THREATS TO BREEDING WADERS: THE IMPACT OF CHANGING AGRICULTURAL LAND-USE ON THE BREEDING ECOLOGY OF LAPWINGS

H.Galbraith

Galbraith,H. 1987. Threats to breeding waders: the impact of changing agricultural land-use in the breeding ecology of Lapwings. *Wader Study Group Bull.* 49, *Suppl./IWRB Special Publ.*7: 102-104.

This study investigated the relationships between agricultural land-use and the breeding ecology of Lapwings *Vanellus vanellus* by comparing breeding biologies in two different habitats, arable farmland and rough grazing. Both land-use policy and specific farming operations have important effects on all aspects of the breeding biology of Lapwings, including choice of nesting habitat, timing of laying, clutch and egg sizes, hatching and fledging success. In the first two years of the study, productivity on the arable site was too low to maintain the population. This was due to a combination of the timing of farming operations, crop growth and habitat availability. In the final year of the study, poor weather in the early spring disrupted cultivation and retarded crop growth. Breeding success on the arable site was comparatively high. In all three years productivity on the rough grazing site was sufficient to maintain the population, in spite of a higher level of predation. The difference between the two sites was due to their markedly different land-use policies. These have major implications for the conservation of breeding populations of waders.

H. Galbraith, Department of Zoology, The University, Glasgow G12 8QQ, U.K. (Present address: Chief Scientist Directorate, Nature Conservancy Council, 12 Hope Terrace, Edinburgh EH9 2AS, U.K.)

INTRODUCTION

The effects of anthropogenic factors on avian population dynamics have received comparatively little attention. In Britain, however, such factors are likely to be of great importance for certain wader species, since some form of agricultural land is their usual nesting habitat (Galbraith *et al.* 1984).

As well as being of considerable academic interest, studies of the effects of agriculture on avian population processes may have important conservation implications. During the last 40 years farming in Britain has changed fundamentally. The traditional mixed farming system with its diversity of crops and mix of cultivation and livestock-rearing has been replaced in many areas by larger-scale units specialising in particular crops, especially cereals. Even in upland areas where, because of unfavourable topography, climate or soil type, cereal cultivation is not economic, the drainage and improvement of marginal grazing land has been widespread.

We know little about the possible effects that these changes might have on wild animal populations. Drastic effects, such as the over-use of pesticides have been well documented. However, the subtle effects which are likely to follow habitat modification are largely unknown. There have, however, been reports of reductions in local breeding populations of waders following changes in agricultural land-use (Green 1980, O'Connor and Shrubb *iin press*). Iff effective conservation policies are to be formulated, more information is needed on the ways in which particular farming practices may modify the population processes of animals on farmland.

Lapwings *Vanellus vanellus* are suitable animals with which to investigate the inter-relationships between agriculture, population biology and conservation for three main reasons: firstly, they are fairly abundant and widely distributed throughout British farmland. Secondly, Lapwings occur in fairly high breeding densities (to the extent of appearing semi-colonial in some areas), which facilitates data collection. Lastly, while they are characteristically birds of farmland, they breed in a variety of habitats within that broad classification (Nicholson 1938, Lister 1964, Galbraith *et al.* 1984). The two Scottish farmland habitats in which the highest densities occur are rough grazing (i.e. marginal upland grassland) and lowland arable land, especially cereal fields (Galbraith *et al.* 1984). As already noted, these are the two habitats most affected by current agricultural changes. By comparing breeding ecology and productivity in both habitats, this study investigated the role of agricultural influences on Lapwing population processes and the resulting conservation implications.

Detailed presentations of the results of the study are currently in preparation and this summary presents only a broad and qualitative overview of the main conclusions.

NESTING HABITAT

Lapwings on both the arable and rough grazing study areas showed significant preferences for particular nesting habitats. On the arable site cereals comprised only 34% of the land area yet approximately 68% of nests were situated in this habitat. On the rough grazing site the vast majority of nests were on unimproved, as distinct from improved, land (unimproved land comprised 84% of the rough grazing study area and held 97% of nests). These preferences are likely to be at least partly attributable to nest crypticity. Potential predators were numerous in both study areas and a high proportion of nests were depredated. I found

nests and incubating adults much harder to locate on the two preferred nesting habitats than on other less frequently occupied habitats.

