van de Bund 1998, Curry 1998). Earthworms prefer soils with a high pH (KCL) >4.5 (Wymenga *et al.* 1991, Brandsma 1999) furthermore the penetrability of the soil depends on the organic matter content and moisture of the soil. When the soil dries out in summer earthworms move to deeper layers of the soil, below 10cm deep, where they are out of reach of an adult Godwit's bill. In this period (before migration) Leatherjackets are an alternative prey. Organic fertiliser application is an important driver of arthropod biomass and reduces the acidity of the soil (Brandsma 1999). Prevention of acidification depends on the natural buffering capacity of the soil and the fertilisation regime (chalking, lit). Areas where salt water penetrates are especially well buffered and usually have high numbers of meadow birds.

Godwit chicks need long grass (>18cm) to feed and hide in and a Godwit family needs at least 0.7-1 hectare of this habitat (Schekkerman *et al.* 1998, Schekkerman 1997). This long grass habitat can be achieved by extending the mowing date (after June 1st), pre-grazing

followed by no-grazing (see below), mowing strips, early mowing (and allowing time for the grass to re-grow) and high grass islands (at least 3-5m wide, Schekkerman & Müskens 2000). For chicks a dry top-soil layer is optimal, since the numbers of invertebrates on dry soils are high compared to wet soils (Siepel *et al.* 1990). Optimal ground water levels for Godwit chicks are presumed to be around at least 45cm below surface level.

5.2. IMPROVING HABITAT QUALITY WITH MANAGEMENT AGREEMENTS

With the expression 'mobile hectares' (Wymenga & van der Heide 1998) agri-environment schemes are meant involving flexible contracts with farmers for six years. Farmers are free to stop after one year. Participation by farmers does not imply rural planning protection on their farmland, as was the case in former agri-environment schemes in The Netherlands. This has been a very important precondition of farmers to participate in this type of management. There is a finacial subsidy for postponing mowing and grazing; yet there are no demands regarding the water table. The height of the subsidy depends on the measures taken. Postponing mowing ranges from 8th of June to the first of July (8, 15, 23 and 30 June are steps). Agricultural measures are not allowed between the 1th of April and one of the dates mentioned. The resting periods therefore are sufficient to lay clutches and raise chicks. Additional measures include refuge strips (strips of 6-12 m broad in modern farmland wich are not mown before a certain date) and non-fertilising of field margins.

Since 2000 collectives of farmers have committed themselves to management agreements on ca. 100,000 ha in the Netherlands. Management agreements and flying hectares are important (and the only) tools to stimulate meadow bird conservation outside reserves. The effectivity can be improved (Verhulst et al. 2006). Ca. 20% is suboptimally located (Melman *et al.* 2005), for instance along a road with trees, or have a history of neglect with respect to fertiliser application leading to soil acidification and an insufficient biomass of soil invertebrates.

5.3. IMPROVING HABITAT QUALITY ON FARMLANDS

A three-quarters if the Godwit-population in Fryslân is found on regular farmland, and there is a need and scope for improvement of breeding success in these areas. In Fryslân, farmers receive help from an army of enthusiastic volunteers that assist them in conserving meadow birds. However, there are more measures than need to be taken:

- Ground water level: The significance of groundwater level for meadow birds is disputed. We think, the main role of the ground water level for the waders among the meadow birds concerns the availability of soil fauna as prey for adult birds; a high level provides earthworms in the topsoil, within reach of wader bills. However, for species as Snipe, Ruff and Garganey, wet grasslands are a prerequisite for settling. They prefer marshy grasslands for breeding and raising their young (Beintema *et al.* 1995a). Ground water levels are regulated by Water-Boards (regionally organised government institutions) and water levels are almost exclusively tailored to the agricultural situation. Farmers can collectively decide to support raising of ground water level.
- Ditches: The sides of ditches (maintenance of ditches is done by farmers, prescribed by the Water-Board) are sometimes too steep, causing Godwit chicks to get trapped.

Farmers can collectively decide to support other ditch profiles, minimizing the risk of chicks drowning.

