BTO RESEARCH REPORT NO. 34

A SMALL-SCALE STUDY OF THE COMPARATIVE USE OF HERBICIDE-TREATED AND UNTREATED HEADLANDS BY BIRDS IN WINTER

A report to the Game Conservancy

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INTRODUCTION

In the Cereal and Gamebirds Research Project the Game Conservancy Trust has demonstrated the beneficial effects for Grey Partridges[1] of not spraying headland 6 m strips adjacent to the field margins (Rands 1985, 86a, 86b). However, there is little information available on whether these benefits extend to other birds during the breeding season or to any species during the winter.

The British Trust for Ornithology carried out two studies to assess the effects of unsprayed headlands on breeding songbirds, both at Manydown Farm, Hampshire (Fuller 1984, Cracknell 1986). Neither study found any indication that feeding intensity nor lengths of feeding bout differed between sprayed and unsprayed headlands. Although there was some evidence in the earlier studies that Dunnocks fed preferentially in unsprayed headlands this was confined to spring barley crops and was not evident in winter cereals and was not confirmed in the later study. Furthermore, there were no significant differences in breeding density (Fuller 1984), in brood size, or in fledging success (Cracknell 1986) between hedges adjacent to sprayed and unsprayed headlands. Thus, for the main species studied (Blackbirds, Dunnock, Yellowhammer and Chaffinch) there was no detectable effect of leaving headlands unsprayed. However, these studies were not comprehensive and the low densities of birds and the small number of treatment replicates meant that any effects would have been difficult to detect.

1. Scientific names given in Appendix.

There is no direct information on the effects on seed-eating passerines of leaving unsprayed headlands as stubble over winter. However, the seeds of many broad-leaved weeds are known to be important winter food of several species. In particular the seeds of Polygonum, Stellaria, Sinapsis arvensis and Chenopodium album are favoured food of the Greenfinch, Linnet, Tree Sparrow, Chaffinch and Yellowhammer (Collinge 1923,Murton 1971, Newton 1967, 1972). These weeds have declined markedly in cereal crops since the early 1960s as a result of the increased use of herbicides (Potts, 1986). Weed seeds are an important food of several farmland birds and therefore the potential benefits of unsprayed headlands should be regarded as an important subject for research. Furthermore, population indices calculated from the British Trust for Ornithology Common Bird Census show that Linnet and Tree Sparrow populations on farmland have declined substantially since the 1960s and there is evidence that this decline has been predominantly caused by the reduction in available weed seeds (O'Connor and Shrubb, 1986).

The purpose of this study was to test methods aimed at assessing the use of cereal stubble headlands by birds in winter and the effects of leaving these headlands unsprayed.

STUDY AREA

The study area and locations of the fields are shown in Fig. 1. The majority of the area consists of arable farmland with spring-and winter-sown wheat and spring-sown barley the predominant crops. The