When selecting nesting territories on the arable site, male Lapwings showed a significant preference for those cereal fields that were large and distant from trees and hedges. This, presumably, confers anti-predation benefits. Furthermore, cereal fields close to permanent pasture is the main feeding habitat on the arable site of both adults and chicks. Thus, the avoidance of predation and the proximity of suitable feeding habitat are important constraints on the selection of nesting habitats.

CLUTCH SIZE AND LAYING SEASON

Approximately 78% were of 4 eggs; the remainder were mainly of 3 (18%) and 2 (4%) eggs. There were no differences between years in clutch size or between first and replacement clutches. Early clutches on the arable site, however, were generally smaller than those on the rough grazing site. This was probably due to disruption during laying caused by cultivation in the cereal fields.

Whereas laying on the rough grazing site extended into late May, on the arable study area, apart from a few exceptions, it ended in early May. This early truncation of laying was probably due to crop growth rendering the cereal fields unsuitable as a nesting habitat. The few exceptions already referred to were of birds which had failed earlier on spring cereals colonising a field which was cultivated abnormally late in the season. This late cultivation effectively created suitable bare nesting habitat long after more typical cereal fields had developed long vegetation.

BREEDING SUCCESS AND PRODUCTIVITY

Hatching success

Hatching success was influenced mainly by predation and cultivation. The level of predation was highest on the rough grazing site (where predators were more abundant). In spite of smaller losses to predators on the arable site; losses due to cultivation reduced hatching success to a level significantly below that of clutches on the rough grazing site. Breeding density (as measured by nearest neighbour distance) had no effect on hatching success.

Fledging success and brood movements

Although most adult Lapwings nested on either cereal fields or unimproved rough grazing, the chicks normally left these habitats soon after hatching to move to permanent pasture or improved rough grazing, respectively. The shift was partly due to more plentiful prey in the habitats into which the chicks moved. On the arable site, however, crop growth in the natal cereal fields was also an important determinant of brood movements: in the final year of the study, bad weather in the early spring delayed cultivation and crop growth. In that year the chicks were able to remain in their natal cereal fields.

Fledging success was markedly different in both habitats. In the first two years of the study 6.9% and 14.6% of chicks on the arable site survived to fledging. On the rough grazing site the corresponding figures were 22.1% and 23.8%. During these two years, rapid crop growth in the cereal fields of the arable site forced broods to move to permanent pasture fields where the vegetation was kept short by grazing. This habitat shift was obviously hazardous since it coincided with a period of weight loss and high mortality. Those broods which hatched in cereal fields from which there was easy access to pasture survived better than those without such access. In the final year of the study when poor weather retarded crop growth and the arable chicks were able to remain in the cereal fields, fledging success was comparable to that on the rough grazing site.

DISCUSSION

Many aspects of Lapwing breeding ecology are sensitive to agricultural land-use patterns: crop type and growth rate, field size and the timing and intensity of cultivation influence nesting habitat selection, hatching and fledging success and chick growth and movements. By nesting on intensively-farmed arable land, Lapwings suffered a reduction in productivity (see Table 1) to a level at which it is unlikely that the population could maintain itself (ring recoveries suggest that the annual adult mortality is approximately 33% and the first year mortality is 44% (Bak and Ettrup 1982). However, ring recoveries consistently overestimate the mortality of waders (Evans and Pienkowski 1984). If, as seems likely, the true adult and first-year mortalities are of the order of 25-30% and 35-40%, respectively, then, assuming an equal sex ratio of chicks, each female in a hypothetical population would have to fledge on average 0.8 young per year if the population was to remain stable.) This prompts the obvious question: if arable land is unsuitable as a nesting habitat than why do so many Lapwings nest there?

Table 1. Productivity of Lapwings in both study areas over the three years of the study.

