The impact of farming on over-wintering bird populations

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Abstract

Field boundaries and fields in stubble, set-aside, winter wheat and improved grassland in County Kildare were surveyed for birds on 15 occasions between October 2001 and February 2002. A total of 40 species was recorded on all sites during the period of the study. Arable farming that retains stubble throughout the winter supports the greatest species richness and diversity with the lowest being recorded on improved grassland. Individual species showed preference for certain sites. Seed-feeding species, yellowhammer and skylark, preferred stubble while invertebrate-feeding species, fieldfare and meadow pipit preferred grassland. The analysis demonstrated that certain components of habitat were responsible for differences in species present and density.

Key index words: birds and farming, bird habitat and over-wintering birds.

Introduction

Farmland provides a breeding and over-wintering habitat for a range of bird species across Europe (Tucker and Heath, 1994; Tucker, 1997). The farmland bird community consists of habitat generalist and open country specialists (O'Connor and Shrubb, 1986). Populations of farmland birds in Europe have declined markedly during the last quarter of the 20th century, representing a severe threat to biodiversity (Donald *et al.,* 2002). The decline in farmland birds in Britain has had a particular effect on seed-feeding birds (Fuller *et al*., 1995). Loss of habitat, decline in habitat diversity and changes in the time of sowing and harvesting of cereal crops with the subsequent loss of winter stubbles have had a major impact (Chamberlain *et al*., 2000; Donald and Vickery, 2000).

In Ireland, research indicates a decline in certain farmland birds, with such species as yellowhammer (*Emberiza citrinella*) and skylark (*Alauda arvensis*) suffering acute declines (Newton *et al*., 1999). The yellowhammer has declined by 50% in Irish breeding population and/or range in the past 25 years while the skylark has declined between 20-49% in breeding population in the past 25 years (Newton *et al*., 1999). The corn bunting (*Miliaria calandra*) is believed to be extinct in Ireland. The reduction in the proportion of spring-sown cereals and winter stubble along with agricultural polarisation and farm specialisation may have contributed to the decline of this species and other seed-eating farmland birds (Taylor and O'Halloran, 2002). The attributes of field boundary are also important when determining the composition of farmland bird communities. However, it is suggested that these attributes are less important for over-wintering birds when compared with breeding populations (Moles and Breen, 1995). The objectives of this research were to assess the use of farmland by birds during the winter months and to determine the land-use characteristics that attract birds.

Materials and Methods

The data were collected in 2001 and 2002 from four sites in Co. Kildare, grid reference N9021. Sites consisted of winter stubble, set-aside, grassland and an area of winter wheat.

Stubble: This field had been in cereals since 1979 and was approximately 15 hectares. In the winter of 2000/2001 wheat was sown and stubble remained in the field after the crop was harvested. The stubble area that remained was used as a sample site in the winter of 2001/2002. Two ponds were present in the west corner of the site. Surrounding habitats included winter cereals and grassland.

Set-aside: Under a revision of the Common Agricultural Policy of the European Union (EU) in 1992 arable land can be set aside from production, in a measure designed to reduce surplus grain. Cereal producers claiming EU Area Aid on more than 15 hectares are obliged to set aside a minimum of 10% of the area claimed and they may voluntarily set aside up to 40% of the total area (O'Sullivan, 2003). Three fields of non-rotational (>3 years) set-aside were used and the total area was approximately 10 hectares. It had been sown with a mixture of white clover (*Trifolium repens*), Italian ryegrass (*Lolium multiflorum*) and perennial ryegrass (*Lolium perenne*) in 1994, with the same sward present at the time of sampling. Surrounding habitats included winter cereals and grassland.

Grassland: This field consisted of improved grassland with a mixed sward dominated by perennial ryegrass and was approximately 14 hectares. There was a river adjoining the western boundary. Surrounding habitats included winter cereals, improved grassland, a small bog and woodland dominated by Scots pine (*Pinus sylvestris*).

Winter wheat: This field had been in winter cereals since the 1970's and was approximately 15 hectares. This area was sown with winter wheat in September 2001. Surrounding habitats included stubble (until January 2002), set-aside, winter cereals and deciduous woodland.
Sites were smaller than those recommended by the International Bird Census Committee (1969) due to the complex nature of field boundaries within Irish farmland which in turn limited the area that could be surveyed in a visit. A similar situation has arisen in previous Irish farmland bird studies, for example, Lysaght (1989) and Moles and Breen (1995).

