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A baseline breeding bird survey of Perth & Kinross in 2008

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A report to Perth & Kinross Council

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CONTENTS

LIST OF TABLES & FIGURES

Tables

Main text

Appendices

Figures

EXECUTIVE SUMMARY

1 A special survey of breeding birds in Perth & Kinross was commissioned by the Perth & Kinross Council and undertaken by BTO staff and volunteers in the spring of 2008. The aim of the survey was to set a baseline for future studies of bird population change.

2 The full value of the 2008 survey will be realised only when future repeat surveys are conducted and estimates are made of bird population change in the intervening period. These estimates can then be compared with equivalent figures for wider regions, such as Scotland and the UK, allowing the Council to assess its contribution to sustainable development and its progress towards improved environmental performance.

3 Standard BTO/JNCC/RSPB Breeding Bird Survey methodology was used, for which the sampling unit is the 1-km square. Twenty 1-km squares surveyed by BBS volunteers were supplemented in 2008 by a further 43 squares surveyed by professional fieldworkers. Within each square, a 2-km transect route is followed. Two counting visits were made to each square during the breeding season (April to early July). Birds, habitat and mammals were recorded.

4 The survey was successful in setting a baseline for repeat surveys in future years. All squares were randomly selected. The samples of squares and of transect routes showed minor departures from a true random selection, but these were to be expected and are broadly similar to those seen in the national BBS sample.

5 The average of 25 bird species per 1-km square matched the average for the whole of Scotland in the 2008 BBS, but this figure compared unfavourably with 30 species per square in Wales and 32 in England.

6 Across all 63 squares surveyed in 2008, 111 species of birds were recorded, including most of the breeding land birds in Perth & Kinross. Of these, 34 species were present on at least 20 squares and would therefore provide a reasonably reliable measure of population change when compared with data from future repeat surveys. Zero counts in 2008 may also be useful for monitoring where a square is found to be occupied in a future survey; sample sizes may thus rise, and possibly more than 34 species may meet this threshold.

7 Species trends, when they become available following repeat surveys, could be combined into multi-species indicators to investigate questions of conservation relevance. For example, indicators could be compared between Perth & Kinross and other regions, or between groups of birds, such as residents and migrants, or birds of different main habitats.

8 Eleven species of mammals were recorded. The data can contribute to national monitoring of the most abundant mammals but are insufficient for monitoring at the scale of Perth & Kinross alone.

9 BTO recommends that, to maximise the reliability of population change estimates from future repeat surveys, these surveys should follow the routes, dates and times of the 2008 survey as closely as possible. Consideration should be given to expanding the number of sample squares in the next survey, to benefit the precision of subsequent estimates of population change, although this is likely to incur extra costs.

10 It is recommended that, for maximum output of data, intervals between surveys should be in the region of 2–4 years.

1 INTRODUCTION

Bird population trends are increasingly a concern of both local and national government. In Scotland, naturally occurring birds and their habitats are protected under the Wildlife and Countryside Act 1981, the Nature Conservation (Scotland) Act 2004 and the EC Birds Directive (79/409/ EEC and amendments). At the UK level, government has adopted a Public Service Agreement to reverse the long-term decline in the number of farmland birds by 2020 (PSA 3: www.defra.gov.uk/corporate/busplan/spending-review/psa2004.htm). Following the publication of the UK Biodiversity Action Plan 1994, species action plans have been developed to aid the recovery of a range of particularly vulnerable species of birds. These and other commitments bring a responsibility to all levels of government to consider the needs of wild bird populations.

The British Trust for Ornithology (BTO) has a long history of organising bird monitoring programmes to which volunteers contribute their birdwatching skills. The largest scheme for monitoring the population levels of widespread breeding bird species is the Breeding Bird Survey (BBS), which is supported by BTO, the Joint Nature Conservation Committee and the Royal Society for the Protection of Birds. BBS, in combination with its predecessor the Common Birds Census, produces long-term trends for bird populations at UK, country and regional levels (Risely *et al* 2009). It is these trends that provide most of the data for the various government indicators of bird populations. Bird population trends for Scotland are on line at www.scotland.gov.uk/about/scotperforms/indicators/breedingbirds. Whereas trends can be produced separately for Scotland, Wales and Northern Ireland, and for Government Office regions within England, sample sizes generally do not allow trends to be generated for smaller regions or counties. There is thus a gap in bird-monitoring information at the level of regional government, such as counties and unitary authorities within England and Wales, and council areas within Scotland.

In 2008, Perth & Kinross Council commissioned the first of what is intended to become an ongoing series of surveys of breeding birds across the council area. The overall purpose of the surveys will be to gather data, specific to Perth & Kinross, on population trends among widespread breeding birds; such trends, and multi-species indicators derived from them, will be compared against national results and will help the Council to assess its progress towards sustainable development and improved environmental performance. The specific aim of the 2008 survey has been to set a baseline, for comparison with repeat survey data that are planned to be collected in Perth & Kinross in future years.

This report summarises the results of the 2008 survey, which was conducted by BTO staff and volunteers. The technique that was employed was to boost the existing sample of squares in Perth & Kinross, surveyed by BBS volunteers on an ongoing, annual basis, with a further set of squares surveyed professionally. This method maintains complete compatibility with the UK-wide BBS; it also allows assessments to be made of population change for relatively small areas, while allowing direct comparison of results with estimates of change at larger geographical scales, up to UK and even European level.

1.1 Summary of objectives for the 2008 survey

- To undertake, with a combination of professional surveyors and volunteers, a sample survey of breeding bird populations across Perth and Kinross that is sufficient to form a baseline for future studies of bird population change.

- To produce a report detailing the results of the baseline survey.

This initial report does not discuss population trends, for which future repeat surveys will provide the necessary data for comparison with the 2008 baseline.

2 METHODS

By agreement between BTO and the Perth & Kinross Council, the survey was planned to consist of two parts: a professional survey of a random sample of 1-km squares of the Ordnance Survey (OS) national grid, using BBS methods, supplemented by similar data from volunteers contributing from Perth & Kinross to the BBS itself.

An initial simulation was undertaken, based on BBS data for Perth & Kinross for earlier years, to assess how many squares would be needed in the total sample. For calculating population trends from BBS data, the number of squares on which the species has been recorded (in at least one of the years in the series) has an important effect on the reliability of the population trend. For the simulation, a working assumption was adopted that a minimum sample of 20 occupied squares would provide population trends of sufficient reliability. The simulation estimated that, for around 30 of the most widespread bird species to reach this threshold level of occupied squares, between 60 and 70 squares should be surveyed in total.

Around 20 volunteer surveys were expected and so the sample size for the professional survey was set at 40–50 squares. The professional fieldworkers employed for this survey were seasonal employee Nick Green (NG) and Dr David Douglas (DJTD) from the BTO Scotland offices in Stirling.

No special procedures were adopted for the volunteer side of the survey, which was allowed to proceed as normal, under the guidance of the BBS's regional organisers.

2.1 Field methods

The field methods adopted for the professional survey were identical to those used by volunteers in the national BBS scheme and used the standard forms and instructions (downloadable from www.bto.org/bbs/take_part/download-forms.htm). In summary, surveyors are asked to make two visits, one between early April and mid May (termed 'early') and a second between mid May and the end of June ('late'). These two visits are intended to ensure that the observer samples the birds that are active and conspicuous early in the breeding season, as well as summer migrants that arrive to breed in late spring and other species that are more detectable at this later stage of the year.

