Research Report No. 28

BREEDING POPULATION ESTIMATES FOR SELECTED BIRD SPECIES IN ITE SAMPLE SQUARES

by Robert Hudson*

A report from the British Trust for Ornithology
to the Institute of Terrestrial Ecology (Merlewood)
in respect of work done under
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The present Report, on the work performed under the above contract, is limited to description of the methodology used and discussion of the likely sources of error arising from this type of indirect estimation. The contract results comprise 256 pages of tabulation (one per ITE sample square); these have been handed separately to ITE Merlewood, and photocopies retained by the British Trust for Ornithology (Habitats Research Department).

INTRODUCTION

Over the last eight years the scientific staff of Merlewood Research Station (ITE) have developed a stratified land classification system for Britain; within this, 32 divisions (land classes) are recognised. A series of randomly-selected sampling squares (1 x 1 km) has also been established, these squares being 256 in number or eight per land class. Studies already made by Merlewood biologists have shown that estimates derived from sample-square parameters are valid for the land class as a whole and can be translated into national figures. Therefore the system is potentially a powerful tool for predicting the consequences of land use change, and its efficacy will increase with the number of data sets incorporated into the sampling system.

Birds are a conspicuous part of the environment, and are easier to identify and count than most other animals. Some bird species are remarkably adaptive to new or altered habitats, while others are more specialised in their requirements so that their local status changes significantly when their preferred habitat is increased or reduced in area. Hence terrestrial birds can give useful indications as to the consequences of environmental changes, so that avian density data are an obvious choice for inclusion into the Merlewood data base.

WORK PROGRAMME

In February 1987 the British Trust for Ornithology accepted a contract to provide breeding bird density data to ITE Merlewood, in the form of population estimates for each of the 256 sample squares (1 x 1 km) for an appropriate range of species.

This contract required:

(a) liaison with ITE Merlewood on the selection of species, which should be representative of the range of bird species likely to be affected most by land use change;

(b) use of BTO Common Birds Census data to produce density contour maps, for woodland and farmland habitats separately;

(c) estimations of bird numbers for each 1-km sample square for the selected species, based on the contour maps but when necessary using empirical judgement to supplement the CBC data;

(d) use of land classes already identified with the CBC data to aid estimations of densities and numbers;

(e) discussion of the results with ITE; and

(f) provision of a summary report.

Following preliminary discussion with Dr R.G.H.Bunce (Merlewood), it was agreed to use 41 species, including representatives of woodland (W), farmland and moorland (F) and wetland (A), plus a sample of generalist species (G). Those selected were as follows.

Mallard	Anas platyrhynchos	A
Sparrowhawk	Accipiter nisus	W
Buzzard	Buteo buteo	F
Kestrel	Falco tinninculus	G
Moorhen	Gallinula chloropus	A
Golden Plover	Pluvialis apricaria	F
Lapwing	Vanellus vanellus	A
Redshank	Tringa totanus	A
Stock Dove	Columba oenas	F
Collared Dove	Streptopelia decaocto	G
Kingfisher	Alcedo atthis	A
Great Spotted Woodpecker	Dendrocopos major	W
Skylark	Alauda arvensis	F
Swallow	Hirundo rustica	F
Tree Pipit	Anthus trivialis	W
Meadow Pipit	Anthus pratensis	F
Yellow Wagtail	Motacilla flava	A
Grey Wagtail	Motacilla cinerea	A
Pied Wagtail	Motacilla alba	A
Wren	Troglodytes troglodytes	G
Dunnock	Prunella modularis	G
Robin	Erithacus rubecula	G
Nightingale	Luscinia megarhynchos	W
Redstart	Phoenicurus phoenicurus	W
Blackbird	Turdus merula	G
Sedge Warbler	Acrocephalus schoenobaenus	A
Whitethroat	Sylvia communis	F
Blackcap	Sylvia atricapilla	W
Wood Warbler	Phylloscopus sibilatrix	W
Willow Warbler	Phylloscopus trochilus	G
Goldcrest	Regulus regulus	W
Spotted Flycatcher	Muscicapa striata	G
Marsh Tit	Parus palustris	W
Coal Tit	Parus ater	W
Great Tit	Parus major	G
Nuthatch	Sitta europaea	W
Chaffinch	Fringilla coelebs	G
Goldfinch	Carduelis carduelis	F
Yellowhammer	Emberiza citrinella	F
Reed Bunting	Emberiza schoeniclus	A
Corn Bunting	Miliaria calandra	F

The habitat categorisation of certain of these species is somewhat arbitrary, but the arrangement used here is considered a realistic one on an assumption that one significant use of the contract data

will be to predict the consequences of land use change. Buzzard and Stock Dove nest as often in woodland as on farmland, while Goldfinch and Yellowhammer not infrequently nest on woodland edge, but all four are dependent on open country (farmland or sheepwalk) for their feeding. Pied Wagtails will nest in built-up areas and could have been placed with the generalists, but they are better as indicators of aquatic sites. The species listed here as generalists are so designated because of their adaptability to habitat change and in particular their ability to breed successfully in residential areas; but this trait is less developed in the Willow Warbler, which only just merits inclusion in this category. Eight of these generalists reach their maximum densities in woodland, one (Kestrel) on farmland, while only one (Collared Dove) is at its most numerous close to human habitations.

METHODOLOGY

Woodland and farmland

The BTO Common Birds Census (CBC) was launched in 1961, initially for the purpose of assessing on an annual basis the changes in population levels of the more common British breeding species. Volunteer (mainly amateur) observers each select a farmland or woodland plot which they census annually, using a territory mapping method described in Marchant (1983). Typically, farmland plots are 60-100 ha in size and woodland plots 15-30 ha; and 80-100 of each are censused each year.

