Breeding Birds as a Farm Product

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Abstract: *Since the 1950s, meadowbird populations have been under increasing threat from radical changes in farming practices. We studied the possibilities for conserving meadowbirds on modern, intensive dairy farms in the Netherlands. Here, the conventional strategy for the conservation of meadowbirds is to restrict farming intensity and compensate farmers for their production losses. To increase the breeding success of meadowbirds, however, dairy farmers can fine-tune farming practices to yearly and local circumstances. Because this fine-tuning is difficult to enforce by legislation, we propose that farmers be paid for clutches bred on their land. Thus, farmers are paid for what they produce, but not restricted in their farming practices. The results of the first small-scale experiments, in which breeding success was compared between farms where farmers were paid for meadowbird clutches and farms where farmers were not paid, are encouraging. Breeding success of meadowbirds was significantly higher where farmers were paid than where they were not (breeding success of Lapwing [*Vanellus vanellus*]: 64.7% on paid farms, 48.2% on unpaid farms; Black-tailed Godwit [*Limosa limosa*]: 63.1% paid, 39.3% unpaid). The effects on meadowbird populations could not yet be detected. The per-clutch payment system is less expensive than compensation for income losses: paying for clutches costs 40 Euro per clutch, whereas compensating for income losses costs 100–400 Euro per clutch (1 Euro is approximately equal to 1 U.S. dollar). Farmers are enthusiastic, and the system encourages cooperation between farmers and nature conservationists.*

Aves Reproductoras Como un Producto de Granja

Resumen: *Desde 1950, las poblaciones de aves de pradera han estado amenazadas por cambios radicales en las prácticas agrícolas. Estudiamos las posibilidades de conservar las aves de pradera en las granjas lecheras modernas e intensivas en Holanda. Aquí, la estrategia convencional para la conservación de aves de pradera consiste en restringir la intensidad productiva y compensar las pérdidas a los granjeros. Sin embargo, para incrementar el éxito reproductivo de las aves de pradera los granjeros pueden ajustar sus actividades productivas a las circunstancias anuales y locales. Debido a que es difícil que los ajustes sean de observancia forzosa proponemos que se pague a los granjeros el número de nidadas producidas en sus terrenos. Así, a los granjeros se les paga lo que producen y no se les restringen sus prácticas productivas. Los resultados de estos experimentos a pequeña escala, en los que el éxito reproductivo fue estudiado en granjas a cuyos dueños se les pagaron las nidadas en comparación con granjas sin pago, son alentadores. El éxito reproductivo de las aves fue significativamente mayor en las granjas cuyos dueños recibieron pago que en donde no lo hubo (éxito reproductivo de* Vanellus vanellus *64.7% en granjas pagadas, 48.2% en granjas sin pago;* Limosa limosa *63.1% en granjas pagadas, 39.3% en granjas sin pago). No se pudieron detectar efectos sobre las poblaciones de aves de pradera. El sistema es menos costoso que la conservación basada en la compensación de pérdidas en la producción. El pago de nidadas tiene un costo de 40 Euro por nidada, mientras que la compensación de pérdidas tiene un costo de 100 – 400 Euro por nidada (1 Euro equivale aproximadamente a 1 dólar U.S.). Los granjeros están entusiasmados y el sistema promueve la cooperación entre granjeros y conservacionistas.*

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Introduction

In the long run, nature conservation will be successful if it is supported by local communities and if it is economically viable (Western & Wright 1994; Tisdell 1995; Shyamsundar 1996). This is especially true in situations where conservation is closely linked to local human activities, as often is the case in agricultural areas. Because setting aside protected areas in such situations is difficult, the conservation of wildlife on farmland depends on the participation of farmers. Yet conservation strategies that try to reconcile the interests of farmers with the conservation of wildlife on farmland are few. Most of the cases discussed by McNeely (1993) and Western and Wright (1994) involve attempts to buffer human impact on protected areas.

The conventional strategy for conserving wildlife on farmland is to stop intensive activity and compensate the farmers for their production losses, a strategy common in numerous countries (e.g., Lämås & Fries 1995; Beintema et al. 1997; Gunningham & Young 1997). Restricting farmers in their farming practices, however, does not foster commitment of farmers to nature conservation, and economic theory suggests that subsidies for ceasing unwanted activities may not have the desired long-term effect (Baumol & Oates 1988; WRR 1992; Kruk et al. 1995).