Sites were surveyed for birds from 6th of October 2001 to 17th of February 2002, all sites being sampled on the same morning of each visit. A total of fifteen visits were made with the last set of data being recorded within four days of the stubble being ploughed. The sampling method used was a variation of the line transect method (Bibby *et al.*, 2000). During each visit, the perimeter of each field was walked, followed by a diagonal line from one corner of the field. Both bird species presence and abundance in hedgerows and open fields were recorded. Overflying birds were not recorded. The transects were selected systematically to provide a representative sample of each site; the same routes being walked on each sampling visit. The order which each site was sampled at each sampling occasion was randomised. Sample lines were walked at 2 km per hour which is in line with standard sampling practice (Bibby *et al.*, 2000).

Analysis
Bird species diversity indices were calculated for each site using the Shannon-Weiner index (Krebs, 1980), $\sum p_i \ln p_i$, where p_i is the proportion the *i*th species contributed to the total number of all species. The indices were calculated using the total number of species recorded and their abundance on each of the four sites throughout the survey. Analysis of bird populations considered the different species presence and abundance in addition to the preference of certain species towards particular sites. A total of 15 species that were abundant in all sites or were of conservation significance in Ireland were selected for detailed analysis. The diet of specific species was also considered when analysis was carried out with broad categories being used to segregate species, invertebrate-feeding and seed-feeding. This categorisation is not absolute as many seeding-eating species take invertebrates and other plant material, while some invertebrate-feeding species take fruit and seed (Wilson *et al.*, 1996).

Results

Species diversity
A total of 40 species were recorded in all sites during the survey (Appendix 1). The greatest number of species was recorded on stubble while the grassland had the lowest number of species. Bird diversity on the stubble was higher than all the other sites. Set-aside had the lowest species diversity of the four sites (Table 1).

Table 1. The Shannon-Weiner species diversity indices and the species richness recorded in the four habitat types surveyed.

Management	Shannon-Weiner species diversity index	Species richness
Stubble	2.908	33
Set-aside	2.420	30
Grassland	2.527	28
Winter Wheat	2.584	29

Table 2 gives the occurrence and the percentage of the population of individual species in the four sites surveyed. Bird species that occurred in all sites include robin (*Erithacus rubecula*), wren (*Troglodytes troglodytes*) and chaffinch (*Fringilla coelebs*). Other species showed a preference towards occur in specific sites. Blue tit (*Parus caeruleus*) was also recorded in all habitat types. Blackbird (*Turdus merula*) represented a similar percentage of the bird population across all sites (6.9-9.3%). Song thrush (*Turdus philomelos*) occurred on all sites but appeared to show preference towards stubble. Rook (*Corvus frugilegus*) represented a greater percentage of the population and occurred in greater numbers on stubble when compared with the other sites. Individual species showed preference for certain sites. Goldfinch (*Cardualis carduelis*) avoided the winter wheat and represented a greater percentage of the population and occurred in greater numbers on the grassland when compared with stubble and set-aside.

Table 2. A list of the distribution of the 15 selected species that were analysed and their contribution toward the bird population in each of the sites.

	Stubble		Set-aside		Grassland		Winter Wheat	
Species	**Total**	**% of Bird Population**	**Total**	**% of Bird Population**	**Total**	**% of Bird Population**	**Total**	**% of Bird Population**
Woodpigeon	53	5.7	212	29.0	53	8.4	101	22.5
Skylark	133	14.4	2	0.3	13	2.1	5	1.1
Meadow Pipit	0	0.0	3	0.4	46	7.3	4	0.9
Pied Wagtail	1	0.1	1	0.1	0	0.0	5	1.1
Robin	92	9.9	88	12.1	66	10.4	48	10.7
Blackbird	64	6.9	57	7.8	59	9.3	37	8.2
Fieldfare	50	5.4	60	8.2	128	20.3	7	1.6
Redwing	18	1.9	32	4.4	69	10.9	8	1.8
Song Thrush	27	2.9	19	2.6	3	0.5	14	3.1
Coal Tit	10	1.1	5	0.7	0	0.0	1	0.2
Blue Tit	34	3.7	55	7.5	21	3.3	29	6.5
Wren	25	2.7	53	7.3	31	4.9	23	5.1
Yellowhammer	27	2.9	0	0.0	0	0.0	21	4.7
Chaffinch	86	9.3	51	7.0	42	6.6	74	16.5
Goldfinch	7	0.8	5	0.7	15	2.4	0	0.0
Rook	66	7.1	9	1.2	22	3.5	19	4.2
Others	233	25	78	10.7	64	10.1	53	11.8
Total	**926**	**100**	**730**	**100**	**632**	**100**	**449**	**100**