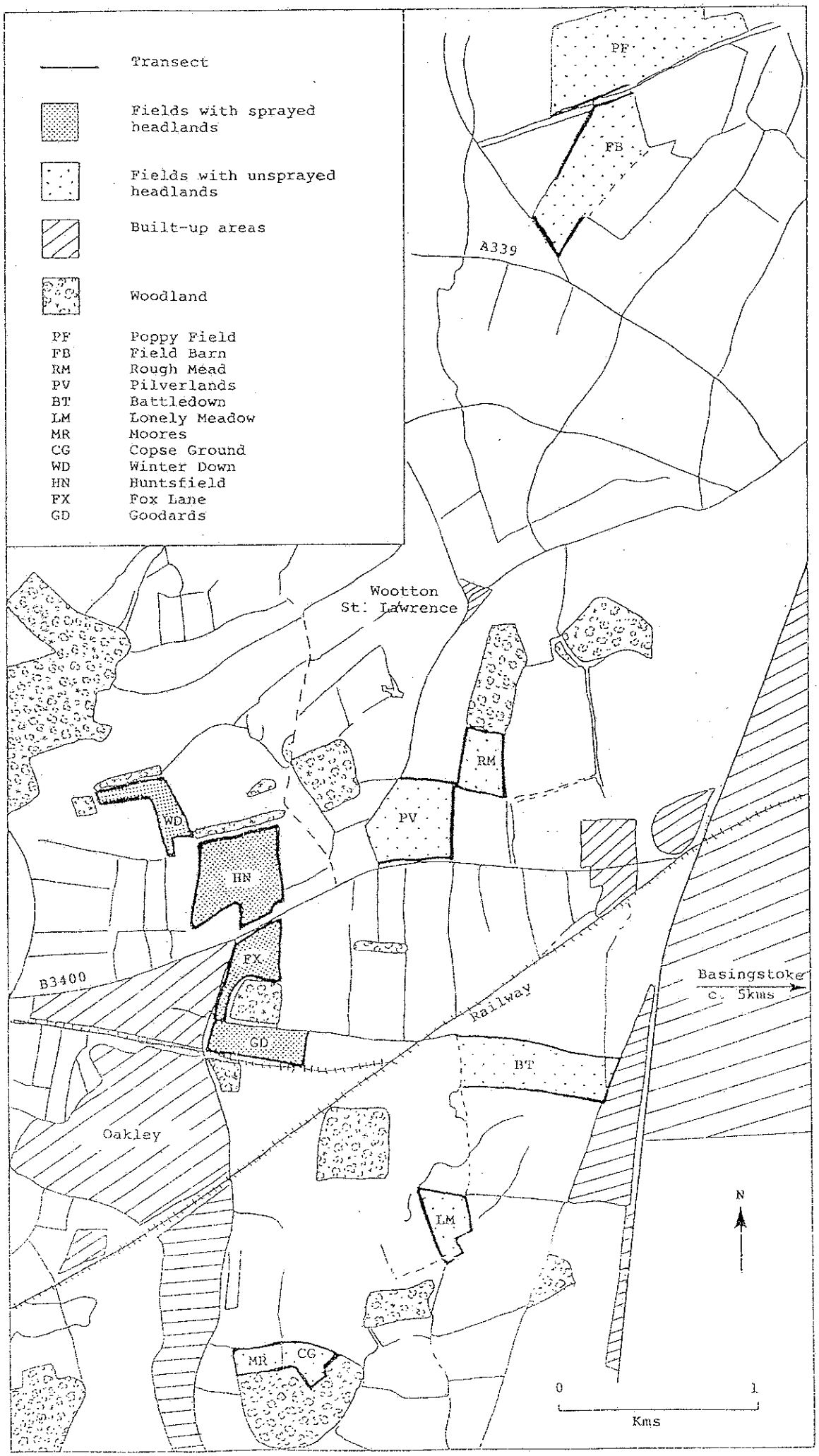

Figure 1. The location of fields within the study area.

Manydown Farm Estate covers most of the study area and includes all the study fields except for two (Poppy Field and Field Barn) which are part of Rookery Farm. There are several large areas of deciduous woodland (up to 20 ha), the majority of which consist of mature oak Quercus standards with a coppiced hazel Corylus avellana understorey. There are many smaller coppices and mature deciduous trees are frequent in the hedgerows. All the study fields except Battledown and Pilverlands were bordered at some point by a stand of deciduous woodland.

The field boundaries adjacent to the transects consisted of a wide variety of types, although the entire length was bordered by a hedge in all but three fields (Battledown, Huntsfield and Winter Down). Most hedges were less than 1.5 m tall and regularly trimmed, but a few were untrimmed and reached heights over 2.5 m. Although a full description of hedgerows was not carried out as part of this preliminary study there were no apparent consistent differences between the fields with herbicide treated and untreated headlands.

Twelve stubble fields were chosen, each of which had been sown with spring barley except for Field Barn which was winter sown barley. All fields were ploughed before seed drilling. Each received an application of broad spectrum herbicide (eg Swipe) after crop establishment in April followed by a fungicide to control mildew where necessary. Field Barn received broad spectrum herbicide applications in the autumn and the following summer in addition to a spring general fungicide application.

The fields with headlands left unsprayed received no herbicide in a strip 6 m wide along the entire field margin (corresponding to the width of one tractor-mounted spray-boom). Table 1 shows which fields had headlands untreated with herbicide in the study year and in the

TABLE 1. Field herbicide treatments in the three previous years to the study.

TREATMENT

FIELD NAME	CODE	PREVIOUS CROP YEAR 83/84	84/85	85/86	STUDY HARVEST YEAR	DATE	NOTES
POPPY FIELD	PF	+	+	+	-	C.14/8	
FIELD BARN	FB	+	+	+	-	C.28/7	
WINTERDOWN	WD	?	+	-	+	19/8	
HUNTSFIELD	HN	+	+	+	+	23/8&27/8	
FOX LANE	FX	-	+	-	+	21/8	
GOODARDS	GD	L	+	-	+	21/8	
MOORES	MR	+	-	-	-	17/8	1
COPSE GROUND	CG	+	-	-	-	17/8	
LONELY MEADOW	LM	-	-	+	-	18/8	
BATTLEDOWN(NORTH)	BT	G	-	+	-	14-15/8	2
PILVERLANDS	PV	B/P	-	+	-	21/8	
ROUGH MEAD	RM	OR	-	+	-	18/8	

+ = Herbicide applied to headland.
- = No herbicide applied to headland.
L = Ley.
G = Permanent Grass.
B/P = Beans/Peas.
OR = Oil-Seed-Rape.

