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South West London Waterbodies SPA Wildfowl Population Analysis

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EXECUTIVE SUMMARY

1. The South West London Waterbodies SPA, which comprises seven SSSIs, is designated for internationally important numbers of wintering Gadwall and Shoveler. It also supports large numbers of Tufted Duck. Over the past decade, however, numbers of these waterfowl have been suggested to decline across the SPA.

2. Explanations suggested for the apparent waterbird declines across the SPA include a change in phenology of some species; human disturbance has also been postulated as a contributory factor.

3. Using Wetland Bird Survey (WeBS) data and WeBS Alerts techniques, trends of Gadwall, Shoveler and Tufted Duck were analysed at the SPA and SSSI level. Each trend was viewed in the context of the national and regional trend of the relevant species.

4. At the SPA level, no declines in any of the species reviewed were found over a period of ten years or more. One 'Alert' was fired; this was for Shoveler, which declined by 30% over the last five years of analysis.

5. At the SSSI level, High Alerts for 'all time' (generally the period 1989-2000) were fired for Gadwall on three of fifteen site combinations, Shoveler on one site and Tufted Duck on two sites, in response to declines greater than 50%. A number of shorter-term High Alerts (≥50% declines) and several Medium Alerts (≥25% declines) were also triggered at specific sites, with various caveats.

6. Comparison of the timing of peak counts at national and SPA scales revealed little difference in the peak mean count month. The majority of peak counts within the standard index window were made within one month of the comparison peak count.

7. Plotting the peak mean counts across all SSSIs revealed little evidence of shifts in timing of peak counts. Most peak counts occurred inside the standard WeBS index window, therefore apparent declines are unlikely to be due to excluded data.

8. Negative effects of human disturbance on waterbirds cannot be ruled out. Recreational disturbance measured by the Wetlands Advisory Service (2003) at Thorpe Park and Wraysbury II Gravel Pits may have contributed to species declines identified here.

9. Future monitoring of the SPA (and component SSSIs) is recommended to include detailed WeBS Alert analysis, in order to examine whether recent SPA-level negative trends in Gadwall and Tufted Duck mark the beginnings of sustained decline or acceptable fluctuation.

1. INTRODUCTION

The South West London Waterbodies SPA consists of seven component SSSI reservoirs, gravel pits and lakes. These include reservoirs at Staines, Kempton Park and Wraysbury, and gravel pits at Thorpe Park and Wraysbury again. The SPA is designated under Article 4.2 of the EU Birds Directive (79/409/EEC) for its internationally important numbers of over-wintering Gadwall *Anas strepera* and Shoveler *Anas clypeata*, but also supports important winter populations of Tufted Duck *Aythya fuligula*.

Over the past decade, it has been suggested that numbers of these waterbirds have declined across the SPA. It is unclear whether these declines are real or represent normal annual fluctuation of the relevant populations. Peak counts recorded at the SPA were reported to be 'out of step' with national peak counts (Wetlands Advisory Service 2003). Changes in phenology could reflect climate change (Parmesan & Yohe 2003, Root *et al*. 2003) and would be of particular relevance to apparent declines in Shoveler and Tufted Duck, as the standard Wetland Bird Survey (WeBS) indices for these species are based on a subset of count months for which numbers are considered most reflective of the stable population (September and October for Shoveler, November through to February for Tufted Duck; Pollitt *et al*. 2003). A sufficiently large change in phenology could erroneously resemble a species decline, when actually a species was stable or increasing. Large counts could fall outside of the index months and would not be included in standard WeBS indexing. Gadwall are indexed on all months from September through to March and are thus not prone to such an issue.

Recreation has also been cited as a factor that could be contributing to waterbird declines. Activities such as sailing and angling take place on a number of the component sites, and have done prior to SSSI and SPA designation. Evidence for increases in these pursuits is scarce, and recreational pressure is even believed to have decreased in some locations. However, it has been suggested that leisure activity may be involved in the apparent decline of waterbird numbers, particularly on the SSSIs Wraysbury & Hythe End Gravel Pits and Wraysbury No.1 Gravel Pit.

In order to determine whether the three species of duck have declined on the South West London Waterbodies SPA, and across the individual component SSSIs, the WeBS 'Alerts' system will be used. This procedure generates smoothed indices of waterbird trends, and can identify changes in site, regional and national level populations (e.g. Austin *et al*. 2003, Austin *et al*. 2004). Any declines identified on the SPA will be examined in the context of regional and national species trends, to ensure that apparent site level effects are not merely reflecting wider processes.

1.1 Aims

- To determine whether Gadwall, Shoveler and Tufted Duck on the component SSSIs of the SW London Waterbodies SPA have decreased more than would be expected as a result of 'normal' between-year variation, having taken regional and national species trends into account.
- To do the same for the SW London Waterbodies SPA and other relevant combinations of SSSIs.
- To determine whether the timing of peak counts on the SPA and component waterbodies can serve to explain apparent declines.

2. METHODS

2.1 Data and Site Structure

WeBS data

Data from the Wetland Bird Survey were used in the analysis. WeBS is a long-term waterbird monitoring scheme, relying on the monthly counts of thousands of volunteers across the UK. Estuaries and inland waterbodies are included in the 'Core Count' programme, whilst Low Tide data is also collected at some tidal sites. WeBS Core Counts were used for all site / species combinations for which data were available during the period 1989/90 (hereafter 1989) to 2000/01 (hereafter 2000). This cut-off date is consistent with the last year for which a WeBS report exists (Pollitt *et al*. 2003). These data were used to construct annual species indices for the three species under review.

WeBS annual indices are calculated using count data collected between September and March. Within this period, the months for which the numbers of a given species are at their most stable are those used for producing the index, and these months differ between species. Gadwall (GA) are indexed on all seven months, Shoveler (SV) indices are based on September and October counts, whereas the index for Tufted Duck (TU) relies on data from November through to February. A consequence of adopting the standard WeBS indexing months is that, in addition to the breeding season, the passage period is also excluded from analysis, thereby guarding against large transitory fluctuations in numbers. The WeBS Alert system (section 2.2) was employed to quantify declines.

However, to investigate the possibility that changes in phenology could help to explain the apparent declines, data from outside the standard indexing months were also analysed where possible. Some data existed for most species / site combinations, although as Gadwall is indexed on seven months, there were fewer 'extra' counts for this species.

Site combinations

Analyses were performed at various spatial scales. Smoothed indices were produced for all three species of duck at the SPA level. Also, trends were created for the same species at the SSSI level (Appendix 1. for list of sites and subsites; Appendix 3. for map of sites). For Wraysbury No.1 Gravel Pits and Wraysbury & Hythe End Gravel Pits, various combinations of component sites were analysed (Appendix 1.).

To compare site trends with regional trends, counts of Gadwall, Shoveler and Tufted Duck made on WeBS sectors across the eastern half of the Environment Agency Thames region were indexed, using all available data spanning the period 1989/90-2000/01. It was not considered appropriate to compare trends at the South West London Waterbodies SPA with Thames region counts in western Britain or at estuarine sites, and so inland sectors in southeastern England were targeted. Appendix 2. illustrates which counties intersect the Thames region, and which were included in the analysis. To compare site trends with national trends, all available data for the same species and years were indexed for Great Britain as a whole.

2.2 Analysis

Full details pertaining to the use of Generalized Additive Models (GAMs) for the calculation of annual waterbird indices and the fitting of smoothed trend curves by the WeBS Alert System are available elsewhere (Leech et al. 2002, Atkinson *et al*. 2001). An overview is given here.

Annual indices

The index value for a particular winter is the number of birds present in that winter (summed monthly counts) expressed relative to the number of birds present in the base winter, which is arbitrarily set at

100. The WeBS Alert System assigns the base winter to be the most recent winter in the data being analysed.

Missing values, inevitable with count data, are accounted for by the GAM which fits a model with site, year and month factors. For n years of data, when a GAM model is fitted using (n-1) degrees of freedom the resulting index values are equivalent to those that would have been obtained using the Underhill indexing method (Underhill & Prŷs-Jones 1994), formerly used by WeBS for generating annual indices, except that, unlike that method, poor quality but higher than average counts are excluded and thus not permitted to inflate index values. The latter is essential to ensure that the smoothed trends (see below), which are obligate in their use of GAMs, are based on the same data as the annual indices. Imputation was only used for analysing data at the SPA, regional and national levels. It was not felt appropriate to impute data at the SSSI level or below, as the baseline dataset is too small. Indices were left incomplete where counts were missed at the lowest levels.

When producing the index, average monthly counts were assigned a 'count quality'. If greater than 50% of the standard indexing months were counted, the count was considered of good quality. Where data existed for less than 50% of the standard count months, the count was considered of lesser quality.

