BTO Research Report no. 552

Bird Survey Assessment for Bayer CropScience, Great Chishill

Authors

Mark F. Hulme and Gavin M. Siriwardena

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1. CURRENT MONITORING AND ANALYSIS

The monitoring protocol followed at Great Chishill since 2002 by Alan Harris consists of three, monthly transect surveys conducted during winter and summer each year. The approach is modelled on the national Breeding Bird Survey (BBS), as is applied to single 1 km squares, with several variations. First, twelve 200 m transect sections are walked, instead of ten, and these transects are positioned to cover all the habitats present on the farm and to sample the whole farm area evenly, rather than being positioned, nominally, as two parallel transect lines that sample the habitat randomly. Second, birds are recorded in bands of up to 50 m from the transect line, more than 50 m from the line and in flight, as opposed to up to 25 m, 25-100 m, more than 100 m and in flight (as in the BBS). Third, three visits (monthly, April to June and December to February) are conducted instead of two (April to mid-May and May to June).

The BBS was designed to produce reliable national data through low-intensity monitoring over a sample of thousands of sites. The method is not ideally designed for informing about changes in bird numbers at single sites, which are likely to fluctuate considerably between years due to chance sampling variation (such as whether two or three local robins happen to be singing as the surveyor walks past, or whether the weather during the survey is cool or warm, affecting swallow activity and detectability, for example). Having said that, the general transect approach is a good way of standardizing methods and effort between survey visits and increasing annual visit numbers is a good way of limiting problems with chance fluctuations in numbers of birds detected. Note, however, that this method is less suitable for wintering than for breeding birds, because many species flock in winter and are very mobile, making counts at any given spot very unpredictable and subject to large fluctuations.

The non-random location of transects at Great Chishill probably actually matches the situation in the BBS quite well, because transects in the latter are also likely to be biased towards linear features in practice. This means that counts are probably biased towards higher counts for hedgerow species and lower ones for field centre ones, in terms of the real densities per unit area, but this is probably not a particularly serious problem because there are more hedgerow species and because many field centre species are fairly readily detectable by sight or sound (e.g. lapwing, partridge spp., skylark).

The distance bands currently in use are not as good as those in the BBS. Specifically, the central band is too wide and the outer one, having no formal outer limit, cannot technically be used in distance analysis to estimate densities. The central band should be narrow enough that birds along the transect line itself (where, nominally, there is a 100% chance of detecting all birds that are present) can be separated from birds far enough away that their detectability is lower. Thus the 25 m band in the BBS is better, although this too is not ideal and is a compromise between the practicalities of recording and what would be ideal methodologically. Likewise, having the 25-100 m band in BBS and then an outer, unbounded one is better, but the ideal would be to have as many bands as possible, or to record absolute distances from the transect line for each observation. A recommendation for future surveys would be to switch to the distance bands used in the BBS. This would make density estimation by distance sampling and direct comparisons with BBS results possible, although it should be noted that density estimates of this type may be inaccurate or biased because, for example, transects do not cover the habitat at random (being located near boundary habitats) or not all birds along the transect line are detected. Note also that this approach is unlikely ever to be particularly accurate for a single site; like the BBS in general, it is designed to work over a large sample of study areas such that chance sampling effects are averaged over. In addition, distance analysis assumes that all individuals are independent, i.e. that the locations of different birds are not affected by those of other birds. This is clearly a problem for flocking species, meaning that density estimates for such species tend to be unreliable, and is a greater problem in winter, when more species are found in flocks and group sizes tend to be more variable. It would therefore not be advisable to use the transect distance bands to analyse the winter count data.

Overall, the survey method being used at Great Chishill is sound. Most importantly, it is consistent between years, allowing comparison of population trends with other data sets, such as the BBS. The aspects in which it is not ideal reflect compromises with feasibility and are often similar to the compromises made for the BBS. The major recommendation would be to adjust the distance bands in which the data are recorded to match those in the BBS. (If historical survey maps are available, this could actually be done retrospectively.) This would enable formal comparison of density estimates with regional and national averages. The nature of bird behaviour in winter makes them harder to survey then and transect surveys are not generally regarded as most suitable, although they do again have the advantage of easy standardization between years. A recommendation for winter might be to change to a whole-area search method (as described by RSPB ref), which should produce results that fluctuate less between years. However, this would require considerably more survey effort and is more prone to inter-observer variation. As with the transect data, there is also still no comparable national data set against which to judge count results. A pragmatic solution might be to maintain the existing approach in winter, but to interpret the results advisedly: it is inevitable that there will be fluctuations from year to year just by chance, with odd observations producing large apparent changes between years. An example of this is shown by the observation of a remarkable flock of 770 linnets on one visit during winter 2009-10: it is highly unlikely that this represents the specific number of linnets supported by the habitats on the farm in any meaningful sense.

1.1 Comparison of Great Chishill Data with National and Regional Trends

The Great Chishill survey results provide standardized winter and spring survey data from spring 2002 to winter 2009-10 that can be compared to national and regional bird population trends to examine whether local changes are different from averages at larger scales. This was readily possible for breeding bird populations (spring surveys) because data from the national BTO/JNCC/RSPB Breeding Bird Survey (BBS) are available for the same time period. There are no analogous, large-scale, winter data sets to allow easy comparisons with the Great Chishill winter data, but each winter's results can be compared with BBS data for the following spring.

Formal statistical tests cannot usefully be conducted to assess the reliability of apparent differences because the Great Chishill data represent a single data point in each year to compare with tens or hundreds from the BBS. However, the 95% confidence intervals around BBS indices (i.e. the data ranges in which we are 95% certain that the true population level lies) allow a visual assessment of whether the Great Chishill results really show different pattern to those from the national or regional scales.

It was intended to compare the Great Chishill results to national, regional (surrounding counties) and county-specific (Cambridgeshire) trends to consider the patterns in Great Chishill, but too few BBS survey squares have been covered in Cambridgeshire alone to make the calculation of BBS index data worthwhile for this smallest scale. Comparisons are, therefore, limited to those between the Great Chishill site-level data and each of the regional and national scales (selecting similar, farmland-dominated habitats from the range covered by the BBS).

2. METHODS

2.1 Breeding Bird Survey

The BBS is a national, volunteer survey that has been organized by the BTO since 1994. It involves visiting a 1 km square twice over the course of a summer (early and late counts) and recording all birds observed or heard from a 2 km of transect per 1 km^2 (for full methodology see: Gregory *et al.* 1996). Birds are noted on a map as being within 25 m of the transect, 25-100 m from the transect or beyond 100 m from the transect. Broad habitat data are recorded along the transect lines. Squares surveyed are a random sample across the UK, stratified by observer density, and the total number of squares covered each year varies depending on observer numbers and effort, although observer consistency from year-to-year is encouraged.

2.2 Great Chishill Survey Data

The Great Chishill data collected by Alan Harris during May-June and December-February each year between spring 2002 and winter 2009-10 were summarized by season. Counts were summed across all twelve 200 m transect sections for each survey visit. Winter and spring counts were analysed separately because there are differences between the bird communities that inhabit farmland from season to season and because changes in bird behaviour mean that the detectability of individuals and groups/flocks can be very different between seasons for some species.

Maximum total counts across the three spring visits were then calculated as the best index of annual breeding numbers for each species. As discussed above, wintering numbers are subject to larger chance variations than breeding counts, so median total counts were used instead of maxima across the three winter count visits to produce an annual index of numbers of each species present. This means that extremely low and high counts were excluded, but that population levels that were sustained over two or more survey visits in a given winter will have been considered to be “real” for that year.