Yellowhammer (Fig. 1) only occurred on two sites namely winter wheat and stubble. The highest numbers recorded were on stubble on the last visit before ploughing started. Skylark (Fig. 2) was consistently, apart from visit 14, recorded on stubble and represented a high percentage of total bird population. This species did occur on all sites but clearly a preference towards stubble is illustrated. Woodpigeon (*Columba palumbus*) was another species that occurred on all sites. However, the trend illustrates an overall preference towards set-aside (Fig. 3). Early on in the survey, visit 3, a large number of woodpigeon were recorded on winter wheat. Meadow pipit (*Anthus parentis*) avoided stubble (Fig. 4) but occurred in relatively large numbers on grassland and represented an important percentage of total bird population. Fieldfare (*Turdus pilaris*) was recorded on all sites but it represented the most important percentage of the community species on grassland (Fig. 5). Chaffinch (*Fringilla coelebs*) was an important species in all sites; with the highest populations being recorded when stubble was ploughed (Fig. 6).

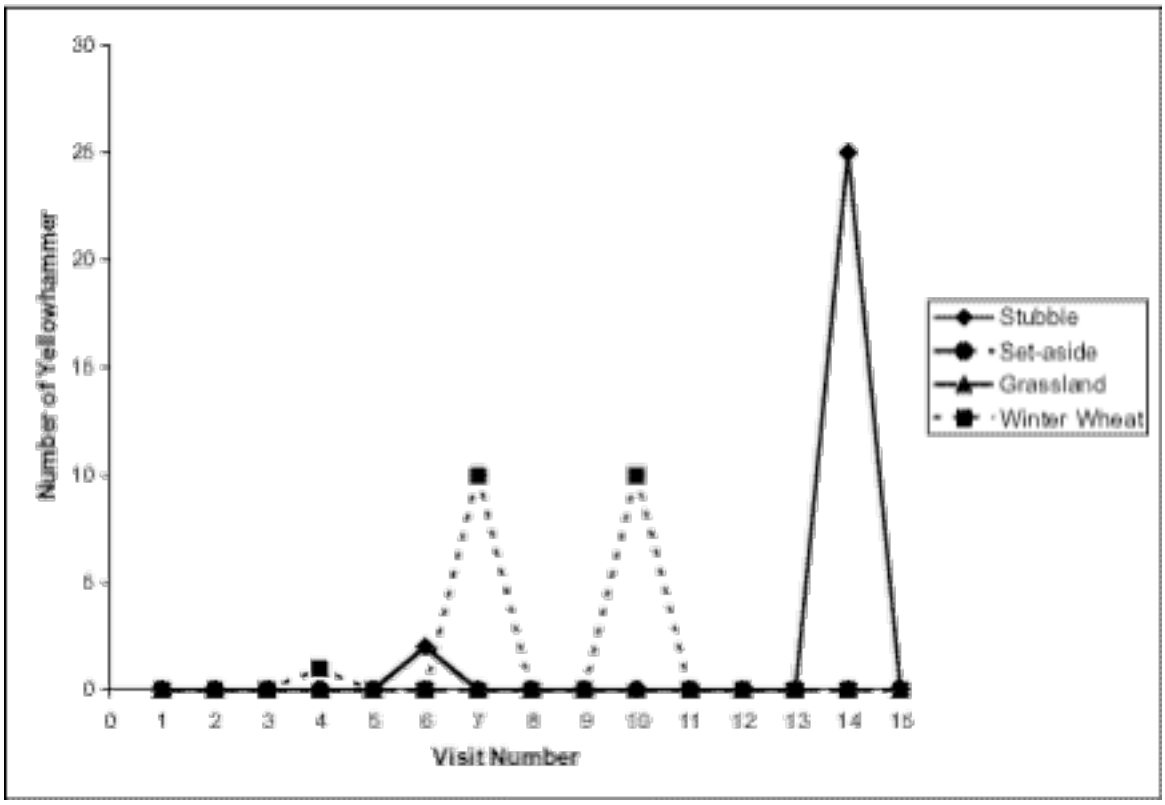

Figure 1. Numbers of yellowhammer recorded during the survey in the winter 2001/2002.