NOTES
1 = Dyno-Drive used after harvest.
2 = Roundup applied after harvest.

previous three years.

Unfortunately I discovered after completing the fieldwork that two fields (Poppy Field and Field Barn) that I had been informed had been fully sprayed had in fact received no herbicide applications this year in their headlands. This reduced the number of fully sprayed (fields) available for comparison with those with unsprayed headlands.

After the harvest (the dates of which are shown in Table 1.) the stubble fields were left unburnt. However, Battledown had an application of broad spectrum herbicide (Roundup) and both Moores and Copse Ground had partial cultivation by a Dyno-drive to encourage germination of spilt grain.

METHODS

FIELD METHODS

Six visits to the site were made between 21 September and 5 November 1987 (Table 2). Unfortunately two fully sprayed fields (Goodards and Fox Lane) were ploughed earlier than anticipated, reducing the sample size for this treatment. Occasionally some fields were not surveyed during visits because of bad weather or disturbance from farming activities. All counts were made between 07.00 and 14.00 hrs and fields were visited in a random order on each occasion. Fieldwork was not carried out in persistent rain or in winds greater than force 4.

Counts were made by walking along the transect length of each field (consistent between visits), following the inner tyre track (inner tramline) adjacent to the headland strip. All species were

TABLE 2. Fields and dates of bird surveys.

		SURVEY DATES					
		SEPTEMBER		OCTOBER			NOVEMBER
FIELD	SPRAYED/ UNSPRAYED	21st	28th	12th	22nd	30th	5th
WINTERDOWN	S	*	*	*	*	*	*
HUNTSFIELD	S	*	*	*	*	*	*
FOX LANE	S	*	*	P	P	P	P
GOODARDS	S	*	*	P	P	P	P
MOORES	U	*	*	*	*	*	*
COPSE GROUND	U	*	*	*	*	*	*
LONELY MEADOW	U	*	*	*	*	*	*
BATTLEDOWN	U	*		*	*	*	*
PILVERLANDS	U		*	*	*	P	P
ROUGH MEAD	U		*	*	*	*	*
POPPY FIELD	U		*	*	*	*	
FIELD BARN	U		*	*	*	*	*

S = Sprayed headland, U = Unsprayed.

* = Birds counted.

P = Ploughed (counts no longer possible).

counted and ascribed to either the headland zone, if between the hedge and the inner tramline (approx 5.5 m from the hedge), or to the interior zone, if between the tramline and an imaginary line 50 m from the field boundary. Pheasants and Woodpigeons which were easy to detect, were counted in the headland strip and the entire remaining field area. I made all counts personally, using 10 x 40 binoculars.

ANALYSIS

Transect lengths and area of each field, headland transect zone and interior transect zone were calculated from 1:2000 surveyors maps (Table 3). These were used to convert each count to densities for each visit. A derived mean density for each species in each zone of each field was then calculated as:

$$\text{antilog}\left[\frac{1}{n}\sum \log(x_i+1)\right] - 1$$

Where x_i = bird density on the i^{th} visit (count/ha)

n = number of visits.

The derived means were then taken as the basic data, from which arithmetic means, with standard errors, were calculated in the usual way.

RESULTS

COMPARISONS OF BIRD DENSITIES

The mean densities of those species that occurred on 3 or more

TABLE 3. Field count zone areas.

FIELD NAME	SPRAYED/ UNSPRAYED	CODE	TRANSECT LENGTH(m)	HEADLAND AREA(ha)	INTERIOR AREA(ha)	FIELD AREA(ha)
WINTER DOWN	S	WD	1628[1]	0.895	6.77[2]	6.77
HUNTSFIELD	S	HN	2020[1]	1.111	8.99	18.88
FOX LANE	S	FX	1471[1]	0.809	6.54	7.53
GOODARDS	S	GD	1412	0.777	6.28	8.34
MOORES	U	MR	686	0.377	3.05	3.46
COPSE GROUND	U	CG	686	0.377	3.05	4.00
LONELY MEADOW	U	LM	1177[1]	0.647	5.24	6.57
BATTLEDOWN (NORTH)	U	BT	2039	1.121	9.07	20.18
PILVERLANDS	U	PV	1569	0.863	6.98	14.95
ROUGH MEAD	U	RM	1177[1]	0.647	5.24	7.73
POPPY FIELD	U	PF	451	0.248	2.01	21.64
FIELD BARN	U	FB	1216	0.669	5.41	15.19

S = Sprayed headland, U = Unsprayed.