2.3 Population Indices

BBS data were used to determine national and regional population trends for all species found at Great Chishill survey. Only survey squares that were dominated by farmland were used, in order to match the habitat at Great Chishill as closely as possible. The whole of England was used to produce national trends and the counties of Cambridgeshire, Hertfordshire and Essex were considered to represent the region in which the farm lies, given the location of Great Chishill at the borders of the three counties. To reflect the survey design, as is standard with BBS data (Risely *et al.* 2009), a weighting was used in the model based on the coverage of squares in each region of the country, the weighting being the number of squares surveyed divided by the total number of squares available in a county or region to avoid bias towards areas with more observers. Population indices from 2002 to 2009, using only electronically-entered, un-verified data for 2009 since these data had not yet been checked and paper records had yet to be input. Indices were calculated by year for each species using log-linear Poisson models (fitted using the GENMOD procedure in SAS statistical software), with square and year as class variables and a weighting by region (calculated as above). Maximum counts across the two visits were used as the count variable for analysis. This is the standard method for calculating population indices from BBS data. After back-transformation, the parameters for each class level of “year” were scaled to a value of 1 in the first year (2002), so each year’s value represented the relative change in abundance versus the first year considered (2002). Analytical 95% confidence intervals were calculated for the parameter estimates in each year.

To produce comparable trends to the BBS from the Great Chishill data, the maximum (spring) or median (winter) counts across visits for each year were standardized by dividing by the count in the first year of surveys (spring 2002 or winter 2002-03). Thus, both spring and winter time series of count data for each species started at one in the first year, as BBS indices do. When plotted on the

same graph, this then shows clearly whether the Great Chishill farm trends diverge from the national or regional ones for each species.

2.4 Species Richness

The annual mean number of species recorded per square (known as "species richness" in ecological jargon) was calculated, along with its 95% confidence intervals, from BBS data for England and the three counties around Great Chishill between 2002 and 2009. The same parameter was also calculated for the Great Chishill survey data for comparison.

2.5 Density Estimates

BBS data were used to estimate densities of a number of species in different habitats across the UK; full methods and results are presented in Newson *et al.* (2005) and only a summary is provided here. Distance sampling techniques, implemented in the free software Distance 3.5 (DISTANCE, Version 3.5; Thomas *et al*. 1998), were applied. This approach measures the drop-off in detection of birds with distance from the transect line and accounts for this in translating observed counts into population indices. BBS count data were pooled across both visits and birds recorded beyond 100 m from the transect were excluded. Count data from the two remaining bands were fitted with half-normal detection functions and the decline in detectability was modelled for 20 broad habitat classes to account for differences in detectability between habitats. Regional estimates of density for each habitat were then calculated to account for regional variation in sampling effort. Habitat-specific population estimates were calculated by multiplying habitat-specific density estimates for each region by the area represented by that habitat in each region. The area of each habitat within each region was calculated from the proportion that each habitat comprised of the total area of each region. The habitat data that the observer would have recorded had they walked the ideal transect line through the square were used in these calculations as this represents the true random sample of the region (Field & Gregory 1998). National population estimates were calculated as the sum of regional habitat-specific population estimates. A mean density of each species in each habitat across the UK was estimated by dividing the habitat-specific national population estimates by the estimated total area of that habitat in the UK. Confidence intervals for the estimates for each species were calculated using a bootstrap resampling procedure of 400 iterations (Crowley 1992). This is a standard method for estimating the variability of parameters estimated from data sets like the BBS and it shows how precise the annual estimates from the BBS can be considered to be.

As discussed above, the distance bands currently used in the farm surveys at Great Chishill are not very well suited to calculating meaningful densities for comparison to the BBS, and it is debatable whether useful density information can really be gained from data for a single site, so we have not tried to calculate densities from the data provided. The BBS estimates, however, provide a baseline to which future local density estimates might be compared.

3. RESULTS AND DISCUSSION

3.1 Population Indices

Comparisons between the population indices calculated from BBS data and the Great Chishill farm breeding season data are shown in Figure 3.1 for all species that were sufficiently common to support meaningful analyses in both data sets (N.B. no species were recorded at Great Chishill that were too rare for population indexing from the national or regional BBS). Each species-specific graph shows the national and regional BBS trends alongside that for Great Chishill.

As would be expected, the data from the single site at Great Chishill show more fluctuations between years and more complex temporal patterns the BBS results, which are averaged over tens or hundreds of sites. There was little evidence for divergent trends between Great Chishill and larger spatial scales, suggesting that bird populations on the farm are, generally, faring neither better nor worse than those across the wider landscape. Within this general pattern, however, several species showed some differences in population trend between Great Chishill and elsewhere, mostly suggesting healthier populations on the study farm. Greenfinch (Figure 3.1g) and linnet (Figure 3.1j) trends both showed marked increases at Great Chishill until 2007, in contrast to the broader trends. Abundances of both species subsequently fell, but remained higher than the background levels. The recent decline of greenfinches probably reflects the impact of a disease, trichomoniasis, which has affected the species nationally, but there is no such clear explanation for the linnet pattern. Robin (Figure 3.1m) and yellowhammer (Figure 3.1s) both increased considerably between 2003 and 2004, changes that were not apparent in the BBS data, and the increased population levels were then, broadly, sustained, although further increases have not occurred. Further, the song thrush population at Great Chishill has fluctuated a lot, but has seen a sustained, more positive, trend than the national pattern since 2006 (Figure 3.1p). Conversely, however, skylarks at Great Chishill seem to be in steeper decline than the national average, at least since 2006, but possibly since 2004 (Figure 3.1n). Long-tailed tits also showed a more negative trend than in the national or regional populations, but counts were stable from 2004 onwards and this pattern probably just shows an unusually high count in 2002 (Figure 3.1k). Overall, however, none of these patterns are sufficiently clear-cut to suggest that habitat or management quality for these species is particularly different at Great Chishill compared to elsewhere. Without knowledge of the detail of cropping patterns and non-cropped habitat content at Great Chishill, it is difficult to formulate informed hypotheses as to why differences in population trends, such as the apparently steeper local decline of skylarks, might exist. It is possible that such apparent patterns reflect chance effects caused by the reliance of the Great Chishill patterns on data from the equivalent of just one BBS square. These patterns could also reflect influences from beyond the farm boundary, because the ranges of many surveyed individuals of most species, especially in winter, will include neighbouring farms and, even for species considered to be “resident”, areas of habitat that are several kilometres away.