Smoothed GAM trends

Natural temporary fluctuations in numbers, for example those caused by variation in the severity of conditions over the winter period, can differ in size and / or direction from longer-term trends, hindering their interpretation. Extreme values may trigger false Alerts due to misinterpretation of temporary, short-term declines as longer-term trends. Alternatively, long-term trends that may have led to Alerts being flagged could be obscured by short-term fluctuations. In order to avoid such misinterpretations and misidentifications when calculating Alerts, the Alerts System uses GAMs to fit a smoothed trend curve to the annual indices. This it does by a reduction in the number of degrees of freedom available to the GAMs. As the number of degrees of freedom is decreased from (n-1) the trend become increasingly smooth until ultimately with one degree of freedom the smoothed curve becomes a linear fit. The WeBS Alert System adopts a standard (n/3) degrees of freedom to produce a level of smoothing that, while removing temporary fluctuations not likely to be representative of long term trends capture those aspects of the trends that may be considered to be important.

Changes in numbers calculated using values from a smoothed GAM trend are less likely to be due to the effects of temporary fluctuations in numbers, or to errors when sampling, than results produced were annual index values to be used. Thus, using GAMs reduces the probability that a decline from a short-lived unsustainable peak in numbers would be responsible for triggering an Alert.

Alerts

Proportional changes in the smoothed GAM trend in numbers are calculated by subtracting the smoothed GAM trend value at the start of the time-frame from the smoothed GAM trend value in the final winter. Calculated change values are expressed as a percentage of the index at the start of the period. Larger values therefore indicate larger proportional changes in numbers, with positive values equating to relative increases in the numbers and negative values equating to relative decreases over the specified time period. These values are then categorised according to their magnitude and direction. Declines of between 25% and 50% inclusive are flagged as Medium Alerts and declines of greater than 50% as High Alerts. Although they will not promote discussion within this report, increases are sometimes flagged in the appropriate tables. In order to facilitate comparison of decreases and increases in numbers, increases of between 33% and 100% are described as Medium increases, while increases of greater than 100% are described as High increases. This allows for the proportionally greater increase required to return numbers to their former level following a given decrease.

Alerts were generated over three time frames; the five-year period 1995-2000, the ten-year period 1990-2000, and the 'all time' period, running from 2000 back to the earliest date for which data were available (generally 1989). This technique was applied to all sub-SPA sites, and to the SPA itself. Alerts were issued with a caveat if based on average yearly counts of less than 25 birds.

Alerts were based on species trends using the standard WeBS indexing months (Austin *et al.* 2004). This ensured consistency with other research, allowed sector-level comparison with SPA, regional and national trends, and reduced noise that could be introduced from counts of juvenile birds or passage migrants. However, in response to concerns that peak counts of birds at component sites of the South West London Waterbodies SPA were occurring outside of the standard index window, Alerts were also generated using all available data for all species during the period September - March.

Regional and national comparisons

To compare trends at the SPA and SSSI level with those for the same species at wider spatial scales, statistical procedures recently developed for WeBS Alerts (Banks & Austin 2004) were employed. Binomial models were used to assess the relative proportion of the SPA total held by each SSSI and site combination. This procedure was also used to investigate the proportion of the regional and national totals supported by the SSSI or site combination.

The proportion, i.e. the number of birds counted at a site per year divided by the total SPA, regional, or national number for the year, was modelled by logistic regression. The models were binomial and specified a logit link function. Count values were only included in analysis where coverage was complete.

Output plots were generated for each species / site combination. In this way, the proportion of the region's birds occurring at a given site could be calculated across years. The 95% confidence limits obtained represent the confidence in the calculation of the proportion as it varies with the total number of birds in the SPA, region or nation, and the between-month variation in the average proportion a site holds in a given winter.

Changes in waterbird numbers are reflected in three possible proportional trends; positive, negative and stable.

Where numbers on a site undergo expansion, and regional trends decline or remain stable, a proportional increase is seen at the site under review. The trend is for estimates to increase with time, with largely non-overlapping confidence limits.

Negative trends in the proportional estimate suggest one of three scenarios, and consideration of species' regional and site trends can determine which applies. Firstly, the site trend could be in decline while the regional trend increases or remains stable. Thus the proportion at the site becomes smaller as the two trends diverge. Secondly, the site trend could be stable whilst the regional trend increases. Thirdly, both trends may increase, but at different rates. If regional counts were formerly low, a particular site may have held a relatively high proportion of the regional total. If the species in question then expands across the region but remains stable at the site, the relative proportion at the site will decrease. Where a WeBS Alert has been fired, it may be safe to assume the first explanation is more likely.

Plots can also be produced that suggest a species is relatively stable in numbers in comparison to the region, typically where a horizontal line can be drawn between the ranges of all confidence limits. These plots do not signify in which direction the site and regional trends are heading (i.e. increasing, decreasing or stable), merely that they remain consistent to each other.

A spreadsheet was also produced detailing the months in which peak counts occurred for all site / species combinations. This allows visual inspection of how consistent the timing of peak counts is.

3. RESULTS

3.1 Species Trends

3.1.1 South West London Waterbodies SPA

In this and all subsequent trend graphs, closed symbols indicate 'good' quality count data, whilst open symbols indicate counts based on less than 50% of the standard index months for the species.

3.1.1.1 Gadwall

Across the SPA as a whole, this species has shown a steady increase since 1989 (Figure 3.1.1.1). Numbers peaked in 1998, with a subsequent drop-off in the following two winters. However, despite this recent negative trend, Alerts were not fired for Gadwall across any of the comparison time periods (five year, ten year and 'all time'), and numbers were still higher in 2000 than in 1995.

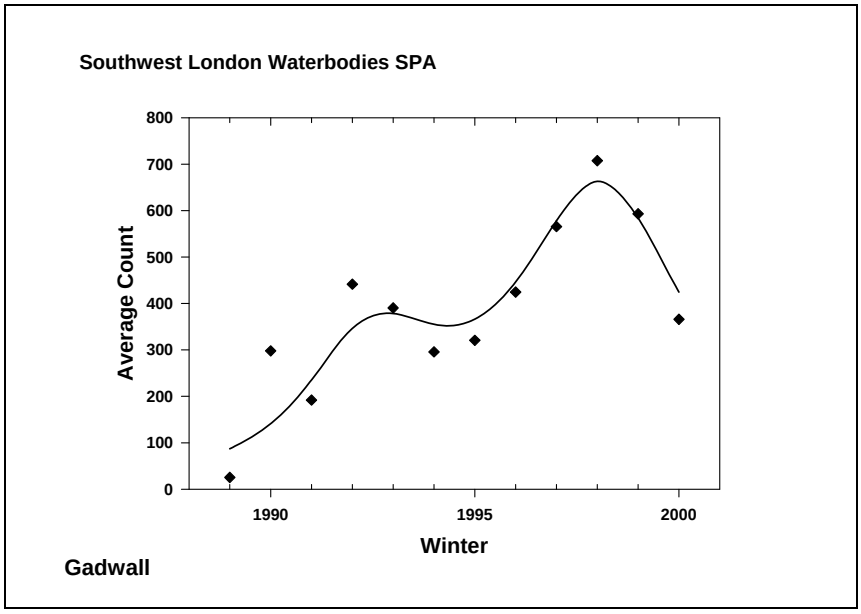

Figure 3.1.1.1 Smoothed index for Gadwall on the South West London Waterbodies SPA.

3.1.1.2 Shoveler

The smoothed index for Shoveler shows an almost symmetrical pattern. Numbers rose sharply in 1994 after a shallow decline from an average of around 400 birds, and the trend has been for a further period of moderate decline since (Figure 3.1.1.2). However, current population levels are still greater than ten years ago, and those in 1989. The current period of decline is reflected in a Medium Alert being triggered for the five-year time span, this due to a 30% decrease since 1995 (Table 3.1.1). It should be noted that the trend showed a large fluctuation during the period 1993-1995, so it is possible that current apparent declines could be reversed in a relatively short time period. Furthermore, the Medium Alert should perhaps be treated cautiously, as the WeBS Alert system uses a 'biological filter' to interpret certain species declines (section 4.1).