Habitat	No. of females	Fledglings/ female
Rough grazing	74	0.8
Arable	62	0.4

One possible answer is that arable farmland may have been more suitable as a nesting habitat in the past but has recently become less so. The poor breeding success of birds on the arable land was partly due to egg-losses during cultivation and th rapid growth of cereals. The latter shortened the breeding season and forced the chicks to undertake hazardous journeys to pasture. Whether or not broods had easy access to pasture was a major determinant of their survival. Thus, the growth characteristics of the crop and the accessibility of pasture were important influences on Lapwing breeding performance.

From conversations with local farmers it became apparent that the habitat mixture on the arable site had changed greatly over the previous 10-15 years. The local changes that occurred matched those which have characterized British farming as a whole, with a reduction in the amount of livestock and pasture and an increased emphasis on cereal production. Whereas during the three years of the study pasture comprised 19% of the land under crops,

15 years previously it had comprised 50%. As pasture fields were ploughed and replaced with cereals, the amount of suitable nesting habitat increased but easy access from there to pasture became more restricted.

In addition to more land being sown with cereals, the nature of the cereal crop itself has changed: traditional crop varieties have been replaced with strains which are more tolerant of crowding, disease and pest resistant, and faster growing. This has encouraged farmers to sow at a higher plant density. The result of this is likely to be that modern cereal fields are more impenetrable and less hospitable habitats for lapwing broods than they once were. The harsh weather in the final year of the study simulated the earlier conditions by slowing down crop growth and creating bare patches in the fields and it is interesting that the chicks were then able to remain in the cereal fields and their survival improved.

According to the local farmers, Lapwings were more abundant and widespread on the arable site before the reduction in pasture acreage. Thus the change in land-use has been followed by a population reduction, probably due to reduced breeding success.

The apparent continuing attractiveness of arable farmland to nesting Lapwings can, perhaps, be explained by the easier access to high quality feeding habitat. The prey biomass on permanent pasture (the preferred feeding habitat on the arable site) far exceeds that on the rough grazing site and the feeding success of adults was, consequently, higher there. Because of this, nesting females were in better body condition on the arable site and they laid bigger eggs. The chicks which hatched from these eggs were larger and heavier for their size (i.e. they were carrying greater yolk, protein or carbohydrate reserves). In the absence of a high mortality due to anthropogenic factors, bigger hatchlings grew faster and survived better than their smaller contemporaries.

It may be that the attraction of short-term benefits in feeding success together with the relatively recent nature of the habitat changes that have occurred, explain the continued existence of Lapwings on the arable site. In the past, Lapwings may have found arable land a suitable nesting habitat because it provided cryptic nest sites (spring cereal fields) and high quality feeding areas for both the adults and chicks. By nesting on arable land female Lapwings could attain better body condition and lay larger eggs, which increased the prospects of chick survival. However, by removing pasture and altering the growth characteristics of the crop, modern farming has reduced the suitability of intensively farmed arable land as a nesting habitat. If this is so, the situation is unstable and further population reductions might be expected to occur, especially if the current trend toward the replacement of pasture with cereals continues.

REFERENCES

Evans,P.R. and Pienkowski,M.W. 1984. Population dynamics of shorebirds. *In* Burger,J. and Olla,B.L. (eds.)., *Behaviour of Marine Animals,* Vol. 5. Plenum Press, New York.

Galbraith,H., Furness,R.W. and Fuller,R.J. 1984. Habitats and distribution of waders breeding on Scottish agricultural land. *Scottish Birds* 13: 98-107.

Green,G.H. 1980. Changing agricultural practice, Scotland and breeding waders. *Wader Study Group Bull.* 43: 5.

Lister,M.D. 1964. The Lapwing habitat enquiry 1960-1961. *Bird Study* 11: 128-147.

Nicholson,E.M. 1938. Report on the Lapwing enquiry, 1937. *British Birds* 32: 170-191, 207-229, 255-259.

O'Connor,R.J. and Shrubb,M. in press. Some effects of agricultural development on British bird populations. *In* Bunning,J. (ed.)., *Man and Birds.* Witwatersrand Bird Club Symposium (Johannesburg).