- Mowing: For the species of the 'Black-tailed Godwit-group' (also including Lapwing, Oystercatcher, Tuffed duck, Krakeend) grassland management, and especially mowing, seems to be the key factor (Schekkerman & Müskens 2000, Wymenga 1997) Farmers can decide not to mow an area in total, but to work their way through the area in phases. By doing this, there is always habitat available where BTG chicks can hide. Another option is to leave refuge strips unmown. These strips should be at least 3-5m wide to be effective (Schekkerman & Müskens 2001). Not only can survival of chicks be enhanced by leaving areas (temporarily) unmown, the mowing activity itself can also be modified. For instance farmers can decide to mow patches starting in the centre, and subsequently mowing outwards to the periphery, this allows for more escape options for chicks (Teunissen & Willems 2004). In addition, farmers should never mow patches with breeding meadow birds at night.

- Management planning: Though not scientifically based, practical experiences show that meadow bird aimed management planning can offer feeding and refuge habitat for wader chicks. So presenting long regrown grass within reach of late mown fields offers the opportunity to switch at the moment the late fields are mown.

5.4. IMPROVING HABITAT QUALITY IN NATURE RESERVES

Minimal reproductive output figures for meadow birds should be developed for reserves and ecological farmland as well, in order to evaluate their value as meadow bird reserve. In many reserves the situation with respect to soil invertebrates is not optimal and for these we suggest the following improvements:

- Systematic research on the limiting factors of a reserve from a meadow bird perspective.
- Investigate alternatives to raw manure, for instance the feasibility of mixing dead plant material (originating from the reserves) with manure, and using this as fertiliser.
- It is of outmost importance that reserves apply grazing and mosaic management, this means that the reserve should be a patchwork of different management regimes. Not just one grazing or one mowing regime. In addition, early grazing is an important feature.

Grassland areas can be originally designated as nature reserves on the basis of both botanical values and the presence of meadow birds. However, grassland reserves need to be managed and it is not always clear which measures need to be taken. For instance, in general fertiliser application reduces the botanical diversity of an area, but is crucial for many meadow birds. Fertiliser application, managing ground water levels and the mowing and grazing regime are the most important management issues in grassland reserves (Oosterveld 2006a). Key or critical bird species (Corncrake, Snipe, Ruff), although very demanding in terms of habitat quality, are not so dependent on soil arthropods and prefer high ground water levels. Management directed to these species can easily be combined with management directed towards preserving botanical values. However, areas of conflict arise between botanical values and critical meadow birds such as Black-tailed Godwit and Redshank.

In 2003-2006 the 60 most important meadow bird reserves in Fryslân are assessed in a systematic way (E. Oosterveld, Altenburg & Wymenga ecological consultants). Sets of reserve specific measures have been compiled in close cooperation between reserve managers, local experts and researchers.

Probing godwit catches earthworm, easily being looked at: wishfull thinking of researches! Photo manipulation: Benny Klazenga, Katlijk, Netherlands.

6. EVALUATING THE HEALTH OF LOCAL MEADOW BIRD COMMUNITIES

The first signal that indicates an unhealthy local meadow community is a decline in numbers. A systematic decline should be determined on the basis of information collected over at least 3 years, since first-year Godwits stay their first year in Africa. To get insight in a development at least a three year period is needed. Two main factors are usually associated with local declines: the local population has become too small to sustain itself (and is incapable of providing a buffer against natural fluctuations in population size) or reproduction is insufficient (number of chicks per pair is insufficient to counterbalance mortality).

As a rule of thumb we adhere to a population size of 50 pairs for a sustainable population that can buffer natural fluctuations in mortality and reproduction. This combined with the densities that different species of meadow birds reach in good habitat, allows us to calculate the minimum required area size for different species (table 2). When an area does not reach sufficient breeding numbers one should investigate options to improve the habitat or investigate options that promote a better connectivity with neighbouring areas.

To develop breeding performance targets one needs to make a number of assumptions, that are beyond the scope of this report, therefore we stick to a crude approximation of hatching success published by Beintema *et al.* (1995a). Determining hatching success is a labour intensive method and therefore the concept of Crude Territory Success (CTS) was developed (Nijland 2002). CTS is the number of alarming pairs in the time period just after hatch, divided by the total number of pairs in the area. CTS is a crude measure, and it mainly gives a rough indication of the performance up to the moment of hatching. The lack of detail in this method is compensated by its efficiency; a large area can be covered in a relatively short time span.