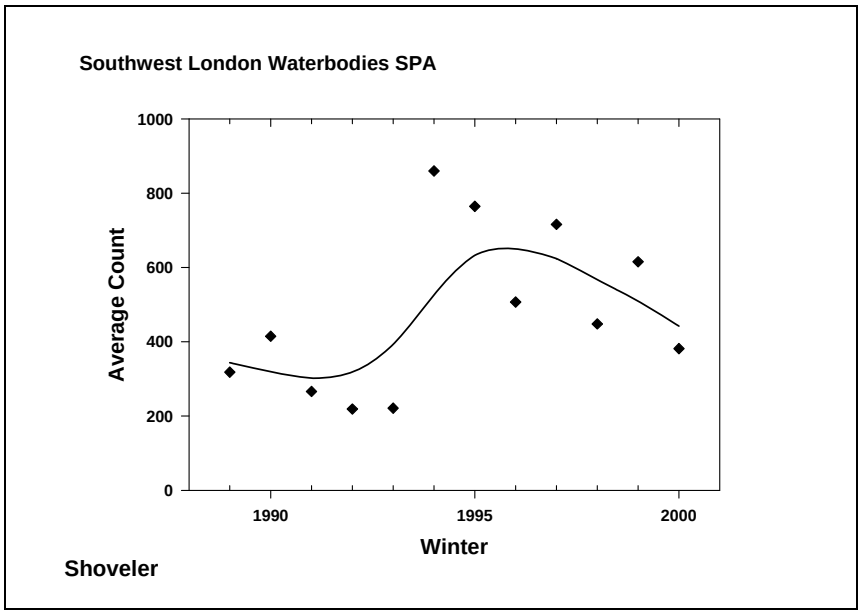

Figure 3.1.1.2 Smoothed index for Shoveler on the South West London Waterbodies SPA.

3.1.1.3 Tufted Duck

In common with Gadwall, numbers of Tufted Duck have increased on the SPA, although at a slower rate (Figure 3.1.1.3). Average counts have risen from below 500 birds in 1989 to over 1,000 in 2000, whilst the ten-year period witnessed a 52% increase in Tufted Duck numbers. Although declines were recorded on some component sites (Kempton Park Reservoirs, Wraysbury & Hythe End Gravel Pits SPA sectors), increases were witnessed on others, often from initially low numbers (Wraysbury Number 1 Gravel Pits - especially South sector, Knight & Bessborough Reservoirs, Wraysbury Reservoir: Table 3.1.1). Since 1995, there has been a small decline (7%), which should be considered within the range of 'natural' population fluctuation for the species.

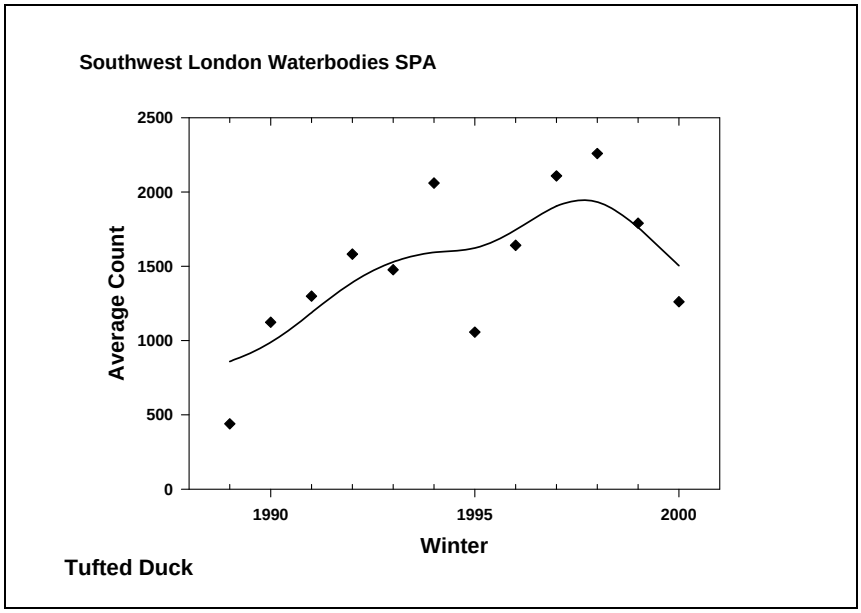

Figure 3.1.1.3 Smoothed index for Tufted Duck on the South West London Waterbodies SPA**.**

3.1.2 Regional and National Trends

3.1.2.1 Gadwall

At both national and regional levels, Gadwall numbers have increased steadily over the past 11 years (Figure 3.1.2). The number of Gadwall wintering in Great Britain has risen by approximately 3,000 birds since 1989, with record levels recorded each year but 2000/01 (Pollitt *et al*. 2003). The winter of 2000/01 was therefore slightly unusual, and this is reflected in the regional trend. At this spatial scale, despite evidence of some fluctuation (accounted for by the smoothed GAM), year-on-year increases were also seen, with a period of steep increase from 1997. Counts in 2000 bucked this short-term trend, although numbers were still higher than in 1996.

3.1.2.2 Shoveler

Across Great Britain as a whole, the Shoveler index has remained largely stable over the time period studied (Figure 3.1.2). There is a degree of fluctuation around the smoothed GAM, with three high counts from 1989 – 1991 being followed by three lower counts before a return to 1990 levels. The regional trend has likewise shown fluctuation between years, with declines around 1992 followed by increases in 1994 and 1995 (Figure 3.1.2). Overall, the Shoveler index for the Thames region is fairly stable.

3.1.2.3 Tufted Duck

Tufted Duck indices are very similar at both regional and national scales (Figure 3.1.2). The general trend is for a shallow increase, with limited fluctuation. At the regional level, the index is stable at around 4,000 birds, with an increase of around 400 birds since 1989. Nationally, the trend has shown minimal fluctuation, with a greater relative increase over the same period; it is possible that the wintering population is affected by concurrent increases seen in native breeding Tufted Duck (Crick *et al.* 2004).

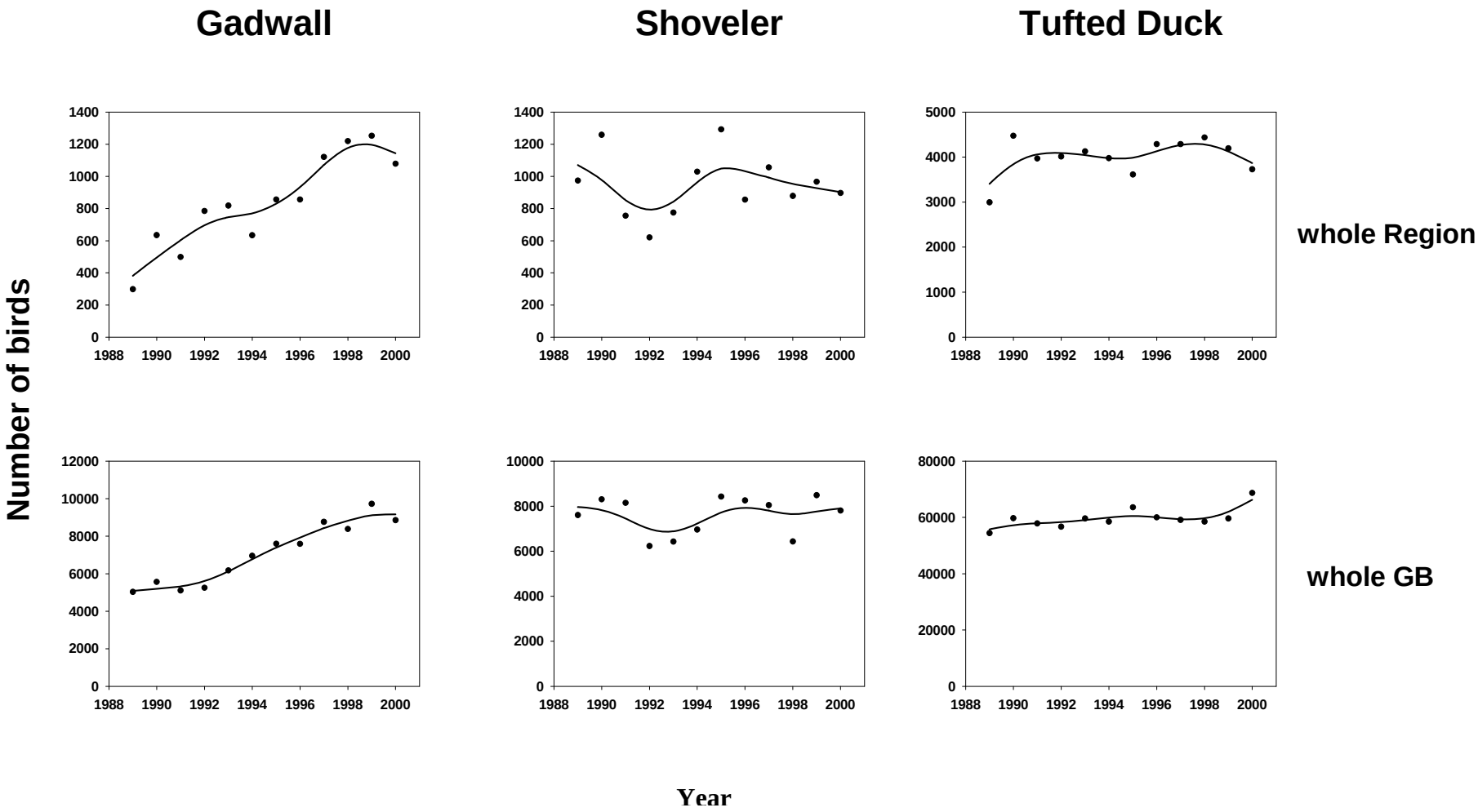

Figure 3.1.2 National and Regional smoothed GAM trends for Gadwall, Shoveler and Tufted Duck.