We investigated a new conservation strategy aimed at motivating farmers to increase the densities of grassland breeding birds by paying farmers for clutches found on their land. It differs essentially from conventional conservation measures in that farmers are paid for a "product" and are not restricted in their farming practice.

Background

The Netherlands is known for its wide polder landscape: areas of grasslands punctuated by windmills and crisscrossed by canals and ditches. Grassland-breeding birds (meadowbirds) are an important feature of the polder landscape on national and international levels. In all 28 bird species are regarded as meadowbirds in the Netherlands (Verstrael 1987). The core of the meadowbird community consists of six wader species: Oystercatcher (*Haematopus ostralegus*), Lapwing (*Vanellus vanellus*), Black-tailed Godwit (*Limosa limosa*), Redshank (*Tringa totanus*), Common Snipe (*Gallinago gallinago*), and Ruff (*Philomachus pugnax*) (Beintema 1983). The Dutch polders are the breeding grounds of a significant percentage of the populations of most of these meadowbirds (Piersma 1986; Kruk 1993; Beintema et al. 1997). The Black-tailed Godwit is the species most dependent on the Dutch polders: about 80–90% of the entire Western and Central European population breeds there (Piersma 1986).

Most meadowbirds in the Netherlands breed in farmers' grasslands (Beintema 1986). Since the 1950s, these birds are believed to be under increasing threat from radical changes in farming practices (Beintema 1983; Beintema 1986; Musters et al. 1986; Kruk 1993). Due to the general love for meadowbirds in the Netherlands, measures were taken to reduce farming intensity (Beintema et al. 1997). Reserves were set aside and farmers in certain crucial areas, called *relatienotagebieden*, the equivalent of the English "environmentally sensitive areas" (Kruk 1993), are offered financial compensation for using less intensive forms of agriculture (Beintema et al. 1997). These measures have a number of serious drawbacks.

First, they restrict farmers in their farming practices and limit their freedom of enterprise. Second, they do not promote cooperation between farmers and conservationists because both parties are led to see conservation values as incompatible with agricultural values. Third, the number of meadowbirds conserved by the measures is uncertain because populations are not monitored. Fourth, the measures tend to be expensive because farmers have to be compensated for production losses. (In 1994 the Dutch government spent between 100 and 400 Euro per meadowbird clutch in production-loss compensation within the relatienotagebieden [Kruk et al. 1996].) This raises the question of whether it is possible to stop the decline of meadowbirds, minimize restrictions to farmers, and spend less money.

At the end of the 1970s a nature conservation strategy was proposed in which farmers would be paid for the occurrence of wildlife on their farms (de Meijere 1979). This proposed strategy has several advantages: (1) the conservation agency pays only for wildlife actually present on the farmer's land; (2) when the intensity of farming is not affected, there are no income losses, and the scheme generates extra income for the farmer; (3) farmers are stimulated to do what they do best: produce roughage, milk, meat, and animals, and wildlife becomes another product; (4) farmers are free to work as they choose, which might encourage creativity; (5) farmers and nature conservationists are prompted to work together because of their common interest to increase the production of wildlife in rural areas; and (6) farmers will focus on the birds that need protection most if a high price is paid for a scarce species and a lower price for a more common one. To find out whether this strategy was applicable to meadowbirds, in the early 1980s we studied whether individual farmers could influence breeding densities. The conclusion of this earlier study was that breeding success is a key influence on densities and one that farmers can influence without changing the intensity of their farming practices (Musters et al. 1986; Kruk 1993). Influencing breeding density by affecting breeding success involves fine-tuning of farming practices to yearly and local circumstances, such as the start of the breeding season and the location of the nests, and this is difficult to enforce by legislation. Paying farmers for clutches bred on their land—preferably without further regulation—might be the instrument to motivate farmers to adopt such farming practices.