1. Transect length = entire perimeter.

2. Field area used where interior area is greater and therefore spurious, due to narrow shape.

occasions are summarized in Table 4 and are also presented graphically in Figs. 2 and 3.

Although some species (Red-legged Partridge, Grey Partridge, Skylark and Linnet) were only present on headlands that had been unsprayed and Pheasant and Yellowhammer showed higher densities in these areas, none of the differences was statistically significant. Furthermore, although this difference was also apparent when all the counts of seed-eating species were combined, it was again not significant. A similar trend occurred in the field interiors, with higher densities of Red-legged Partridge, Grey Partridge and Pheasant in field with unsprayed headlands. In addition, Skylark and Linnet were confined to these fields. However, none of these differences were statistically significant.

The fact that the differences in density between fields with different headland treatment were consistent between headland and interior regions suggests that even if such differences did occur, they were the result of properties of the entire fields and not just the headland. Indeed, if unsprayed headlands do provide more profitable feeding areas, and are therefore preferred to treated headlands, then one would expect a relatively higher use of the headland region within such fields. To investigate this further, the proportion of the total density of each species occurring in the headland region was calculated.

TABLE 4. Mean derived means of species density (counts/ha) for headland and field interior zones, in fields with sprayed and unsprayed headlands.

	HEADLAND COUNTS				FIELD INTERIOR COUNTS			
SPECIES	SPRAYED	UNSPRAYED	t	P	SPRAYED	UNSPRAYED	t	P
Red Legged Partridge	0 -	0.477 (0.323)	1.48	0.18	0.024 (0.024)	0.032 (0.032)	0.16	0.87
Grey Partridge	0 -	0.272 (0.213)	1.27	0.24	0.051 (0.034)	0.079 (0.066)	0.28	0.79
Pheasant	0.246 (0.176)	1.16 (0.851)	1.06	0.32	0.0057 (0.0057)	0.098 (0.082)	1.12	0.3
Woodpigeon	0.049 (0.032)	0.026 (0.026)	-0.552	0.59	0.025 (0.025)	0.030 (0.014)	0.15	0.884
Skylark	0 -	0.346 (0.182)	1.89	0.10	0 -	0.105 (0.071)	1.49	0.179
House Sparrow	0.262 (0.205)	0.215 (0.119)	-0.21	0.84	0.082 (0.082)	0.034 (0.024)	-0.56	0.609
Chaffinch	0.061 (0.036)	0.033 (0.033)	-0.53	0.61	0 -	0 -	-	
Linnet	0 -	0.225 (0.147)	1.53	0.17	0 -	0.052 (0.047)	1.10	0.308
Yellowhammer	0.312 (0.146)	0.336 (0.182)	0.08	0.94	0.063 (0.049)	0.022 (0.009)	-0.81	0.475
All seedeaters[1]	0.598 (0.127)	1.24 (0.454)	1.35	0.21	0.134 (0.119)	0.213 (0.117)	0.42	0.682

Standard errors are shown in parentheses. There were 5 degrees of freedom for each t-test. Where necessary, the t-test procedure allowed for unequal variences.