On each BBS visit, surveyors walk two fixed 1-km transects through each 1-km square and record all birds that they see and hear. Each transect is divided into five 200-m sections, and birds are recorded at the section level. Individual birds that can be seen or heard from several transect sections are recorded only once, in the section where first observed. The perpendicular distance of each bird from the transect line is also allocated to one of three categories (less than 25m, 25–100m and greater than 100m), according to the position at which it was first detected, and birds in flight were recorded separately. The use of distance bands allows data to be resolved at the level of 200m x 50m and 200m x 200m rectangles, although this more detailed information is required only for more complex analyses.

The standard placement of the two transect lines is parallel, running either north–south or east–west, 500m apart and 250m from the edge of the square. In almost all BBS squares, however, this pattern requires modification according to the nature of the terrain and the

constraints of access. Where access constraints make it necessary, it is acceptable to extend the transect outside the nominal square.

The BBS method requires a simple assessment of habitat for each 200-m section of transect. Up to two habitat types can be coded, using a hierarchical system designed by BTO and employed for all BTO surveys (Crick 1992). The 'first habitat' is defined as the one the observer considers to be the most relevant to birds along the section, and is normally the most extensive. A 'second habitat' can also be described, where present. Each habitat can be described with up to four levels of coding.

BBS observers are also encouraged to record mammals. Almost 80% of survey volunteers do so, although recording is essentially casual and no special efforts are made to detect species that are difficult to observe. Mammal records are collated at the level of the whole 2-km transect, and not at section level nor in distance bands. Mammal recording was set as a requirement for the professional surveys.

2.2 Square selection and coverage

To obtain the required final sample size of between 40 and 50 sites for the professional survey, we initially selected, at random, 60 1-km squares from the Ordnance Survey national grid that lay within or partly within the Perth & Kinross council area. This larger initial sample was intended to allow for some dropout of squares that were unsuitable – because of unsuitable terrain, because they would require too much time to access, or because access permission was necessary but not obtained.

One square, which held small sections of the north and south banks of Loch Tay, was immediately rejected from the list as uncoverable. Each of the remaining 59 squares was examined on the OS map and given a priority rating on a specially devised seven-point scale, according to its apparent suitability. Squares scored a high priority if they were in open terrain and relatively quick to access from a public road. Lower priority scores were given to squares on steep slopes or in trackless forest, where special access permission would be needed, or that would be particularly time-consuming to reach. The two professional fieldworkers were given a list of the 59 randomly selected 1-km squares and asked to survey at least 40 of them, using the priority category as an aid to efficiency in day-to-day planning.

By the end of the 2008 fieldwork season, 43 of the 59 squares allocated to professionals had been surveyed. The 16 random squares that were listed but not surveyed had mostly been categorised as low priority (Table 1), because they were difficult or time-consuming to reach. Two of the three squares awarded the lowest priority category (7) required a walk of 15 km or more to reach from a public road, while the third was partly in Loch Ericht and required a walk of 10 km.

The national BBS has a large preselected random sample of 1-km squares from which a subset is actually surveyed by volunteers. The density of the preselected sample varies regionally according to the expected take-up by volunteers, and the effects of the uneven distribution of squares are removed from the results by a regional stratification during the analysis. Perthshire and Kinross lie in different BBS regions and sampling density is slightly higher in Kinross than in Perthshire. Of the 80 1-km squares selected randomly for possible

BBS coverage and lying wholly or partly within Perth & Kinross, volunteers surveyed 20 squares in 2008.

Table 1. Squares surveyed professionally in 2008 in relation to their priority category.

Priority category	Surveyed	Not surveyed
1 (high)	12	
2	14	1
3	7	
4	3	2
5	4	
6	3	10
7 (low)	0	3
Total	**43**	**16**

The total coverage achieved by the 2008 survey was 63 1-km squares. As would be expected from a random distribution, the 63 actual survey squares are scattered across the area, with no discernible pattern (Fig 1). Some squares lay across the boundary of the council area. By chance, there are no survey squares along the southwestern or northern edges to the area.

The 43 squares surveyed professionally have a broad distribution within Perth & Kinross, although there were few along the remoter and more mountainous borders in the north and west of the area. All 20 of the squares surveyed by volunteers lay in the central or southern parts of Perth & Kinross. The higher BBS sampling density in Kinross has led to there being a conspicuous cluster of volunteer squares in that area.

2.3 Route placement

A further element of the random selection of BBS sites, beyond the selection of random 1-km squares, concerns the placement of the actual transect route within the square. The ideal route placement is described in the survey instructions but in practice, as noted above, it is hardly ever possible to follow the ideal route. Minor deviations from the standard route placement are inevitable but are unlikely to affect the results of the survey significantly, especially if the same transect routes are followed in repeat surveys.

In most squares in the Perth & Kinross sample, as in the national scheme, actual transect lines typically followed paths or roadsides, rather than the 'ideal' cross-country route placement as described in the BBS instructions. In several squares the two 1-km lines were butted end-to-end. In one square surveyed professionally (NO1448), access constraints meant that only nine 200-m sections were included.