Research Questions

To design a system for paying farmers for clutches bred on their land, we set up small-scale, regional experiments on dairy farms in which we cooperated with farmers, conservationists, and governmental agencies. In these experiments, the scheme was that each farmer would report the number of clutches on his land, and all reports would be verified. We sought answers to the following questions: (1) How successful are farmers that are paid for meadowbird clutches in increasing breeding success? (2) How successful are farmers in finding clutches? (3) Which method of reporting clutches by farmers reflects the production of clutches most accurately? (4) Can the reports of the farmers be adequately verified? (5) What costs are incurred by the farmer for protecting and reporting clutches, and what are the costs of verifying reports?

Methods

During the experiments, *breeding success* was defined as the percentage of clutches that hatched, *incubated clutches* as clutches that birds are sitting on at the counting date, and *hatched clutches* as clutches hatched at the counting date.

We selected 24 farms in the Western Peat Area of the Netherlands which we regarded as representative of modern dairy farms; 15 of these farms were "experiments" and 9 were controls. On each farm, we selected about 8 ha of land that included the most meadowbird-rich plots on the farm. On average, the 15 experimental farms proved more modern than the average dairy farm: the experimental farms had 52 ± 18 cows, whereas the average Dutch dairy farm grew from 40 cows in 1990 to 48 in 1998, (LEI-DLO & CBS 1999). No conservation measures were taken on these farms except those that were part of the experiment. No farms with special management, such as ecological farming, were selected. In the second stage of the experiment (1995–1996), the number of experimental farms had to be reduced to 10 because of lack of research capacity. Control farms were reduced to 3 because six farmers got involved in meadowbird management so heavily that their farms could no longer be regarded as controls.

The experiments took place between 1993 and 1996. In the first stage (1993–1994), the farmers did not receive any payment for the clutches found on their farms because no price had yet been set and one of our aims was to collect information for pricing clutches. During the second stage (1995–1996), farmers were paid for clutches incubated on their land. Here, the aim was to collect further information on the success of farmers in protecting clutches.

To examine whether more than one report per year would significantly enhance the number of clutches reported, the farmers were asked to report the number of incubated and hatched clutches on one counting date in 1993 and on two dates in 1994. To avoid double counts, these two dates were at least 1 month apart.

During the breeding period in both years, clutches present on the farms were located by researchers and followed over time with weekly visits. We assumed that all clutches were found by the researchers. The data collected were used to check the accuracy of the report system (one vs. two counting dates) and the ability of farmers to find, identify, and report clutches.

To make efficient verifying of the reports possible, the farmers included a map of their farm on which the clutches were indicated, and in the field they marked the clutches with sticks stuck in the ground. Within 3 days, the reports were checked by researchers who had no previous knowledge of the location or state of the clutches on the farm, thus simulating agency personnel. In 33 cases, hatched clutches were artificially constructed to see whether these fraudulent clutches were identified as such by the researchers who checked the reports.

We assessed the effect on breeding success of the farmers' efforts to enlarge the number of successful clutches by following all clutches found on the 15 experimental farms and comparing these with all clutches found on the 9 control farms. From these data the clutch survival rates per nest day were calculated, and these were used to estimate the average percentage of clutches hatched by Mayfield's (1975) method (Johnson 1979):

$$S = 1 - (\mathrm{NL}/(\mathrm{NO}+\mathrm{NL})), \quad (1)$$
$$\mathrm{SD}(S) = ((\mathrm{NO}-\mathrm{NL})*(\mathrm{NL}/\mathrm{NO}^3))^{1/2},$$
$$\text{and } H = S^B,$$

where S is the survival rate per nest day, NL is the number of nests lost, NO is the number of nest days observed, SD(S) is the standard deviation of S, H is hatching success, and B is the breeding period in days. We tested whether the clutch survival rates on experimental farms were higher than those on control farms (one-sided test of z score, following Johnson 1979).

To find out whether farmers that are paid increase their income from clutches found on their land, we studied the change in clutch density on each farm for which data from all 4 years of the study period were available (i.e., 10 experimental and 3 control farms). We calculated the regression coefficient in the logarithmically transformed number of clutches (Ln(N + 1)) per study area per farm, and we tested whether the average regression coefficient was higher in the experimental than in the control farms (one-sided Student's t test).