Table 2. *Breeding parameters for meadow birds. The following parameters are given: density in good habitat (in pairs per hectare), the minimum required area that could sustain a population of 50 pairs (in hectares). Hatching success (%), Crude terrritory success (%, see text for explanation) and the required number of fledglings per pair for the populations to be stable. Based on [1]Beintema et al. 1995, [2]Wymenga et al. 2001 [3]Den Boer 1995, [4]Schekkerman & Müskens 2000 and own data..*

	Density (pairs/100ha)	Minimum required area for 50 pairs (ha)	Hatching success (%)	Crude territory success (%)	Required fledglings (per pair)
Black-t Godwit *Limosa Limosa*	20-30	175-250[2]	60[1]	>45-50	0.6 – 0.7[4]
Redshank *Tringa totanus*	10	500	60[1]	>44	0.7 – 1.0[3]
Shoveler *Anas clypeata*	5-10	500-1000	-	-	
Garganey *Anas querqedula*	2-5	1000-2500	-	-	
Ruff *Philomachus pugnax*	2-5	1000-2500	-	-	
Snipe *Gallinago gallinago*	2-5	1000-2500	-	-	
Lapwing *Vanellus vanellus*	20	-	60[1]	-	0.8 – 1.0[3]

7. DEALING WITH OPPOSING MEASURES AND MOSAIC MANAGEMENT

Mosaic management, a patchwork of different management regimes fine tuned to the needs through-out the season, is the optimal solution for meadow birds (Beintema *et al.* 1995a, Schekkerman *et al.* 1998, Oosterveld 2006b). The patchwork should contain the following elements (explained below): mowing in phases, areas that differ in grazing, type and intensity of fertilisation and the presence of marshy ponds and botanical diversity. In the next paragraphs we outline which are the ingredients of this optimal mosaic management (Oosterveld & Altenburg 2004). See also figures 6 and 7 for an impression.

From 2000 onwards collectives of farmers started with the (first steps towards) mosaic management on an area level. The concept is still developing. The first results are not clearly positive. The pilotproject Nederland Gruttoland showed insufficient reproduction, because of heavy predation in the chick phase and cold weather (Schekkerman *et al.* 2005). While there were questions about the effectiveness of the mosaic for chick survival. Furthermore, results over six years on 3.000 ha of mosaic management in the North of the Netherlands (mainly Fryslân) show positive population trends of Lapwing, Black tailed Godwit, Redshank and Oystercatcher compared to national trends, but it is not clear if these are the result of the mosaic management (Oosterveld 2006b, Oosterveld *et al.* in prep).

Box 4: Optimal mosaic management

- *A two-to-one ratio between the area mowed versus grazed*
- *Mowing dates (at least four): May 15, June 1, June 15, July 1*
- *Grazing on parcels without nests*
- *Permanent grazing (max. density 2-3 cows per ha)*
- *Fertiliser load 80-110 Kg N/ha (annually) and preferably raw manure (but liquid manure is better than no fertiliser at all)*
- *Critical pH (KCL):>4.5*
- *Area of marshy ponds: 0.5 ha/100ha*
- *On farmland: Max. distance between parcels with similar mowing date: 400-500m*
- *On farmland: Area of Godwit-chick land= 0.7 hectare per Godwit family*
- *Mosais management should always be tailor-made*

7.1. SEQUENTIAL MOWING REDUCES CHICK AND NEST LOSS

- Early mowing (before May 15th) is important for replacement clutches for Lapwing and foraging habitat for Lapwing and Redshank chicks. In June early mowed areas attain the optimal sward height (18cm) for Godwit chicks.

- Late mowing (after June 8th) is important for successful hatching of Godwit nests and foraging habitat for Godwit chicks. Various late mowed parcels should ideally be located at distances no further than 400-500m apart, since this is distance that can be covered by commuting chicks and their parents.
- Very late mowing (after June 15th) presents important breeding habitats for late-breeders such a Corncrake, Ruff, Garganey and Snipe and for meadow passerines that use the area for their second breeding attempt.

In nature reserves it is advised to mow at the following dates: May 15th, June 1st, June 15th and July 1st. In addition, on agricultural grasslands refuge strips and 'mowing strips for indoor cattle feeding' (see below) are important items in the mosaic.

- Refuge strips are strips or blocks that stay unmowed. If there are nests on the parcels that need to be mowed, they can provide shelter for the eggs or chicks. Depending on the size, they can also be used as a corridor to suitable areas. They should be at least 3-5m wide and not located on a steep slope (Schekkerman & Müskens 2000).
- Mowing strips for indoor feeding are daily strips of grass that are mown and directly fed to the cows that remain indoors. Farmers can choose which strip to mow, thereby avoiding the (marked) nests. This creates strips with various sward lengths throughout the season (Figure 6).