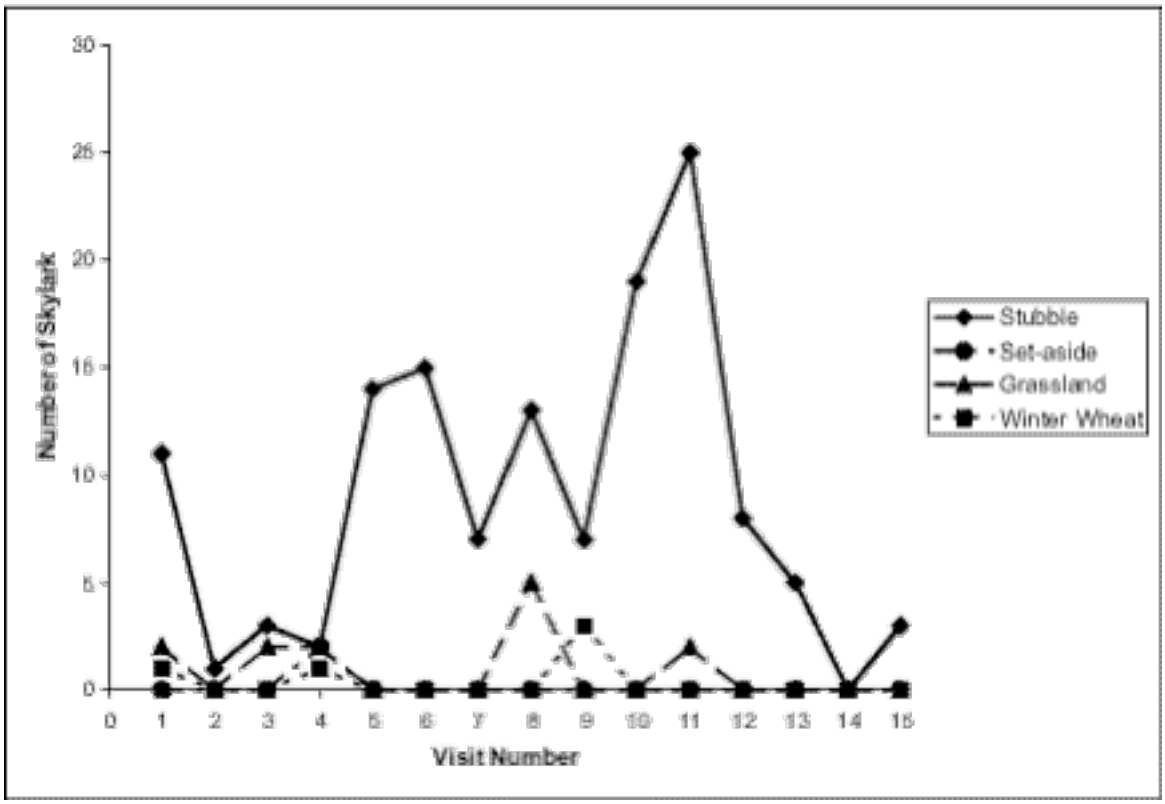

Figure 2. Numbers of skylark recorded during the survey in the winter 2001/2002.