Throughout 1994 the farmers kept a record of the time spent on and the expenditures related to the experiments. Time spent by farmers was regarded as being worth 15.29 Euro per hour, according to standard compensations (Min-

Table 1. Meadowbird breeding success on experimental (n = 15) and control farms (n = 9).

Species	*Breeding period in days* (B)	*Nest days (NO)*[a]	*Nests lost (NL)*[b]	*Survival rate per nest day* (S)	*SD*(S) *per nest day*	*Hatching success* (H) (%)	Z	p *(one-sided)*
Lapwing	27						1.902	0.029
experimental		6359	103.3	0.984	0.00159	64.7		
control		916	25.11	0.973	0.00540	48.2		
Black-tailed Godwit	24						2.404	0.008
experimental		3859	66.38	0.983	0.00209	63.1		
control		734	25.85	0.966	0.00680	39.3		
Redshank	24						0.952	0.171
experimental		566	20.28	0.965	0.00781	38.7		
control		116	7	0.943	0.02211	20.6		

[a]*Data from 1993–1996.*
[b]*Nests lost (NL) can be a fractional number because a clutch is not always lost completely.*

isterie van Landbouw, Natuurbeheer en Visserij 1993). Additional information on costs was collected by interviewing the farmers who participated in the experiments. These data were used to estimate the minimum price per clutch necessary to motivate farmers to take part in the new conservation strategy. In addition, the time spent verifying the farmers' reports was recorded. We set the cost of time spent by agency personnel on checking at 31.78 Euro per hour (van Harmelen et al. 1996). The cost to farmers and the cost of verifying their reports were used to estimate the cost of the new conservation strategy per clutch.

Results

Breeding Success

The farmers' participation in the experiments resulted in higher breeding success (Table 1). Lapwings and Black-tailed Godwits showed significantly more hatching success on experimental farms than on control farms (Lapwing: 64.7% experimental, 48.2% control; Black-tailed Godwit: 63.1% on experimental, 39.3% control; Fig. 1). Redshank also showed more hatching success on experimental farms (38.7% experimental, 20.6% control), but the difference was not significant. The increased hatching success did not result in higher densities of clutches on the plots studied within the research period (Table 2).

Finding, Identifying, and Reporting Clutches

Farmers found 71% of the 255 clutches found by researchers in 1993 and 78% of the 236 clutches found by researchers in 1994. In the second year of the experiment, the percentages were slightly higher for all bird species, indicating that experience can lead to improved efficiency in finding clutches. Only 334 clutches out of 365 found by the farmers were reported, because some clutches were lost or hatched before the counting date. The farmers attributed only 2 of the clutches reported to the wrong bird species, both in the first year of the experiment.

Of the reported clutches (n = 334), most were incubated at the counting date (n = 216). The remaining clutches were hatched (n = 118), but this number is be-

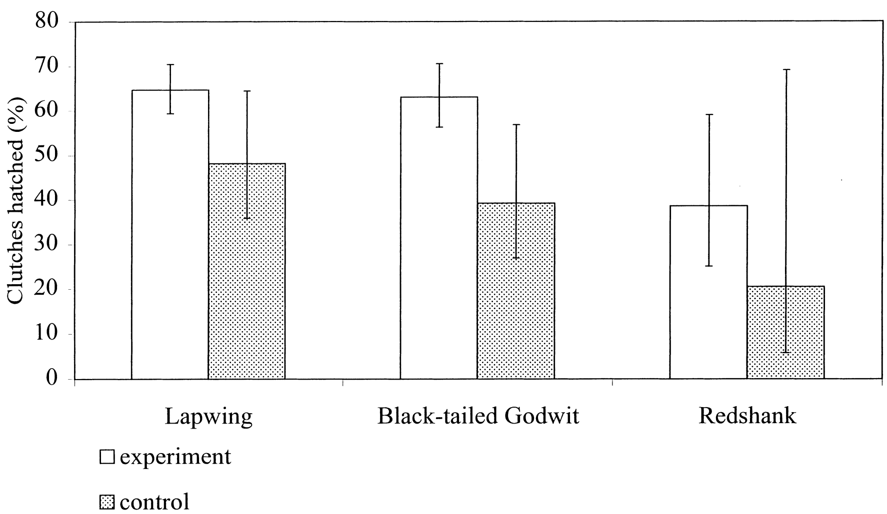

Figure 1. Differences in breeding success of three meadowbirds between farmers who were paid for clutches (experiment, n *= 15) and farmers who were not (control,* n *= 9). A 95% confidence limit is indicated by the line. Data are from 1993–1996. Number of nest days and statistical testing are given in Table 1.*

Table 2. Trend in clutch densities on experimental and control farm plots during 1993–1996.