3.1.3 Staines Moor SSSI

Site trends for Gadwall and Shoveler at Staines Moor reflect those on the SPA as a whole, and to a lesser extent, the regional and national trends (Figure 3.1.3). Although the SSSI holds only small numbers of Gadwall, and a consistently small proportion as estimated by WeBS counts (hereafter referred to as 'proportion') of the SPA total, there has been a steady increase over the past twelve years, with an especially large increase since 1995. Shoveler trends at Staines Moor are very similar to the SPA trend and show similar fluctuation, unsurprising in that a large estimated proportion of the SPA total was counted here. This proportion appears to have substantially declined in recent years, and a Medium Alert was triggered for the five-year period, in common with the SPA trend for the species (Table 3.1.1). Again, interpretation of this decline should include reference to the biological filter (section 4.1)

Tufted Duck at Staines Moor SSSI have shown declines since 1989, with a Medium Alert triggered (Figure 3.1.3, Table 3.1.1). This is in contrast to the increasing SPA trend. The proportion of the SPA and regional totals of Tufted Duck supported by Staines Moor looks to have declined sharply since 1989, with some evidence of a slight upturn in recent years.

3.1.4 Knight and Bessborough Reservoirs

This SSSI does not support large numbers of Gadwall, but the index for this species has steeply risen (Figure 3.1.4). Average counts of Shoveler on the site reached above 200 in 1995, but since that winter have declined consistently. This peak is consistent with the pattern for the entire SPA, and Knight & Bessborough Reservoirs were predicted to hold between 20% and 50% of the SPA total around this time. The rapid decreases since 1995 resulted in a High Alert status being issued in response to a 63% decline (Table 3.1.1), although over this time period, results should be accepted cautiously in context of the WeBS Alerts 'biological filter' (section 4.1). The regional trend for Shoveler has been largely stable, reflected in the proportional plot (Figure 3.1.4). As the regional trend has remained fairly constant, so the regional proportion at the SSSI reflects the SSSI trend, suggesting that the SSSI trend cannot be explained by wider species trends. Data for Tufted Duck are variable in availability, but the smoothed trend for the five-year period seems consistent with the SPA trend in that it is downward. However, numbers of Tufted Duck on this SSSI are predicted to reflect only a small fraction of the SPA total.

3.1.5 Thorpe Park Number 1 Gravel Pit

The smoothed index for Gadwall at this SSSI shows a marked contrast to the SPA trend (Figure 3.1.5). Numbers have declined from a peak in 1993, although it should be noted that counts were not available before this date. This resulted in an 'all time' High Alert being fired (Table 3.1.1). The proportion of the regional total has changed only minimally since 1995, implying that the sector trend could reflect regional population effects. Counts of Shoveler at Thorpe Park are negligible, never exceeding yearly averages of four birds. The trend for Tufted Duck fluctuates, with the pattern over the last six years of analysis reflecting that for the SPA.

3.1.6 Kempton Park Reservoirs

Gadwall trends at Kempton Park are broadly in step with those at the SPA and regional levels, with steady increases from 1990 to 1998 (Figure 3.1.6). Trends in the last two years of analysis (1999 and 2000) are similar to those across the SPA, marking the possible beginning of a decline. The proportion of Gadwall on the site as a function of the SPA and regional totals appears to be increasing, with little change since 1994. Numbers of Shoveler have increased from a baseline average of no birds to over 60 in the year 2000. However, the total yearly average does not exceed 25 birds and so the >1000% increase (Table 3.1.1) should be treated with caution. Tufted Duck show a clear decline at Kempton Park, both in the smoothed trend (Figure 3.1.6) and the High Alerts fired for all time periods considered (Table 3.1.1). The corresponding proportions of SPA, regional and national levels are all

modelled to decrease accordingly, although at the regional level, the range of confidence limits suggest that sector-level changes could be consistent with regional patterns, as a horizontal line can be plotted through the range.

3.1.7 Wraysbury Reservoir

Numbers of Gadwall and Tufted Duck counted on Wraysbury Reservoir are fairly trivial in relation to numbers present on other component sites within the SPA, and contribute little to the SPA trend. Yearly Gadwall numbers are very small (usually averaging five or lower), whilst the index for Tufted Duck is fairly stable, with occasional fluctuations (Figure 3.1.7). However, Shoveler numbers at Wraysbury Reservoir were consistently between 20% and 80% of the SPA total for the early 1990s (Figure 3.1.7). This figure is now lower, and High Alerts were triggered for all three time periods reviewed (Table 3.1.1). The period of decline seems consistent with those at the SPA and regional level, and the stable proportion at the regional level implies changes in step with wider changes, although the negative trend is steeper at the sector.

3.1.8 Wraysbury & Hythe End Gravel Pits (including Yeoveney Lake and County Ditch Lake)

The site trend for Gadwall closely follows that of the SPA itself, with continuous increases up to the start of a decline after 1998 (Figure 3.1.8). It is perhaps too early to assess the importance of this apparent decline as over five years Gadwall numbers have still increased. However, as this SSSI regularly holds between an estimated 20% and 80% of the SPA total, close monitoring is required. The site appears to be becoming increasingly important for Gadwall, as the proportion of the SPA total held by this SSSI has increased steadily since 1989. There also appears to be some change in the proportion of Shoveler held by the SSSI, with an increase from no birds in 1989 to an estimate of over 0.2 of the SPA total in 2000, although the trend indicates a degree of fluctuation about the trend line during this time and confidence limits about the proportional estimate are wide. The only Alert at this SSSI was fired for Tufted Duck, with a 46% decline over five years triggering a Medium Alert (Table 3.1.1). The short-term nature of this decline suggests interpretation using the biological filter, but this trend is broadly consistent with the SPA trend, even though short-term declines have been greater at the SSSI level. Also the proportion of the SPA and regional totals held by this SSSI fluctuates from year to year. In 1989 nearly 80% of Tufted Duck on the SPA were estimated to be found at Wraysbury & Hythe End Gravel Pits, although subsequently the population of this duck has increased on other component sites of the SPA, leading to a diminished relative 'site importance' of the SSSI for this species.

3.1.9 Wraysbury Number 1 Gravel Pit

Little change is evident in any of the three species trends at Wraysbury Number 1 Gravel Pit SSSI. A five-year Medium Alert was triggered for Gadwall (Table 3.1.1), but the species trend suggests that this was based on a return to stable levels from a short-term peak (Figure 3.1.9), and this level of fluctuation would be allowed for by the biological filter over this time period. The proportion of Gadwall at the SSSI in comparison to SPA and regional levels has likewise remained at a consistently low figure except for two peak years. Shoveler numbers rarely exceed a yearly average count of 20 birds and this site supports relatively few of the Shoveler on which the SPA is designated. The site trend for Tufted Duck resembles the SPA trend, and although there was a moderate 'all time' increase, the species appears fairly stable at this SSSI.

3.1.10 Wraysbury Number 1 Gravel Pit (North)

The data for this sector, part of Wraysbury Number 1 Gravel Pit SSSI, are difficult to analyse in depth as the sector has been infrequently counted in isolation. Gadwall and Shoveler numbers have remained low in comparison to other component sectors (Figure 3.1.10). Tufted Duck show some evidence of a

decline over the past few years of analysis, but there are insufficient data to calculate Alerts (Table 3.1.1).

3.1.11 Wraysbury Number 1 Gravel Pit (South)

This sector is subject to the same limitations as the previous sector. Again, data are lacking to calculate instructive species trends, logistic model predictions or Alerts (Figure 3.1.11; Table 3.1.1). Tufted Duck is the only species counted in average yearly numbers greater than 30.

3.1.12 Wraysbury II (North) Gravel Pit

Available data for this sector, which comprises part of Wraysbury & Hythe End Gravel Pits SSSI, produced smoothed indices that fired two Alerts. Gadwall trends triggered a Medium Alert over five years (the short time period suggesting caution be exercised in interpretation), and a High Alert over 'all time' (Figure 3.1.12; Table 3.1.1). Although the smoothed trend is incomplete, and there appears to be fluctuation in the trend, logistic model predictions suggest that the proportion of total SPA Gadwall held at the lake is beginning to decrease. Likewise, a negative trend in the regional proportion estimates intimates that declines are inconsistent with regional trends. Tufted Duck exhibit a similar smoothed index to Gadwall, but it is not justified to calculate Alerts. A zero count was recorded in the year 2000, which theoretically results in infinite change over the time periods used. Again the counts appear to fluctuate, although the relatively stable proportion of Tufted Ducks found at this sector (in all years apart from 2000) imply that this trend may be mirroring the SPA trend. It will be important to monitor whether two years of declines since 1998 continue in later years.