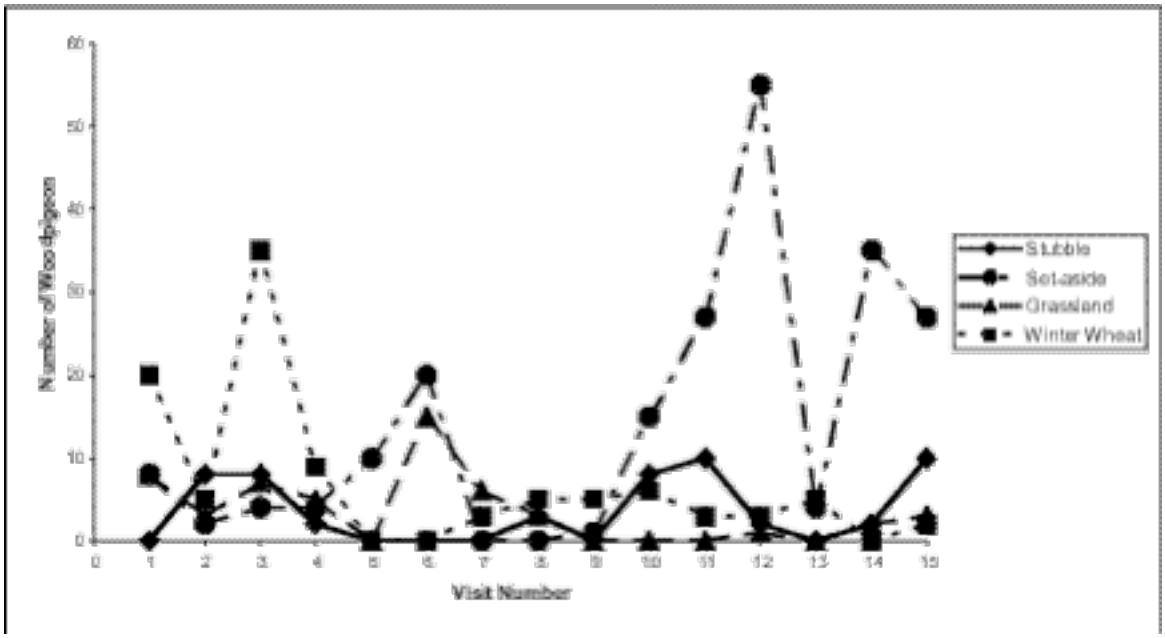

Figure 3. Numbers of woodpigeon recorded during the survey in the winter 2001/2002.

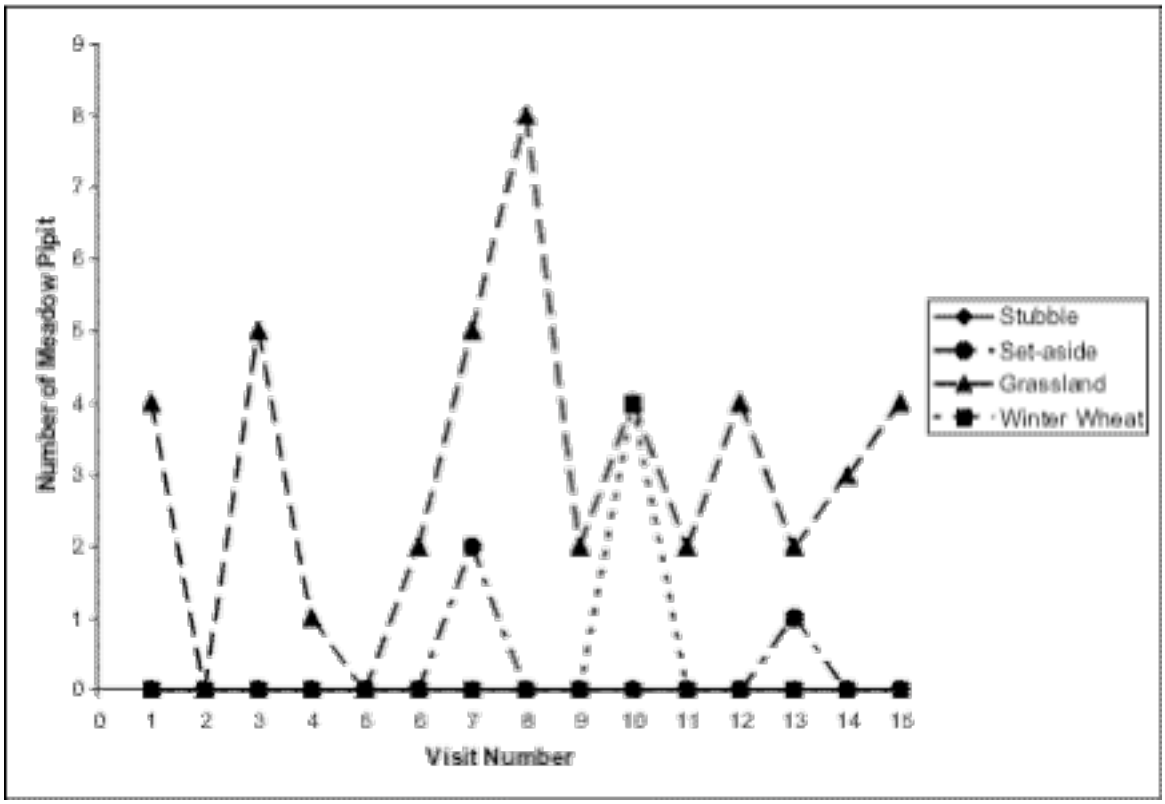

Figure 4. Numbers of meadow pipit recorded during the survey in the winter 2001/2002.

