# MEADOWBIRDS IN THE NETHERLANDS

## by Albert Beintema

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### Introduction

Meadow birds are defined as bird species that breed predominantly in agricultural grasslands, either grazed meadows or hayfields. In our studies the term meadow birds is mainly reserved for six species of shorebirds: the Oystercatcher Haematopus ostralegus. the Lapwing Vanellus vanellus, the Black-tailed Godwit Limosa limosa, the Redshank Tringa totanus, the Ruff Philomachus pugnax, and the Common Snipe Gallinago gallinago. These species form the main core of the meadow-bird community. Originally denizens of open, natural habitats, they have found that cultivated grasslands offer a satisfactory alternative. Probably due to the higher level of soil productivity in such fields, they can thrive in very much higher densities than in their natural habitats. For example, on one square kilometre of good meadow-bird habitat one can find more than a hundred nests each of the Oystercatcher, Lapwing, and Black-tailed Godwit as well as twenty nests each of the Redshank, Ruff and Snipe.

A meadow-bird community can only develop on this scale within narrow margins formed by a rare combination of climate, soil, hydrological conditions, and management practices. The probability that this combination will occur spontaneously seems small, and at present the phenomenon is restricted mainly to The Netherlands and, within that country, to the lowest-lying regions. Thus, the Dutch meadow-bird populations are of great international importance, a fact which is recognized by private and governmental nature conservancy organizations. The situation is exemplified by one species: the roughly 100,000 pairs in The Netherlands represent some 80% of all Black-tailed Godwits of western and central Europe. Excellent meadow-bird land can develop on lowland peat, on silty alluvial plains, and even better, on a combination of these two types of soil. Many of the richest places are found on old lowland peat covered with clay deposits during more recent transgression periods. In the past, due to drainage problems, dairy farming was the only economically feasible kind of agriculture in such areas. The typical flat Dutch polderland is drained by a dense network of ditches and canals. The water table lies very close to the surface, and in the winter parts may even be flooded. In this habitat, the birds find good nesting cover and sufficient food for egg production early enough in the season. Wet conditions mean postponement of agricultural work in the fields for many weeks, which makes safe hatching possible, and the moisture also guarantees abundant insect food for the chicks later in the season.

Intensification of dairy farming begins with lowering of the water table to allow earlier access to the fields for heavy machinery or cattle, as well as to permit the soil to warm up faster to promote vegetation growth in the spring. Acceleration of growth is further enhanced by the application of fertilisers. Generally, the result is that all processes in the grassland tend to occur earlier in the season. Although the birds respond to this advancement with an earlier start of the breeding season, they are nevertheless exposed to heavy management practices, such as mowing or intensive grazing, much sooner in their cycle, because of the faster growth of the vegetation. In addition, higher production levels are reflected by higher cattle densities, which means higher nest losses due to trampling. Thus, the delicate balance between birds and management has been disturbed. The meadow-bird species no longer produce enough offspring, and their populations are steadily declining.

Meadow birds have long been a matter of concern for the RIN (Research Institute for Nature Management), and more specific research on them was started by the Institute in 1973.