7.2. IMPROVING HABITAT QUALITY THROUGH GRAZING

The presence of 30-40% of grazed areas is presumed to be optimal in a mosaic structure.
The following mowing regimes should be applied:

- Early grazed areas, grazed in early spring (until May 1st, followed by a time period without grazing between May 15th and June 15th) are important foraging habitat for BTG chicks. The side effect of early grazing is that some nests get trampled by cattle. This can be prevented by placing nest protection devices over the nests.
- Permanently grazed areas are important for feeding Lapwing and Redshank chicks. BTG chicks only seem to select extensive grazing when unmown fields are not available anymore (Oosterveld in prep.). Grazing pressure must be low in order to obtain a varied vegetation structure. The density of cattle should be tuned to the growth of the grass, allowing a low grazing pressure when the grass is relatively short. The vegetation becomes varied when removal of biomass is less than what is produced. Roughly a grazing pressure of two cows per ha throughout the season is sufficient, except in the peak grass growth period (May 1st to June 15th) when a density of three cows per hectare is advisable.
- Late grazed areas are areas that are grazed late in the season. This grazing regime is an important tool to achieve structure in the vegetation and produces an optimal sward length for the next spring. The varied structure of the vegetation produces small tussocks with relatively long swards where early nesting Godwits and Redshanks can breed.

Refuge strip

Refuge strip

Marshy pond

Late mowed herb rich field

Early and later mowed fields

Figure 6
Mosaic management in practise: variation in mowing and grazing dates, built in modern farming practice.Photo's Ernst Oosterveld, A&W.

7.3. IMPROVING HABITAT QUALITY BY FERTILISATION: TYPE AND INTENSITY

Raw manure is the most preferred fertiliser since it can be easily used by soil invertebrates and buffers the acidity of the soil. However, it is nowadays hard to obtain. Optimality is reached by an amount of 15-20,000 Kg raw manure per hectare, which translates into 80-110 Kg nitrogen per hectare. Fertilisation should preferably take place on an annual basis. Biomass of earthworms can vary enormously; most Godwit areas in Fryslân have values between 50-200 g/m^2 (Wymenga & Alma 1998, A&W unpublished data). Usually a minimum value of 15-30 g/m^2 is used (Brandsma 1999), below these values foraging is no longer profitable. However a word of caution is needed here. Sometimes high breeding densities can be found in areas with hardly any significant number of earthworms, suggesting that there is no clear one tot one relationship between earthworm abundance and Godwit breeding numbers.

Figure 7. *Example of mosaic management in the area of Delfstrahuizen in Fryslân in a spatial configuration. Explanation of legenda: green line = refuge strip, yellow = mowing in May, blue = grazing with restricted dates, dotted bleu = early grazing with rest period afterwards, red = postponed mowing, hatched blue = open marshy area/pool for roosting, green = mowing for indoor-fed cattle (with period), hatched green = reserve.*

7.4. PRESENCE OF MARSHY AREAS AND BOTANICAL DIVERSITY

Areas with shallow ponds are important during the settlement phase. Meadow birds that are just arriving congregate around these ponds. Later in the season, when these marshy areas are drying out, they are used by Redshank chicks for foraging and offer breeding places for Ruff and Snipe. As a rule of thumb, per 100 hectare there should be 0.5 hectare of marshy area present. In general, invertebrate abundance and diversity coincides with a high botanical diversity and therefore low fertility. Godwit families with chicks have some preference for botanically rich patches at the end of May and the beginning of June. However, as stressed before, at the beginning of the season adults need habitat with a high density of soil arthropods, and this coincides with a high fertiliser load. In optimal meadow bird areas, both types of habitat are available. In good meadow bird habitat there is variation in vegetation height present, especially during the settlement period. Lapwing and Oystercatcher prefer to nest in short vegetation, while Redshank and Godwit prefer taller grass.

Vegetation domination by tall plants like Soft rush (*Juncus effuses*) is a problem in many reserves, because it influences the openness of the area. Meadow bird numbers usually drop if an area gets invaded by this plant. Regular mowing is an efficient counter measure but it should be continued over time. It is not always clear what causes the invasion of Soft rush.
Important factors are:

- acid conditions
- wet conditions with fluctuating water levels
- high fosfate load
- low kalium level

In a highly dominated situation combined action on these subjects, over several years, is essential for success.

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