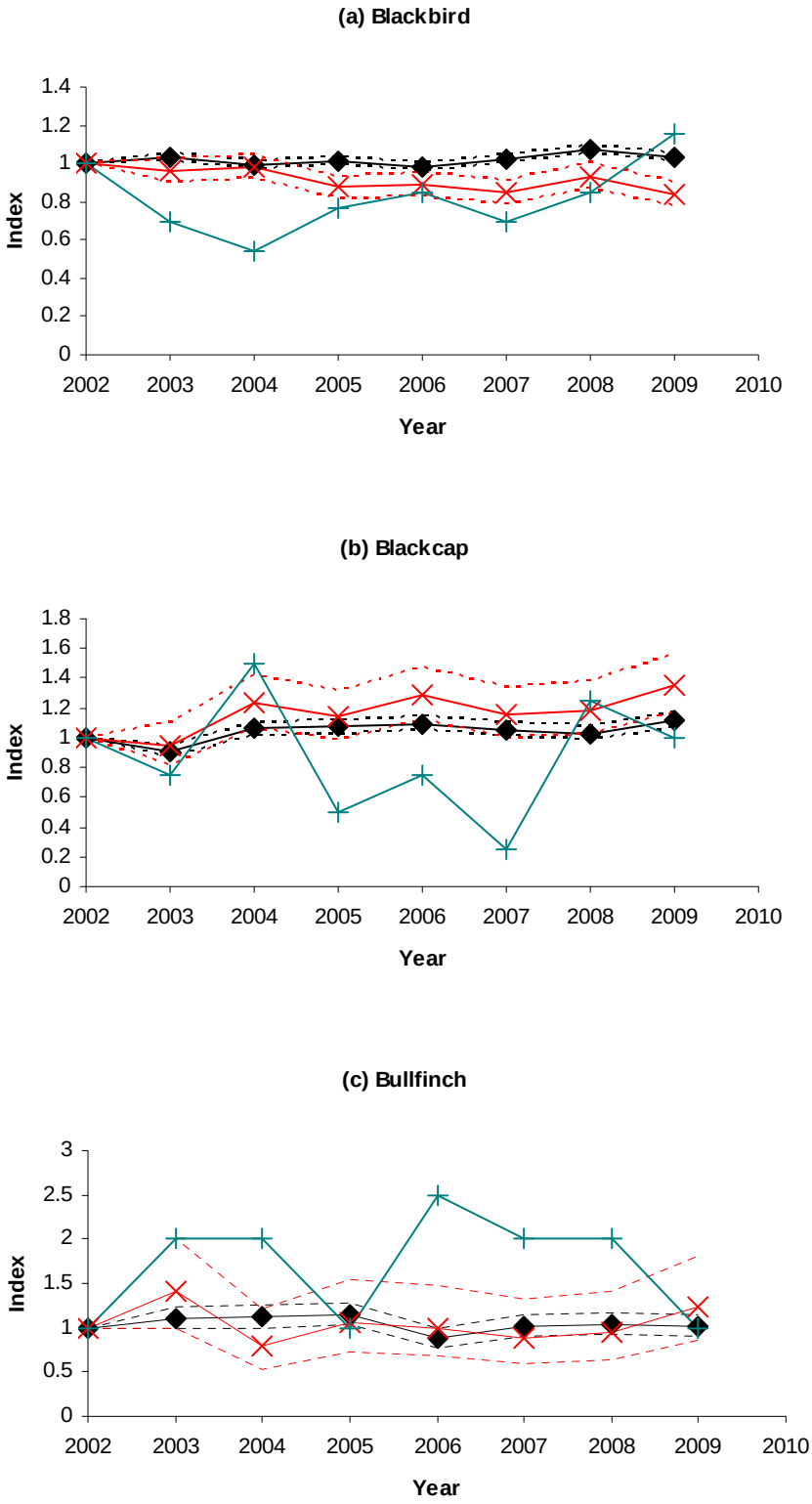
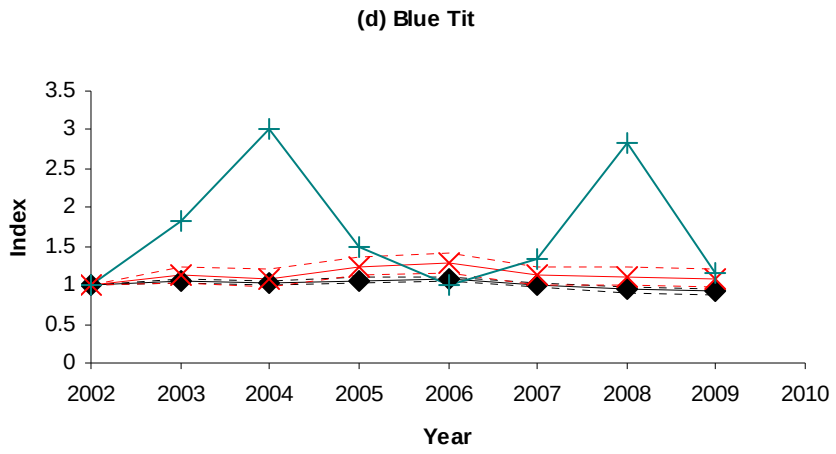
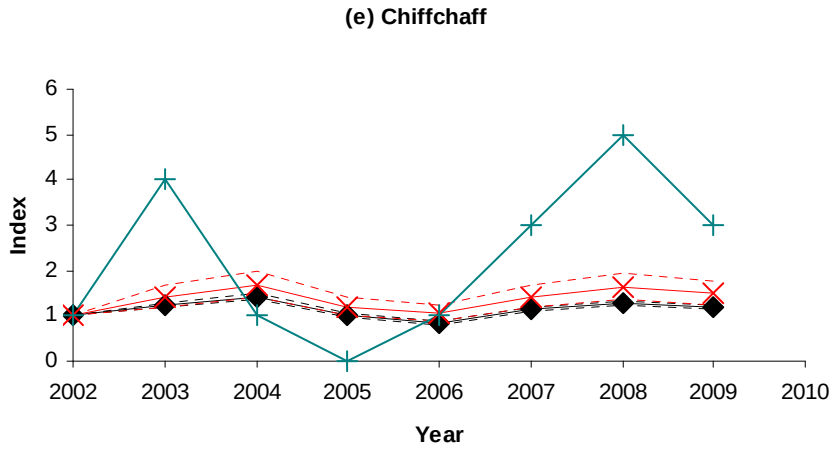
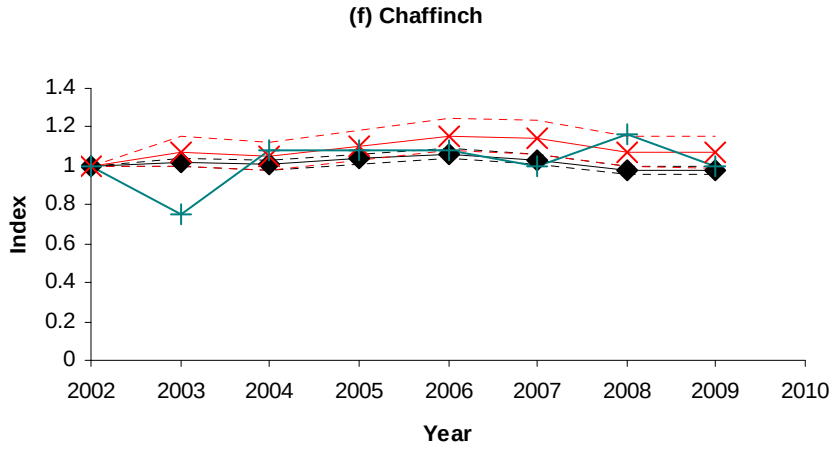


Figure 3.1 Breeding population trends for all species at Great Chishill (green pluses) and in the BBS samples for the whole of England (black diamonds) and Cambridgeshire, Hertfordshire and Essex (red crosses).







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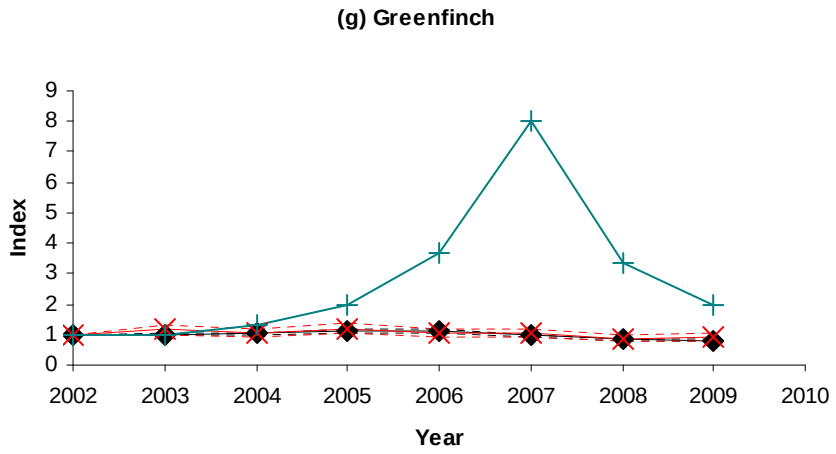