### Preliminary investigations and lines of research.

Field work in 1973 and 1974 was mainly devoted to the Redshank, on the grounds that substantial amounts of information had already been published on the Lapwing, Black-tailed Godwit, Oystercatcher, and Ruff. In Europe, the Redshank is primarily a coastal bird, and it is not surprising that in the province of Friesland the highest inland breeding densities were found in places with high-salinity conditions. These occur especially where old lowland areas were soaked with seawater during transgression and later covered by clay. Superficial drainage eventually resulted in accumulation of underground salt in the lowest parts. Long ago, such deposits were 'mined' to exploit the salt commercially by burning the peat and extracting it from the ashes. The Klaarkampermeer Reserve offers the best example of this history: a small lake created by salt extraction is surrounded by saline meadows supporting extremely high densities of Redshanks (several nests per hectare, locally). Features which attract the Redshanks are the very fine structure of the vegetation (Festuca rubra and Juncus gerardi), making it highly suitable for nesting, and the permanent presence of silty, muddy ditches for feeding. As early as 1974 it became evident that Redshank studies would not provide solutions for meadow-bird problems in general, and that a community rather than a species approach was needed. Therefore, a start was made in 1974, with help of some students, on the investigation of meadow birds as a comunity, with special attention to any correlations between breeding success and densities on the one hand and agricultural procedures on the other, and to the impact of major sources of disturbance (roads, farms, villages) on the distribution patterns of the birds. The results of these studies provided confirmation of the negative correlation of both success and density with farming intensity and the positive correlation between density and distance from major roads, but no information about the underlying mechanisms was obtained. In 1975, correlations with vegetation types as a product of management were studied.

Also in 1975, a start was made on a more ambitious program, again in Friesland. This project concerned the influence of the water table as a major factor. Initially, an attempt was made to separate the influence of the water-table from that of management intensity, but this proved to be impossible, because management itself is directly influenced by the water-table. We therefore decided to compare various complete and complex systems, with the water-table as the main distinguishing character. The idea was first to identify differences between locations, and then see whether these differences recur in areas where changes take place. For this purpose, 14 plots totalling about 3000 ha were chosen, the size of the individual plots ranging from 70 to 300 ha. Basically, there were three combinations: A. areas with high water tables and relatively low farming intensities; B. areas where water tables were lowered some years ago and management intensities are high; and C. areas where conditions would be changed during the course of the investigations, either from A to B as part of a re-allotment program, or the reverse, i.e. in areas where meadow-bird reserves are being established. All three types were represented in both clay and peat areas as the most important soil types for meadow birds. In five successive years, the birds were counted at least three times in each season. The results of this work are interesting and useful, but less adequate than expected. Comparison of localities confirmed the already-known correlation, but once again without revealing the mechanisms involved. Comparison between years was even disappointing, because in many cases changes took place too slowly to be detected in a 5-year period and it seemed probable that most effects were masked by the effects of strong meteorological differences between the years. However, a closer look at these differences suggested new lines of research. Comparison of counts within one season shows a sudden drop of the number of pairs present in June. Such a drop is to be expected when the young fledge and families leave the area to congregate in summer roosting places, but in some years this drop took place too early, which means that many pairs must have left the area without raising young. This holds especially for years when good weather prevailed during May and grazing and mowing could start early, which suggests that losses due to management play an important role in this pattern. Another hypothesis is that prolonged dry weather reduces the chance of survival for chicks, via a reduction of available insect food. It is evident that under dry conditions families with chicks wander over great distances and concentrate in the lowest and wettest places.

Most pairs produce young in wet springs, when regular rainfall delays mowing, but cold rainy weather has an adverse effect on the smaller chicks, whose thermoregulation is not yet sufficiently developed. Ringing results show that in some years with a long series of cold days at the end of April and the beginning of May, almost all early-born Lapwing chicks are wiped out. This shows clearly how narrow are the margins referred to in the introduction and also how necessary it is to investigate these margins with respect to both hatching success and chick survival.

The counting program in Friesland was terminated at the end of the 1979 season simply because other work had higher priority, but it will be interesting to revisit these plots a number of times during the next few years. At present, the main research lines concern the problems described above, and deal mainly with population dynamics and food biology which will be discussed further in the next two sections.

Population dynamics.

To maintain themselves, all animal populations must produce enough offspring to compensate for their mortality. Mortality rates in meadow birds can be calculated from ringing recoveries, but the assessment of production is more complicated. The easiest factor to study is hatching success. Nest records were collected as early as 1974, but were kept on a more regular basis from 1976 onward, mainly during the counting program in Friesland. Nest observations were particularly frequent in 1980 and 1981, when the effect of trampling by cattle was investigated specifically. Data up to 1982 are available for about 600 nests of various species.