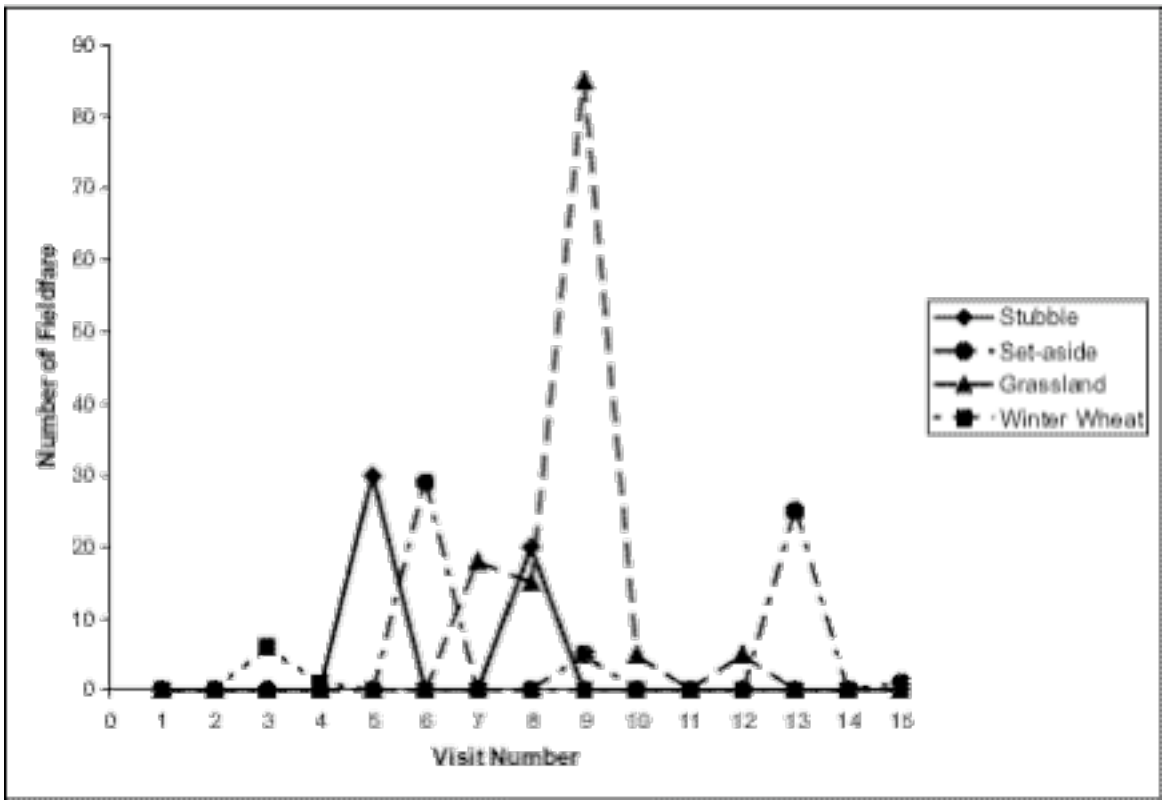

Figure 5. Numbers of fieldfare recorded during the survey in the winter 2001/2002.