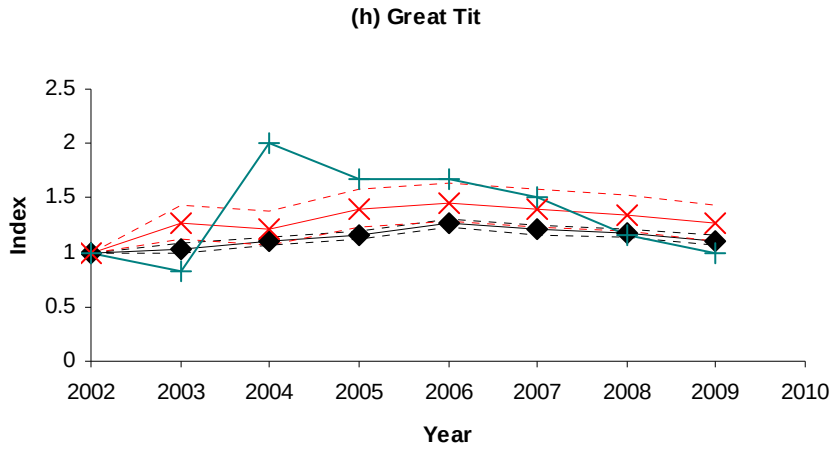

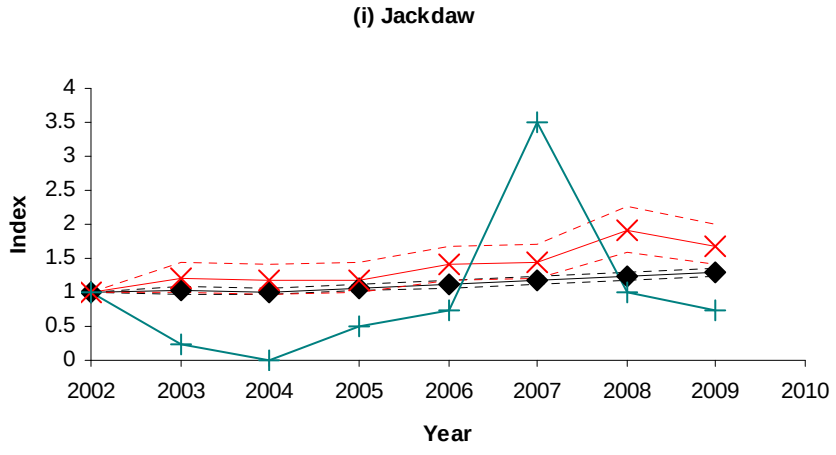

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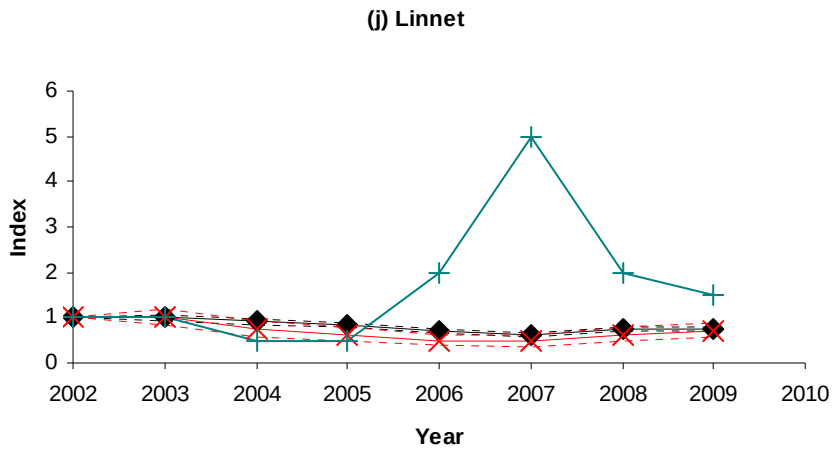

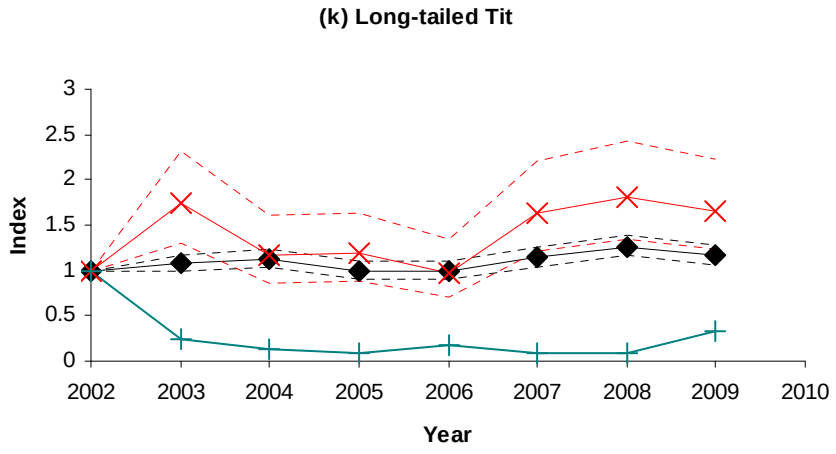

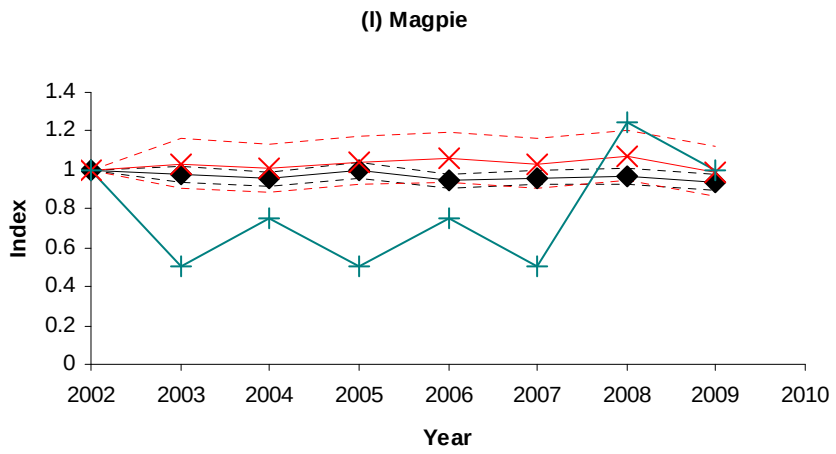

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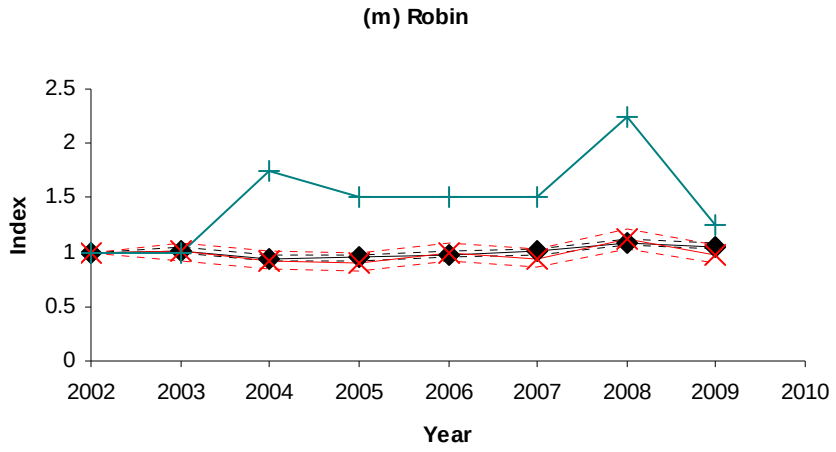