1. Initial Skylark, House Sparrow, Chaffinch, Linnet and Yellowhammer counts combined.

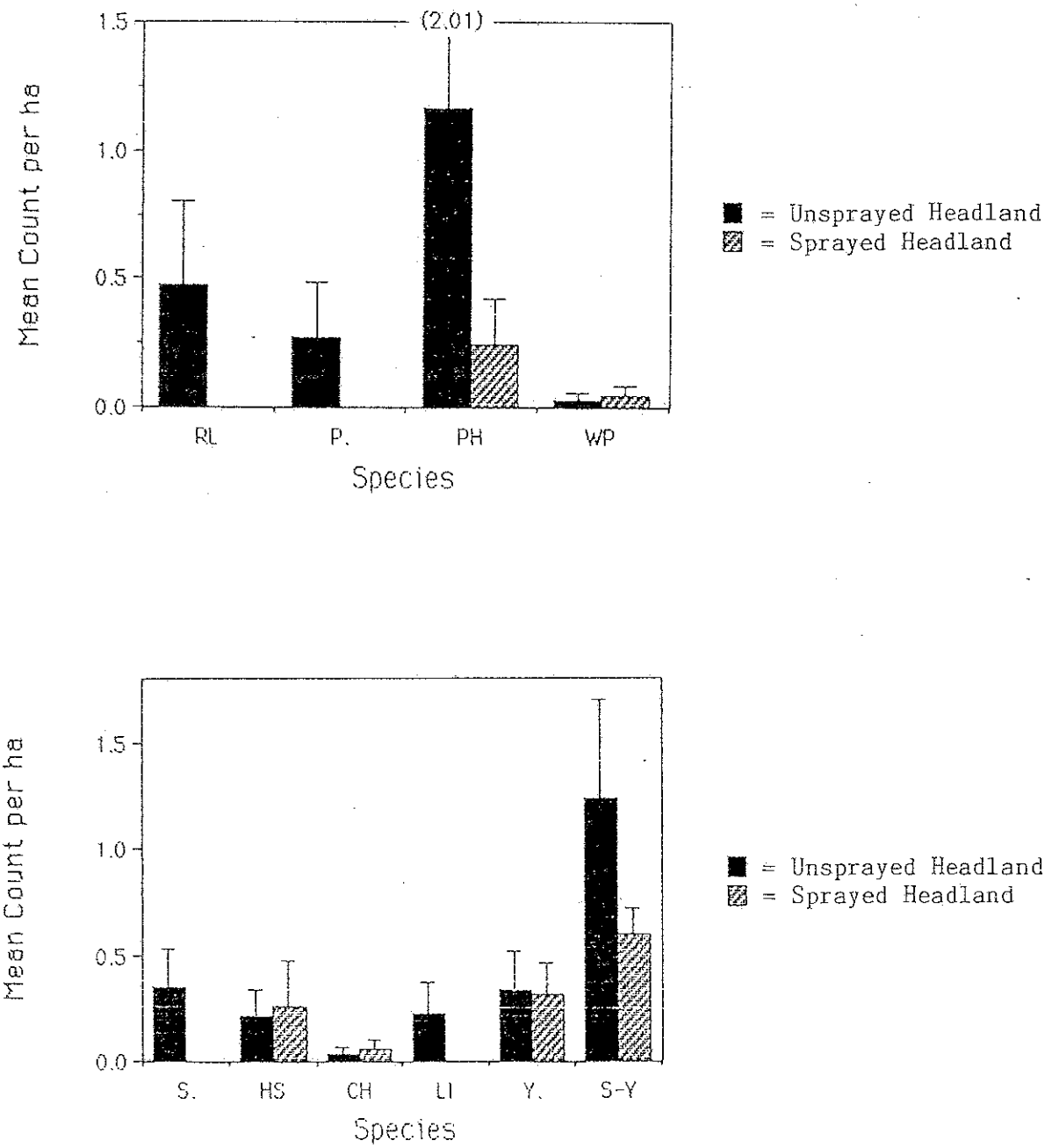

Figure 2. Mean bird densities on cereal stubble headlands.
Species codes are: RL = Red-Legged Partridge, P = Grey Partridge, PH = Pheasant, WP = Woodpigeon, S = Skylark, HS = House Sparrow, CH = Chaffinch, LI = Linnet, Y = Yellowhammer, S-Y = combined counts of seed-eaters (Skylark - Yellowhammer).
Standard errors are indicated.

