



# Countryside Bird Survey Report

1998 - 2005





# Countryside Bird Survey Report 1998-2005

## Report No.2

### Contents

1	<b>Summary</b>
1	<b>Introduction</b>
2	Methods
2	<b>Results</b>
2	Coverage
3	Habitat
3	Species
8	<b>Discussion</b>
9	References
9	Appendix 1
10	Appendix 2

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# Countryside Bird Survey Report 1998-2005

## Summary

The Countryside Bird Survey (CBS) has been in operation since 1998. Its primary aim is to monitor breeding bird populations in the Republic of Ireland. A random sample of 10 km squares was selected, and within each, the most southwesterly 1 km square is surveyed twice during each breeding season. Bird numbers are counted along two roughly parallel 1km transects in each square. A total of 395 1km squares has been surveyed in the eight years of the survey, with an average of 300 squares covered in any one season. Coverage was best in the eastern part of the country, though other regions were considered to be adequately covered. The total number of species recorded, in the period 1998-2005, was 128. Wren *Troglodytes troglodytes*, Robin *Erithacus rubecula*, Blackbird *Turdus merula* and Chaffinch *Fringilla coelebs* were the most widespread occurring species, being found in 90% or more of squares, while Rook *Corvus frugilegus*, Starling *Sturnus vulgaris*, Wren, Jackdaw *Corvus monedula* and Woodpigeon *Columba palumbus* were the most abun-

dant. Trend analyses were carried out on 52 species, these being the species which were recorded in 30 squares or more. The majority of species have remained stable, and in general, terrestrial breeding bird populations appear to have fared well since 1998. Overall, finches and warblers showed the greatest apparent increase, while songbirds and tits also increased, though to a lesser extent. Swallow *Hirundo rustica* and House Martin *Delichon urbica* and corvids remained relatively stable. Statistically significant trends were shown for 25 species, 17 of which were shown to be increasing. Greatest increases were seen in Feral Pigeon *Columba livia*, Stonechat *Saxicola torquata*, Blackcap *Sylvia atricapilla*, Goldfinch *Carduelis carduelis*, Redpoll *C. flammea* and Bullfinch *Pyrrhula pyrrhula*. Eight species were shown to be decreasing, with Kestrel *Falco tinnunculus*, Swift *Apus apus*, Skylark *Alauda arvensis* and Wheatear *Oenanthe oenanthe* showing the greatest significant declines. Regional analyses showed that more species declined in the western region (coastal counties between Clare and Donegal inclusive, and also Roscommon, Longford, Westmeath and Offaly) than the east (east coast counties between and Louth and Wexford, and also Cavan, Monaghan, Kildare and Carlow) and south (all counties south of the Shannon Estuary including Limerick and Tipperary), while more increases were found in the latter two regions.

## Introduction

Breeding bird populations in Ireland are heavily influenced by land management practices, particularly as Ireland's landscape is dominated by farmland, which comprises approximately 70% of terrestrial habitats. Of a total of 35 land-based wildlife habitats that have been identified in the Republic of Ireland (Fossitt 2000), 26 occur on farmland, most of which are maintained by farming practices (Jones *et al.* 2003). The remainder of the country is composed primarily of peatland and forest.

The distribution range and abundance of terrestrial breeding birds in Ireland was first described in a breeding bird atlas carried out between 1968 and 1972 (Sharrock 1976). A second atlas survey

carried out between 1988 and 1991 (Gibbons *et al.* 1993) showed that significant changes had occurred over the 20 year period. Many of these changes were attributed to agricultural intensification.

In 1998, the Countryside Bird Survey (CBS) was initiated with the primary objective of monitoring breeding populations of common and widespread species in the Republic of Ireland. The first report, produced by Coombes *et al.* (2001) indicated that breeding bird populations fared relatively well between 1998 and 2000, with most species remaining stable, or showing apparent increasing trends.

This present report is based on a longer time series, and provides summarised results of the CBS over an eight-year period between 1998 and 2005.



Grasshopper Warbler. Dramatic annual fluctuations, but overall population is stable. (Dick Coombes).

## Methods

The scientific names of all species mentioned are listed in Appendix 1.

The CBS uses a line-transect method. Two visits to each survey square per year are undertaken. These visits are timed so that the first is in the early part of the breeding season (April to mid-May) and the second at least four weeks later (from mid-May to the end of June). This reflects the abundance of residents and early migrants, which tend to be more easily detected on the first visit, and later migrants, which are more abundant in the second visit. Observers are asked to begin their counts between 06:00 and 07:00 hours to coincide with maximum bird activity, but to avoid concentrated song activity at dawn. Observers are also encouraged to record only adult birds they see or hear as they walk along their transect routes. Bird counts in heavy rain, poor visibility, or strong winds are discouraged. Survey work has been carried out during all seasons since 1998, but was prevented in 2001 by foot-and-mouth restrictions.

Full details on the survey design and production of species indices are presented in Appendix 2.

Population trends were produced for the Republic of Ireland and were also produced at three spatial (regional) levels; the Republic was divided into three regions, based on broad habitat and land management practices (Fig. 2). The western study region includes all coastal counties between Clare and Donegal inclusive, and also Roscommon, Longford, Westmeath and Offaly. The southern study region includes all counties south of the Shannon Estuary (including Counties Limerick and Tipperary) and east to and including Counties Waterford, Kilkenny and Laois. The eastern study region encompasses all east coast counties between and Louth and Wexford, and also includes Cavan, Monaghan, Kildare and Carlow.

Colonial nesting species are not adequately monitored using the CBS methodology. Trends for these species, particularly seabirds and some breeding wader species are not presented here.