Species	Average regression coefficient	SD regression coefficient	Student's t	p (one-sided)
Lapwing			−1.142	0.855
experimental	0.0046	0.0368		
control	0.0230	0.0193		
Black-tailed Godwit			−1.267	0.883
experimental	−0.0264	0.0344		
control	−0.0100	0.0121		
Redshank			0.8199	0.236
experimental	−0.0035	0.0370		
control	−0.0230	0.0358		

low the number that could have been reported by the farmers: hatched clutches were not always counted and marked by the farmers because they had lost their "nature value" in the farmers' view. It is unknown how many hatched clutches would have been reportable if farmers had treated them as incubated clutches. More clutches were reported by two counts within one season than by one: farmers reported 36% of all clutches present during the complete season after one count, and 49% after two counts.

Verifying Reports

In 1993, researchers simulating agency personnel were unable to find 9% of the 100 incubated clutches reported. In 1994, 8% of 116 reported incubated clutches were not found. For hatched clutches these rates were poorer: of the 39 and 79 clutches reported as hatched in 1993 and 1994, respectively, 21% and 27% were not found, respectively.

In a number of cases, the state of the clutches had changed between the reporting and checking date. In 1993, 28% of the incubated clutches hatched in the meantime, and in 1994 this percentage was 15%. Only 14% (n = 7, 1993) and 23% (n = 26, 1994) of the artificially constructed hatched clutches were recognized as such. In 1994, 5% of the real hatched clutches were designated as artificially constructed.

Costs

The average cost to farmers, calculated from their own records, was 65.79 Euro per clutch (all species together; Table 3), varying between farmers from 12 to 192 Euro. The costs for time spent on clutch conservation and for loss of grass production—17% of the total cost or 11 Euro per clutch according to the farmers' records (Table 3)—were also calculated independently on the basis of data provided by the Dairy Farm Manual (Informatie en Kennis Centrum Veehouderij 1993). This resulted in an estimate of 10 Euro per clutch, demonstrating the reliability of the farmers' records.

The average costs of verifying the farmers' records were estimated based on the fact that five farms could be checked per day and that about 10 clutches were reported per farm. Thus, 50 clutches could be checked in 8 hours, 0.16 hours per clutch, which results in 5.08 Euro per clutch.

Discussion

Conservation Success

Participation of farmers in a payment scheme for meadowbird clutches resulted in significantly more hatching success. According to the survival model developed by Beintema and Müskens (1987), hatching success needed for the maintenance of the population is 62% for Lapwing, 63% for Black-tailed Godwit, and 40% for Redshank (Kruk 1993). Hatching success on the control farms was insufficient for population maintenance and on the experimental farms approximated adequate maintenance figures (Fig. 1). The Dutch polder landscape can be regarded as a mosaic of grassland plots that differ in meadowbird breeding success. Some plots have a breeding success

Table 3. Costs incurred by farmers for meadowbird clutches (in Euros).

Activity	Average hours per clutch	Costs per hour	Costs per clutch	Percentage of total costs (%)
Searching for clutches	3.30	15.29	50.47	77
Conservation measures	0.74	15.29	7.21	11
Product losses	—	—	3.90	6
Management and administration	0.27	15.29	4.21	6
Total			65.79	100

above that needed for maintenance (sources sensu Pulliam 1988); others are below the success needed (sinks). Regional populations of meadowbirds decrease if breeding success in the sinks is not compensated for by breeding success in the sources. Our results suggest that the efforts of farmers can turn grasslands from sinks into nonsinks or maybe even sources. Therefore, large-scale application of the scheme may end the decrease in regional meadowbird populations.