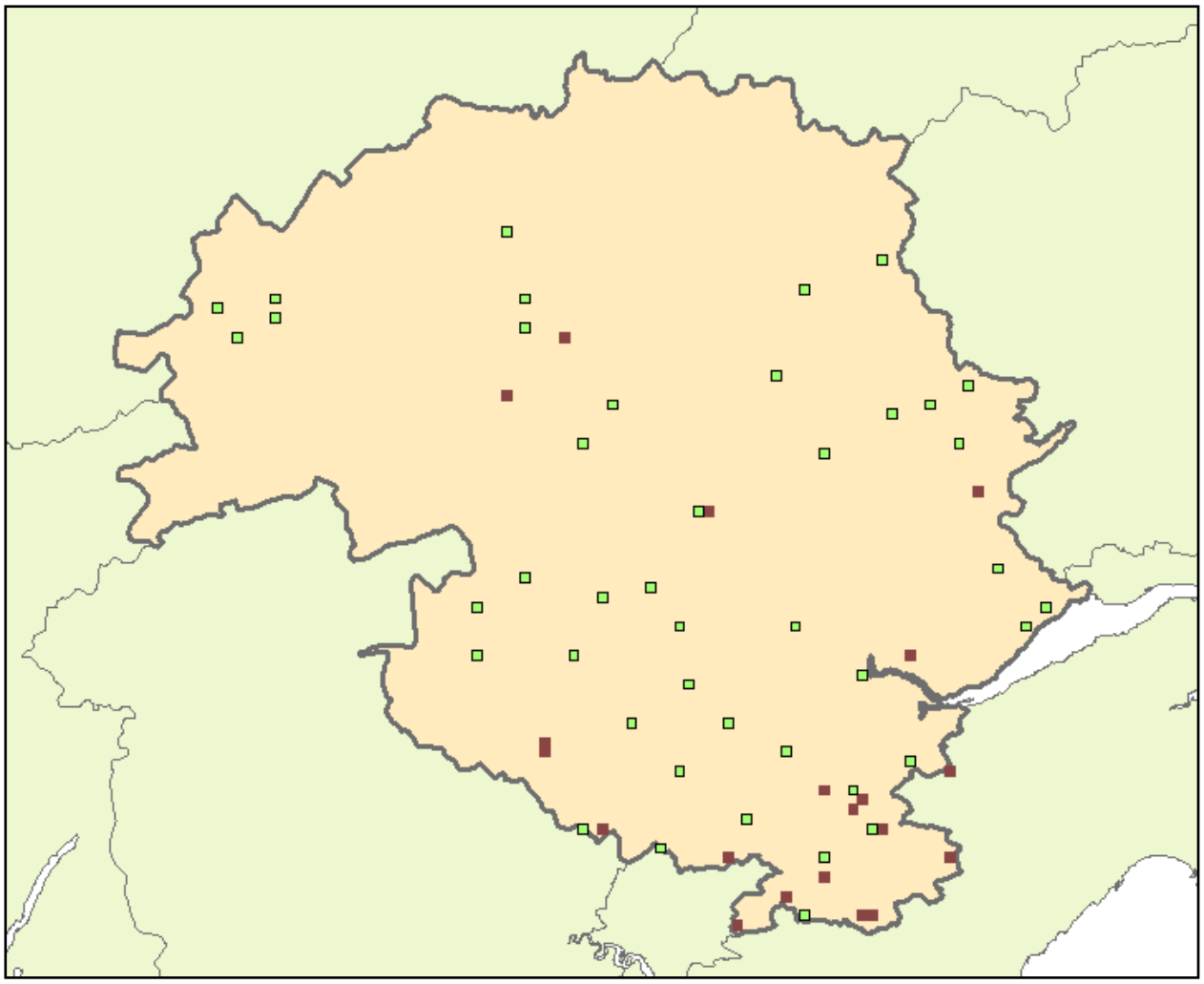

Figure 1. The distribution of the 63 1-km squares covered during the 2008 survey. Squares with dark shading are the 20 squares surveyed by volunteers as part of the national BBS sample. Paler squares are the 43 surveyed by professional fieldworkers. The boundaries of Perth & Kinross and of adjacent council areas are also shown.

2.4 Visit dates and times

The standard two visits were made to all but two of the 63 squares surveyed (see Appendix A1). An opportunity was taken to add square NN9003 to the professional sample during the 'late' visit period: no 'early' visit had been made to this square. The volunteer for NN7814 also missed the 'early' visit.

Visit dates for the professional surveys all lay within the recommended 'early' and 'late' periods of the 2008 breeding season: 1 April to 15 May and 16 May to 30 June, but three 'early' and four 'late' visits made by volunteers fell outside these periods, with an especially tardy 'late' visit on 27 July.

Standard advice to BBS observers is to conduct fieldwork only in the morning, because many birds are easier to detect during the first half of the day. The latest of 39 visits conducted by volunteers was begun at 09:35 am (Table A1.2). Restricting the surveys to early mornings was considered not to be a practical option for the professional survey, however, given the long travel times often required to reach the square, and the efficiencies to be gained by covering several squares per day. Of the 85 professional survey visits, 30 were begun after 12 noon (Table A1.1).

2.5 Data capture

After the completion of fieldwork, the professional fieldworkers transcribed the data from each field recording sheet onto a summary sheet, as totals by species for each transect section and distance category. All paperwork was then returned to BTO HQ. This included a map of each of the surveyed squares with the route and transect-section boundaries marked on it, to enable precisely the same route to be followed in subsequent years.

Following that, staff at BTO HQ input the summary sheets in a standard Excel format. To combat errors in transcription and input, extensive checks were made of the summary sheets for missing or incorrectly transcribed data, and the Excel spreadsheets were checked for consistency, with special attention paid to unexpected species or counts. Errors found were corrected in the Excel workbook, which remained the top copy of the data.

Data for the general BBS are captured both on paper summary sheets that require input and on line, using a standard web form, thus avoiding the need for subsequent processing. Of the 20 squares surveyed by volunteers in 2008, eight sets of data were supplied to BTO HQ on paper and input by an outside contractor, while 12 were supplied on line. Bird counts for these 20 squares were collated and added to the Excel workbook alongside the professionally collected data. For data collected online, counts were available only by square and species, and not by visit, section or distance category.

There are two or three further BBS squares where volunteers might have made surveys in 2008 but for which no returns have yet been submitted. Should these data arrive at BTO HQ, they will be available for inclusion in the analysis of future repeat surveys.

2.6 Data analysis

This baseline survey gives little scope for detailed analysis, for example of population change. Rather, we present simple tabulations of the numbers of occupied squares and the mean numbers of birds per species and square.

For each species and square, the ‘number of birds’ is calculated in the following way. The calculations were made using a program specially written in SAS, which reads directly from the Excel workbook. The program first sums the counts for each visit across all ten transect sections and all four distance categories to give a total count for the whole 2-km transect route within the square: for this study, information is not needed separately from the transect sections or distance zones. The ‘number of birds’ is then the higher of these two summed values, from the ‘early’ and ‘late’ visits. For volunteer data submitted online, these calculations had already been made, before the data were added to the workbook.

This higher, summed count is the value that is used as standard in comparisons of BBS bird counts, for example across years to estimate bird population change at national and regional levels. Once repeat survey data from Perth & Kinross become available, these are the figures that will be used to model population change and to compare changes within Perth & Kinross with those in broader regions.

The program also calculates the number and proportion of occupied squares, and the mean count per square, because these are factors that influence the value of the data for population monitoring.

Zero counts for 2008 are not shown in the totals of occupied squares, but could sometimes be included in models of BBS population change, where there are non-zero counts from the same square in other years. For this reason, the sample sizes of occupied squares as tabulated for 2008 are not necessarily final – rather, they are minimum estimates of the number of squares that could contribute to trend estimates for each species: any square recorded as not occupied in 2008 but found to be holding the species in a future survey could also provide usable data. Following from this, the numbers of species that are estimated to have attained the threshold sample size for calculating population change will also be minima rather than final figures.

3 RESULTS

3.1 Birds detected by the 2008 survey

The survey recorded more than 11,000 individuals of a total of 111 species of birds (Table 2). The professional surveyors recorded more species than the volunteers, owing to the larger number of squares they surveyed, but fewer individuals per square, presumably because of the higher proportion of upland squares in the professional sample.

Table 2. Numbers of bird species and of individual birds recorded by the 2008 survey.

Survey sample	No. of squares	No. of species	No. of individual birds
Professional	43	101	6,133
Volunteer	20	97	4,887
Combined sample	63	111	11,020

The mean number of species per square was 25.1, which matches the mean figure of 25 species per BBS square encountered across Scotland as a whole in 2008 (Risely *et al* 2009). Across BBS squares in England and Wales in 2008, mean figures of 32 and 30 were recorded, in line with the generally higher species richness in those countries, and the lower proportion there of relatively species-poor upland squares.

The distribution of species richness across the 63 squares in Perth and Kinross appears to be bimodal (Figure 2). The commonest value was 33 species but there was also a cluster of relatively depauperate squares with around 14 species recorded. This may reflect the difference between open heathland or moorland habitat, where few species are found, these being mainly specialists of upland sites, and lowland squares, where habitat is typically more varied and species richness correspondingly higher.

Bird species recorded during both parts of the 2008 survey are listed in Table 3, in taxonomic order (BOU 2009), together with their current conservation listing (Eaton *et al* 2009), total counts, mean counts per square, and numbers and proportions of squares occupied. Two exotic species (Peacock and Red-tailed Hawk) appear at the end of the sequence: these non-native species, though often seen in the wild in Britain, do not have self-sustaining breeding populations here and are therefore not included in the BOU British List.