## Results

### Coverage

In total, 395 squares have been surveyed at least once between 1998 and 2005, though the number covered in any one season ranged from 259 in 1998 to 325 in 2000. Overall, 381 squares were surveyed

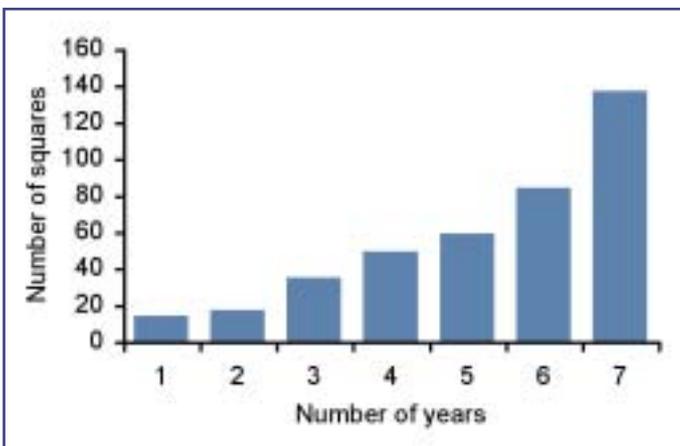


Figure 1. Frequency histogram of square coverage.

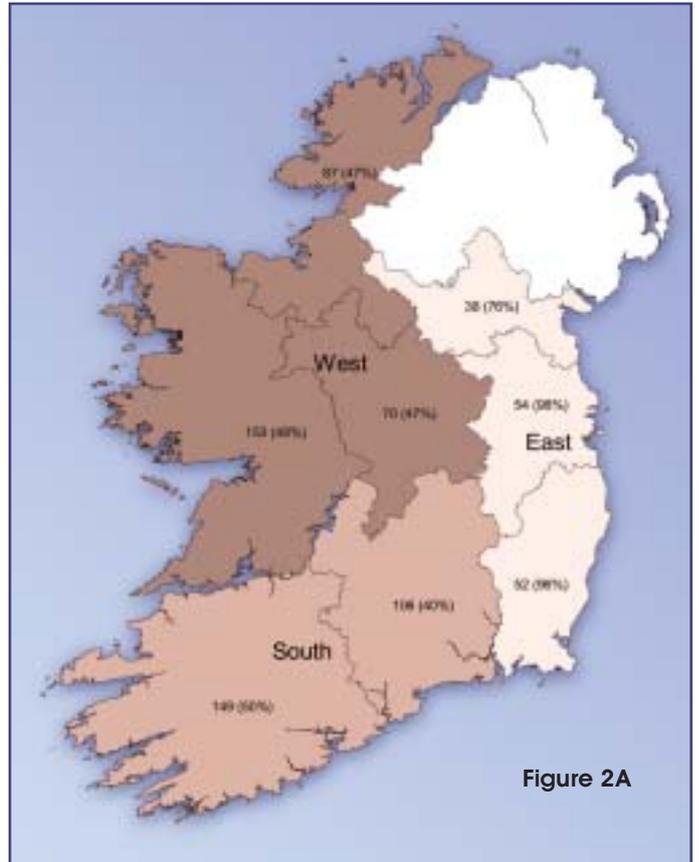


Figure 2A

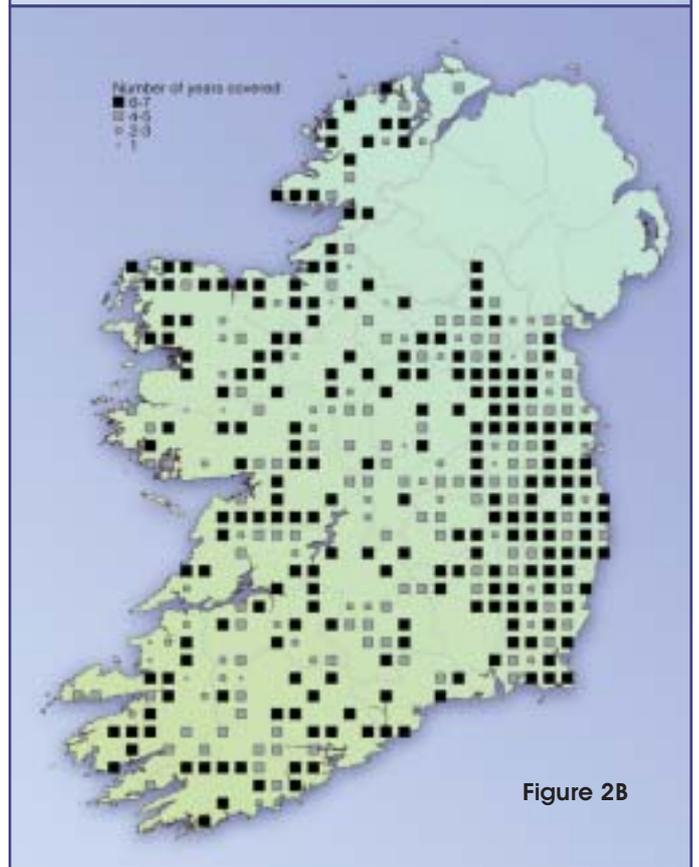


Figure 2B

Figure 2. Maps showing coverage during the CBS between 1998 and 2005, illustrating the three main study regions and eight sampling regions, also showing the extent of coverage within each (a, top) and the location of the squares covered (b, bottom).

in two or more seasons and were included in trend analyses. Most squares (55%) were covered in at least six out of the seven possible survey years (excluding 2001, when no fieldwork was carried out) (Fig. 1).