That we found no increase in density of clutches may be due to the fact that only meadowbird-rich plots within the farms were used in the experiments and controls. These plots may have been saturated with breeding pairs. A recent study of the natal philopatry of meadowbirds shows that adult Black-tailed Godwits tend to return to an area within 5 km from the place they were ringed as a chick, so greater breeding success may be expected to increase local populations first (Kruk et al. 1998). Thus, it might be possible for farmers to increase their income from clutches found on their land by incorporating other plots into the scheme. Cooperation between neighboring farmers to enlarge breeding success in an area larger than the average farm might be a promising strategy for farmers to increase clutch densities and income from the scheme.

Application of the Scheme

Paying farmers for incubated clutches proved an applicable system. Paying farmers for hatched clutches does not seem wise because hatched clutches were not regarded as valuable by farmers and often were not reported. Of those that were reported, a relatively large number was subsequently not found by researchers simulating agency personnel. Besides, artificially constructed hatched clutches are hard to recognize and can easily lead to fraud.

Paying for incubated clutches may be problematic because only hatched clutches are relevant for population maintenance, but a farmer is not likely to deliberately destroy an incubated clutch after his report is verified and thus endanger the production of clutches the following year.

Having clutches assessed by the farmers themselves appears appropriate: the farmers (or volunteers on their farms) are quite capable of finding clutches and reporting their results. Two counts are obviously more effective for breeding success than one. More than two counts per season was rejected by the farmers because of the amount of time involved. Checking of the reports by agency personnel is a practical procedure.

Costs

The mean costs per clutch incurred by farmers, when analyzed in more detail than presented in our results, was influenced by the long time spent searching for clutches by two farmers. More experience on the part of these farmers would have increased searching efficiency. If the data from these inexperienced farmers are left out, the costs are estimated at 35 Euro per incubated clutch. Thus, the total costs involved in an efficient system of payment for meadowbird clutches are estimated at 40 Euro per clutch (35 Euro for the farmer and 5 Euro for checking reports), considerably less than the 100–400 Euro per clutch spent for compensating production losses in 1994 by the Dutch government in the relatienotagebieden. In contrast to travel time, travel costs were not incorporated in the calculation of the costs of verifying reports. One study suggests that these costs are around 1.5 Euro per clutch (van Harmelen et al. 1996). Of course, large-scale application of the scheme may change total costs: farmers in other regions may have to spend either more or less time searching for clutches, and the costs for verifying reports may be influenced by scale effects.

On the basis of these results, we propose prices for incubated clutches, depending on the rareness of species in the Netherlands, that vary from 12 Euro for the common Oystercatcher to 120 Euro for the rare Ruff. These prices were actually paid in the second stage of our experiment (1995–1996) and are still paid there and in other regions of the Netherlands where experiments were started in 1996.

Participation

Most of the farmers participating in the experiments reacted enthusiastically to the scheme and cooperated wholeheartedly with conservationists. The experiments have led to other initiatives in several regions throughout the Netherlands. At present, in the Western Peat Area alone, the scheme is in use on 11,000 ha of grassland (Kuiper 1998).

Conclusions

The success of this project offers opportunities for large-scale studies of the scheme. Important questions from the point of view of conservation biology remain: Does the production of meadowbird clutches on farms lead to increasing populations on the farm and on a regional scale? Does large-scale application of the scheme lead to a change in total costs? Until now, we have concentrated our studies on the effects of the scheme on farmers and on meadowbirds; will this scheme have positive effects for other species as well?

The idea of nature as a product can be applied in other situations, especially in intensively used areas where few set-aside options exist. Populations of different kinds of rare plants and animals can be fostered by different people, such as farmers, foresters, horticulturists, and other managers of rural and urban areas, and they can be paid for by government, business, or nature conservation organizations.

At least five conditions must be met to make this new form of nature conservation successful. First, there must be a "buyer" for the nature products. Second, the plants or animals to be produced must be regarded as a valuable element of nature by the producers. Third, the producer must have control over the wildlife concerned. Fourth, the wildlife produced must be easy to count; success must be measurable. And fifth, it must be possible to produce the desired wildlife without major disturbance to mainline economic activities so that wildlife production will not compete with primary forms of production. The production of wildlife through incentives may be an attractive alternative to restrictive measures in areas where nature conservation has to be combined with intensive human activities.

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