For the purposes of the present contract, CBC data were used for a nine-year period: 1978-1986. For each plot the annual numbers of territories for the selected species were converted to a standard density (territories per 100 ha). All plots had been censused in at least two years and some for the full range of nine years. For each plot, a mean density was calculated for each species from all the available censuses. This smoothed short-term fluctuations in numbers caused by (eg.) extremes of winter temperatures and their influence on the survival of resident species, or variable Sahel rainfall affecting the survival of migrant species which winter in Africa. Data for farmland and woodland plots were kept separate, with the exception of four species (Moorhen, Grey Wagtail, Nightingale, Sedge Warbler) for which registrations were few in number so that pooling was necessary.

The ranges of recorded densities (territories/100 ha) per species for woodland and farmland separately were then divided into three (or sometimes four) bands for the contour mapping, the divisions being selected to give equal numbers of points within each band. The density bands used are shown in Table 1. The data were then sent (on magnetic tape) to ITE Merlewood for production of the 55 contour maps. Four examples of these contour maps are included (Figures

TABLE 1. DENSITY BANDS SELECTED FOR USE IN CONTOUR MAPPING

Farmland

1	Mallard	0.1-3	3.1-6	6.1-29	
2	Sparrowhawk	0.1-1	1.1-2	2.1-3	
3	Kestrel	0.1-1	1.1-2	2.1-5	
4	Lapwing	0.1-2	2.1-5	5.1-40	
5	Redshank	0.1-1	1.1-2	2.1-10	
6	Stock Dove	0.1-2	2.1-4	4.1-14	
7	Collared Dove	0.1-2	2.1-4	4.1-45	
8	Skylark	0.1-6	6.1-15	15.1-25	25.1-70
9	Swallow	0.1-2	2.1-5	5.1-8	8.1-20
10	Great Tit	0.1-3	3.1-8	8.1-15	15.1-42
11	Wren	0.1-9	9.1-20	20.1-35	35.1-280
12	Robin	0.1-8	8.1-18	18.1-30	30.1-125
13	Blackbird	0.1-10	10.1-25	25.1-40	40.1-146
14	Blackcap	0.1-2	2.1-5	5.1-37	
15	Whitethroat	0.1-2	2.1-5	5.1-23	
16	Willow Warbler	0.1-3	3.1-8	8.1-15	15.1-58
17	Spotted Flycatcher	0.1-2	2.1-4	4.1-15	
18	Dunnock	0.1-6	6.1-12	12.1-20	20.1-183
19	Meadow Pipit	0.1-2	2.1-4	4.1-66	
20	Pied Wagtail	0.1-1.5	1.6-3	3.1-11	
21	Yellow Wagtail	0.1-1.5	1.6-3	3.1-18	
22	Goldfinch	0.1-2	2.1-4	4.1-17	
23	Chaffinch	0.1-10	10.1-20	20.1-35	35.1-100
24	Corn Bunting	0.1-2	2.1-5	5.1-30	
25	Yellowhammer	0.1-8	8.1-20	20.1-50	
26	Reed Bunting	0.1-3	3.1-6	6.1-34	

Woodland

27	Sparrowhawk	0.1-3	3.1-6	6.1-18	
28	Buzzard	0.1-3	3.1-6	6.1-10	
29	Kestrel	0.1-3	3.1-6	6.1-24	
30	Stock Dove	0.1-4	4.1-9	9.1-20	20.1-64
31	Collared Dove	0.1-5	5.1-15	15.1-95	
32	Great Spotted Woodpecker	0.1-4	4.1-8	8.1-15	15.1-42
33	Great Tit	0.1-20	20.1-40	40.1-80	80.1-300
34	Coal Tit	0.1-10	10.1-30	30.1-60	60.1-218
35	Marsh Tit	0.1-4	4.1-20	20.1-181	
36	Nuthatch	0.1-5	5.1-20	20.1-56	
37	Wren	0.1-40	40.1-80	80.1-130	130.1-465
38	Robin	0.1-40	40.1-80	80.1-130	130.1-394
39	Redstart	0.1-3	3.1-10	10.1-95	
40	Blackbird	0.1-40	40.1-90	90.1-150	150.1-482
41	Blackcap	0.1-9	9.1-25	25.1-50	50.1-207
42	Whitethroat	0.1-5	5.1-15	15.1-25	25.1-198