Coverage was greatest in the eastern half of the country and relatively poor elsewhere (Fig 2a&b). There was close to 100% coverage in the eastern and southeastern sampling regions, while 75% of squares were covered in the northeast region and between 40% and 50% of squares in the remaining five regions (Fig. 2a). Nonetheless, the number of squares covered regularly in each region (Fig. 2b) was deemed adequate for meaningful analyses of the population trends of several species, including trends at a regional level.

The CBS has been carried out by a combination of BirdWatch Ireland volunteers and professional staff of the National Parks and Wildlife Service and BirdWatch Ireland (Table 1). The popularity has increased throughout the duration of the CBS, with the total number of observers more than doubling between 1998 and 2005. However, there is considerable turnover, with approximately 15% of observers withdrawing from the survey each season.



Wheatear. 5% decline, most notable in the west (Shay Connolly).

**Table 1. Personnel involved in CBS survey between 1998 and 2005, indicating the proportions of volunteer observers and professional staff involved, and the turnover in observers throughout the project.**

	1998	1999	2000	2002	2003	2004	2005	Overall
CBS volunteers	187	214	211	192	187	190	199	372
NPWS staff	37	36	54	60	58	53	48	83
BirdWatch Ireland/contracted staff	9	9	5	11	11	14	15	21
<b>Total</b>	<b>233</b>	<b>259</b>	<b>270</b>	<b>263</b>	<b>256</b>	<b>257</b>	<b>262</b>	<b>476</b>

## Habitat

A total of 57 main habitat types was identified in 3890 200 m sections during the course of this summary period. Within many 200 m sections, there was some variation in the habitat recorded. However, for the purpose of this exercise, a single habitat was selected for each 200 m habitat, this being the most prevalent habitat recorded between 1998 and 2005. On this basis, most squares were described as improved grassland (Table 2), with other main habitats including unimproved grassland and bog.

**Table 2. Main habitats reported in 200m sections during the CBS.**

Main habitats:	% sectors (n=3,890)
Coniferous woodland	2.7
Heathland & bog	15.5
Improved grassland	47.1
Unimproved grassland	12.5
Mixed grass/ filled land	4.4
Tilled land	3.1
Human sites (rural)	2.6

## Species

In total, 128 species were recorded during the summary period, though this total includes some 40 species which are not adequately monitored by CBS methodology (largely waterbirds) and 19 relatively scarce species (recorded on less than 10 occasions). The latter group included Merlin, Quail, Red-legged Partridge, Woodcock, Rock Dove, Turtle Dove, Barn Owl, Long-eared Owl, Short-eared Owl, Whinchat, Ring Ouzel, Redwing, Fieldfare, Reed Warbler, Garden Warbler, Wood Warbler, Pied Flycatcher, Twite and Crossbill. The remaining 69 species were recorded more regularly. Wren, Robin, Blackbird and Chaffinch were the most widespread species, and all were recorded in over 90% of squares (Table 3). Where present, Rook, Starling, Wren, Jackdaw and Woodpigeon were the most abundant (Fig. 3).



Stonechat. Steady increase, especially in the south (Shay Connolly).

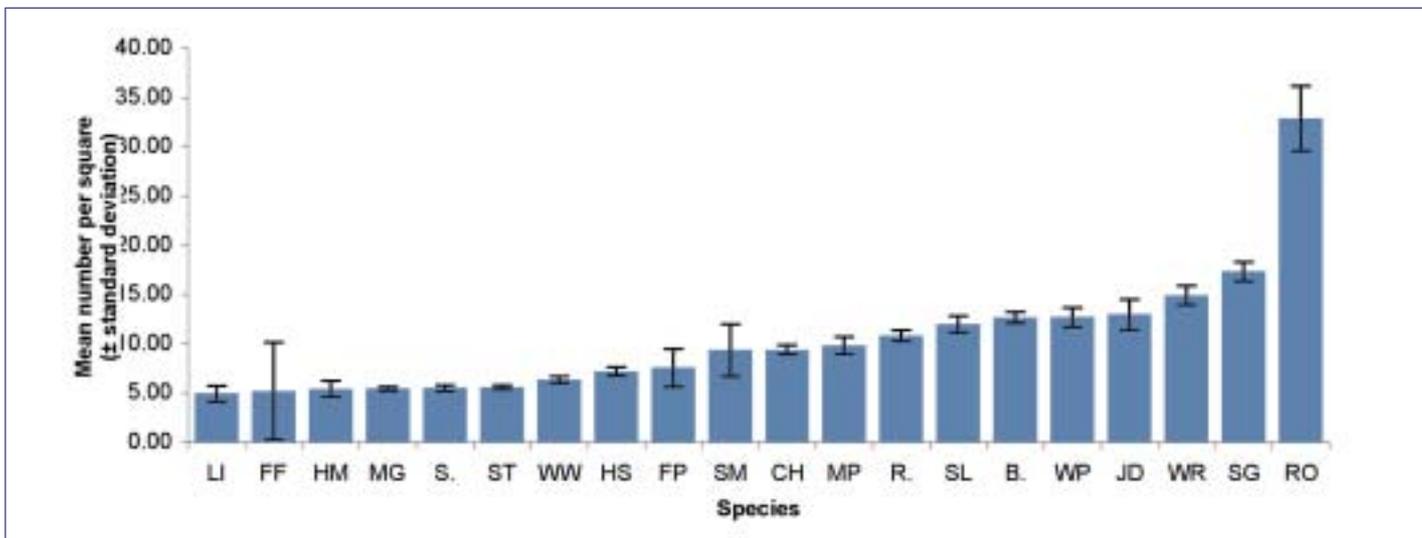


Figure 3. Top 20 most abundant species between 1998 and 2005 (LI Linnet, FF Fieldfare, HM House Martin, MG Magpie, S. Skylark, ST Song Thrush, WW Willow Warbler, HS House Sparrow, FP Feral Pigeon, SM Sand Martin, CH Chaffinch, MP Meadow Pipit, R. Robin, SL Swallow, B. Blackbird, WP Woodpigeon, JD Jackdaw, WR Wren, SG Starling, RO Rook).