For the calculation of nesting success it is not sufficient to assess the percentage of nests lost. This approach leads to overestimation, because nests lost prior to finding are not included. The correct way to express nest losses is on a daily basis. For convenience, we do not use losses for further calculations, but instead take the daily survival rate expressed as a probability. These methods are described by Mayfield (1961, 1975). For most species the daily survival rate of the nests is close to 98% if only losses due to predation are considered. From this daily survival rate, the ultimate hatching sucess can be estimated by multiplying daily rates for each day of exposure successively. If daily survival is constant and the total exposure is say 30 days (laying period plus breeding period), the hatching success is $.98^{30} = .55$. In all of the species studied, however, the daily survival rate is not constant: it is lowest early in the season, rises in May, and drops again slightly toward the end of the season. One of the possible explanations for this pattern is that the predation pressure is lowest during peak densities. Furthermore, incomplete clutches have much lower survival rates than complete ones, due to differences in attendance of the owners. Besides, open nests suffer more predation than concealed nests, both within and between species. Hatching success alone tells nothing about productivity. If all females lay successful repeat clutches, all prior losses are, of course, insignificant. To estimate ultimate breeding success, we developed a mathematical model that takes all repeat clutches into account. The components of the model are the first laying date, the last possible date on which egg loss will give rise to a repeat clutch (deadline), the interval between date of loss and start of repeat clutch, the fraction of the birds that make a new nest if loss occurs (on a daily basis, this rate is 1 at the outset of the season and drops to zero at the deadline), the frequency distribution of laying dates of all first clutches, the duration of exposure to loss of the clutch (laying plus incubation), and a complete set of daily survival rates (predation only). On this basis, the model predicts how many pairs will hatch at least one egg (partial losses are incorporated separately). According to this model, in all of the species studied (Lapwing, Black-tailed Godwit, Redshank, Ruff, and Oystercatcher) the ultimate breeding success will be 90-95%, although almost 50% of all nests initiated will be lost even if only predation is taken into account. This demonstrates the tremendous importance of the second clutches.

The next step in working with the model is to multiply all daily survival rates by an agricultural survival rate. This rate equals 1 for days with no agricultural activities, and is estimated to be 0.85 for manuring or fertilizing and zero for mowing. For grazing, it depends on cattle density, and is derived from a basic 'trampling value', which is the probability that a nest will survive one day of grazing by one animal on one hectare. Surprisingly, it has been found in the field that one day of grazing by twenty animals gives exactly the same amount of loss as twenty days by one animal. This is very convenient, however, because it means we can use a basic value for both situations, although this value does differ between bird species and between types of livestock.

Thus, it is possible to predict breeding success for any management conditions. Analysis of modern theoretical conditions indicated by the agricultural literature gave such low success rates that even if all chicks were to reach adulthood (which never happens since,normally, about half of them die before fledging), recruitment would be too low to sustain the population. Conditions observed in the field proved to be critical in many cases. It may therefore be concluded that where modern farming is practised the reduction of hatching success alone is sufficient to account for a decrease in the breeding population, regardless of the conditions the chicks are exposed to after hatching. The latter conditions will only modify the extinction rate.

The next step will be to obtain more information on chick survival. Since 1976, about 5000 chicks of various species have been measured by volunteers (bird ringers) annually, which gives an idea of the age distribution of chicks over the season. These data have not yet been fully analysed, but preliminary results suggest that chicks grow fastest and survive best in the middle of the season. It is not yet clear what affects survival at the end of the season, but early chicks often show retarded growth and high mortality due to bad weather. Homoiothermia must be achieved in the first few weeks, and during this stage the chicks live in a constant conflict: either forage and become chilled or keep warm (be brooded) but starve. At low temperatures, families show a regular pattern of alternating bouts of brooding and foraging. If the temperature rises above a certain value, brooding ceases. Typically the alternating pattern starts at sunrise, is followed by a midday period without brooding, and there is a return to the alternating period in the last part of the day. For Black-tailed Godwits, this limiting value of the temperature ranges from 25°C on the first day to below 10°C for ten-day-old chicks. By then, they are almost self-sustaining. At extremely low temperatures, hardly any foraging is possible; the chicks lose weight, and if bad weather continues they will die in about four days. Although we are learning more about chick biology, we do not know enough yet to be able to design a chick model to add to the hatching model.