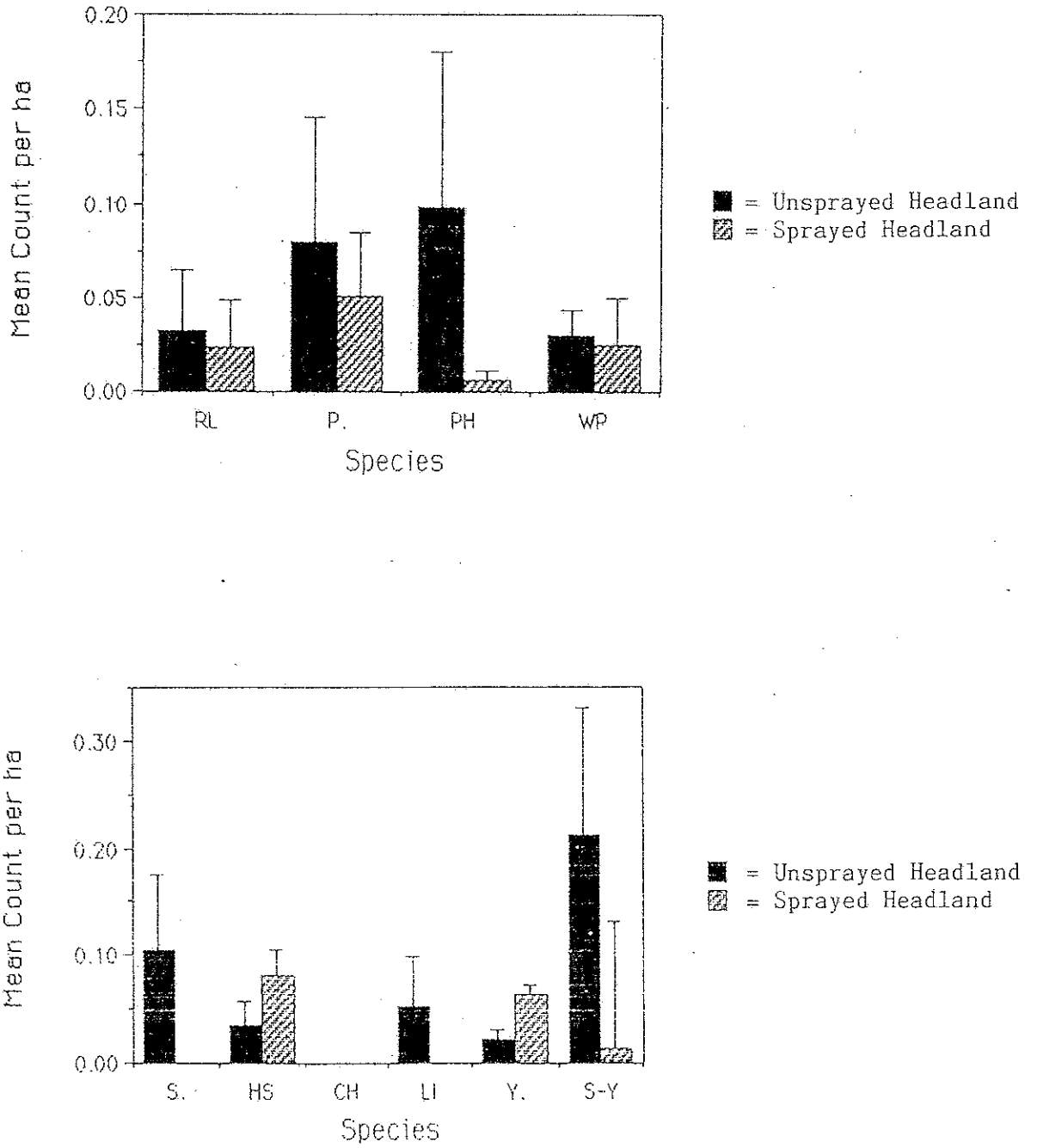

Figure 3. Mean bird densities on cereal stubble field interiors. Species codes are: RL = Red-Legged Partridge, P = Grey Partridge, PH = Pheasant, WP = Woodpigeon, S = Skylark, HS = House Sparrow, CH = Chaffinch, LI = Linnet, Y = Yellowhammer, S-Y = combined counts of seed-eaters (Skylark - Yellowhammer). Standard errors are indicated.

COMPARISON OF HEADLAND USE.

Table 5 summarizes the proportional use of the headland in fields with sprayed and unsprayed headlands. The number of fields for each category for which proportions were calculable are too small in most cases for meaningful significance tests. However, it is apparent that there was no trend for higher proportional use of unsprayed headlands.

DISCUSSION

The main aim of this study was to test methods and identify potential problems for a possible full scale survey. However, it is apparent from the results that there is no evidence that fields with untreated headlands support higher densities of seed-eating birds or have higher porportional use of headlands. Therefore there is no indication that leaving cereal headlands unsprayed with herbicide is beneficial to seed-eating birds using stubble fields in autumn.

These results however, must be put into the context of the problems encountered. Firstly, the density of passerine species using the stubble fields was very low, and their distributions clumped and erratic. The result of this was that most species were absent from most fields on most visits. The resulting predominance of zero counts made meaningful statistical analysis difficult and its validity questionable. This problem was exacerbated by the small number of fields studied. Thus, even if there was an effect of leaving headlands unsprayed, this would have been difficult to detect, unless its magnitude was great.

Another problem was that the study fields differed in many other

TABLE 5. Proportional use of the headland zone in fields with sprayed or unsprayed headlands.

	SPRAYED			UNSPRAYED					
	HEADLAND PROPORTION	n	S.E.	HEADLAND PROPORTION	n	S.E.	t	df	P
Red Legged Partridge	35.8	2	-	80.8	2	-			
Grey Partridge	0	2	-	50.2	3	26.5			
Pheasant	85	2	-	50.5	5	20.8			
Woodpigeon	46.6	3	26.0	17.8	4	17.8	0.95	5	>0.3
Skylark	-	-		77.5	5	7.76			
House Sparrow	74.2	2	-	70.1	3	2.46			
Chaffinch	90	2	-	90	1	-			
Linnet	-	-		48.8	3	26.3			
Yellowhammer	60	4	21.2	72.2	4	3.87	0.57	6	>0.6
All seedeaters	75.4	4	9.03	70.5	5	4.38	0.52	7	>0.6

Headland proportion = (headland density/(headland density + interior density) Arcsine transformed.