Indices were produced for all 52 species which occurred in at least 30 squares (Table 3). Generally, it appears that terrestrial breeding bird species in Ireland have fared quite well between 1998 and 2005. Overall, 17 species were shown to increase, eight species declined, while other species remained relatively stable (Table 3). Greatest increases were seen in Feral Pigeon, Stonechat, Blackcap, Goldfinch, Redpoll, and Bullfinch, while greatest declines were in Kestrel, Swift, Wheatear and Skylark. Patterns of change for several of these species are illustrated in Figure 4.

At regional level, trends were produced for 39 species in the west, 32 in the south and 44 in the east, while the trends of 27 species were compared across all three regions (Table 3). Surprisingly, few species showed consistent increasing or declining trends across the country. These included Skylark and Robin (declines) and Wren, Goldfinch and Bullfinch (increases). Birds fared better in the east and south, with 39% and 28% of species respectively showing significantly increasing trends and 9% and 3% showing declines. In the west, just 17% of species were shown to increase, while 27% declined.

The indices of some of the larger groups of species showed that finches and warblers have fared best, showing annual increases of 7.1% and 4% respectively (Fig. 5). Songbirds and tits have also increased, by 1.2% and 1.6% respectively, while Swallow and House Martin combined, and also corvids have remained relatively stable. The trends shown have only remained broadly consistent within most of these groups (Table 3). There was also considerable variation in the trends of several species in different regions of the country.

The decline in Swallow in the Republic appears to have been driven by a substantial (3%) decline in the west (Table 3). House Martin remained stable in the Republic, due to the combination of a significant decline in the east and increase in the south.

Trends shown by a selection of songbird species are much less consistent. Both Wren and Stonechat have shown significantly increasing trends, while Robin and Wheatear have been in decline (Table 3, Fig. 4). These trends are broadly consistent throughout

country. Dunnock, Blackbird and Song Thrush have also shown increasing trends, though only significant in the east, while Mistle Thrush appears to be declining slightly, though significantly so in the west.

Among the warblers, only Grasshopper Warbler and Chiffchaff appear to be declining, though neither at a significant level. Remaining warbler species have shown increasing trends, particularly in the east of the country.

All tit species have at least remained stable at a national level, with most showing increases in the south and/or east of the country. All tit species appear to have declined marginally in the west, though just Coal Tit at a significant level.

Corvid species have undergone mixed fortunes, with Jackdaw shown to be increasing in the east, Magpie, Hooded Crow and Raven remaining stable and Rook showing a declining trend, particularly in the east and west. However, the trend shown for this latter species should be treated with caution, as it is a highly sociable species and tends to aggregate in very large numbers during the nesting season. This often makes it difficult to distinguish between breeding and non-breeding or juvenile birds, thereby hampering the true trend. All finch species have increased or remained stable during the period of this project. Increases in Goldfinch and Bullfinch throughout the country are particularly noteworthy.



Skylark. Worrying decline (Dick Coombes).

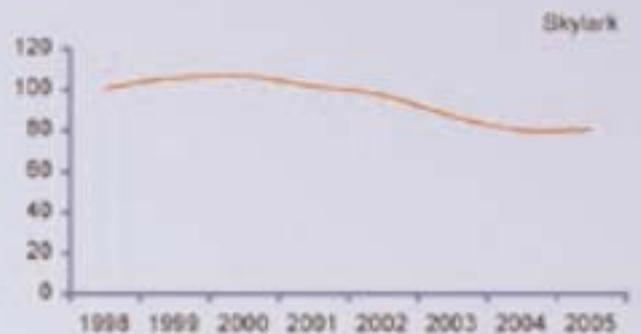
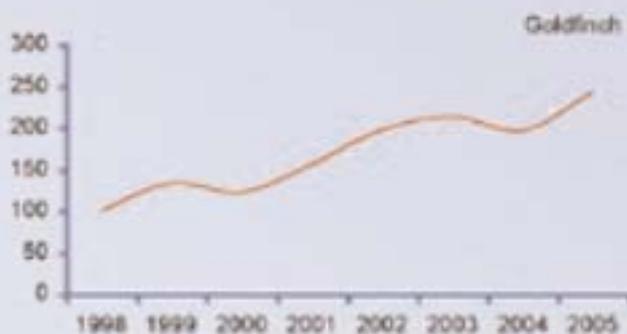
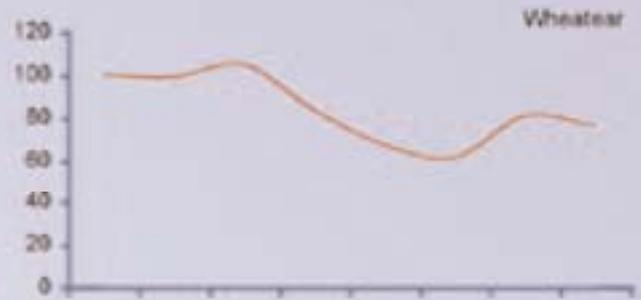
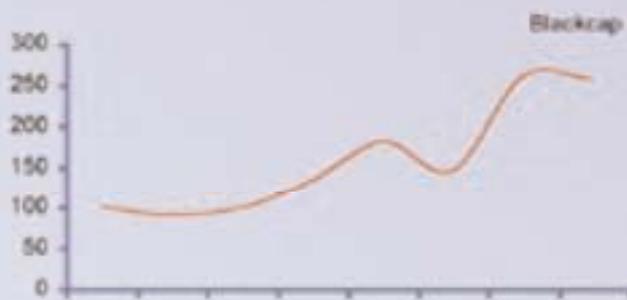


Figure 4. Trends in a selection of bird species (population indices plotted over time) in the Republic of Ireland between 1998 and 2005, showing species with significant increases (figures on the left) and declines (figures on right). In each case, the solid line has been fitted to the data points, while the dashed line represents the line of best fit. Note that scales differ.