contd over

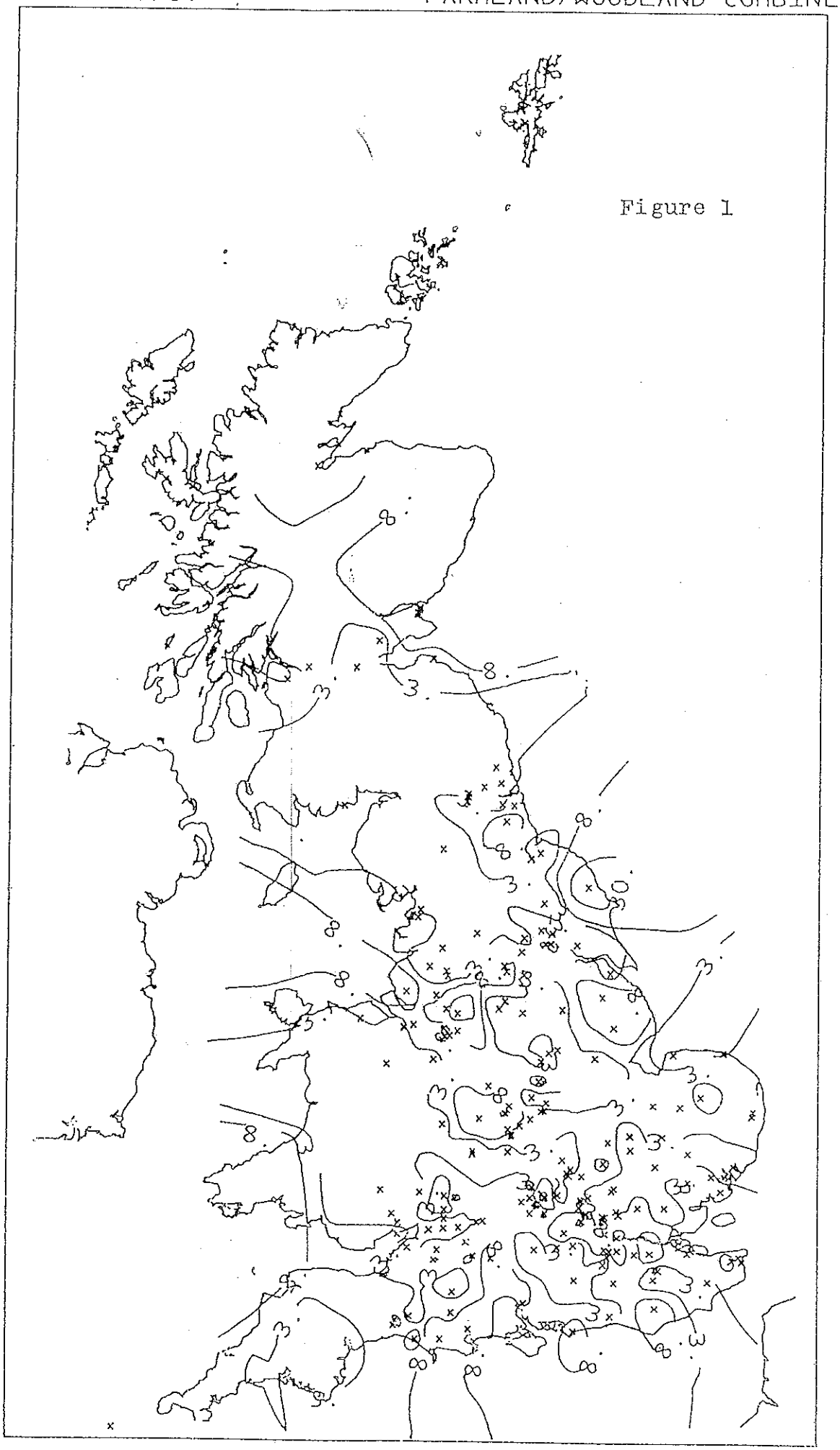
43	Willow Warbler	0.1–25	25.1–50	50.1–100	100.1–325
44	Wood Warbler	0.1–4	4.1–12	12.1–62	
45	Goldcrest	0.1–5	5.1–15	15.1–40	40.1–266
46	Spotted Flycatcher	0.1–6	6.1–15	15.1–83	
47	Dunnock	0.1–20	20.1–40	40.1–80	80.1–325
48	Tree Pipit	0.1–5	5.1–15	15.1–45	
49	Goldfinch	0.1–5	5.1–15	15.1–95	
50	Chaffinch	0.1–30	30.1–80	80.1–125	125.1–331
51	Yellowhammer	0.1–10	10.1–30	30.1–50	50.1–205

Both habitats combined

52	Moorhen	0.1–3	3.1–8	8.1–48
53	Nightingale	0.1–2	2.1–8	8.1–45
54	Sedge Warbler	0.1–2	2.1–8	8.1–85
55	Grey Wagtail	0.1–2	2.1–4	4.1–19

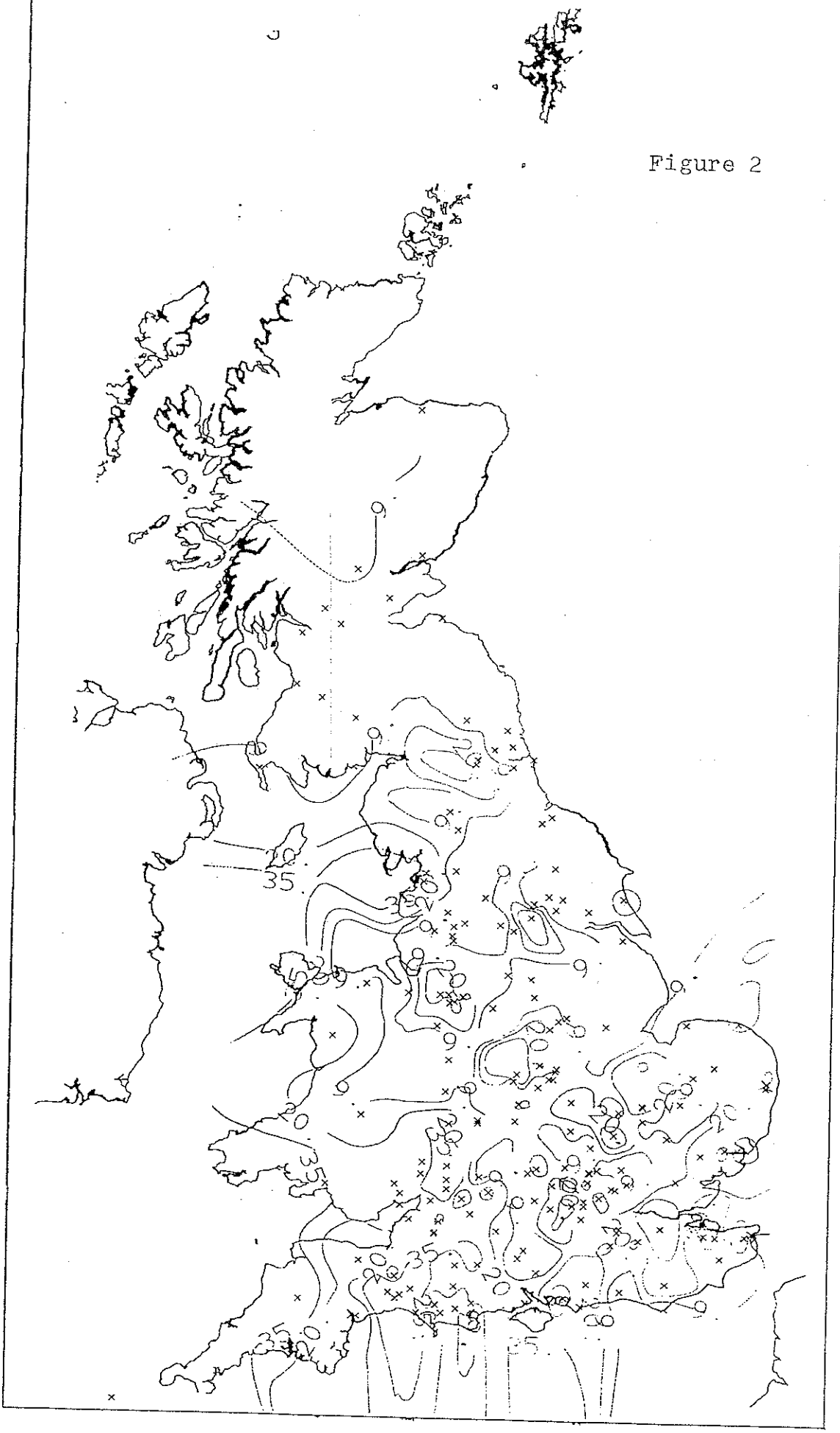
MOORHEN (173) FARMLAND/WOODLAND COMBINED