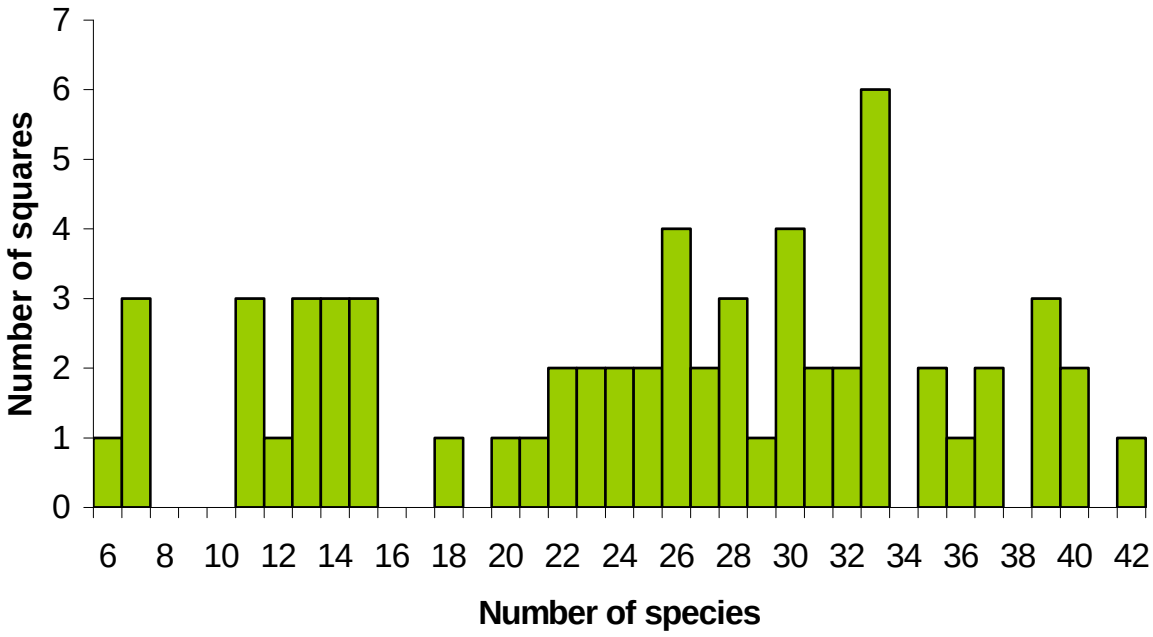

Figure 2. Frequency distribution of the total numbers of bird species recorded in each square (n=63).

Surveys covered a wide range of habitats, at elevations ranging from 7 m to 777 m above sea level. Squares suitable for species normally found coastally, such as Eider *Somateria mollissima*, or above 800 m altitude, such as Ptarmigan *Lagopus muta*, did not occur in the survey sample, and so these species, some of them quite numerous in Perth & Kinross, were not observed during the survey. With these caveats, the total of 111 bird species that were recorded included most of the species expected to occur abundantly in the area, although there were few records of owls and of rarer breeding species, reflecting the lack of nocturnal visits and the relatively low sampling density of the survey's design.

The total also included species that, although they can be present in Perth & Kinross during the breeding season as migrants, late-departing winter visitors or summering individuals, do not breed in the county. There were also species that breed within Perth & Kinross but for which the birds actually observed during the survey were not breeding: these included Cormorant and Herring Gull, which are mainly coastal as breeding birds but more widespread as summering non-breeders.

The most abundant species recorded during the survey was Pink-footed Goose, but this is a non-breeding visitor to Perth & Kinross from breeding grounds mainly in Iceland, and is mostly absent from Scotland between late April and early September. Two flocks, one of around 1,000 birds, were observed on one of the 'early' survey visits, near Loch Leven, which is a major wintering area for the species; these flocks, late to depart for Iceland, totalled far more individuals than were recorded for any other bird species in the survey. Meadow Pipit, Chaffinch, Woodpigeon and Rook, each with over 500 individuals, were the most abundant breeding species recorded by the survey.

Table 3. Bird species detected during the Perth & Kinross breeding bird surveys in 2008. 'Mean count' is the average number of birds counted per square across all 63 survey squares. Red-listed and amber-listed Birds of Conservation Concern (Eaton *et al* 2009) are highlighted.

BoCC	Species	Scientific name	Total birds	Mean count	Squares occupied	% squares occupied
	Mute Swan	*Cygnus olor*	12	0.19	4	6.3
amber	Pink-footed Goose	*Anser brachyrhynchus*	1072	17.02	2	3.2
amber	Greylag Goose	*Anser anser*	13	0.21	4	6.3
	Canada Goose	*Branta canadensis*	5	0.08	2	3.2
amber	Wigeon	*Anas penelope*	1	0.02	1	1.6
amber	Mallard	*Anas platyrhynchos*	78	1.24	24	38.1
amber	Tufted Duck	*Aythya fuligula*	9	0.14	3	4.8
amber	Goldeneye	*Bucephala clangula*	1	0.02	1	1.6
	Red-breasted Merganser	*Mergus serrator*	3	0.05	2	3.2
	Goosander	*Mergus merganser*	4	0.06	3	4.8
amber	Red Grouse	*Lagopus lagopus*	18	0.29	8	12.7
red	Black Grouse	*Tetrao tetrix*	8	0.13	5	7.9
	Red-legged Partridge	*Alectoris rufa*	9	0.14	5	7.9
red	Grey Partridge	*Perdix perdix*	2	0.03	1	1.6
	Pheasant	*Phasianus colchicus*	139	2.21	31	49.2
amber	Little Grebe	*Tachybaptus ruficollis*	2	0.03	2	3.2
	Cormorant	*Phalacrocorax carbo*	10	0.16	3	4.8
	Grey Heron	*Ardea cinerea*	11	0.17	8	12.7
amber	Red Kite	*Milvus milvus*	7	0.11	6	9.5
red	Hen Harrier	*Circus cyaneus*	1	0.02	1	1.6
	Sparrowhawk	*Accipiter nisus*	8	0.13	7	11.1
	Buzzard	*Buteo buteo*	72	1.14	47	74.6
amber	Osprey	*Pandion haliaetus*	1	0.02	1	1.6
amber	Kestrel	*Falco tinnunculus*	22	0.35	14	22.2
amber	Merlin	*Falco columbarius*	1	0.02	1	1.6
	Peregrine	*Falco peregrinus*	1	0.02	1	1.6
	Moorhen	*Gallinula chloropus*	4	0.06	3	4.8
	Coot	*Fulica atra*	7	0.11	3	4.8
amber	Oystercatcher	*Haematopus ostralegus*	75	1.19	30	47.6
amber	Golden Plover	*Pluvialis apricaria*	3	0.05	1	1.6
red	Lapwing	*Vanellus vanellus*	125	1.98	17	27.0
amber	Snipe	*Gallinago gallinago*	26	0.41	12	19.0
amber	Woodcock	*Scolopax rusticola*	4	0.06	2	3.2
amber	Curlew	*Numenius arquata*	129	2.05	28	44.4
amber	Common Sandpiper	*Actitis hypoleucos*	11	0.17	6	9.5
amber	Redshank	*Tringa totanus*	3	0.05	2	3.2
amber	Black-headed Gull	*Chroicocephalus ridibundus*	41	0.65	14	22.2
amber	Common Gull	*Larus canus*	51	0.81	7	11.1