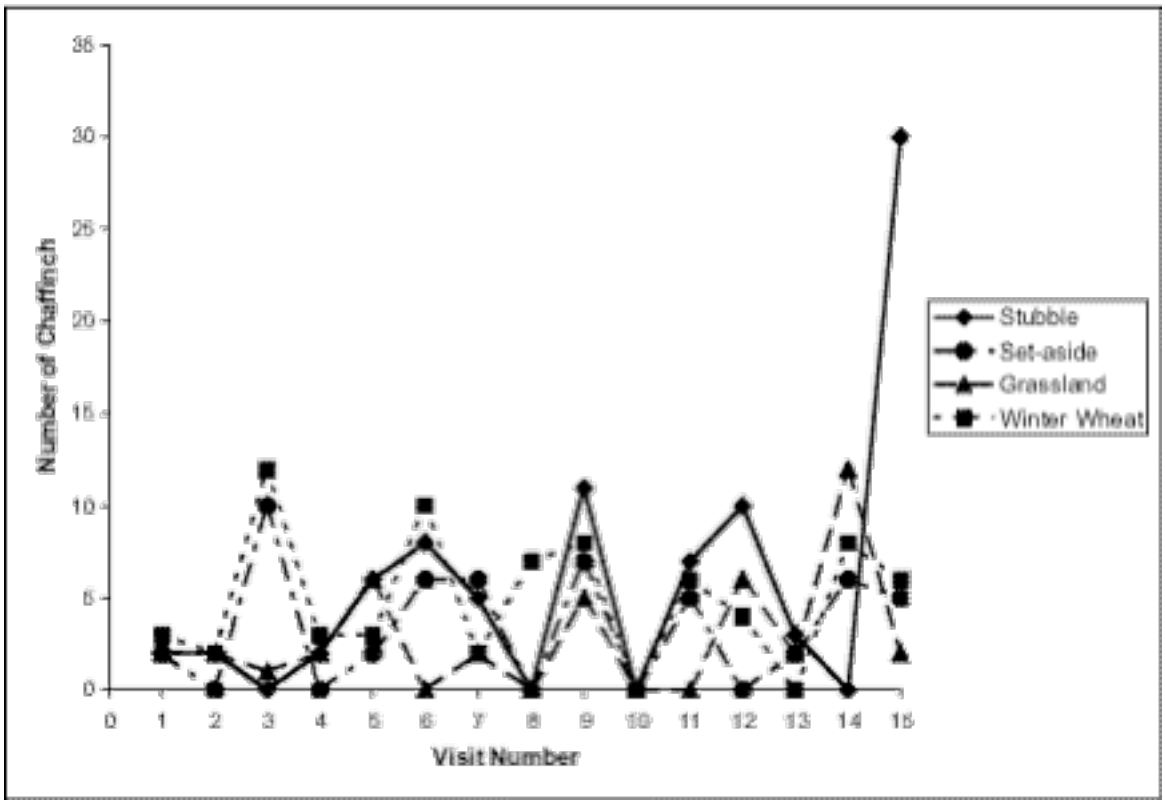

Figure 6. Numbers of chaffinch recorded during the survey in the winter 2001/2002.

Discussion

It is clear that certain species prefer certain sites while other species (e.g. robin, wren and blackbird) occur in all sites probably due to the presence of hedgerows in all sites. Other species were confined to an individual site or attained a high population in a particular site (e.g. skylark in stubble). In general, predominantly seed-feeding species preferred stubble while predominantly invertebrate-feeding species preferred grassland.

Stubble
Crop seeds and the seeds of grasses and a variety of dicotyledonous arable weeds can be found in stubbles (Wilson *et al.*, 1996). This food source is attractive to a variety of seed-feeding species (O'Connor and Shrubb, 1986). Unsprayed stubble left over winter supports many more seed-feeding birds than winter cereals (Wilson *et al.*, 1996). The results highlight the fact that seed-feeding birds prefer stubble e.g. yellowhammer and skylark.. Rook also preferred stubble probably because stubble grain is very important to the winter feeding ecology of the species (Feare, *et al.*, 1974). Probably due to long-term cultivation only a limited number of invertebrate-feeding species preferred stubble. Nonetheless, a number of these species did make appearances in the stubble, e.g. pied wagtail (*Motacilla alba*), fieldfare and song thrush. Stubble had the highest species richness and diversity in this project. Wilson *et al.* (1996) have suggested that seed feeding species that are abundant on stubble are species that have suffered the most widespread decline. Ploughed fields can provide a rich source of seeds at the surface (Wilson *et al.*, 1996) and this is likely to have resulted in the increase in chaffinch numbers after the stubble was ploughed.

Set-side
On set-aside, the regeneration of a vegetation cover from stubble is likely to yield greater benefits for wintering seed-eating birds than sown grass covers (Wilson *et al.*, 1996). The fact that the site used was sown with a mixture of white clover, Italian ryegrass and perennial ryegrass it could be argued that the possibilities for optimising species diversity have been reduced. Nonetheless, certain species did find the site attractive as it was ranked second in terms of species richness. Both invertebrate-feeding and seed-feeding species occurred in large numbers. Woodpigeon, fieldfare and blue tit were the species that occurred in most significant numbers. The white clover was the principle reason for the high number of woodpigeons in the set-aside, since white clover is an important source of winter food (Murton and Westwood, 1974). The tall trees on the site may have been attractive to fieldfare for perching, while blue tits were likely to have been feeding on invertebrates in the hedgerows.