Figure 1



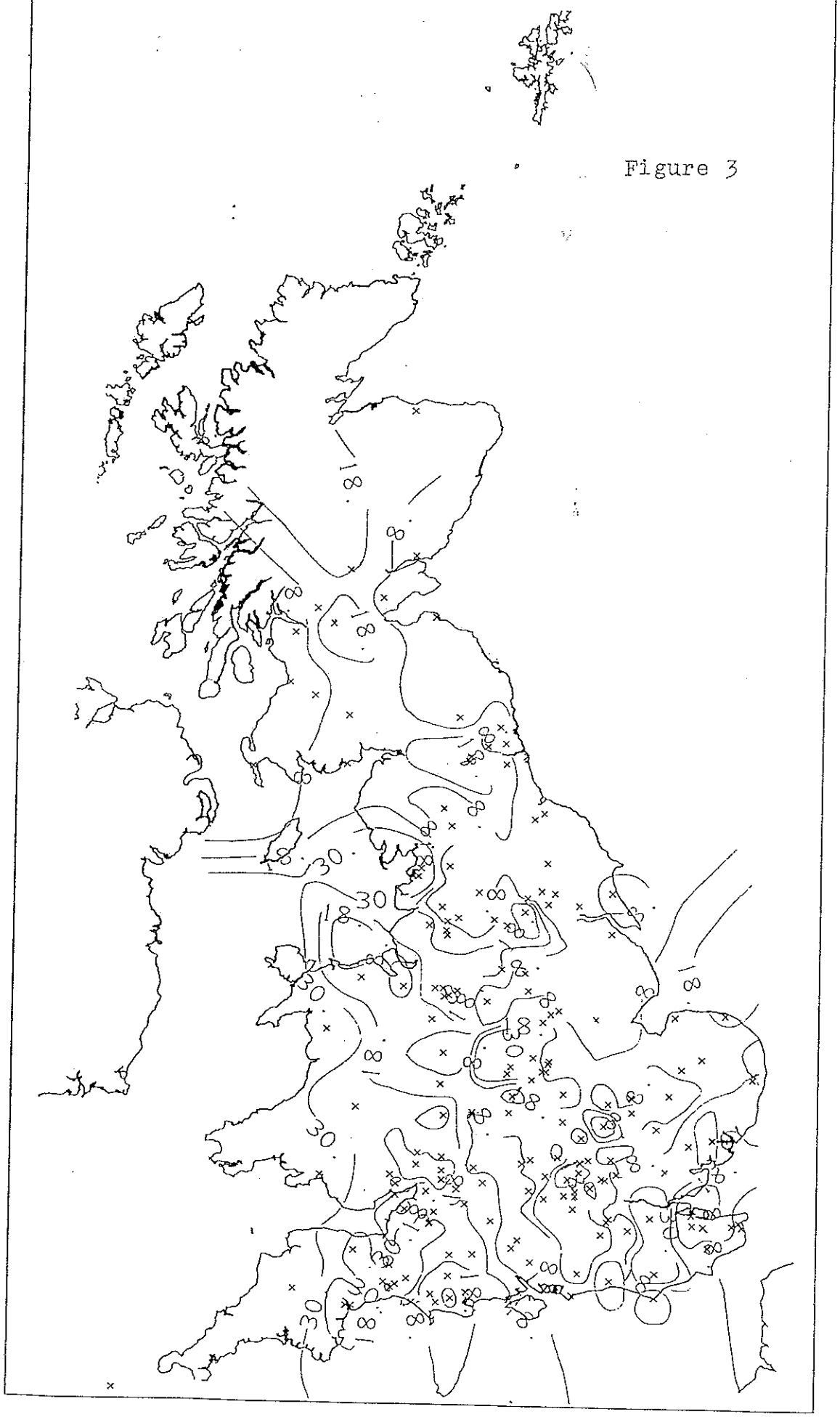
WREN (398) FARMLAND

Figure 2

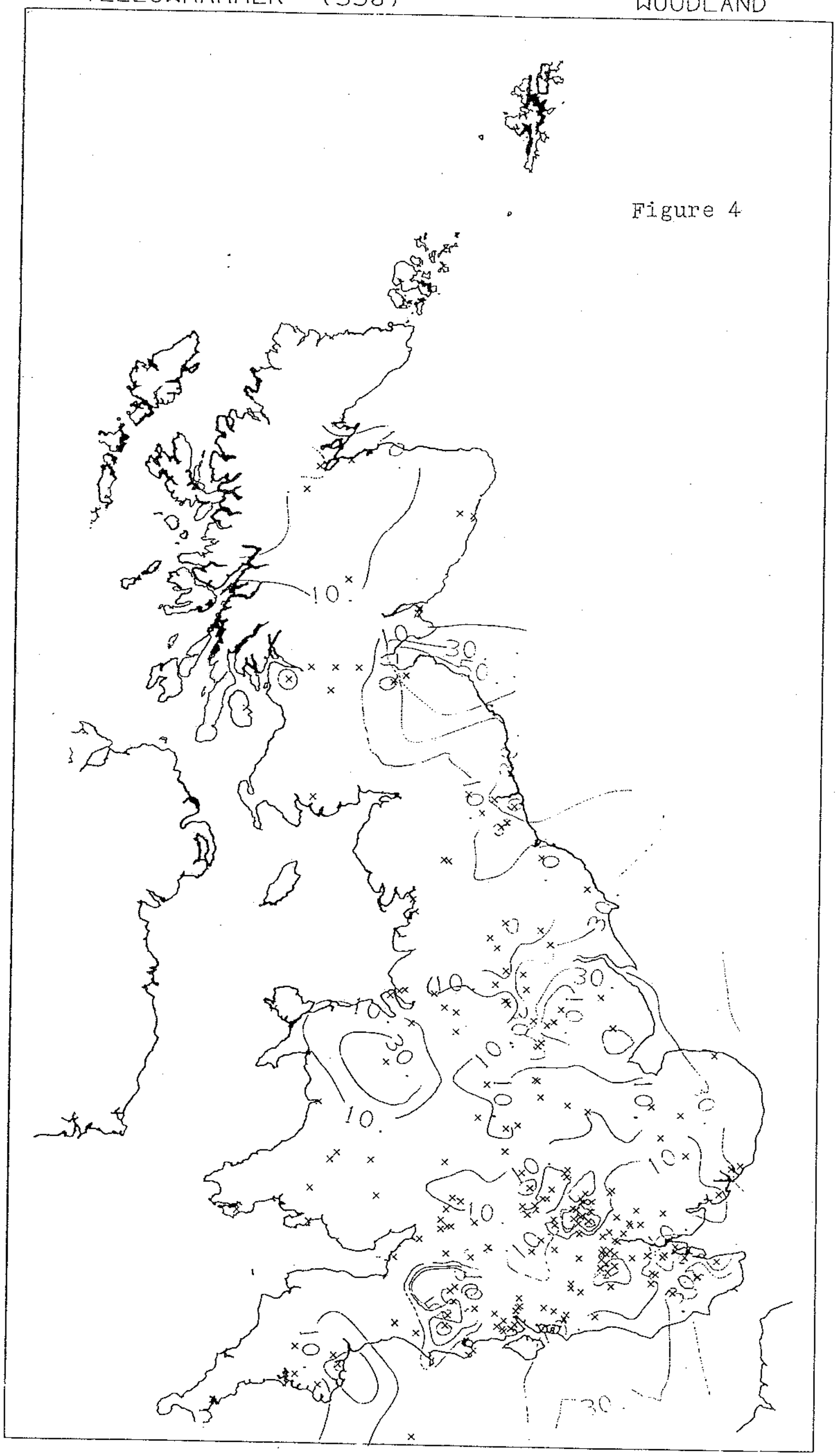


ROBIN (400) FARMLAND

Figure 3



YELLOWHAMMER (558) WOODLAND



1-4); on these, the small crosses mark the positions of the CBC plots used for each.

Other habitats

The BTO also conducts a Waterways Bird Survey, which uses methodology similar to the CBC to census breeding birds associated with rivers and canals. Because of the linear nature of WBS plots, the results cannot be converted into meaningful area densities nor otherwise used in contour mapping; WBS data are best expressed as pairs per unit length of waterway. Where ITE sample squares contained a section of river, stream or canal, the nearest WBS plot was consulted and its associated bird densities were used in proportion to waterway length within the sample square.

The BTO does not have annual monitoring programmes for bird populations associated with residential and industrial areas, standing water bodies, heathland, moorland and saltmarsh. For such habitats, it was necessary to consult published local studies where available (see Bibliography appended) and exercise empirical judgement. For urban and suburban habitats some indications of likely densities were given by Hudson and Marchant (1984), and these have been used here.

Estimating populations in sample squares

Photocopied maps of the 256 sample squares were supplied by Merlewood, and these already had their constituent parcels of land labelled according to the 80 categories of land use defined by ITE. Estimation then proceeded as follows.

(i) A transparent overlay grid (divided into 100 equal units) was used to produce, for each square, percentage figures for broad habitat groupings: (a) woodland and scrub, (b) enclosed farmland, (c) unenclosed uplands, (d) residential and industrial, (e) standing water, (f) saltmarsh, and (g) sea and shore.