3.1.13 Wraysbury II (South) Gravel Pit

This sector also forms part of Wraysbury & Hythe End Gravel Pits SSSI, but shows slightly different trends to the sector previously analysed. Gadwall trends appear to track those of the SPA and the region, although the proportion of Gadwall at the sector in comparison to the SPA total shows an upward trend (Figure 3.1.13). This suggests that the increasing SPA trend could in part be due to increases at this gravel pit. This sector does not support large numbers of Shoveler, and although the trend is upward, total average yearly counts do not exceed 25 birds, so Alerts should be interpreted with caution (Table 3.1.1). Alerts for Tufted Duck are based on substantial counts, and Alerts were fired for five years and 'all time'.

3.1.14 Yeoveney Lake

Yeoveney Lake and the following sector, County Ditch Lake, form part of Wraysbury & Hythe End Gravel Pits SSSI but not the South West London Waterbodies SPA. High Alerts were fired for Gadwall, although these should be accepted cautiously owing to the small number of ducks involved (Table 3.1.1). Shoveler numbers fluctuate somewhat at this sector, but the proportion of the SPA total has remained reasonably consistent, indicating that the population is changing in line with the SPA trend (Figure 3.1.14). Alerts were not fired for Tufted Duck at this sector, and the trend seems stable except for one year of fluctuation.

3.1.15 County Ditch Lake

This small component SSSI sector harbours relatively few birds of any of the three waterbird species analysed in this report. Alerts were subject to caveat for Gadwall and Shoveler, on the basis of small numbers (Table 3.1.1). Tufted Duck are stable in their smoothed trend at this site (Figure 3.1.15; Table 3.1.1).

3.1.16 Wraysbury & Hythe End Gravel Pits (excluding Yeoveney Lake and County Ditch Lake)

Gadwall trends on these gravel pits, which form part of the SPA, resemble the trend for the SPA as a whole, with increases throughout the late 1990s and a drop-off in 2000 (Figure 3.1.16). The index, however, is higher in 2000 than 1995, meaning that no Alerts were fired (Table 3.1.1). The proportion of Gadwall supported by these gravel pits is largely consistent at the SPA level, with some fluctuation. The proportion of the regional total held also fluctuates.

Shoveler have shown steady increases since 1992, and the predicted regional and SPA proportions have increased concurrently (Figure 3.1.16), although numbers are still relatively small in terms of the SPA as a whole. Tufted Duck numbers have declined in the last two years of analysis, triggering a Medium Alert for five years and a High Alert for 'all time' (Table 3.1.1). The five-year Medium Alert would be considered within the species 'normal' range of fluctuation using the biological filter. The regional proportion of Tufted Duck held at the sector combination remained fairly stable until 1999, implying that changes subsequently are out of step with regional trends. The trend does appear to fluctuate somewhat between years however, so it is perhaps too early to judge whether this is the beginning of a period of decline (Figure 3.1.16).

3.1.17 Wraysbury & Hythe End Gravel Pits (North & South) and Wraysbury Number 1 Gravel Pits

This sector combination shows similar patterns to those at the previous consolidation. Large numbers of Gadwall occur on some of these gravel pits, particularly Wraysbury II (South), and the trend has remained largely stable (Figure 3.1.17). The proportion of the SPA and regional totals supported has also remained consistently high. The Shoveler trend is consistently upward, and the proportion of the SPA total also shows a positive upward trend. Medium Alerts were fired for Tufted Duck for the five-year period and for 'all time' (Table 3.1.1). However, as declines appear to have been gradual and shallow, interspersed with occasional high counts, it remains to be seen if the population will show further fluctuation or sustained decline. Also, the five-year trend should perhaps be considered of lesser importance, as the biological filter would prevent Alerts being issued at this time scale for this species. However, as large numbers of Tufted Duck are counted at this sector combination, this situation warrants close monitoring.

3.1.18 'All winter months' Alerts

Alerts based on species trends calculated across all data available for the months September-March appear in Appendix 4. These Alerts are for comparison purposes and should not be taken as accurate reflections of population changes, for reasons presented in section 2.2 (*Alerts*).

No differences appear between standard and 'all month' Gadwall Alerts, as this species is conventionally indexed on the time period September – March. For Shoveler, only one new Alert was fired, a High Alert for all-time at County Ditch Lake (Appendix 4). However, as the average number of birds involved was less than 25, this should not be of great concern.

Tufted Duck, usually indexed between November and February, showed six changes in Alert status using 'all months' data (Appendix 4). At two SSSIs, Staines Moor and Knight & Bessborough Reservoirs, the species were subject to High and Medium Alerts respectively, where using standard months no Alerts were fired. As both these new Alerts were over the five-year period, interpretation using the biological filter should be cautious, as these declines may be within the range of 'normal' population fluctuation. The High Alert triggered at Staines Moor serves to highlight the problems with indexing across all months. Figure 3.2.1 shows that in 1995, an abnormally high number of Tufted Duck were counted between July and October. This may have been due to a successful breeding season or an influx of passage migrants. The seemingly isolated season of high counts would influence the GAM disproportionately, contributing to the five-year decline identified.

At four further sector combinations, Tufted Duck trends changed sufficiently to remove or alleviate Alerts fired using standard indexing. The Medium Alerts fired over 'all-time' at Staines Moor and Wraysbury II (South), and over five-years at Wraysbury & Hythe End N & S with Wraysbury Number 1 Gravel Pits were no longer triggered with the new data. Similarly, the High Alert issued for Wraysbury & Hythe End Gravel Pits (SPA sites only) changed to a Medium Alert, as the species trend declined by 8% less.

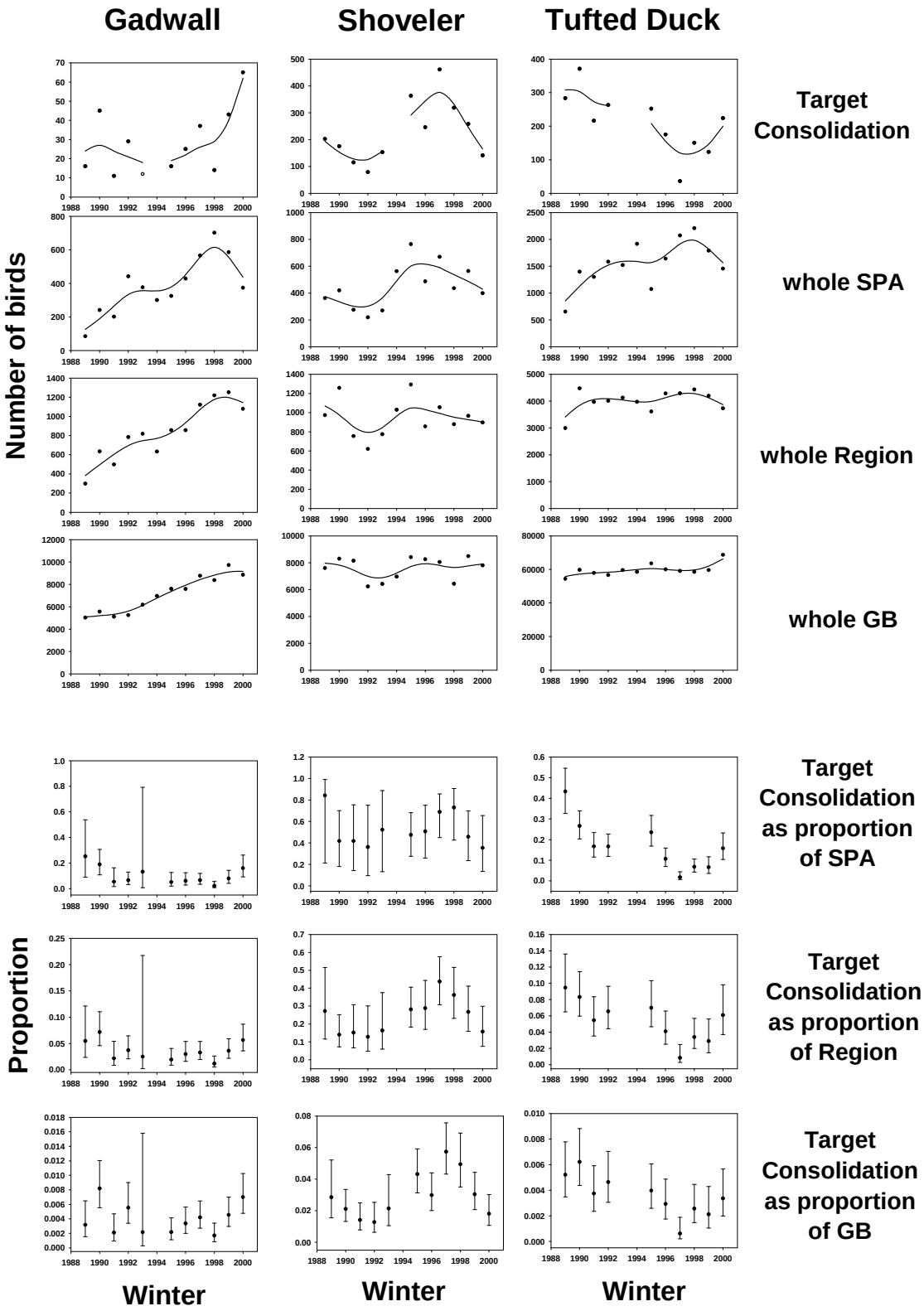

Figure 3.1.3 Staines Moor SSSI. Site trends ('Target consolidation') shown for GA, SV and TU, with SPA, regional and national trends for comparison (top four graphs). The bottom three graphs show bird numbers with confidence limits at the site as a proportion of SPA, regional and national totals, as predicted by logistic models.