Food biology.

The ornithological literature provides information about the food of adult meadow birds. A large proportion consists of soil fauna, in particular earthworms and larvae of tipulids. Modern farming methods lead to an increase of the soil fauna, and therefore there should be no dietary problems for the adults. (This is not true, as will be discussed in the last section.) This situation may be quite different for the chicks, which feed almost exclusively on surface fauna, with the exception of Oystercatcher chicks, which are fed tipulid larvae by their parents. In the other species, the chicks have to feed themselves from the start and are therefore totally dependent on the availability of suitable insect food.

Since 1977, faeces of meadow-bird chicks have been collected during ringing. Analysis of 1000 of these faeces samples in 1982 showed more than 160 taxonomic items (mostly families). Unlike chicks of gallinaceous birds, wader chicks have comparatively weak stomachs and many parts of insects, notably feet, mandibles, and carapaces, but also wings of flies and midges, are defecated intact.

The diet of Lapwing chicks consists mainly of surface-dwelling organisms such as beetles and several kinds of larvae, and the larger chicks especially, consume a fair amount of earthworms and tipulid larvae. Lapwing chicks also dig out of dungpats small beetles and, in particular, the larvae of strationomyds, which are hardly ever found in the faeces of chicks of other species. In contrast, Black-tailed Godwit chicks consume insects of higher vegetation. They are very agile and fast runners, constantly picking flies, midges, and beetles from higher stems and leaves. Worms and tipulid larvae are almost absent in the faeces. The diet of the Redshank is intermediate, but analysis is hampered because at about the age of 10 days the chicks begin to produce pellets, and after that hardly any remains occur in the faeces. The diet of chicks of the Ruff is as varied as that of the godwit chicks, but is the only one which includes fair numbers of spiders. Faeces of Ruff chicks are often characterized by a black fluid component whose origin is unknown. Oystercatcher chicks are fed tipulid larvae and earthworms almost exclusively; it is perhaps the large proportion of tipulids that gives the faeces a peculiar smell which is still recognizable after five years in alcohol.

The explanation of densities; problems for the future

Reference has been made above to planned research, but the crucial problem is that of population density. We can now predict whether or not populations can maintain themselves under certain management conditions, but not at what level. If the prediction is negative the matter is simple: a decrease can be expected. However if, for example, a new reserve is created, it is impossible to predict the ultimate population density under optimal conditions.

The model described above may supply a clue. If we use it to calculate average breeding successes (in fact, probabilities) for a whole area, the spatial distribution of the birds must be taken into account. It is obvious that a plot with many birds will contribute more to the average than one with few birds. It is interesting to make this calculation for all species, assuming them to have been present in the same areas as all the other species. The results from the model indicate that for plots where Ruffs were found breeding, the model predicts the highest survival rates and nesting success for all species. The Ruff is the most vulnerable species in the model, and can thus afford unsuccessful breeding the least. The results indicate that Ruffs are most likely to be found in areas where the observed management conditions predict the best nest survival. Either Ruffs are selecting plots with low management intensity, or they are heavily selected by management practices. If other species have their best breeding success in the same plots as the Ruff, then why do these other species not adopt the distribution pattern of the Ruff? The answer seems to be that plots with Ruffs (i.e. plots with low management intensities) are relatively scarce, and so can only support a small percentage of the present populations of the other, more tolerant, species. The plots used by Oystercatchers (the least vulnerable species, and that which can tolerate the most nest losses) are those where other species, particularly the Ruff, are predicted by the model to have poor survival. This leads to the hypothesis that each species reaches its maximum density, and its highest numbers, in places where the management intensity is just below that at which insufficient nests hatch to maintain the population. Thus population density will increase with increasing management intensity, but at the same time the chance of successful breeding will decrease. When the threshold of management intensity is reached, the population density will level off. When the threshold is exceeded, the population will decrease, and ultimately die out. The threshold level differs between species. It is lowest in the Ruff, and increases in the order Ruff, Redshank, Black-tailed Godwit, Lapwing and Oystercatcher. This sequence explains why the decrease of Ruffs started first, some time ago, whereas Black-tailed Godwits only began to decrease recently, and Oystercatchers can still increase their populations. The Ruff can be used as an indicator for good meadow-bird habitats, although these are not necessarily the best habitats for Oystercatchers.