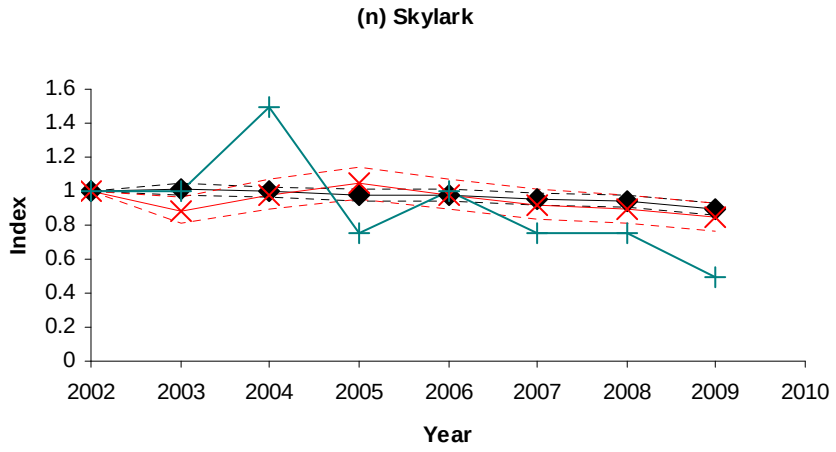

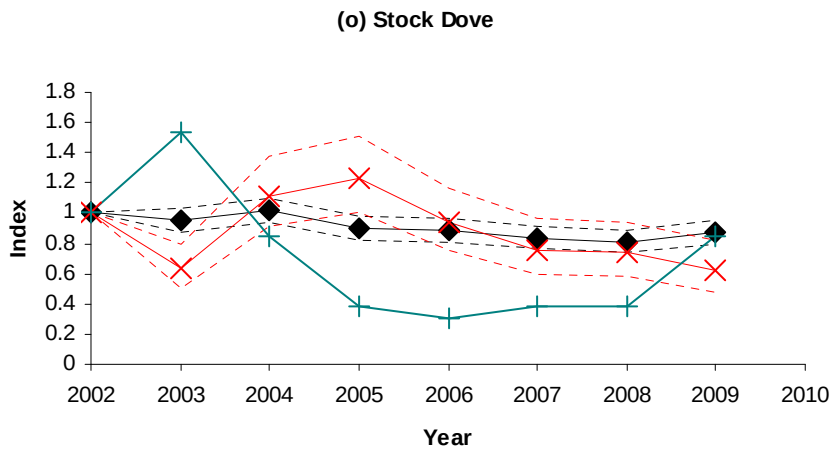

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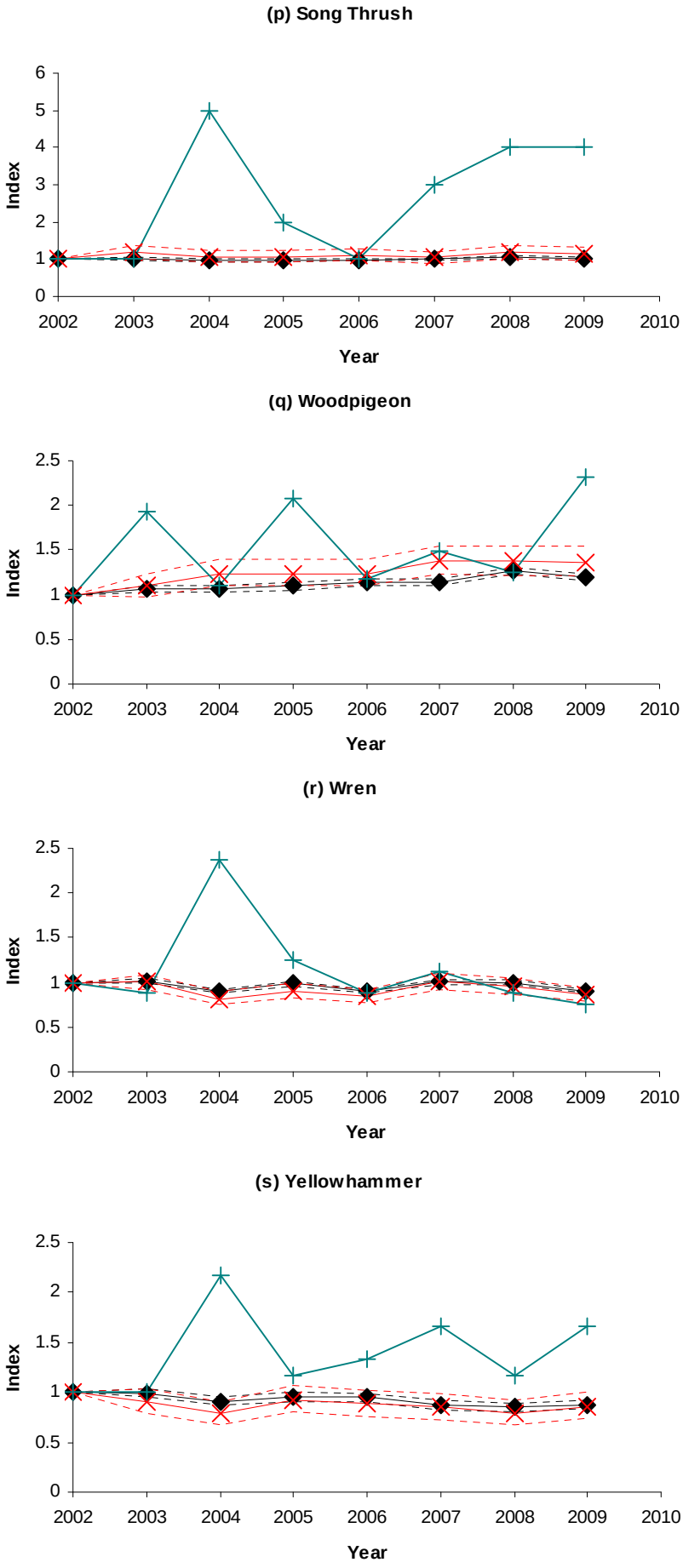


Figure 3.1 Continued.

Figure 3.2 shows the breeding population trends for Great Chishill once again, but with the winter trends as well for comparison, for all species that were present in each season in sufficient numbers. The winter trends tended to show larger fluctuations, as would be expected from seasonal differences in bird behaviour and detectability, but the generally positive breeding season trends for robin and yellowhammer were, broadly, reflected in the winter data too (Figure 3.2i, o). Conversely, however, the decline in breeding skylark numbers was not reflected in winter (Figure 3.2j) and wren showed a shallow increase, overall, instead of a shallow decline (Figure 3.2n). The increase in song thrush breeding numbers was another pattern that was not reflected in the winter counts (Figure 3.2k). Other differences were an increase in blackbird counts, until 2008-09 at least, as opposed to stability in breeding numbers (Figure 3.2a) and a lack of any sign of a recent decline in greenfinch counts in winter, in marked contrast to the spring results (Figure 3.2e). The greenfinch count was at its highest to date in 2009-10, as was that for chaffinch, which was remarkably high relative to the earlier years (Figure 3.2d). As well as sampling artefacts, differences in patterns between seasons could reflect contrasting changes in habitat quality over time between seasons. For example, increases in over-wintered stubble or wild bird cover from year to year could draw in increasing numbers of birds from the area around the focal farm at Great Chishill, while these birds subsequently disperse to breed elsewhere, so there is no clear effect on local breeding numbers. Cold weather could also have a large effect on the counts in any given winter, because birds tend to form larger flocks in such conditions, congregating where food supplies are still available and not covered by snow, for example. This could explain the particularly high counts of greenfinch and chaffinch in 2009-10. Overall, the trends in winter counts suggest that the farm at Great Chishill provides winter habitat that contrasts more strongly, and positively, with the wider countryside, than the breeding bird habitat that is provides. Although this is a broad generalization, in turn it suggests that improvements in habitat management for birds at Great Chishill might best focus on the breeding requirements of key species.