(ii) In these habitat groupings, allotments and orchards were included in farmland, churchyards and cemeteries with residential. Formal recreation areas and sewage farms were allocated to either farmland or residential/industrial, according to whether they were in rural or urban/suburban situations. Similarly, roadside verges and railway embankments or cuttings were allocated to adjacent habitat groups, though it should be noted that these can be attractive to birds depending on the structure of their vegetation.

(iii) Bird densities were estimated separately for habitat groupings which comprised 5% or more of the square. CBC data, especially those for farmland, include already many landscape features which although small in area are ornithologically important (such as ponds, copses, shelterbelts, farmsteads); hence it was generally impractical to estimate separate densities for these.

Only one exception was made to the 5% rule: small areas of plantation in otherwise open upland squares were treated separately.

(iv) For woodland and farmland separately, each ITE sample square was positioned on each of the contour maps and the appropriate density band read off. Since many bird species have breeding ranges which are restricted in varying degrees, as a double-check the BTO Atlas of Breeding Birds (Sharrock 1976) was used to confirm whether or not a species occurred in the 10-km square within which the ITE 1-km square was located.

(v) Since the density bands from the contour maps were ranges of values (eg. 0-5, 10-20), it was necessary to inspect the map of the relevant sample square to assess whether the habitat structure and its likely effects on bird numbers justified use of a low, medium or high point on the density band. An estimate of the number of pairs or territories per species in each habitat grouping was then made in relation to the proportion of that habitat within the square. This was achieved by multiplying the density of species x in habitat y by the proportion of the square covered by habitat y. For example, if habitat y covered 33% of a square and was estimated to hold 15 territories/100 ha, a total of 5 territories would be allocated to that habitat in that square.