BoCC	Species	Scientific name	Total birds	Mean count	Squares occupied	% squares occupied
amber	Lesser Black-backed Gull	*Larus fuscus*	113	1.79	13	20.6
red	Herring Gull	*Larus argentatus*	11	0.17	5	7.9
	Feral Pigeon	*Columba livia*	37	0.59	7	11.1
amber	Stock Dove	*Columba oenas*	15	0.24	7	11.1
	Woodpigeon	*Columba palumbus*	513	8.14	40	63.5
	Collared Dove	*Streptopelia decaocto*	7	0.11	6	9.5
red	Cuckoo	*Cuculus canorus*	17	0.27	15	23.8
	Tawny Owl	*Strix aluco*	1	0.02	1	1.6
	Long-eared Owl	*Asio otus*	1	0.02	1	1.6
amber	Short-eared Owl	*Asio flammeus*	4	0.06	3	4.8
amber	Swift	*Apus apus*	14	0.22	5	7.9
amber	Green Woodpecker	*Picus viridis*	2	0.03	2	3.2
	Great Spotted Woodpecker	*Dendrocopos major*	17	0.27	12	19.0
red	Skylark	*Alauda arvensis*	276	4.38	42	66.7
amber	Sand Martin	*Riparia riparia*	35	0.56	9	14.3
amber	Swallow	*Hirundo rustica*	219	3.48	43	68.3
amber	House Martin	*Delichon urbicum*	54	0.86	20	31.7
red	Tree Pipit	*Anthus trivialis*	15	0.24	10	15.9
amber	Meadow Pipit	*Anthus pratensis*	555	8.81	43	68.3
amber	Grey Wagtail	*Motacilla cinerea*	14	0.22	11	17.5
	Pied Wagtail	*Motacilla alba*	52	0.83	29	46.0
	Dipper	*Cinclus cinclus*	5	0.08	3	4.8
	Wren	*Troglodytes troglodytes*	360	5.71	59	93.7
amber	Dunnock	*Prunella modularis*	68	1.08	34	54.0
	Robin	*Erithacus rubecula*	210	3.33	45	71.4
amber	Redstart	*Phoenicurus phoenicurus*	5	0.08	3	4.8
amber	Whinchat	*Saxicola rubetra*	18	0.29	9	14.3
	Stonechat	*Saxicola torquatus*	42	0.67	17	27.0
amber	Wheatear	*Oenanthe oenanthe*	42	0.67	18	28.6
red	Ring Ouzel	*Turdus torquatus*	5	0.08	3	4.8
	Blackbird	*Turdus merula*	174	2.76	39	61.9
red	Fieldfare	*Turdus pilaris*	23	0.37	1	1.6
red	Song Thrush	*Turdus philomelos*	101	1.6	42	66.7
red	Redwing	*Turdus iliacus*	1	0.02	1	1.6
amber	Mistle Thrush	*Turdus viscivorus*	40	0.63	20	31.7
red	Grasshopper Warbler	*Locustella naevia*	3	0.05	3	4.8
	Sedge Warbler	*Acrocephalus schoenobaenus*	9	0.14	5	7.9
	Blackcap	*Sylvia atricapilla*	24	0.38	13	20.6
	Garden Warbler	*Sylvia borin*	9	0.14	7	11.1
amber	Whitethroat	*Sylvia communis*	54	0.86	22	34.9
red	Wood Warbler	*Phylloscopus sibilatrix*	2	0.03	2	3.2

BoCC	Species	Scientific name	Total birds	Mean count	Squares occupied	% squares occupied
	Chiffchaff	*Phylloscopus collybita*	19	0.3	10	15.9
amber	Willow Warbler	*Phylloscopus trochilus*	352	5.59	52	82.5
	Goldcrest	*Regulus regulus*	54	0.86	22	34.9
red	Spotted Flycatcher	*Muscicapa striata*	15	0.24	7	11.1
	Long-tailed Tit	*Aegithalos caudatus*	26	0.41	11	17.5
	Blue Tit	*Cyanistes caeruleus*	176	2.79	37	58.7
	Great Tit	*Parus major*	91	1.44	29	46.0
	Coal Tit	*Periparus ater*	117	1.86	28	44.4
	Treecreeper	*Certhia familiaris*	15	0.24	10	15.9
	Jay	*Garrulus glandarius*	7	0.11	7	11.1
	Magpie	*Pica pica*	7	0.11	5	7.9
	Jackdaw	*Corvus monedula*	255	4.05	30	47.6
	Rook	*Corvus frugilegus*	506	8.03	25	39.7
	Carrion Crow	*Corvus corone*	399	6.33	43	68.3
	Hooded Crow	*Corvus cornix*	4	0.06	1	1.6
	Raven	*Corvus corax*	13	0.21	8	12.7
red	Starling	*Sturnus vulgaris*	422	6.7	32	50.8
red	House Sparrow	*Passer domesticus*	109	1.73	20	31.7
red	Tree Sparrow	*Passer montanus*	11	0.17	4	6.3
	Chaffinch	*Fringilla coelebs*	537	8.52	54	85.7
	Greenfinch	*Carduelis chloris*	31	0.49	18	28.6
	Goldfinch	*Carduelis carduelis*	41	0.65	20	31.7
	Siskin	*Carduelis spinus*	73	1.16	24	38.1
red	Linnet	*Carduelis cannabina*	163	2.59	25	39.7
red	Twite	*Carduelis flavirostris*	2	0.03	1	1.6
red	Lesser Redpoll	*Carduelis cabaret*	21	0.33	12	19.0
	Common Crossbill	*Loxia curvirostra*	16	0.25	6	9.5
amber	Bullfinch	*Pyrrhula pyrrhula*	5	0.08	2	3.2
red	Yellowhammer	*Emberiza citrinella*	140	2.22	31	49.2
amber	Reed Bunting	*Emberiza schoeniclus*	41	0.65	21	33.3
	Red-tailed Hawk	*Buteo jamaicensis*	1	0.02	1	1.6
	Peacock	*Pavo cristatus*	2	0.03	1	1.6

Of the 111 bird species observed, no fewer than 62 are listed in the newly published listings of birds of conservation concern in the UK (Eaton *et al* 2009): 40 are amber listed and 22 red listed. In many of these cases, especially in the red category, the species has undergone a strong decline in UK population over the recent 25-year period. Amber-listed species may be designated as such because, for example, their European status is less than secure, or for reasons concerned with their winter distribution, and are not all in population decline.

The most widespread species were Wren, Chaffinch and Willow Warbler, each found on more than 50 squares (>80% of squares surveyed). Buzzard was surprisingly widespread, and by far the most commonly observed raptor. Of 73 observations of *Buteo* species, one was of the alien North American species *B. jamaicensis*, which has been recorded interbreeding with *B. buteo* in Scotland in the past, and is potentially a threat to the native species. Red Kite, for centuries absent from Scotland and only recently reintroduced, was observed on six squares.

For monitoring purposes, the species that occurred on more than 20 squares are of special interest, as these are likely to produce a valid estimate of population change when compared with future repeat surveys, and could contribute to an indicator of bird population change across the Perth & Kinross Council area. Data for these species are shown in more detail in Table 4.