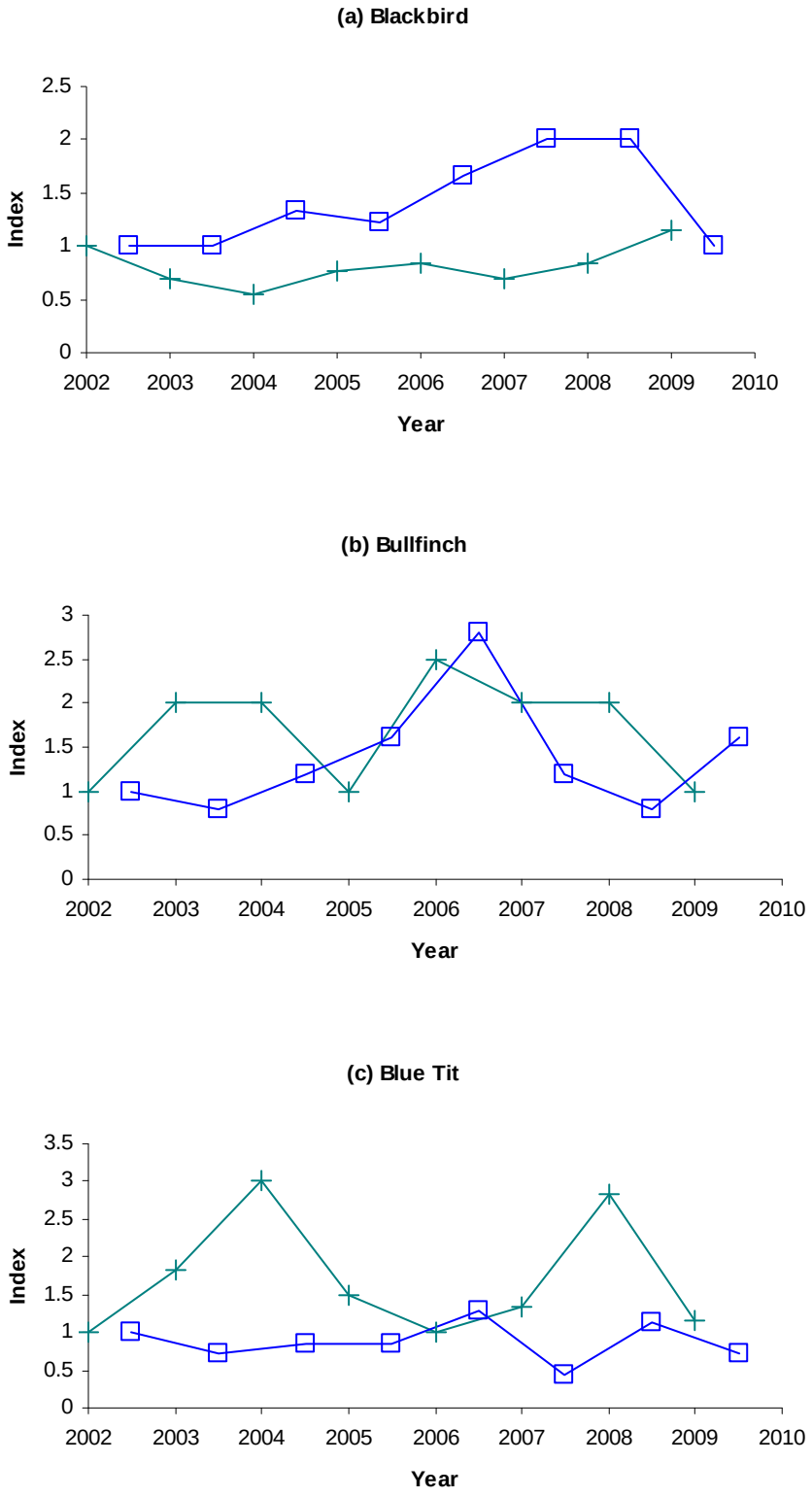
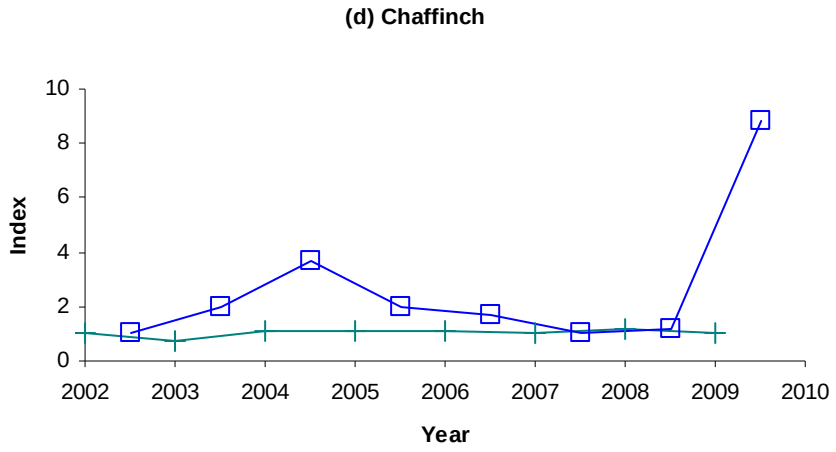
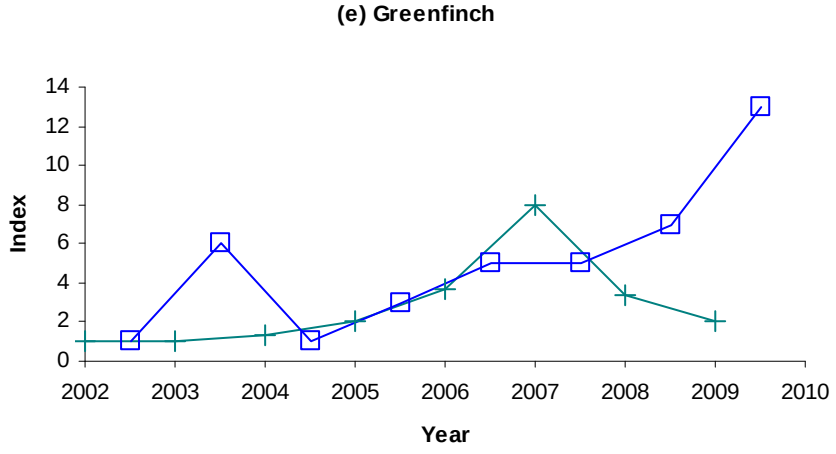
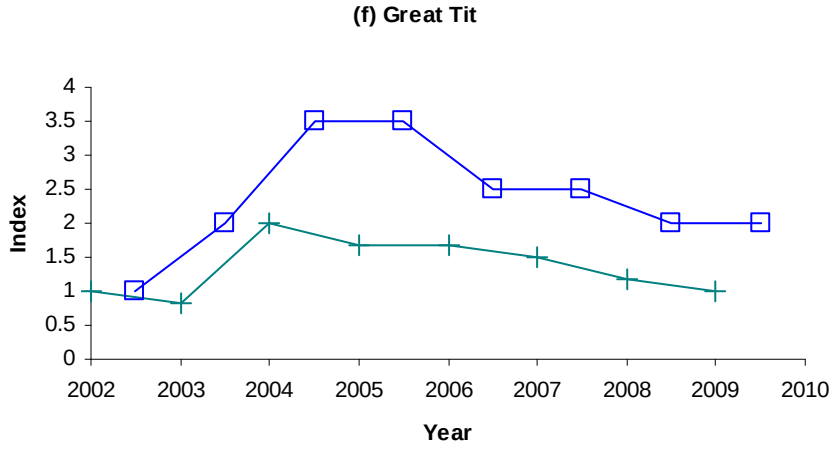


Figure 3.2 Breeding (green pluses) and winter (blue open squares) population trends for all species at Great Chishill.