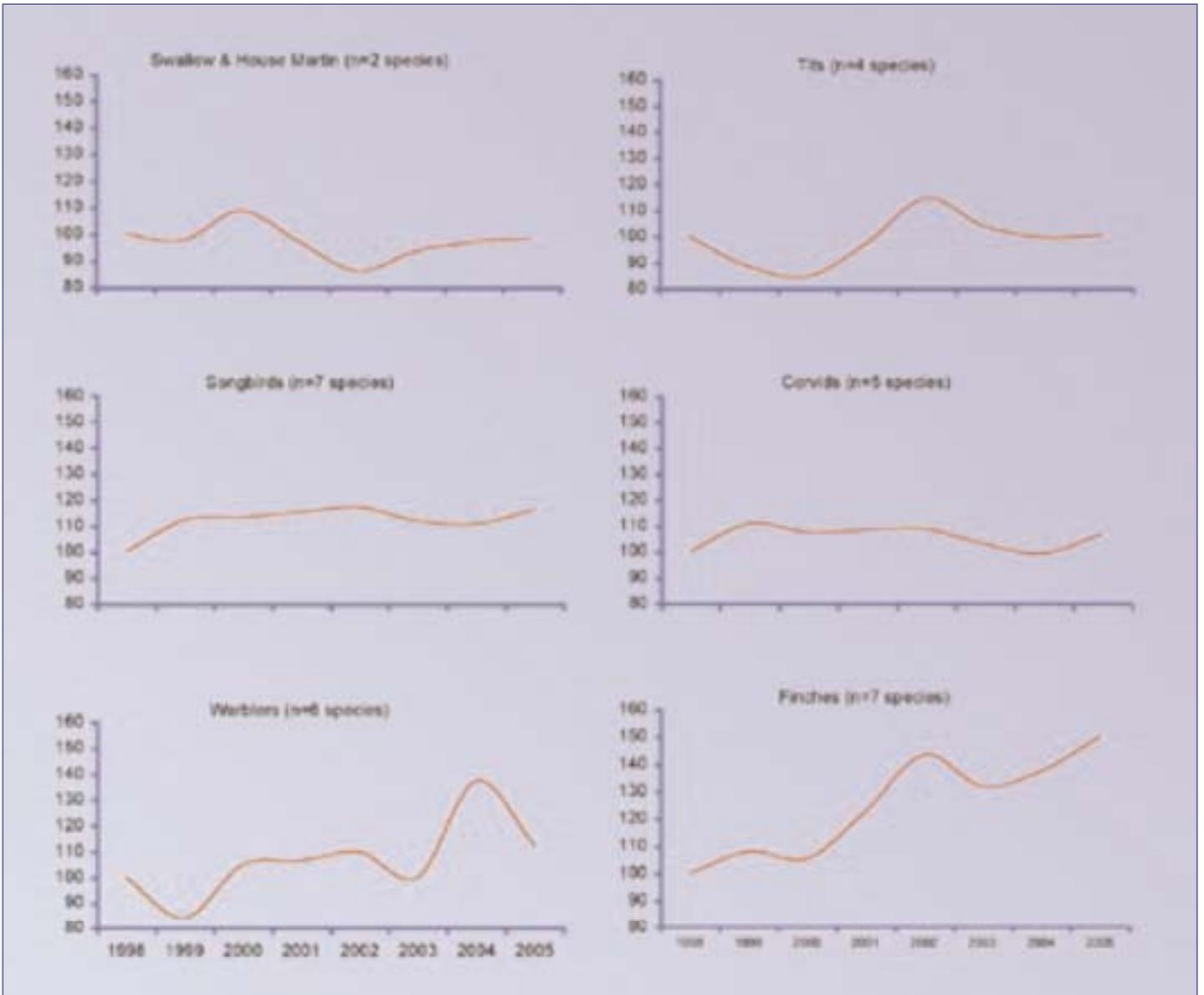


Figure 5. Trends in six bird groups (population indices plotted over time); hirundines (Swallow, House Martin), selected songbirds (Wren, Dunnock, Robin, Stonechat, Blackbird, Song Thrush, Mistle Thrush), warblers (Grasshopper Warbler, Sedge Warbler, Whitethroat, Blackcap, Chiffchaff, Willow Warbler), tits (Blue Tit, Great Tit, Coal Tit, Long-tailed Tit), corvids (Magpie, Jackdaw, Rook, Hooded Crow, Raven), and finches (House Sparrow, Chaffinch, Greenfinch, Goldfinch, Linnet, Redpoll, Bullfinch) in the Republic of Ireland between 1998 and 2005. In each case, the solid line has been fitted to the data points, while the dashed line represents the line of best fit.



Bullfinch. Increasing throughout the country (Billy Clarke).



Jackdaw. Increasing in the east (Michael O'Clery).