(vi) The estimates produced in this way should be regarded as territories, for CBC fieldwork registrations are predominantly of singing males. In most instances a territory will equal one breeding pair. However, a minority of males may fail to attract a mate (but sing more as a consequence), while registrations will also include cases of polygyny and polyandry (eg. in Corn Bunting and Dunnock respectively).

The final results were produced in the form of one comprehensive tabulation per sample square, with the species being grouped according to their assumed preferred habitats. Five specimen sheets are included with this report (as Tables 2-6). The main body of data have been handed separately to ITE Merlewood.

INTERPRETATION

While every effort has been made to produce species estimates per square which are realistic, it is necessary to draw attention to problems and possible pitfalls in using this method of indirect estimation.

Geographical bias in CBC data

As might be expected, the geographical distribution of CBC plots (both woodland and farmland) reflects the geographical distribution

TABLES 2-6. EXAMPLES OF BIRD POPULATION TOTALS ALLOCATED TO ITE SAMPLE SQUARES

Site 2/89. Sussex Downs. The habitat comprises escarpment woodland and scrub with pasture below. The woodland, farmland and generalist birds are well represented, but aquatic species are absent due to the dry nature of the downland terrain.

Site 4/423. Ouse Washes. The habitat is low-lying pasture, subject to flooding in winter and spring. Aquatic species are prominent, but there are only low numbers of farmland and generalist birds due to the shortage of secondary vegetation. Woodland specialists are entirely absent.

Site 5/152. Somerset. Some 70% of the land in this square is being used for residential and recreational purposes (the village of Woodborough), with some peripheral pastures and leys. Generalist species predominate through their ready use of developed areas; the numbers of farmland birds are quite low, while woodland and aquatic species are poorly represented in diversity and numbers.

Site 19/1219. North Yorkshire. The habitat is grouse moor, of heather and heather/cottongrass mixture. Such habitat has poor bird species diversity, but includes birds of special conservation interest (Golden Plover in this instance).

Site 22/1057. Aberdeenshire. Former moorland, the square is now 100% conifer afforestation. All open-country species have been eliminated.

SQUARE CODE ..... 2/89 ..... GRID REF ....507 112....

Table 2.

Predominantly woodland species

	Wood	Enclosed	Unencl-osed	Other	Total
Sparrowhawk	1	-	-	-	1
Great Spotted Woodpecker	1	-	-	-	1
Tree Pipit	3	-	-	-	3
Nightingale	2	-	-	-	2
Redstart	-	-	-	-	-
Blackcap	4	-	-	-	4
Wood Warbler	1	-	-	-	1
Goldcrest	3	-	-	-	3
Marsh Tit	2	-	-	-	2
Coal Tit	4	-	-	-	4
Nuthatch	1	-	-	-	1

Predominantly farmland/moorland species

	Wood	Enclosed	Unencl-osed	Other	Total
Buzzard	-	-	-	-	-
Golden Plover	-	-	-	-	-
Stock Dove	-	2	-	-	2
Skylark	-	15	-	-	15
Swallow	-	-	-	-	-
Meadow Pipit	-	3	-	-	3
Whitethroat	-	2	-	-	2
Goldfinch	-	2	-	-	2
Yellowhammer	2	3	-	-	5
Corn Bunting	-	3	-	-	3

Predominantly aquatic/marsh Species

	Wood	Enclosed	Unencl-osed	Other	Total
Mallard					
Moorhen					
Lapwing					
Redshank					
Kingfisher					
Yellow Wagtail					
Grey Wagtail					
Pied Wagtail					
Sedge Warbler					
Reed Bunting					

GENERALIST SPECIES

	Wood	Enclosed	Unencl-osed	Other	Total
Kestrel	1	-	-	-	1
Collared Dove	-	-	-	-	-
Wren	10	-	-	-	10
Hannock	5	1	-	-	6
Robin	8	-	-	-	8
Blackbird	10	2	-	-	12
Willow Warbler	8	-	-	-	8
Spotted Flycatcher	1	-	-	-	1
Great Tit	5	-	-	-	5
Chaffinch	10	2	-	-	12

Other. In this squre, 'other habitat' comprised .....

Note. All figures are estimated numbers of territories.

SQUARE CODE ....4/423..... GRID REF ....552..292..

Predominantly woodland species

Table 3.

	Wood	Enclosed	Unencl-osed	Other	Total
) arrowhawk					
: eat Spotted Woodpecker					
: ee Pipit					
ightingale					
edstart					
Blackcap					
Wood Warbler					
Goldcrest					
Marsh Tit					
Coal Tit					
Nuthatch					

Predominantly farmland/moorland species

	Wood	Enclosed	Unencl-osed	Other	Total
uzzard	-	-	-	-	-
: den Plover	-	-	-	-	-
tock Dove	-	-	-	-	-
'lark	-	10	-	-	10
llow	-	-	-	-	-
Meadow Pipit	-	10	-	-	10
Whitethroat	-	1	-	-	1
Goldfinch	-	-	-	-	-
Yellowhammer	-	10	-	-	10
Corn Bunting	-	1	-	-	1

Predominantly aquatic/marsh Species

	Wood	Enclosed	Unencl-osed	Other	Total
lard	-	15	-	-	15
orhen	-	10	-	-	10
wing	-	15	-	-	15
shank	-	12	-	-	12
ngfisher	-	-	-	-	-
Yellow Wagtail	-	10	-	-	10
Grey Wagtail	-	-	-	-	-
Pied Wagtail	-	2	-	-	2
Sedge Warbler	-	8	-	-	8
Reed Bunting	-	10	-	-	10

GENERALIST SPECIES

	Wood	Enclosed	Unencl-osed	Other	Total
strel	-	-	-	-	-
'lared Dove	-	-	-	-	-
n	-	4	-	-	4
nnock	-	3	-	-	3
in	-	2	-	-	2
Blackbird	-	5	-	-	5
Willow Warbler	-	-	-	-	-
Spotted Flycatcher	-	-	-	-	-
Great Tit	-	-	-	-	-
Chaffinch	-	-	-	-	-

Other. In this squre, 'other habitat' comprised .....