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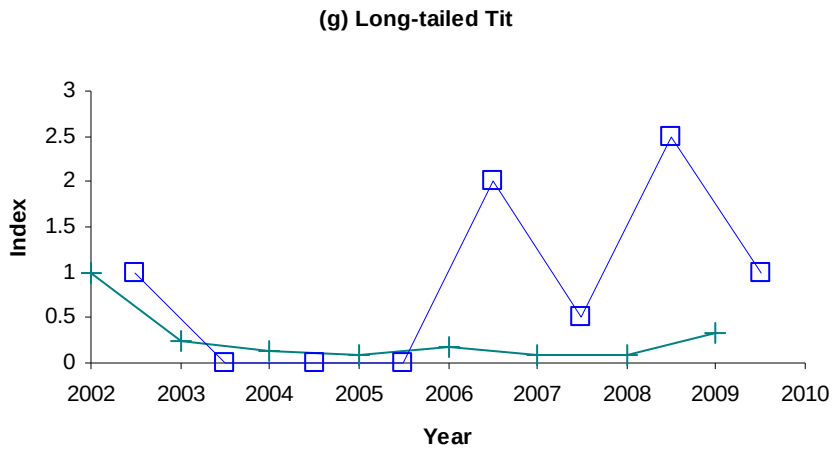

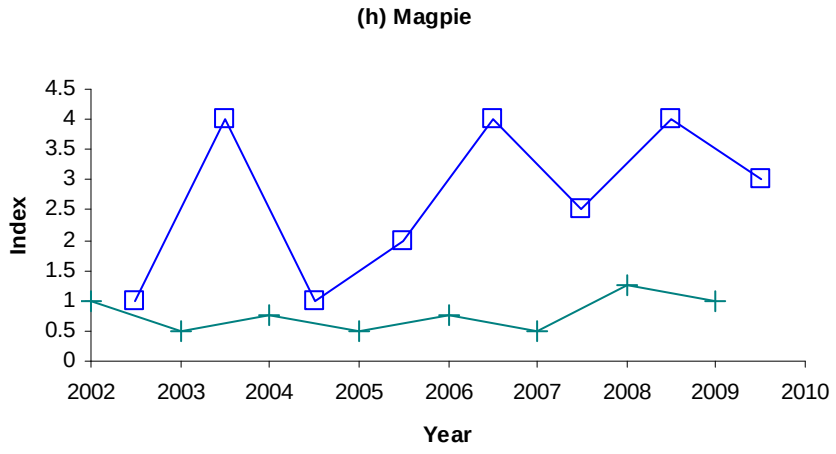

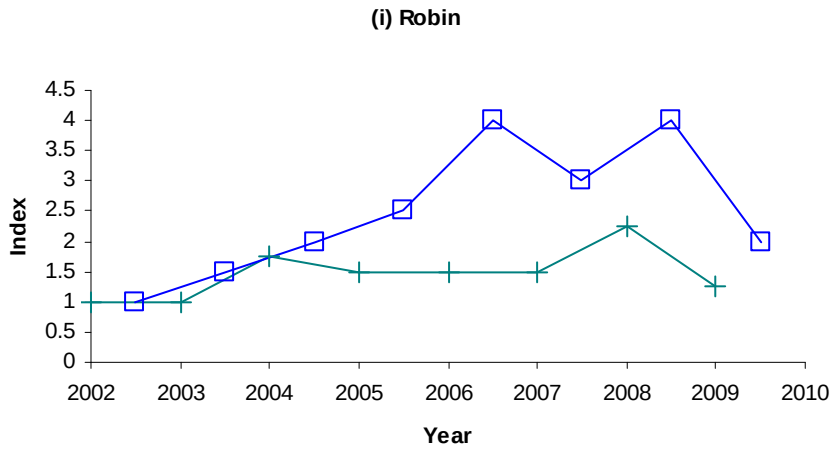

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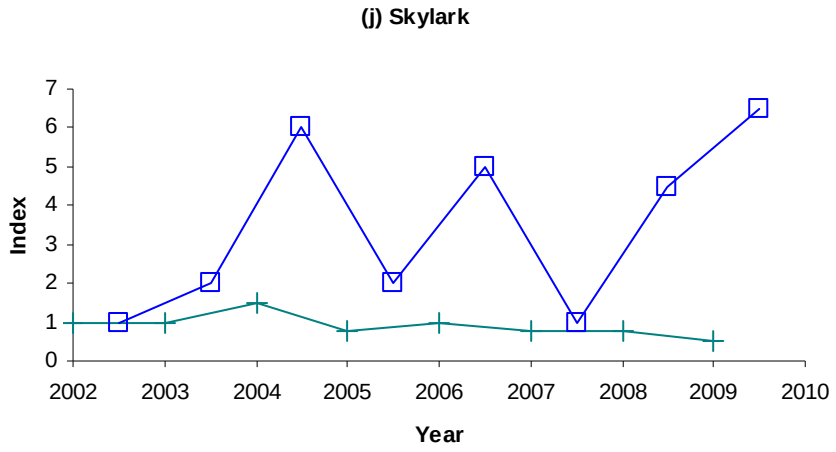

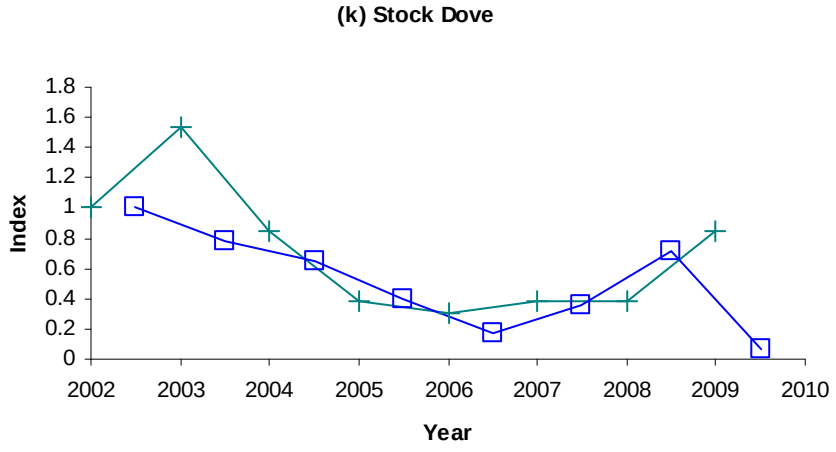

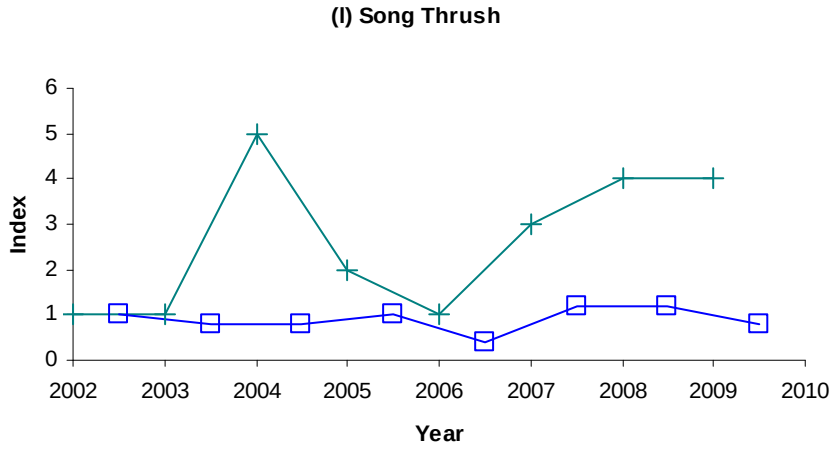

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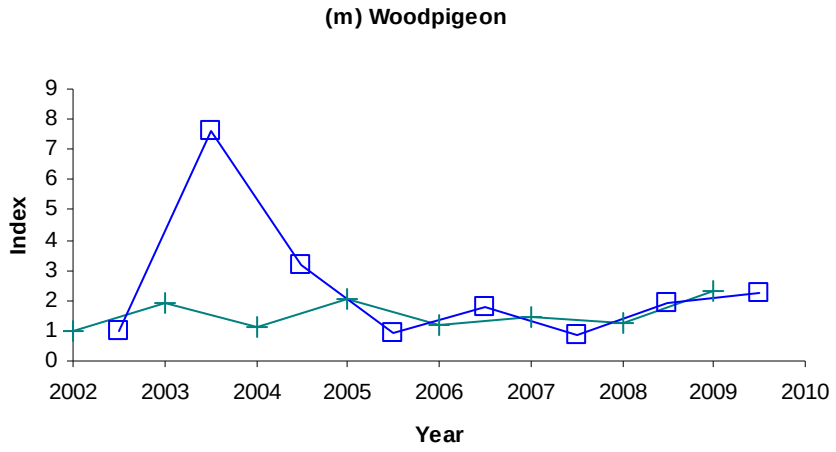