**Table 3. Trends in breeding bird populations in the Republic of Ireland, and at three different geographic levels. The sample size (n) is the mean number of squares in which the species was recorded over the eight-year period (excluding squares surveyed in only one year). The species listed occurred in 20 squares or more, although the power to detect change in species occurring in fewer than about 30 squares is likely to be small and population change estimates should be treated with caution. The annual percentage change in relative abundance between 1998 and 2005 is presented. Shaded cells represent significant population changes, while blank cells (regional analyses) indicate where low sample size prevented trend analysis.**

Species	% squares occupied 2005	Mean number of squares (all years)	Annual change (%)			
			Republic	West	South	East
Grey Heron	22.6	66	1	-1		0
Mallard	25.6	83	-2	-5		4
Moorhen	11.4	38	-1			0
Sparrowhawk	8.4	30	0			
Kestrel	12.8	42	-6			
Pheasant	77.4	224	3	-5	3	7
Feral Pigeon	12.8	34	17			3
Stock Dove	12.8	34	-2			13
Woodpigeon	88.2	263	3	2	2	4
Collared Dove	17.8	52	2			-1
Cuckoo	22.9	75	-1	-1		
Swift	12.8	44	-7			-9
Skylark	42.8	143	-4	-3	-5	-4
Swallow	87.2	262	-1	-3	1	-1
House Martin	32.0	83	0		6	-4
Meadow Pipit	62.3	188	0	-1	-1	2
Grey Wagtail	15.2	49	0			
Pied Wagtail	48.5	139	-1	-4	0	-1
Wren	98.0	288	2	1	3	2
Dunnock	72.1	214	1	-1	0	3
Robin	93.9	281	-2	-2	-1	-2
Stonechat	29.0	70	14	5	34	
Wheatear	9.4	34	-5	-6		
Blackbird	92.6	280	1	0	1	2
Song Thrush	88.2	255	0	-2	1	2
Mistle Thrush	45.8	138	-2	-2	1	-2
Grasshopper Warbler	9.1	34	-1	-2		
Sedge Warbler	21.9	64	6	4		20
Whitethroat	18.9	55	2	9		0
Blackcap	29.0	59	25			21
Chiffchaff	37.0	117	-1	-5	2	-1
Willow Warbler	73.4	199	3	2	3	4
Goldcrest	56.6	146	3	2	3	6
Long-tailed Tit	15.5	47	3			4
Coal Tit	57.6	167	1	-3	3	5
Blue Tit	77.8	229	1	-1	4	1
Great Tit	72.4	200	2	-1	4	5
Magpie	83.2	254	0	-2	0	2
Jackdaw	72.7	218	2	0	2	3
Rook	77.1	243	-2	-3	-1	-2
Hooded Crow	78.1	229	1	-2	4	2
Raven	25.3	70	-1	-4		0
Starling	71.4	212	-1	-2	-1	0
House Sparrow	45.8	128	3	3	3	3
Chaffinch	92.3	271	2	2	1	3
Greenfinch	57.6	171	-1	-2	0	-1
Goldfinch	50.8	116	19	25	27	12
Linnet	44.1	118	6	14	2	3
Redpoll	17.8	45	13			
Bullfinch	52.2	121	13	17	6	23
Yellowhammer	25.6	77	0		8	0
Reed Bunting	28.6	84	4	2		11

Other species recorded (number of squares): Red-Throated Diver (1), Great Crested Grebe (5), Little Grebe (4), Fulmar (2), Manx Shearwater (1), Gannet (2), Cormorant (22), Shag (2), Little Egret (2), Mute Swan (21), Greylag Goose (1), Canada Goose (1), Shelduck (5), Wigeon (1), Teal (3), Shoveler (1), Tufted Duck (4), Scaup (1), Red-breasted Merganser (2), Coot (7), Hen Harrier (3), Water Rail (4), Buzzard (7), Peregrine (5), Merlin (3), Quail (1), Red Grouse (4), Red-legged Partridge (1), Oystercatcher (7), Ringed Plover (2), Golden Plover (7), Lapwing (20), Dunlin (1), Snipe (49), Woodcock (2), Whimbrel (8), Curlew (42), Redshank (4), Greenshank (1), Common Sandpiper (6), Turnstone (1), Black-headed Gull (29), Common Gull (16), Lesser Black-backed Gull (27), Herring Gull (39), Great Black-backed Gull (20), Kittiwake (2), Sandwich Tern (3), Common Tern (3), Guillemot (1), Razorbill (1), Rock Dove (1), Turtle Dove (1), Barn Owl (1), Long-eared Owl (2), Kingfisher (4), Sand Martin (28), Rock Pipit (4), Dipper (6), Whinchat (3), Ring Ouzel (2), Redwing (2), Fieldfare (3), Reed Warbler (1), Garden Warbler (3), Wood Warbler (1), Pied Flycatcher (1), Spotted Flycatcher (29), Treecreeper (22), Jay (9), Chough (6), Tree Sparrow (14), Siskin (16), Twite (2), Crossbill (3).



Swallow. Showing a small decline (Clive Timmons).

## Discussion

With current levels of coverage, the population trends of over 50 bird species can now be adequately monitored. This includes Yellowhammer, currently considered to be of conservation concern in Ireland, and present on the Irish Red List because of its large-scale (greater than 50%) decline in population size and range over the previous 25 years (Newton *et al.* 1999). A further seven species, Stock Dove, Cuckoo, Skylark, Swallow, Stonechat, Grasshopper Warbler and Redpoll, are also of conservation concern, and are Amber Listed, most due to a decline of between 20 and 29% on their population size or range over the previous 25 years (Newton *et al.* 1999).

Most of these species of conservation concern appear to have at least remained stable since the late 1990s. However, the present rates of annual change in Skylark and Swallow, as well as other species such as Kestrel, Swift and Wheatear, are of particular concern. These significant declines were apparent throughout all regions where trends were measured. Of these species, trends were measured in Northern Ireland for Skylark and Swallow only, and over a marginally longer time period, since 1994 (Raven and Noble 2006). Neither species was shown to decline significantly.