Grassland
Modern improved grassland systems are suboptimal habitats compared to arable or mixed agricultural land for farmland bird species (Chamberlain and Fuller, 2001). It has been demonstrated that invertebrate-feeding species prefer grass fields, which most likely reflects the fact that continuous cultivation causes a reduction in soil invertebrates (Wilson *et al.*, 1996). Meadow pipit and fieldfare are invertebrate-feeding species that preferred grassland. A number of seed-feeding species did utilise the field including linnet (*Acanthis cannabina*) and chaffinch. The general avoidance of grassland by seed-feeding species is not surprising given that it was a species-poor sward in which the majority of the species that were present possessed seeds unpalatable to birds (Wilson *et al.*, 1996). The only seed-feeding species to prefer grassland was the goldfinch. This is uncommon, as the goldfinch is known to depend on grain and weed seed during winter (Wilson *et al.*, 1996).

Winter wheat
The recent cultivation of winter cereals along with crop monoculture minimises the availability of either seed or invertebrate food to birds (Wilson *et al.*, 1996). Snipe (*Gallinago gallinago*) and chaffinch were the species that preferred winter wheat. Apart from chaffinch, the majority of seed-feeding species avoided the site. Yellowhammer did occur in numbers but this species was recorded in the field boundaries. It could be suggested that the surrounding habitats of stubble and set-aside could have influenced the species recorded in the field boundary as surrounding habitats can influence bird species present (Chamberlain *et al.*, 1999). Woodpigeon also occurred in numbers, as they were most likely feeding on the beech mast present in the field boundaries which was present on the site in the early part of the survey. Invertebrate-feeding species that visited the site in addition to snipe included song thrush and meadow pipit.

Conclusion

The results indicate that arable farming with stubble retained during the winter supports a greater species richness and diversity. In autumn and winter, diversity and richness is a good indicator of habitat quality (Chamberlain *et al*., 1999). The reduction in food-rich stubbles over the winter, brought about by the increased winter sowing of cereals at the expense of spring- sown crops has been labelled as the determining factor in the decline of some species of farmland birds (Wilson *et al*., 1996). The species that preferred stubble are birds that have suffered acute declines in the past twenty-five years in Ireland, i.e. yellowhammer and skylark (Newton *et al*., 1999). It is suggested that all farmland bird species may have been affected by specialisation with less arable cropping in grassland areas and vice versa, the significance of this is a decrease in habitat diversity (O'Connor and Shrubb, 1986). The reduction in the proportion of spring-sown cereals and winter stubble along with agricultural polarisation and farm specialisation may have contributed to the decline of certain seed-eating birds on Irish farmland (Taylor and O'Halloran, 2002). To reverse recent declines in avian biodiversity on farmland improvement in habitat heterogeneity from individual fields to landscape level is proposed (Benton *et. al*, 2003).

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Appendix 1.

A list of all species recorded and their scientific names.

Common Name	Scientific Name
Grey heron	*Ardea cinerea*
Mallard	*Anas platyrhynchos*
Teal	*Anas creeca*
Sparrowhawk	*Accipiter nisus*
Kestrel	*Falco tinnunculus*
Pheasant	*Phasianus colchicus*
Snipe	*Gallinago gallinago*
Stock dove	*Columba oenas*
Woodpigeon	*Columba palumbus*
Skylark	*Alauda arvensis*
Meadow pipit	*Anthus parentis*
Pied wagtail	*Motacilla alba*
Grey wagtail	*Motacilla cinerea*
Dunnock	*Prunella modularis*
Goldcrest	*Regulus regulus*
Robin	*Erithacus rubecula*
Blackbird	*Turdus merula*
Fielfare	*Turdus pilaris*
Redwing	*Turdus iliacus*
Song thrush	*Turdus philomelos*
Mistle thrush	*Turdus viscivorus*
Long-tailed tit	*Aegithalos caudatus*
Coal tit	*Parus ater*
Great tit	*Parus major*
Blue tit	*Parus caeruleus*
Wren	*Troglodytes troglodytes*
Yellowhammer	*Emberiza citrinella*
Reed bunting	*Emberiza schoeniclus*
Chaffinch	*Fringilla coelebs*
Goldfinch	*Carduelis carduelis*
Green linnet	*Carduelis spinus*
Bullfinch	*Pyrrhula pyrrhula*
Redpoll	*Acanthis flammea*
Linnet	*Acanthis cannabina*
Starling	*Sturnus vulgaris*
Jay	*Garrulus glandarius*
Magpie	*Pica pica*
Rook	*Corvus frugilegus*
Grey crow	*Corvus corone cornix*
Jackdaw	*Corvus monedula*