If this hypothesis is valid, increased management intensity, which means increased grassland production, would lead to enhancement of the potential population density of meadow-birds. This brings us back to food biology, because the tremendous increase in the soil fauna associated with increased management intensity must be responsible for this relationship. However, we know nothing about the underlying mechanisms. Although much more could be said about all the hypotheses that I have mentioned, it is clear that there are so many questions yet to be answered that meadow-bird research will have to be continued for many years.

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# WSG QUESTIONNAIRE: YOUR VIEWS AND COMMENTS AND THE OFFICERS' ANSWERS TO QUESTIONS

## compiled by M. W. Pienkowski

A total of 103 responses to the questionnaire (plus 1 letter without a form) were received by the time of writing. This represents about 20% of the membership; I am informed that a return rate of this size is not atypical of a simple questionnaire without follow-up. As Bulletin 34 was received fairly late in at least some parts of the world, we have delayed analysis until October 1982 to allow as much chance as possible for reply.

Some respondents identified themselves, although this was not requested. Based on this and postage stamps of other replies, 54% of replies came from UK and Ireland, 17% from the rest of Europe, 24% from N. America and 5% from the rest of the world. This matches fairly well with the distribution of membership, except that UK and Ireland are slightly overrepresented in replies and the rest of Europe slightly under-represented. The percentage distribution of membership, in the same order, is: 45%, 27%, 23%, 5%.

### Subscription

Preliminary figures on the subscription option favoured by members were given in Bulletin 34. These can now be updated to include the later responses. 11% (11½ replies - one gave equal first choice) favoured a basic annual subscription of more than £10, 70% £10, 15% £8, and 4% less than £8. Thus, a total of 81% favoured a subscription of at least £10. 7% said they would leave the group if the subscription were to be raised to this extent.

Most second and subsequent choices for subscription rate were distributed as one might expect given the first choices, and are not detailed here. We are somewhat puzzled, however, by one return from a member in Ireland whose first choice was £10, second less than £8, third £8 and fourth more than £10!

The Treasurer suggested the possibility of payment of subscription in advance. Half the people replying (51%) indicated that they would be prepared to do this. This 51% was made up of 12% prepared to pay for 2 years in advance, 23% for 3 years, 8% for 4 years (this includes several who indicated "3 to 5"), 7% for 5 years, 1% for 10 years and 1 person who gave the mathematical symbol for infinity. This could solve all our problems, but we suspect that he or she really meant an uncertain period! Following consideration of these results by the Treasurer and the Committee, the AGM approved the option of paying subscriptions for 3 years in advance. Other enquiries and suggestions concerning finance made have also been considered. These include:

1. "For the past 2 years my check has gone uncashed for about 6 months! It is hard to believe that cash is a problem". Steps have now been taken to revise the procedure for payments from N. America - see Bulletin 36.
2. "Would it be possible to arrange a covenant type scheme?" "Have you considered covenanted subscriptions to enable you to take advantage of tax concessions - although this may involve forming a trust?" This might be difficult to arrange this for such a small membership, especially as it could apply only in Britain. Furthermore, it might be undesirable to place the group under the restrictions of a charity.