Species are listed in Table 4 in the order of their number of occupied squares. The top 11 species were recorded on 40 or more squares and the top 19 on 30 or more squares. These species would provide the most reliable population change estimates when compared with future surveys. The actual number of squares providing data for such analyses would include squares empty in 2008 but holding the species in a future survey, and so could be higher than the figures reported for 2008 alone. A high average number of birds per occupied square is also an indicator that the confidence interval around a population change estimate may be relatively narrow, because the effects of random chance will be relatively less important. Thus, the trend for Buzzard might be somewhat less reliable, and that for House Sparrow more reliable, than the number of occupied squares might suggest.

The species listed in Table 4, and potentially available for inclusion in a Perth & Kinross regional indicator of bird populations, include species predominantly of open country (Meadow Pipit, Skylark), farmland (Swallow, Yellowhammer) and woodland (Coal Tit, Siskin). Trends for all these species could therefore be combined to produce an indicator of bird population change in Perth & Kinross that could apply to all main habitat types. Alternatively, trends for subsets of species occupying common habitat types could be combined to produce indicators of bird population change in those habitats within Perth & Kinross, although each indicator would be drawn from just a handful of species. The habitat categories used in Table 4 (M, F, G, S and W) are not necessarily the ones that would make the most valuable habitat-based indicators. Similarly, indicators could combine species with similar biology and contrast them with other groups, for example to compare trends between resident species and Afro–Palaearctic migrants, hole-nesting and open-nesting species, or small-bodied and large-bodied species. A pragmatic approach would be needed to constructing such indicators, to be discussed and agreed by interested parties, and directed towards topics of conservation relevance.

Table 4. **Summary of data for the 34 bird species recorded on at least 20 squares. Additional squares could contribute to trend calculation if occupied in a future survey year. Mean and standard error in this case are taken across occupied squares only. Main habitats are summarised as follows: M moorland or marsh/wetland, F farmland, G gardens/urban, S scrub/young woodland, W mature woodland.**

BoCC	Species	Main habitats					Squares occupied	% squares occupied	Total birds	Mean birds per square	Std error
		M	F	G	S	W					
	Wren		●	●	●	●	59	93.7	360	6.10	4.09
	Chaffinch		●	●	●	●	54	85.7	537	9.94	6.86
amber	Willow Warbler				●		52	82.5	352	6.77	5.22
	Buzzard		●			●	47	74.6	72	1.53	0.65
	Robin		●	●	●	●	45	71.4	210	4.67	3.58
amber	Swallow		●				43	68.3	219	5.09	4.90
amber	Meadow Pipit	●	●				43	68.3	555	12.91	10.76
	Carrion Crow		●			●	43	68.3	399	9.28	9.15
red	Skylark		●				42	66.7	276	6.57	7.69
red	Song Thrush			●	●	●	42	66.7	101	2.40	1.65
	Woodpigeon		●	●	●	●	40	63.5	513	12.83	17.16
	Blackbird		●	●	●	●	39	61.9	174	4.46	3.35
	Blue Tit			●		●	37	58.7	176	4.76	4.74
amber	Dunnock		●	●	●	●	34	54.0	68	2.00	1.37
red	Starling		●	●			32	50.8	422	13.19	27.69
	Pheasant		●		●	●	31	49.2	139	4.48	5.54
red	Yellowhammer		●		●		31	49.2	140	4.52	4.92
amber	Oystercatcher	●	●				30	47.6	75	2.50	2.98
	Jackdaw		●	●		●	30	47.6	255	8.50	12.30
	Pied Wagtail	●	●	●			29	46.0	52	1.79	1.54
	Great Tit			●		●	29	46.0	91	3.14	2.56
amber	Curlew	●	●				28	44.4	129	4.61	4.42
	Coal Tit			●		●	28	44.4	117	4.18	3.79
	Rook		●				25	39.7	506	20.24	18.27
red	Linnet		●		●		25	39.7	163	6.52	9.07
amber	Mallard	●	●				24	38.1	78	3.25	2.23
	Siskin			●		●	24	38.1	73	3.04	3.01
amber	Whitethroat		●		●		22	34.9	54	2.45	1.82
	Goldcrest			●		●	22	34.9	54	2.45	1.65
amber	Reed Bunting	●	●				21	33.3	41	1.95	1.40
amber	House Martin		●	●			20	31.7	54	2.70	1.56
amber	Mistle Thrush		●	●		●	20	31.7	40	2.00	2.05
red	House Sparrow		●	●			20	31.7	109	5.45	5.51
	Goldfinch			●	●		20	31.7	41	2.05	1.15

3.2 Mammals detected on the professional surveys

Mammal recording was a subsidiary aim of the fieldwork, and was far from complete. The results are of interest nevertheless, because systematically collected data for mammals are scarce.

Of the 43 squares surveyed professionally, 11 recorded no mammals, 16 recorded one species, eight recorded two species, six recorded three species, and two squares each recorded four species. Records included field signs and other evidence, as well as sightings of live animals during survey visits.

In total, 11 mammal species were recorded (Table 5). The most widespread were Roe Deer and Rabbit, and Red Deer, with 148 animals counted, was the most numerous. A record of a Sika from NO0252 was regarded by the observer (NG) as not certainly identified. Single Grey Squirrels, also an invasive non-native species, and a major threat to the survival of Scotland's remaining native Red Squirrel population, were observed in grid square NN8716 by NG and in NO0313 by DJTD.

Table 5. Mammals detected during the professional surveys. Occupied squares were those where any evidence of presence was obtained, including sightings of live animals during survey visits, field signs, and local knowledge.

Species	Scientific name	Squares occupied	% squares occupied	Live animals counted
Red Squirrel	*Sciurus vulgaris*	1	2.3	1
Grey Squirrel	*Sciurus carolinensis*	2	4.7	2
Rabbit	*Oryctolagus cuniculus*	13	30.2	66
Brown Hare	*Lepus europaeus*	6	14.0	10
Mountain Hare	*Lepus timidus*	5	11.6	45
Mole	*Talpa europaea*	3	7.0	0
Feral/Domestic Cat	*Felis catus*	4	9.3	4
Weasel	*Mustela nivalis*	1	2.3	1
Red Deer	*Cervus elaphus*	8	18.6	148
Sika*	*Cervus nippon*	1	2.3	1
European Roe Deer	*Capreolus capreolus*	15	34.9	33

* identification uncertain: see text

4 DISCUSSION

4.1 Survey coverage in 2008

The survey boosted normal BBS coverage in Perth & Kinross by 43 squares in 2008, and 63 squares were surveyed in total. It is still possible that results from a further one or two BBS squares surveyed by volunteers may yet be submitted, thus further increasing the overall sample size. The sample size of 60 squares set beforehand as the minimum for a successful baseline survey was therefore exceeded.

By boosting the number of squares that would normally have been surveyed by BBS, the survey achieved its objective of raising the sample sizes of occupied squares to 20 or more for more than 30 of the most widespread bird species. In fact, there were 34 species for which this threshold was reached. Even were the bar to be raised to 30 occupied squares, a full repeat survey would make trends available for 19 species. The figures of 34 and 19 species could be underestimates, because future repeat surveys might show more squares to be occupied (in at least one of the survey years) and thus increase the numbers of species passing the thresholds of 20 and 30 squares providing data.

Perth & Kinross is a large area of great topological complexity, with many regions remote from roads and difficult to access. The sampling approach necessarily employed meant that observers were able to visit only a small fraction of Perth & Kinross, and only a few hours were spent in each of the sample squares. Several rarer or more restricted bird species that are known to breed in Perth & Kinross were not encountered at all during survey visits.