Note. All figures are estimated numbers of territories.

SQUARE CODE ..... 5/152 ..... GRID REF ..... 342 157 ..

Predominantly woodland species

Table 4.

	Wood	Enclosed	Unenclosed	Other	Total
Sparrowhawk					
Great Spotted Woodpecker					
Tree Pipit					
Nightingale					
Redstart					
Blackcap	-	2	-	-	2
Wood Warbler	-	-	-	-	-
Goldcrest	-	-	-	-	-
Marsh Tit	-	-	-	-	-
Coal Tit	-	-	-	1	1
Nuthatch	-	-	-	-	-

Predominantly farmland/moorland species

	Wood	Enclosed	Unenclosed	Other	Total
Buzzard	-	-	-	-	-
Golden Plover	-	-	-	-	-
Stock Dove	-	1	-	-	1
Skylark	-	3	-	-	3
Swallow	-	6	-	-	6
Meadow Pipit	-	1	-	-	1
Whitethroat	-	2	-	-	2
Goldfinch	-	2	-	-	2
Yellowhammer	-	3	-	-	3
Corn Bunting	-	1	-	-	1

Predominantly aquatic/marsh Species

	Wood	Enclosed	Unenclosed	Other	Total
Mallard	-	2	-	-	2
Moorhen	-	-	-	-	-
Lapwing	-	-	-	-	-
Redshank	-	-	-	-	-
Kingfisher	-	-	-	-	-
Yellow Wagtail	-	1	-	-	1
Grey Wagtail	-	-	-	-	-
Pied Wagtail	-	-	-	2	2
Sedge Warbler	-	-	-	-	-
Reed Bunting	-	-	-	-	-

GENERALIST SPECIES

	Wood	Enclosed	Unenclosed	Other	Total
Kestrel	-	-	-	-	-
Collared Dove	-	1	-	2	3
Wren	-	10	-	8	18
Cannock	-	5	-	8	13
Robin	-	7	-	10	17
Blackbird	-	15	-	15	30
Willow Warbler	-	1	-	-	1
Spotted Flycatcher	-	-	-	1	1
Great Tit	-	6	-	8	14
Chaffinch	-	10	-	2	12

Other. In this squre, 'other habitat' comprised residential and recreational.

Note. All figures are estimated numbers of territories.

SQUARE CODE .....19/1219..... GRID REF ...462..502..

Table 5.

Predominantly woodland species

	Wood	Enclosed	Unenclosed	Other	Total
Sparrowhawk					
Great Spotted Woodpecker					
Tree Pipit					
Nightingale					
Redstart					
Blackcap					
Wood Warbler					
Goldcrest					
Marsh Tit					
Coal Tit					
Nuthatch					

Predominantly farmland/moorland species

	Wood	Enclosed	Unenclosed	Other	Total
Buzzard	-	-	-	-	-
Golden Plover	-	-	5	-	5
Stock Dove	-	-	-	-	-
Skylark	-	-	2	-	2
Swallow	-	-	-	-	-
Meadow Pipit	-	-	20	-	20
Whitethroat	-	-	-	-	-
Goldfinch	-	-	-	-	-
Yellowhammer	-	-	-	-	-
Corn Bunting	-	-	-	-	-

Predominantly aquatic/marsh Species

	Wood	Enclosed	Unenclosed	Other	Total
Mallard					
Moorhen					
Lapwing					
Redshank					
Kingfisher					
Yellow Wagtail					
Grey Wagtail					
Pied Wagtail					
Sedge Warbler					
Reed Bunting					

GENERALIST SPECIES

	Wood	Enclosed	Unenclosed	Other	Total
Kestrel	-	-	-	-	-
Collared Dove	-	-	-	-	-
Wren	-	-	2	-	2
Dunnock	-	-	-	-	-
Robin	-	-	-	-	-
Blackbird					
Willow Warbler					
Spotted Flycatcher					
Great Tit					
Chaffinch					

Other. In this squre, 'other habitat' comprised .....

Note. All figures are estimated numbers of territories.

SQUARE CODE .....22/1057.... GRID REF .....357.832.

Table 6.

Predominantly woodland species

	Wood	Enclosed	Unenclosed	Other	Total
Sparrowhawk	2	-	-	-	2
Great Spotted Woodpecker	2	-	-	-	2
Tree Pipit	-	-	-	-	-
Nightingale	-	-	-	-	-
Redstart	3	-	-	-	3
Blackcap	1	-	-	-	1
Wood Warbler	1	-	-	-	1
Goldcrest	50	-	-	-	50
Marsh Tit	1	-	-	-	1
Coal Tit	30	-	1	-	30
Nuthatch	1	-	-	-	1

Predominantly farmland/moorland species

	Wood	Enclosed	Unenclosed	Other	Total
Buzzard					
Golden Plover					
Stock Dove					
Skylark					
Swallow					
Meadow Pipit					
Whitethroat					
Goldfinch					
Yellowhammer					
Corn Bunting					

Predominantly aquatic/marsh Species

	Wood	Enclosed	Unenclosed	Other	Total
Mallard					
Moorhen					
Lapwing					
Redshank					
Kingfisher					
Yellow Wagtail					
Grey Wagtail					
Pied Wagtail					
Sedge Warbler					
Reed Bunting					

GENERALIST SPECIES

	Wood	Enclosed	Unenclosed	Other	Total
Kestrel	-	-	-	-	-
Collared Dove	-	-	-	-	-
Crow	20	-	-	-	20
Hunnock	3	-	-	-	3
Robin	15	-	-	-	15
Blackbird	10	-	-	-	10
Willow Warbler	30	-	-	-	30
Spotted Flycatcher	-	-	-	-	-
Great Tit	20	-	-	-	20
Chaffinch	40	-	-	-	40

Other. In this squre, 'other habitat' comprised .....