The declines in some aerial insectivores, such as Swift and Swallow, may be indicative of declining invertebrate availability during the breeding season, possibly due to increased use of fertilisers. Declines in other migrant species may reflect conditions elsewhere. For example, it has been shown that the fluctuation in abundance of Sedge Warbler, Sand Martin and Whitethroat is related to annual survival, which is largely related to changes in rainfall on their trans-Saharan wintering grounds (Baillie and Peach 1992, Newson *et al.* 2003).

The consistent increases in several resident species, particularly the finches, may in part reflect suitable breeding conditions, but may also be a consequence of milder winters, allowing greater survivorship. However, the significant declines measured in Robin and Rook, which appear to be continuous, and which were broadly consistent in all regions, are noteworthy, though they currently remain inexplicable.

Numerous examples were presented of contrasting trends between the different regions within the Republic. These probably reflect differences in both habitat availability, and also the associated pressures. Most of these trends presented are consistent with those measured during the 1998-2003 period (Newson *et al.* 2004). In Northern Ireland, no significant declines were evident over a slightly longer period between 1994 and 2005, while 17 species were shown to increase (Raven and Noble 2006). All of these species remained stable or increased in the Republic between 1998 and 2005.

The Irish landscape continues to become modified by developments in agriculture and forestry. Environmental measures that link income support with environmental improvement, have been encouraged to alleviate some of the pressures caused by these practices. Additionally, Ireland is the least wooded country in the European Union, though there are measures to improve the status of native woodlands in Ireland in the next 25 years (McAree 2002).

It is encouraging that most species have increased or remained stable in Ireland during the past eight years. Continued monitoring of the trends of our common and widespread breeding bird population through the CBS will allow us to track how breeding bird populations respond to some of these changes mentioned above. It is expected that the CBS will also allow more informed decision-making on activities that will improve the environment for Ireland's biodiversity.

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## Appendix 1

List of all bird species mentioned in this report:

Red-Throated Diver <i>Gavia stellata</i>	Peregrine <i>Falco peregrinus</i>	Collared Dove <i>Streptopelia decaocto</i>	Wood Warbler <i>Phylloscopus sibilatrix</i>
Great Crested Grebe <i>Podiceps cristatus</i>	Merlin <i>Falco columbarius</i>	Cuckoo <i>Cuculus canorus</i>	Chiffchaff <i>Phylloscopus collybita</i>
Little Grebe <i>Tachybaptus ruficollis</i>	Pheasant <i>Phasianus colchicus</i>	Barn Owl <i>Tyto alba</i>	Willow Warbler <i>Phylloscopus trochilus</i>
Fulmar <i>Fulmarus glacialis</i>	Quail <i>Coturnix coturnix</i>	Short-eared Owl <i>Asio flammeus</i>	Goldcrest <i>Regulus regulus</i>
Manx Shearwater <i>Puffinus puffinus</i>	Red Grouse <i>Lagopus lagopus scoticus</i>	Long-eared Owl <i>Asio otus</i>	Pied Flycatcher <i>Ficedula hypoleuca</i>
Gannet <i>Morus bassana</i>	Red-legged Partridge <i>Alectoris rufa</i>	Swift <i>Apus apus</i>	Spotted Flycatcher <i>Muscicapa striata</i>
Cormorant <i>Phalacrocorax carbo</i>	Oystercatcher <i>Haematopus ostralegus</i>	Kingfisher <i>Alcedo atthis</i>	Long-tailed Tit <i>Aegithalos caudatus</i>
Shag <i>Phalacrocorax aristotelis</i>	Ringed Plover <i>Charadrius hiaticula</i>	Skylark <i>Alauda arvensis</i>	Coal Tit <i>Parus ater</i>
Little Egret <i>Egretta garzetta</i>	Golden Plover <i>Pluvialis apricaria</i>	Sand Martin <i>Riparia riparia</i>	Blue Tit <i>Parus caeruleus</i>
Grey Heron <i>Ardea cinerea</i>	Lapwing <i>Vanellus vanellus</i>	Swallow <i>Hirundo rustica</i>	Great Tit <i>Parus major</i>
Mute Swan <i>Cygnus olor</i>	Snipe <i>Gallinago gallinago</i>	House Martin <i>Delichon urbica</i>	Treecreeper <i>Certhia familiaris</i>
Greylag Goose <i>Anser anser</i>	Dunlin <i>Calidris alpina</i>	Meadow Pipit <i>Anthus pratensis</i>	Jay <i>Garrulus glandarius</i>
Canada Goose <i>Branta canadensis</i>	Woodcock <i>Scolopax rusticola</i>	Rock Pipit <i>Anthus petrosus</i>	Magpie <i>Pica pica</i>
Shelduck <i>Tadorna tadorna</i>	Whimbrel <i>Numenius phaeopus</i>	Grey Wagtail <i>Motacilla cinerea</i>	Chough <i>Pyrrhocorax pyrrhocorax</i>
Wigeon <i>Anas penelope</i>	Curlew <i>Numenius arquata</i>	Pied Wagtail <i>Motacilla alba</i>	Jackdaw <i>Corvus monedula</i>
Teal <i>Anas crecca</i>	Redshank <i>Tringa totanus</i>	Wren <i>Troglodytes troglodytes</i>	Rook <i>Corvus frugilegus</i>
Mallard <i>Anas platyrhynchos</i>	Greenshank <i>Tringa nebularia</i>	Dipper <i>Cinclus cinclus</i>	Hooded Crow <i>Corvus corone cornix</i>
Shoveler <i>Anas clypeata</i>	Common Sandpiper <i>Actitis hypoleucos</i>	Duncock <i>Prunella modularis</i>	Raven <i>Corvus corax</i>
Tufted Duck <i>Aythya fuligula</i>	Turnstone <i>Arenaria interpres</i>	Robin <i>Eritbacus rubecula</i>	Starling <i>Sturnus vulgaris</i>
Scaup <i>Aythya marila</i>	Black-headed Gull <i>Larus ridibundus</i>	Whinchat <i>Saxicola rubetra</i>	House Sparrow <i>Passer domesticus</i>
Red-breasted Merganser <i>Mergus serrator</i>	Common Gull <i>Larus canus</i>	Stonechat <i>Saxicola torquata</i>	Tree Sparrow <i>Passer montanus</i>
Coot <i>Fulica atra</i>	Lesser Black-backed Gull <i>Larus fuscus</i>	Wheatear <i>Oenanthe oenanthe</i>	Chaffinch <i>Fringilla coelebs</i>
Moorhen <i>Gallinula chloropus</i>	Herring Gull <i>Larus argentatus</i>	Ring Ouzel <i>Turdus torquatus</i>	Greenfinch <i>Carduelis chloris</i>
Water Rail <i>Rallus aquaticus</i>	Great Black-backed Gull <i>Larus marinus</i>	Blackbird <i>Turdus merula</i>	Goldfinch <i>Carduelis carduelis</i>
Hen Harrier <i>Circus cyaneus</i>	Kittiwake <i>Rissa tridactyla</i>	Song Thrush <i>Turdus philomelos</i>	Siskin <i>Carduelis spinus</i>
Sparrowhawk <i>Accipiter nisus</i>	Sandwich Tern <i>Sterna sandvicensis</i>	Redwing <i>Turdus iliacus</i>	Twite <i>Carduelis flavirostris</i>
Buzzard <i>Buteo buteo</i>	Common Tern <i>Sterna hirundo</i>	Mistle Thrush <i>Turdus viscivorus</i>	Linnets <i>Carduelis cannabina</i>
Kestrel <i>Falco tinnunculus</i>	Guillemot <i>Uria aalge</i>	Fieldfare <i>Turdus pilaris</i>	Redpoll <i>Carduelis flammea</i>
	Razorbill <i>Alca torda</i>	Grasshopper Warbler <i>Locustella naevia</i>	Crossbill <i>Loxia curvirostra</i>
	Rock Dove <i>Columba livia</i>	Sedge Warbler <i>Acrocephalus schoenobaenus</i>	Bullfinch <i>Pyrrhula pyrrhula</i>
	Turtle Dove <i>Streptopelia turtur</i>	Reed Warbler <i>Acrocephalus scirpaceus</i>	Yellowhammer <i>Emberiza citrinella</i>
	Feral Pigeon <i>Columba livia</i>	Garden Warbler <i>Sylvia borin</i>	Reed Bunting <i>Emberiza schoeniclus</i>
	Stock Dove <i>Columba oenas</i>	Whitethroat <i>Sylvia communis</i>	
	Woodpigeon <i>Columba palumbus</i>	Blackcap <i>Sylvia atricapilla</i>	