Densities are mean derived means of species density.

The t-test procedure allows for unequal variances where necessary.

aspects of agricultural management besides herbicide treatment, in particular, the number of years in which the headland had been unsprayed and post-harvest management (see Table 1.). The number of years with uninterrupted unsprayed headlands may be important, for example, if the build-up of benefical seeds for birds is slow. Another variable was the use of a Dyno-drive Cultivator to mix the top soil layer and encourage seed germination in two of the unsprayed headland fields. Clearly, this may have reduced the availability of weeds seeds to birds and thus potentially biased the unsprayed headland sample. This is particularly noteworthy because both of these fields (Moores and Copse Ground) held virtually no small seed-eating passerines (see Appendix).

Another variable that I did not study was the location of feeding and release areas for gamebirds, which could have had important effects on distribution.

Lastly, the characteristics of field boundaries were not measured in my study. These are important for the distribution of some passerines in winter (Arnold 1983, Osborne 1984) and therefore may further contribute to variation in the study. This might have partially obscured any treatment effect, although the apparent lack of any consistent differences in boundary character between treatments suggests that a significant bias was absent.

In general, the overiding problem was the low density of birds in the study fields. This may be because small seed-eating passerines are uncommon within the entire study area because of lack of suitable nesting sites, limited food resources, high predation rates etc. Alternatively, these species may use other more profitable feeding locations in winter. This is especially likely in this study area as

there are many areas of game-food crops, unmanaged field margins, copses and woodland, though I did not see large numbers of passerines in such areas.

Clearly, the low density of birds is a major problem that must be overcome in any future study. This could possibly be done by choosing a suitable 'indicator' species for an intensive study using radio-tracking techniques. For example, regular location of a feeding flock of Linnets or Tree Sparrows might be used to establish the important factors affecting their feeding location. However, this technique does not focus on the central question of the benefit of headlands to the species and may be useless if the tagged birds are utilising alternative food supplies. In addition, there may be associated problems with the radio tracking, such as initial location and catching of birds, movement of birds out of the study area, and the short life of transmitters on such small birds.

Alternatively, a more suitable study area could be found, with higher densities of birds, a larger number of available study fields, more evenly dispersed control (fully sprayed) fields, fewer alternative food supplies and stubble fields that are left throughout the winter. Indeed, this is essential for any future intensive study, regardless of the methods intended to be used.

An extensive approach could be used to overcome the problem of low bird density by surveying a very large number of fields. Such a study could be carried out by the BTO as a membership based survey in co-operation with the Game Conservancy Trust. Through the BTO Regional Representative network members could be put in contact with local farmers participating in the Cereal and Gamebirds Project and asked to survey stubble fields with sprayed and unsprayed headlands periodically

throughout the winter. The methods used for estimating bird densities in the present study would be appropriate for a membership based survey, although further information on hedge structure, presence or absence of adjoining woodland etc. would also be required. Agricultural information on crop type, spraying regime and cultivation methods etc. would be required from the farmer.

Although this approach would be less 'powerful' than a selective intensive study because birds would be absent in many fields, it would present fewer practical problems. Based upon the density of Yellowhammers in sprayed headlands (0.312 birds/ha standard error = 0.146) and using the formula of Sokal and Rohlf (1981, pp. 247), we can predict that a study aimed at detecting a 20% difference between treatments in 80% of cases at a probability level of 0.05 would require at least 430 sample units (fields) per treatment. Thus if we assume that participants survey on average 10 fields per treatment per farm, 43 farms would be required to reach this desired level of precision. This level of participation could be easily acheived from the BTO membership. However, it might be difficult to find the required number of farms with adequate numbers of control (unsprayed) fields. Furthermore if we apply the same criteria to a less abundant species, for example Linnet (0.225 counts/ha, standard error = 0.147), then 840 samples are required. Alternatively, if an intensive approach is used (as in this study), but at a more suitable site then even if Yellowhammer and Linnet densities are doubled and their standard deviations halved the number of samples required will be 30 and 55 respectively.

CONCLUSIONS

1) This study measured the density of birds on cereal stubble headlands and field interiors in 4 fields that had full herbicide treatment and 8 fields that had headlands unsprayed. No difference in density was found between fully-treated and headland-untreated fields, either for the headlands themselves or for the field interiors.

2) The small scale of the study and low density of birds meant that, even if there was a beneficial effect of leaving headlands unsprayed for some species, this was unlikely to have been detected.