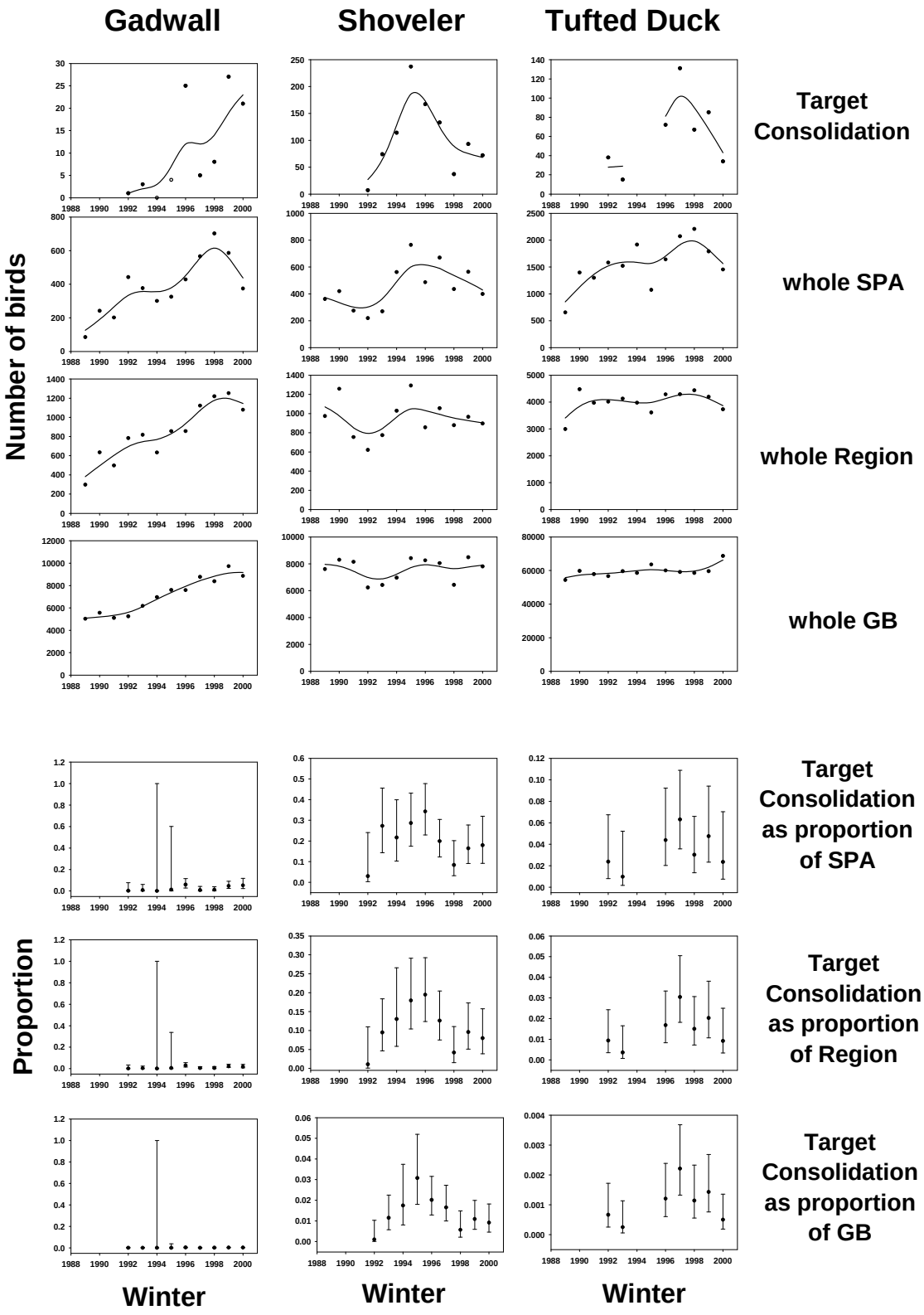

Figure 3.1.4 Knight & Bessborough Reservoirs SSSI. Site trends ('Target consolidation') shown for GA, SV and TU, with SPA, regional and national trends for comparison (top four graphs). The bottom three graphs show bird numbers with confidence limits at the site as a proportion of SPA, regional and national totals, as predicted by logistic models.

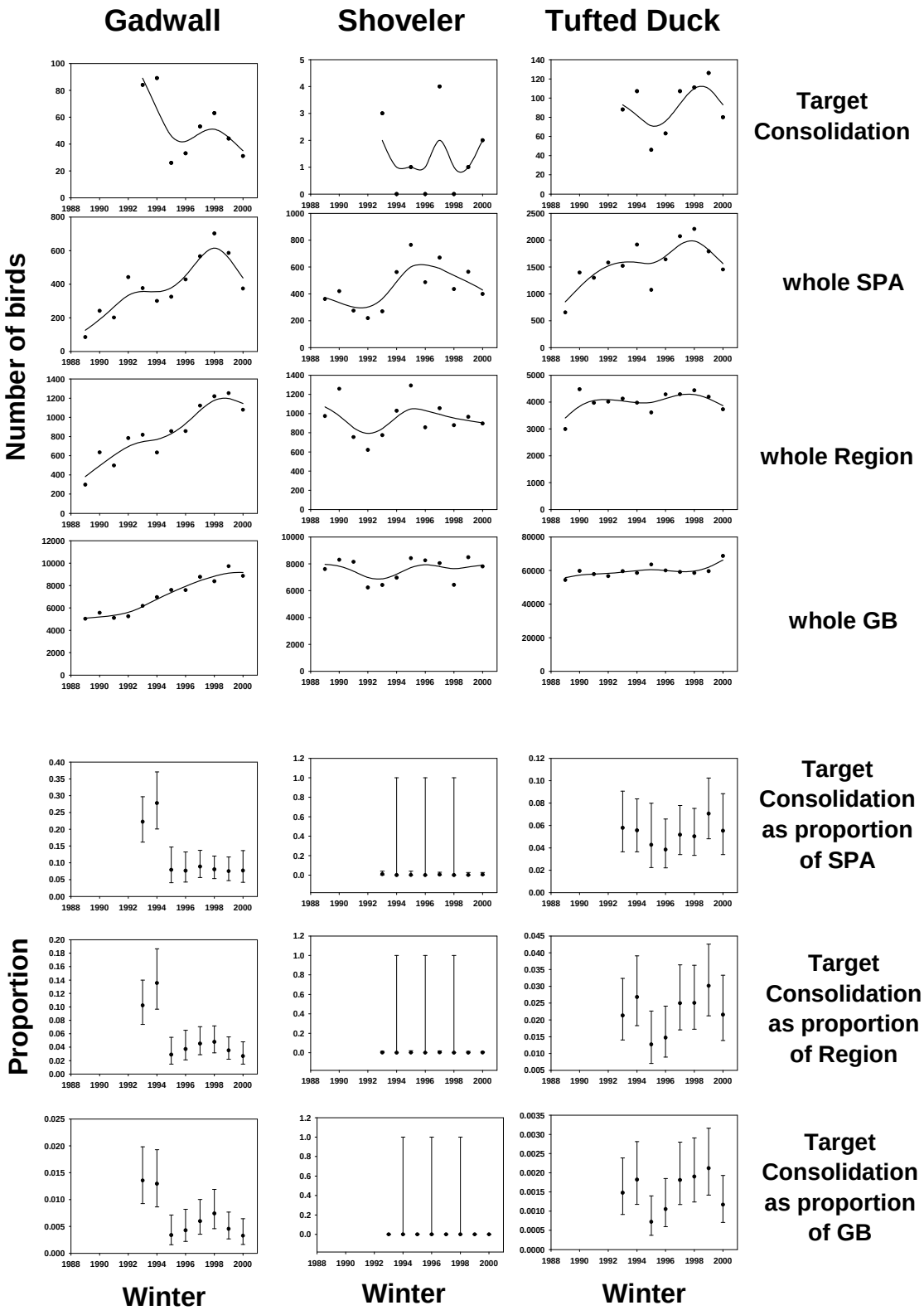

Figure 3.1.5 Thorpe Park No. 1 Gravel Pit SSSI. Site trends ('Target consolidation') shown for GA, SV and TU, with SPA, regional and national trends for comparison (top four graphs). The bottom three graphs show bird numbers with confidence limits at the site as a proportion of SPA, regional and national totals, as predicted by logistic models.