## Appendix 2

### Survey design & field methods

The CBS is based on a random stratified approach. The Republic was divided into eight regions, and 10 km squares (based on the Irish National Grid) were randomly selected within each, and allocated in sequence. For each 10 km square selected, the 1 km square at the extreme southwest corner is surveyed. Those with less than 50% land, e.g. coastal areas or lake shores, have been excluded, leaving some 700 possible survey squares. The survey aims to achieve coverage of the same 1 km squares each year, ideally by the same observer, although there is likely to be some changeover of survey participants.

The ideal survey route within each 1 km square comprises two parallel lines, each 1 km in length about 500 m apart and about 250 m from the edge of the square. For practical reasons there is often deviation from the ideal route. Each 1 km transect is divided into five 200 m sections, at which level all information is collected.

Three visits to each survey square per year are undertaken. During a reconnaissance visit, the transect routes are planned and habitat information recorded. Habitat data are recorded using codes from an established hierarchical system common to a range of bird surveys in the UK (Crick 1992). Bird counts are carried out on the second and third visits.

### Analytical techniques

The total numbers of adult birds of each species detected in each 1 km square were calculated for each year. The maximum of the two counts (from early and late visits) was used as the annual measure of relative abundance for each species. Annual population indices were

calculated using TRIM (Trends & Indices for Monitoring Data), a program used for the analysis of time series of counts with missing observations (Pannekoek & van Strien 1996). Counts are modelled as a function of square (site) and year effects, with interpolated estimates for site-year combinations with missing data. The stratified sampling design results in unequal representation of regions across Ireland, so annual counts were weighted by the inverse of the proportion of the area of each region that was surveyed that year. Population trends for species occurring on a mean of 30 or more squares over the duration of the survey were estimated by examining the overall rate of annual change, as caution is urged because of the low precision associated with sample sizes smaller than 30 (Joys *et al.* 2003).

Population change is usually displayed in the form of indices, where the results from one season are set to some arbitrary figure, usually 1 or 100, and index values are calculated for all other seasons according to how each relates to the base season. A constant rate of decline is exponential when illustrated. For example, if a population is declining by 50% each year, then if the initial index is 1, the index at timepoint 2 is 0.5, at timepoint 3 is 0.25. If the population doubles each year, the index values for the respective timepoints are 2, 4 and 8. Index values are thus measures of relative abundance for a species, and usually the relationship between this and the absolute abundance is unknown.

The mean annual change was estimated by fitting a regression line through the data. Trends were calculated across all habitats. Trends were also produced for a number of bird groups (defined by species of similar habits and habitats) by calculating the geometric means of the annual indices of the respective