3) Any future intensive study area should contain:

a) Higher densities of wintering birds using the field margins.

b) A minimum of 30 fields for each treatment category, the two types being interdispersed.

c) Consistent management practices within each treatment category, regarding the length of time headlands have been unsprayed.

d) Stubble fields that have not been partially cultivated and will be available for the entire winter period.

4) A future study should also consider incorporating:

a) An extensive approach using volunteer observers to survey a large number of fields across a range of study areas.

b) Radio-tracking techniques in intensive studies on an appropriate indicator seed-eating species (eg. Linnet or Tree Sparrow), to locate flock feeding locations.

c) Field margin descriptions for inclusion in statistical analysis.

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REFERENCES

Arnold, G.R. (1983). The influence of ditch and hedgerow structure, length of hedgerows, and area of woodland and garden on bird numbers on farmland. Journal of Applied Ecology, 20, 731-50.

Collinge, W.E. (1924-27). The food of some British Wild Birds. Collinge, York.

Cracknell, G.S. (1986). The effects on songbirds of leaving cereal crop headlands unsprayed. BTO. Research Report 18.

Fuller, R.J. (1984). The distribution and feeding behaviour of breeding songbirds on cereal farmland at Manydown Farm, Hampshire, in 1984. BTO Research Report 16.

Murton, R.K. (1971). Man and Birds. Collins, London.

Newton, I. (1967). The adaptive radiation and feeding ecology of some British finches. Ibis 109, 33-98.

Newton, I. (1972). Finches. Collins, London.

O'Connor, R.J. & Shrubb, M. (1986). Farming and Birds. Cambridge University Press, U.K.

Osborne, P.J. (1984). Bird numbers and habitat characteristics in farmland hedgerows. Journal of Applied Ecology, 21, 63-82.

Potts, G.R. (1986). The Partridge: pesticides, predation and conservation. Collins, London.

Rands, M.R.W. (1985). Pesticide use on cereals and the survival of partridge chicks: a field experiment. Journal of Applied Ecology, 22, 49-54.

Rands, M.R.W. (1986a). The survival of gamebird chicks in relation to pesticide use on cereals. Ibis, 128, 55-64.

Rands, M.R.W. (1986b). Unsprayed headlands: The answer for gamebirds? Game Conservancy Annual Review, 17 56-61.

Sokel, R.B. & Rohlf, F.S. (1981) Biometry, Second edition. W.H. Freeman and co. San Francisco.

APPENDIX

. SCIENTIFIC NAMES OF BIRDS MENTIONED IN THIS REPORT.

Red-legged Partridge	Alectoris rufa
Grey Partridge	Perdix perdix
Pheasant	Phasianus colchicus
Woodpigeon	Columba palumbus

Skylark	Alauda arvensis
House Sparrow	Passer domesticus
Tree Sparrow	Passer montanus
Chaffinch	Fringilla coelebs
Linnet	Carduelis cannabina
Yelllowhammer	Emberiza citrinella

DERIVED MEAN BIRD DENSITIES (BIRDS/ha) FOR EACH SPECIES IN EACH FIELD.

			SPECIES								
FIELD	SPRAY	REGION	RL	P.	PH	WP	S.	HS	CH	LI	Y
WINTERDOWN	+	H			0.749	0.133			0.133		0.133
		I	0.096	0.063	0.023	0.096					0.044
HUNTSFIELD	+	H						0.187	0.113		0.604
		I		0.142		0.102					
FOX LANE	+	H			0.237	0.064		0.863			
		I						0.328			0.208
GOODARDS	+	H									0.513
		I									
MOORES	-	H		0.465							
		I			0.0379						
COPSE GROUND	-	H									
		I			0.0772						
LONELY MEADOW	-	H	1.47	1.71	6.81		0.203		0.265		0.694
		I		0.54	0.670	0.089					0.060
BATTLEDOWN (NORTH)	-	H					1.32	0.912		0.932	0.136
		I				0.102	0.342	0.194			0.040
PILVERLANDS	-	H			0.293		0.045	0.492			1.45
		I				0.022		0.045			0.045
ROUGH MEAD	-	H			2.22	0.205	0.998			0.865	
		I				0.024	0.502			0.380	
POPPY FIELD	-	H	2.35								
		I	0.256								
FIELD BARN	-	H					0.200	0.319			0.405
		I		0.092				0.034		0.034	0.034

Spray: + = fully sprayed, - = Unsprayed headland.
Region: H = Headland, I = Interior.
Species codes are: RL = Red-legged Partridge, P = Grey Partridge, PH = Pheasant, WP = Woodpigeon, S = Skylark, HS = House Sparrow, CH = Chaffinch, LI = Linnet, Y = Yellowhammer.