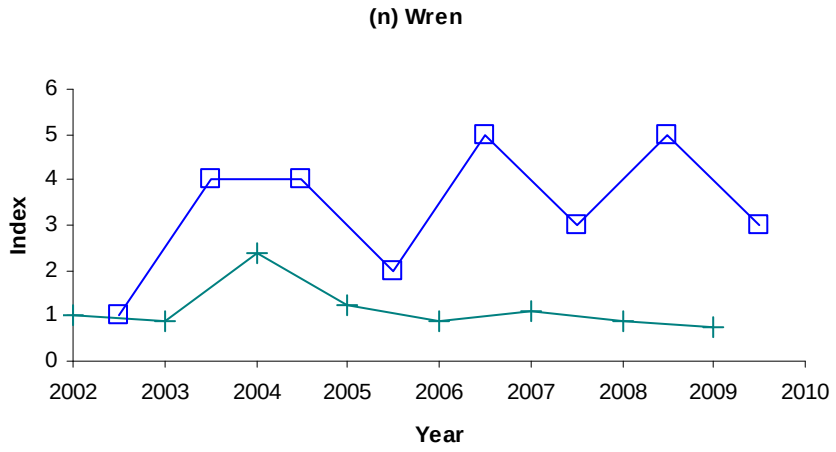

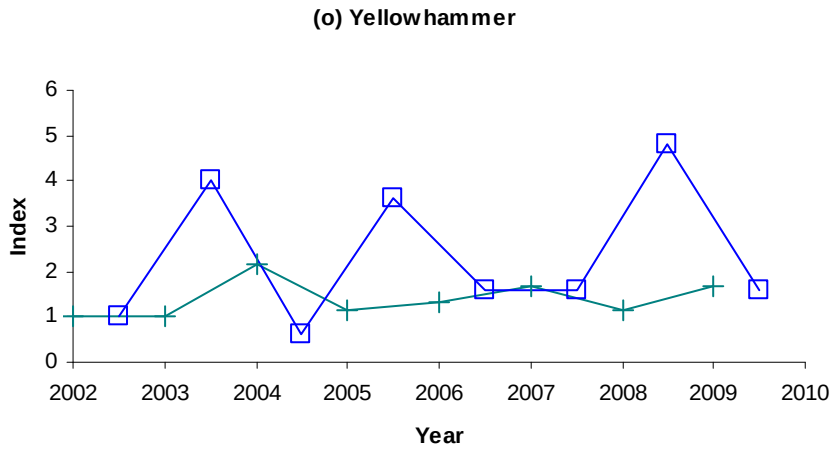

Figure 3.2 Continued.

3.2 Species Richness

Results for species richness calculations are displayed in Figure 3.3, which shows mean species richness per BBS square and for the farm at Great Chishill each year. It is important to note that variations in species richness tend to be small, involving one or two species per year, because the majority of species are always seen in some number each year. Thus, variations typically reflect the presence or absence (or non-detection) of a few relatively uncommon species and should not be over-interpreted. In addition, the pool of possible species is larger in the breeding season than in winter because more species migrate to inland Britain to breed than to spend the winter. It is, therefore, unsurprising that breeding season species richness at Great Chishill is higher than that in winter (Figure 3.3). However, it is noteworthy that both are higher, on average, than the BBS averages for England or the three counties centred on Great Chishill (Figure 3.3). This suggests that the study farm provides habitat for a wider range of species than the average farmland-dominated BBS square. In addition, the broadly increasing trend in winter species richness (Figure 3.3) supports the impression for the species-specific survey results that the quality of winter habitat for birds at the farm has increased over time.

A caveat to these conclusions is that the Great Chishill surveys use twelve 200 m transect section as opposed to the ten used in the BBS. Hence, all other factors being equal, it might be expected that the survey would detect 20% more species (in fact, it is unlikely that the difference would be so large in practice because the "extra" transect sections are unlikely to consists of a radically different habitat and the relationship between transect length and species richness is unlikely to be linear). On average, the annual BBS species richness values were 32.5 for the region around Great Chishill and 31.6 for England; correcting the averages for Great Chishill to take account of the (maximum) bias of 20% produces estimates of 34.2 for the breeding season and 29.7 for the winter. Thus, the breeding season value is still high, suggesting that the farm does indeed support more species than the landscape average. There are no data to provide a similar, direct, comparison for the winter, but the average still seems high compared to the BBS estimates, given the reduced species pool in winter.

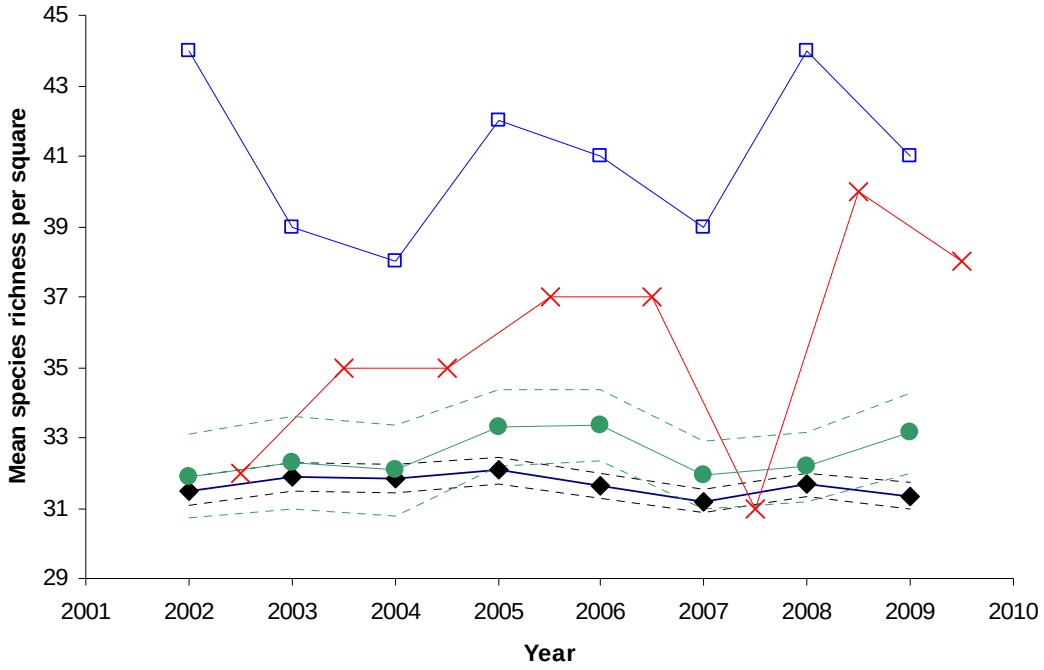

Figure 3.3 Annual species richness data from the BBS (per square) and Great Chishill (across the whole farm). Black diamonds show data from the BBS for the whole of England (dashed lines show 95% confidence intervals), green circles show BBS estimates for Cambridgeshire, Hertfordshire and Essex (again with 95% confidence intervals), red crosses show winter data and open blue squares spring data for Great Chishill.

3.3 Density Estimates

As an example of what can be produced from BBS data using Distance sampling, mean density estimates for the UK on tilled farmland (19.4% of UK by area) for key farmland species, with confidence intervals, are displayed in Table 1. Comparable estimates could be obtained for Great Chishill if the survey methods were changed to use BBS-type distance bands, as described above, although it remains the case that, as with the count results, single site data are subject to fluctuations and sampling effects that affect the strength of the conclusions that can be drawn from apparent differences within or between datasets.

Species	Arable Farmland Density (birds per km$^{2)}$	
	Estimate	95% Confidence Interval
Woodpigeon	46.1	41-53
Turtle Dove	0.7	0-1
Skylark	18.9	16-22
Dunnock	16.6	15-19
Blackbird	32.5	29-36
Song Thrush	2.8	2-4
Whitethroat	15.3	13-17
Jackdaw	5.7	4-8
Starling	13.7	11-17
Greenfinch	11.3	9-13
Linnet	17.1	14-20
Bullfinch	1.3	1-2
Yellowhammer	24.8	22-27

Table 1 Mean density of birds in tilled farmland in UK as calculated from Distance sampling using BBS data (Newson *et al.* 2005).

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