A number of practical aspects of BBS surveying necessarily limit the value of this survey method for making a snapshot of breeding birds in any given region. Important ones concern the selection of survey squares, route placement, and the timing of visits. The ways these may have affected the Perth & Kinross survey in 2008 are discussed below.

Squares made available to the professional surveyors totalled 59, of which 43 (73%) were surveyed. By chance, none of the 59 squares lay along the coastal strip of Perth & Kinross, alongside the Firth of Tay, where a number of coastal-breeding species occurring within the county would have been concentrated. A much larger random sample would have been required to make sure that all habitat types for birds were included, and this would have been prohibitively expensive.

The 16 squares selected but not surveyed were probably biased to some extent towards the more remote sites: this leaves room, therefore, for some minor deviation from the representativeness of a fully random sample. Bias in the sample is more apparent in the 20 squares surveyed by volunteers, which were a much smaller subset (25%) of the squares that were available to them. The 20 volunteer squares were concentrated into the Kinross region, where the density of squares and of potential observers were both higher than in more remote, upland sections of the county.

None of the squares, however, was chosen for subjective reasons, such as the nature of its bird populations or the likelihood of any particular future trend. Covering more lowland squares and fewer in the remotest uplands, where fewer bird species and individuals would be

expected, would have the effect of increasing the average species richness and total birds in the squares covered, thus increasing the samples for monitoring bird trends.

Where route placement differs from the standard pattern, the species of birds recorded and the numbers counted may differ from a truly random sample from that square. In practice, totals are likely to be higher, especially in a square that contains areas relatively empty of birds, which observers might tend to avoid. Deviations from the standard route are inevitable in nearly every 1-km square in the BBS sample. Again, they tend to increase the numbers of birds in the monitoring sample.

The BBS method requires only 1–2 hours of observation per 1-km square per year. BBS data aim to be a representative sample of the birds breeding in a square, but do not necessarily include every species present, and certainly do not include every individual bird. The extent to which the birds present are sampled depends upon the skill of the observer and on the detectability of the birds at the time of the visit, as well as on route placement. Most birds become less detectable after mid morning and therefore the visits made for this survey during the afternoon will have been less efficient than those in the early morning.

None of these limitations, which mostly apply in similar degree to the whole of the BBS sample and not just to the present survey, is thought likely to influence future estimates of population change, provided that the same transect routes are followed and that the visit dates and times of future repeat surveys are broadly similar to those of 2008.

4.2 Recommendations for repeat surveys

The use of the BBS method, with its standard and well-established field protocol, ensures that the survey can be repeated very closely in future years. We would strongly recommend that the same sample squares and transect routes are included in future repeat surveys. Comparing like with like removes any effects that may stem from the routes followed in 2008 being not fully representative of the entire Perth & Kinross council area.

All BBS surveys are subject to variation according to weather, season, time of day, and the skill of the observer. In small samples, chance is also an important factor. It is recommended that future repeats of this survey be undertaken that match the dates and times of the 2008 survey as closely as possible, to minimise the variation that stems from these sources.

Relatively frequent repeats, say at two-year or three-year intervals, would be advantageous because data would amass more quickly: conclusions will become more certain as the number of repeat surveys grows. A second point is that the longer the interval between surveys, the more difficult it will be to link bird population changes to local habitat change or a change in management policy. On these grounds, we recommend that the ideal interval between surveys should be in the region of 2–4 years.

Consideration could be given to increasing the number of sample 1-km squares surveyed by professional staff, for example by surveying additional squares from the original random selections. This would tend to increase the extent and precision of monitoring achievable by subsequent surveys but would also add to the costs of undertaking the fieldwork.

The number of squares that would be surveyed by BTO volunteers, alongside a future professional survey, could not be guaranteed, but could be expected to be similar or slightly above the 20 recorded in 2008. Some turnover of squares in the volunteer sample is inevitable, but BTO should make special efforts to maintain coverage at the 20 squares surveyed in 2008, perhaps using professional fieldworkers in those squares where no volunteers were available.

4.3 Realisation of overall project aims

The full value of the 2008 survey for monitoring will be realised only when further special surveys are undertaken and comparisons made between the results. A first repeat survey would enable an assessment of linear population change between the two survey years, while subsequent repeats would allow increasingly more complex models of population change to be fitted. Results from the 2008 survey indicate that it would be possible to calculate trends for at least 34 bird species, following a full repeat survey.

To some extent, it may be possible to use volunteer BBS data for intervening years between professional surveys. By themselves, the volunteer data are inadequate for monitoring owing to the relatively small sample of squares surveyed, but they may give an indication of population trajectories on an annual basis between the points fixed at longer intervals by the full Perth & Kinross survey years.

Although 11 species of mammals were also recorded in 2008, by the professional surveys alone, these data are insufficient for monitoring at the scale of Perth & Kinross. The data can contribute, however, to national monitoring of the mammal species observed most abundantly.

Trends at national and some regional levels are calculated routinely by BTO from BBS results and posted on its web site at www.bto.org/bbs/trends/index.htm. In general, bird trends obtained from Perth & Kinross would be expected to be broadly similar to those in Scotland as a whole and to the overall trends in the UK populations. It will be of particular value to Perth & Kinross Council, however, to relate these population trends clearly to the area for which they have statutory responsibilities and to assess to what extent these responsibilities are being discharged. In some species, trends may be either more negative or more positive in Perth & Kinross than in wider regions, and in these cases the Council may wish to investigate the reasons for these differences and take conservation action if appropriate.

Certain groups of bird species share similar pressures on their populations, so that combining their trends into a multi-species indicator sheds light on the influence of these common factors. For example, many species of trans-Saharan migrants have been in long-term decline and a comparison of indicators for migrants and resident species shows the plight of the migrants in a simple and direct way. We would recommend that the data be used in this way, with indicators and their constituent species being designed to address particular conservation issues. For example, indicators could be compared between Perth & Kinross and other regions, or between groups of birds, such as birds of different main habitats. Decisions on which indicators would be of value should be postponed until repeat survey data are available, and can be reviewed with each new repeat survey.

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APPENDIX A1 Visit dates and times

The fieldwork visits made by professional surveyors during 2008 are listed in Table A1.1. 'Early' refers to the early part of the BBS season, between 1 April and 15 May, and 'late' to the second half, between 16 May and 30 June. Most visits were made by Nick Green (NG), who performed two periods of concentrated fieldwork between 22 April and 8 May and between 20 May and 7 June. David Douglas (DJTD) made five additional 'early' visits on 8 and 9 May. Table A1.2 gives equivalent data for the squares surveyed by BBS volunteers.

Table A1.1. The 43 squares covered by the professional survey in 2008, with dates, times, observer initials and number of species recorded.