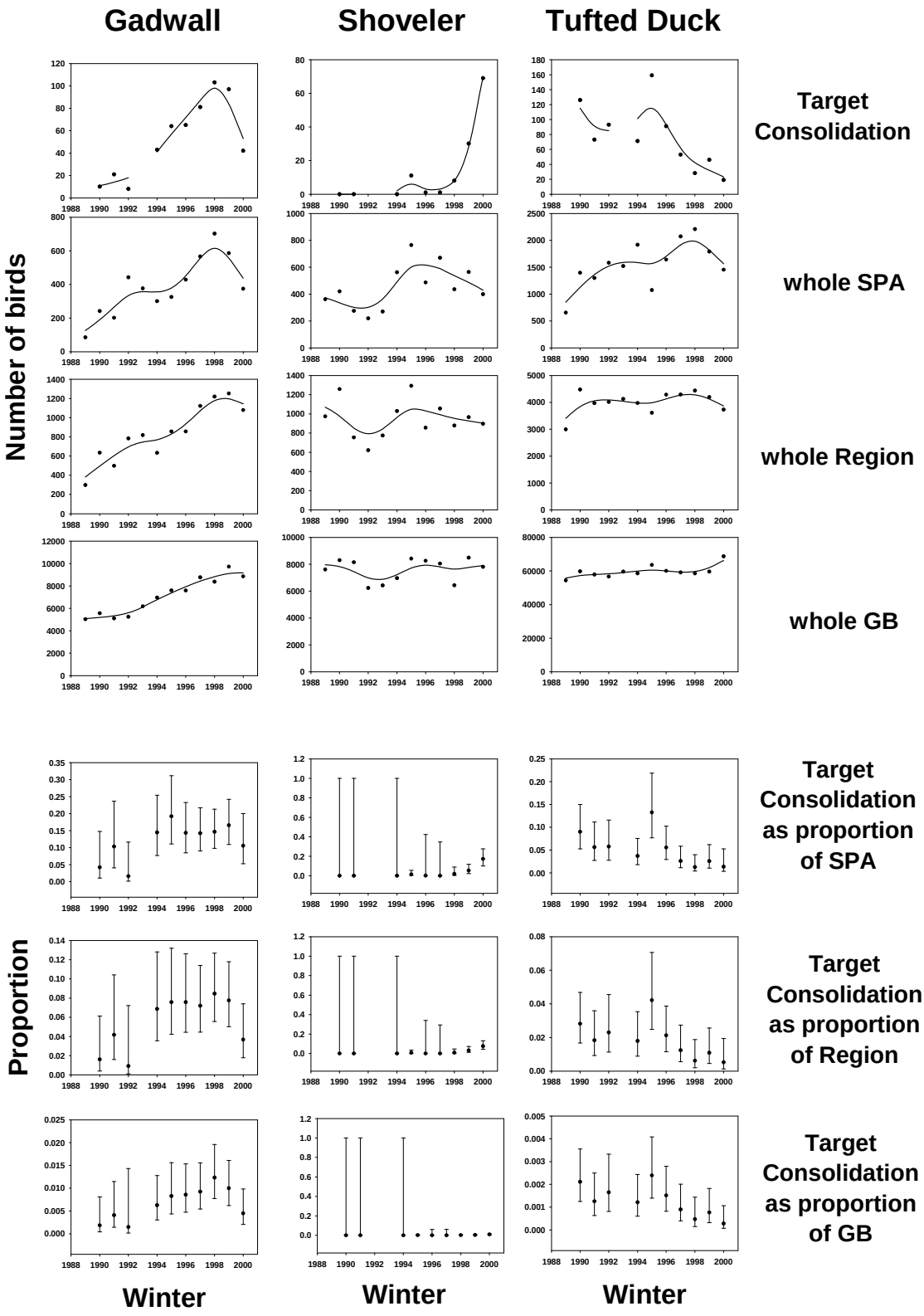

Figure 3.1.6 Kempton Park Reservoirs SSSI. Site trends ('Target consolidation') shown for GA, SV and TU, with SPA, regional and national trends for comparison (top four graphs). The bottom three graphs show bird numbers with confidence limits at the site as a proportion of SPA, regional and national totals, as predicted by logistic models.

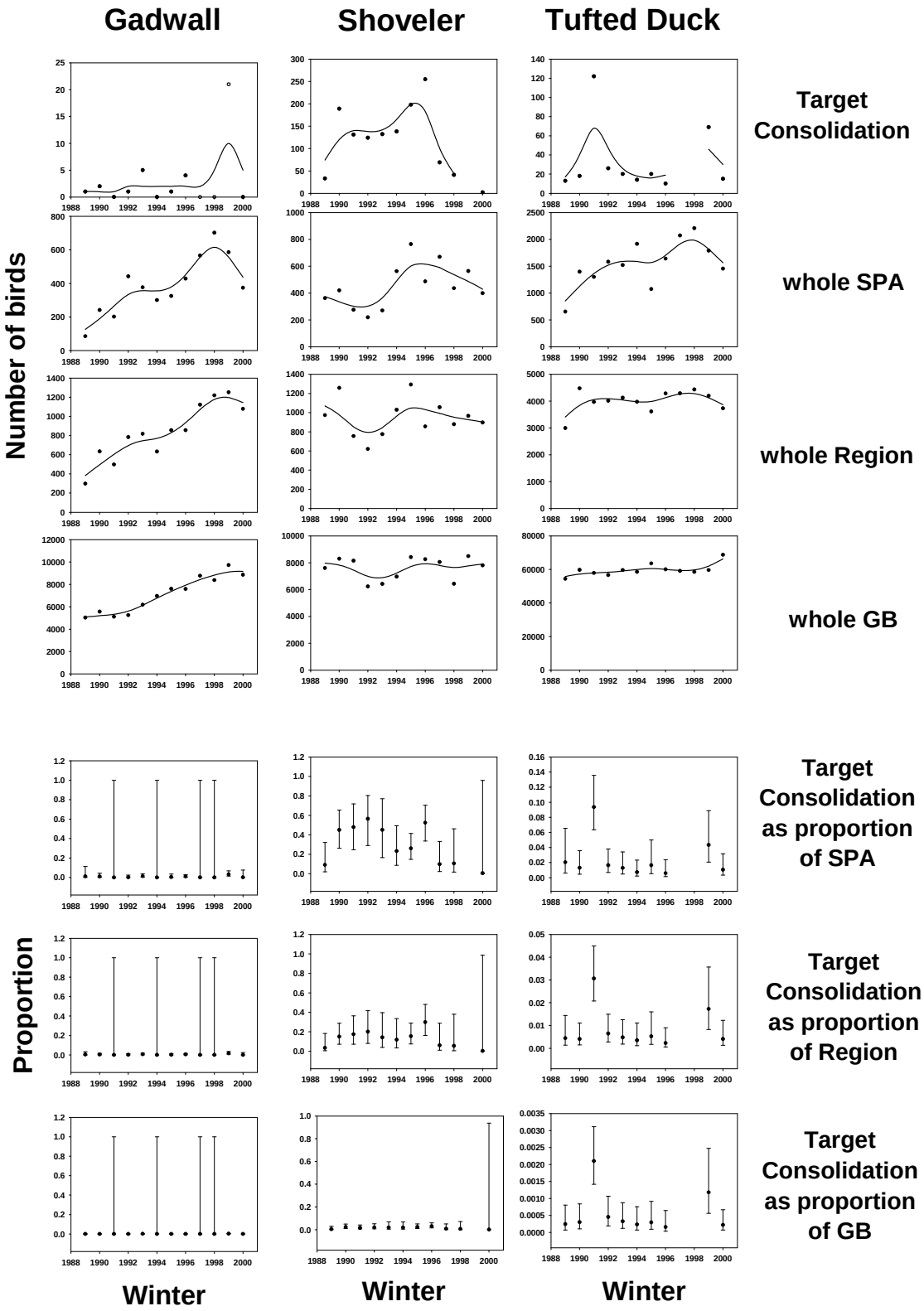

Figure 3.1.7 Wraysbury Reservoir SSSI. Site trends ('Target consolidation') shown for GA, SV and TU, with SPA, regional and national trends for comparison (top four graphs). The bottom three graphs show bird numbers with confidence limits at the site as a proportion of SPA, regional and national totals, as predicted by logistic models.