Note. All figures are estimated numbers of territories.

of birdwatchers, with substantial bias towards southern and central England. Only within these regions can it be claimed that CBC data are representative (Fuller et al 1985). With few CBC sites in the South-western Peninsula (Devon and Cornwall), Wales, northern England and Scotland, the contour lines on the contour maps were inevitably coarser for those regions and there were more instances of "best judgement" having to be used. The Scottish islands posed particular difficulties in respect of their passerine birds.

Nature of CBC data

Individual CBC plots vary in their composition: "woodland" includes mature hardwoods, coppice, tall scrub, conifers, mixed woodland and well-timbered parkland; while "farmland" includes a wide range of arable crops, grazing and mixed farming. It was impossible to treat the different permutations separately, though to some extent they will be associated with particular land classes. In practice, only single sets of woodland and of farmland values could be used to construct the contour maps. Self-evidently, the different types of woods and farms are not equally attractive to birds even within a region; thus many types of deciduous woodland have higher species-diversity than coniferous plantations, and there will be higher bird densities on mixed farmland than on cereals alone (Fuller 1982, O'Connor and Shrubb 1986). We have sought to take such factors into account when selecting points on each species density band (see Methodology), though it is likely that a residue of error remains.

Other habitats

As already stressed (see Methodology) there are no national density data for certain prominent habitat types, such as residential and industrial, unenclosed heathland and moorland, and saltmarsh. Some figures from local studies have been found in the literature; but it is impossible at present to predict the degree to which such figures have wider application. However, they have been used in default of anything better.

Limitations of ITE maps

The maps supplied by Merlewood were photocopies of the Ordnance Survey 1:10,000 series, and these had already been marked up with the categories of land use. Extremely helpful though these land use data were, they could not answer all questions of ornithological relevance. Of particular importance to the present study was the nature of field boundaries: wall, fence or hedgerow, and if the latter its height, thickness and composition. For most farmland bird species the field boundary is potentially more important than the field itself, but seldom could this feature be characterised from the maps provided. Similarly, it could not readily be decided from the maps whether rivers and canals were flanked by natural vegetation or were dredged and cleaned. Nor was it usually possible to determine the age of woodland or stage of succession in scrub. In conifer

plantation, young plantings have much higher bird diversities and densities than mature crops; while in hardwood stands there are higher bird densities where there is understorey or where trees have matured and provide nest holes. Inevitably, such uncertainties will influence the accuracy of the bird estimates.

Habitat usage by birds

As well as providing overall species estimates per 1-km square, these are also sub-divided into broad habitat groupings (woodland, enclosed farmland, unenclosed upland, residential, etc.). It should be noted, however, that individual bird territories will often be large enough to encompass more than one habitat group. Thus a pair may breed on woodland edge but be dependent on farmland for feeding (eg. Stock Dove, Collared Dove, Yellowhammer), or nest on farmland but lead nidifugous young elsewhere after hatching (eg. Mallard, Lapwing), or forage over different habitats according to patterns of insect emergence (eg. Spotted Flycatcher). It is important to bear in mind that habitat segregation is not rigid even at the level of the single territory.

The problem of large territories

Following on from the last paragraph, special mention must be made of the problem of predicting bird of prey densities. Three species were included in the project: Buzzard, Sparrowhawk and Kestrel. Pairs of raptors require large "home ranges" for their hunting, and often these exceed 500 ha in size. We have allocated territories to the 1-km sample squares when these contained apparently suitable nesting areas; in practice, a square could fall with a pair's home range without the nest being sited there. When territory size exceeds 100 ha, extrapolations from sample 1-km square data will lead to overestimation of population size.

Irregular distributions

While abundant bird species occur wherever suitable habitat is available, scarcer species can be rather patchy in their distributions and absent from woods or farms that seem eminently suitable. Good examples are Redstart, Nightingale, Wood Wabler, Nuthatch and Corn Bunting. Though the BTO Atlas of Breeding Birds was consulted to confirm that a species occurred in the relevant 10-km square (see Methodology), we had no way of confirmimg presence in a particular 100 ha section of it. Territories were assumed wherever apparently suitable habitat was present.

Temporal changes in habitat use

It is well established that bird species will make increased use of suboptimal habitats at times when their population levels are high, but contract again as population pressures fall (O'Connor and

Fuller 1985). Such oscillations in CBC data will have been smoothed by averaging across years for the individual plots used. However, where density estimates have been taken from the literature, or extrapolations made for regions inadequately covered by the CBC, no allowance could be made for possible year-to-year fluctuations in the extent to which species occupy suboptimal sites.

ASSOCIATIONS BETWEEN CBC PLOTS AND LAND CLASSES

The BTO does not routinely classify its CBC sites by land class. However, this was done for a sample of sites during one particular study into the representativeness of farmland CBC data (Fuller *et al* 1985). No woodland sites have been identified to land class.

In the study referred to, 103 farmland sites were allocated to a land class, by assessment of the 1-km square which contained the largest portion of the CBC plot. Twenty of these sites were historical ones that had been discontinued by 1975. The remaining 83 were distributed by land class as follows.

ITE land class	No. of CBC farmland plots identified to land class	ITE land class	No. of CBC farmland plots identified to land class
1	10	12	3
2	11	13	1
3	6	14	0
4	16	15	2
5	1	16	1
6	2	17	4
7	0	18-24	0
8	4	25	2
9	6	26	2
10	8	27	2
11	2	28-32	0

Hence nearly 70% of the plots used in that study related to just six land classes (nos.1-4,9 and 10), being those categories which were most strongly represented in southern and central England.

The study by Fuller *et al* (1985) addressed (among other things) the question of whether there were detectable variations between bird densities in different land classes. It used four sample years of farmland data (1966, 1971, 1976, 1981), to control for temporal variation, and had to combine adjacent land classes (from no.5 onwards) to provide adequate sample sizes. No species was found to display a systematic relationship with land class; six of the eleven species assessed showed significant differences between

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