Grid square	'Early' visit			'Late' visit			Total no of bird species
	Date	Start time	Observer	Date	Start time	Observer	
NN4459	2 May	1250	NG	27 May	1135	NG	11
NN4656	2 May	1030	NG	27 May	0950	NG	29
NN5058	2 May	1405	NG	27 May	1248	NG	18
NN5060	5 May	1025	NG	27 May	1420	NG	15
NN7123	25 April	0900	NG	22 May	1335	NG	26
NN7128	25 April	1110	NG	24 May	1450	NG	15
NN7467	6 May	0820	NG	26 May	1340	NG	13
NN7631	29 April	0955	NG	1 June	1025	NG	6
NN7657	4 May	1205	NG	31 May	0935	NG	13
NN7660	4 May	1000	NG	31 May	1050	NG	14
NN8123	23 April	0930	NG	21 May	0645	NG	35
NN8205	27 April	0925	NG	25 May	0845	NG	37
NN8245	26 April	1055	NG	30 May	1230	NG	13
NN8429	8 May	1355	NG	2 June	0945	NG	7
NN8549	22 April	0950	NG	20 May	1210	NG	32
NN8716	22 April	1520	NG	20 May	0840	NG	33
NN8930	25 April	1330	NG	30 May	0850	NG	20
NN9003	–	–	–	4 June	1151	NG	7
NN9211	24 April	1115	NG	22 May	0905	NG	33
NN9226	22 April	1310	NG	20 May	1025	NG	14
NN9320	24 April	0925	NG	22 May	1200	NG	30
NN9438	3 May	0915	NG	30 May	1015	NG	35
NN9716	1 May	0910	NG	22 May	1030	NG	26
NN9906	26 April	1420	NG	25 May	1040	NG	11
NO0252	8 May	1015	NG	29 May	0910	NG	15
NO0313	9 May	0800	DJTD	5 June	1150	NG	39
NO0426	7 May	0940	NG	24 May	0825	NG	36
NO0561	5 May	1350	NG	29 May	1210	NG	12
NO0702	24 April	1300	NG	21 May	1332	NG	27
NO0744	3 May	1125	NG	24 May	1200	NG	31

Grid square	'Early' visit			'Late' visit			Total no of bird species
	Date	Start time	Observer	Date	Start time	Observer	
NO1009	23 April	1430	NG	21 May	1210	NG	24
NO1121	7 May	1145	NG	24 May	1010	NG	33
NO1205	23 April	1610	NG	21 May	1050	NG	22
NO1364	3 May	1415	NG	29 May	1340	NG	21
NO1448	8 May	1445	DJTD	7 June	0915	NG	25
NO1612	1 May	1110	NG	21 May	0915	NG	32
NO1849	8 May	0925	DJTD	7 June	1045	NG	30
NO2145	8 May	1125	DJTD	6 June	1200	NG	28
NO2251	8 May	0720	DJTD	6 June	1005	NG	40
NO2532	1 May	1435	NG	23 May	0925	NG	33
NO2826	30 April	1350	NG	23 May	1224	NG	24
NO3028	1 May	1310	NG	23 May	1105	NG	31
NT0596	27 April	1125	NG	25 May	1220	NG	23

Table A1.2. The 20 squares covered by BBS volunteers in 2008, with dates and times of visits.

Grid square	'Early' visit		'Late' visit		Total no of bird species
	Date	Start time	Date	Start time	
NN7450	12 May	0650	12 Jul	0650	11
NN7813	2 Jun	0925	27 Jul	0935	30
NN7814	–	–	26 May	0645	14
NN8056	8 May	0735	15 Jul	0750	7
NN8405	6 May	0750	20 Jun	0705	22
NN9538	22 May	0605	24 Jun	0600	42
NN9702	25 Apr	0700	2 Jul	0715	26
NO0700	20 Apr	0600	8 Jun	0600	40
NO0709	20 Apr	0814	8 Jun	0812	25
NO1007	5 May	0726	7 Jun	0711	26
NO1108	2 May	0700	21 Jun	0531	30
NO1305	27 Apr	0630	1 Jun	0630	28
NO1623	14 May	0730	17 Jun	0730	39
NO2002	14 May	0720	18 Jun	0715	28
NO2011	6 May	0612	24 Jun	0430	23
NO2340	9 May	0545	16 Jun	0600	33
NS9895	18 Apr	0845	24 Jun	0630	33
NT0398	5 Jun	0720	30 Jun	0702	37
NT1196	21 Apr	0730	31 May	0730	27
NT1296	27 Apr	0720	10 Jun	0730	39

APPENDIX A2 Habitats covered

BBS observers routinely collect habitat data by 200-m transect section. Observers are asked to make an initial visit to the square to record habitat and establish a route, in addition to the two counting visits, thus making three separate visits to the square during the season. A separate initial visit is especially helpful in squares new to the BBS sample, where a route has to be set up for the first time. In the present survey, however, because of the time constraints and the difficulty of reaching many of the sites, reconnaissance and habitat recording were generally combined with the first counting visit – habitat being recorded once the bird survey for the transect had been completed.

The main function of habitat data in the context of the present survey is to enable the assessment of any change in habitat that may occur between the 2008 baseline survey and future repeat surveys, and any links between habitat change and bird population trends in the intervening period.

A summary of habitats recorded in the 43 squares surveyed professionally appears as Table A2. The table summarises the first two levels of recording for the 429 200-m sections surveyed, across the 43 random 1-km squares. Summing the percentages for the first-level codes, farmland was noted for 40.6% of first habitats, heathland & bogs for 29.2%, and woodland for 19.2%. Scrub, grassland, human sites, water bodies and cliff were also noted.

The second-level habitat codes (*eg* A1, A2) describe habitat type more precisely. The dominant habitat category for the survey squares was dry heath D1, which was the 'first' habitat on more than a quarter of 200-m sections. Tilled land, improved grassland and coniferous woodland were also well represented. The most common 'second' habitats were in the farmland and woodland categories, indicating that these often occurred together in farmland–woodland mosaics. More than half of the 429 transect sections (243) were not given a 'second' habitat: most of these were open heathland or moorland sections from which other habitat types were absent.

Owing to the random nature of the square selection, these data should be a broadly representative sample of bird-habitat types within Perth & Kinross, although influenced to some extent by observer choice of which squares to cover and the placement of transect routes.

Table A2. Frequency of habitat categories as 'first' or 'second' habitats within the 429 200-m transect sections surveyed professionally in Perth & Kinross in 2008.

Code	Habitat category	First habitat		Second habitat		Total and ranking	
		n	**%**	**n**	**%**	n	rank
A	**Woodland**						
A1	Broad-leaved woodland	17	4.0	21	4.9	38	6
A2	Coniferous woodland	55	12.8	27	6.3	82	4
A3	Mixed woodland	8	1.9	24	5.6	32	8
A4	Broad-leaved, waterlogged	2	0.5			2	
B	**Scrubland or young woodland <5m tall**						
B1	Regenerating natural or semi-natural woodland	1	0.2			1	
B6	Clear-felled	1	0.2	7	1.6	8	
B7	Other			7	1.6	7	
C	**Semi-natural grassland/marsh**						
C2	Grass moor	5	1.2			5	
C3	Grass moor mixed with heather	5	1.2			5	
D	**Heathland and bogs**						
D1	Dry heath	109	25.4	6	1.4	115	1
D2	Wet heath	8	1.9	2	0.5	10	
D3	Mixed heath	8	1.9			8	
E	**Farmland**						
E1	Improved grassland	62	14.5	33	7.7	95	3
E2	Unimproved grassland	18	4.2	19	4.4	37	7
E3	Mixed grass/tilled land	14	3.3	1	0.2	15	
E4	Tilled land	80	18.6	22	5.1	102	2
E6	Other farming			1	0.2	1	
F	**Human sites**						
F2	Suburban	5	1.2			5	
F3	Rural	26	6.1	13	3.0	39	5
G	**Water bodies (fresh water)**						
G2	Small water body (50–450 sq m)			1	0.2	1	
G7	River (>3m wide)	5	1.2			5	
I	**Inland rock**						
I1	Cliff			2	0.5	2	
	None			243	56.6	243	–