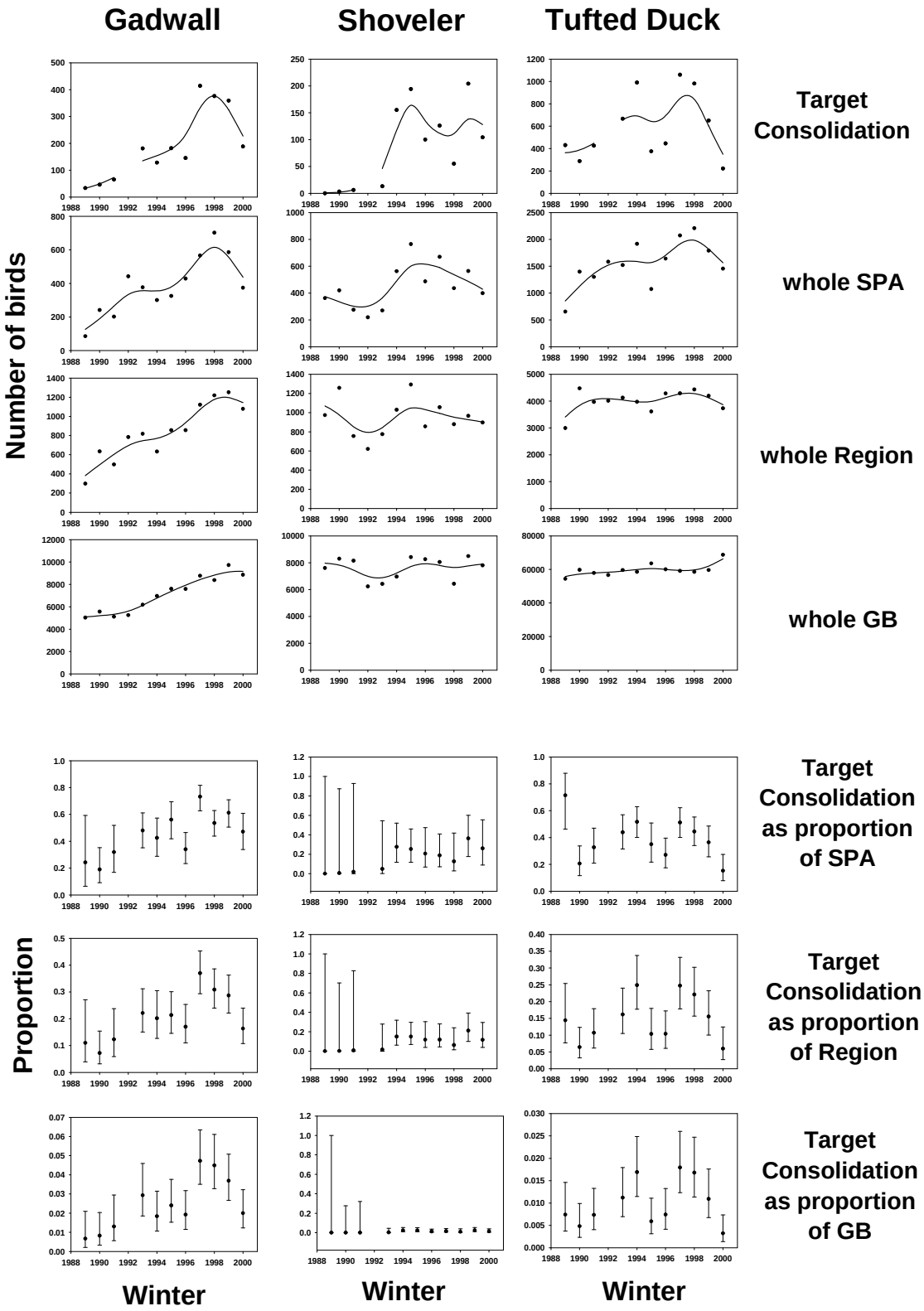

Figure 3.1.8 Wraysbury & Hythe End Gravel Pits (complete) SSSI. Site trends ('Target consolidation') shown for GA, SV and TU, with SPA, regional and national trends for comparison (top four graphs). The bottom three graphs show bird numbers with confidence limits at the site as a proportion of SPA, regional and national totals, as predicted by logistic models.

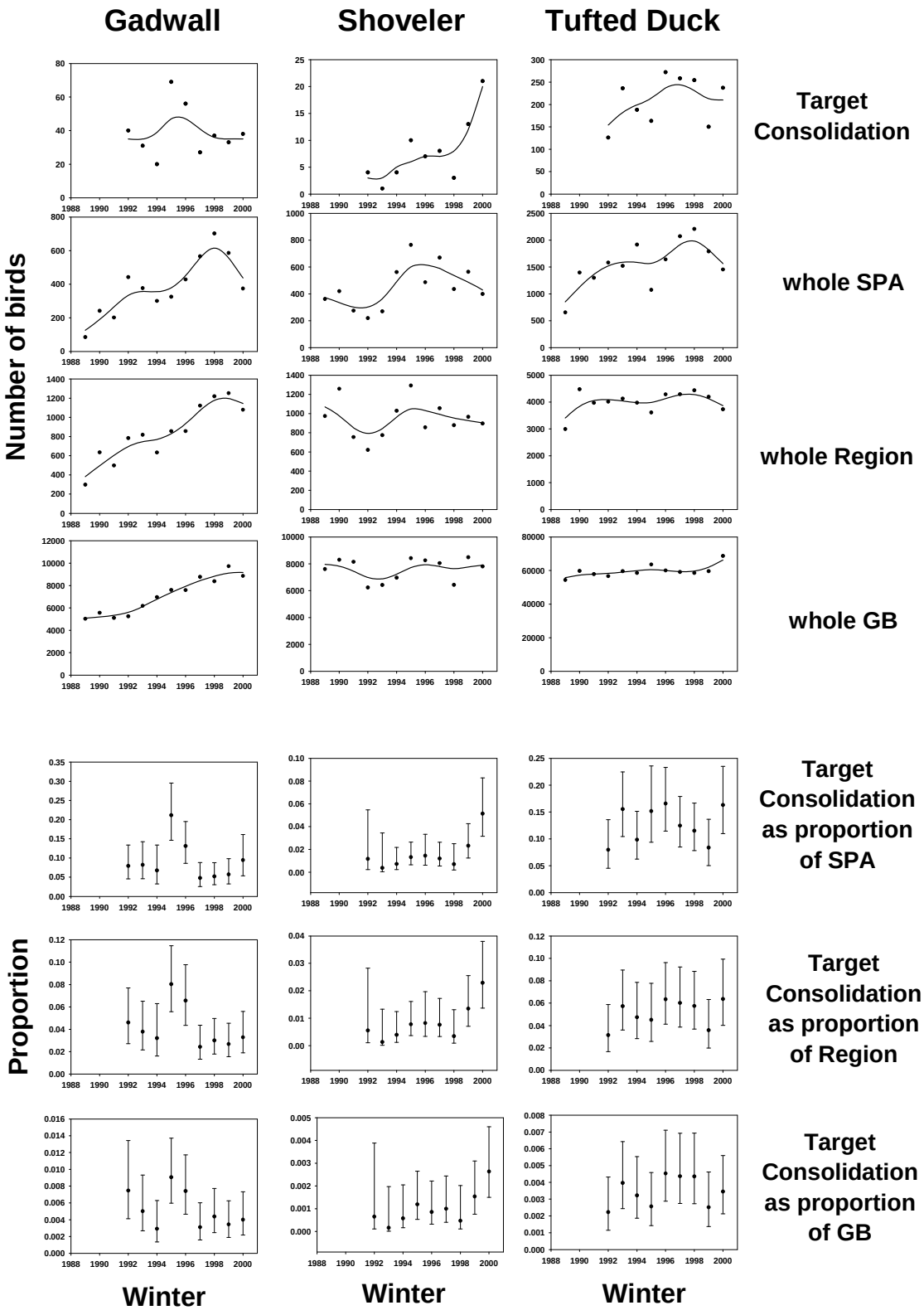

Figure 3.1.9 Wraysbury Number 1 Gravel Pits SSSI. Site trends ('Target consolidation') shown for GA, SV and TU, with SPA, regional and national trends for comparison (top four graphs). The bottom three graphs show bird numbers with confidence limits at the site as a proportion of SPA, regional and national totals, as predicted by logistic models.

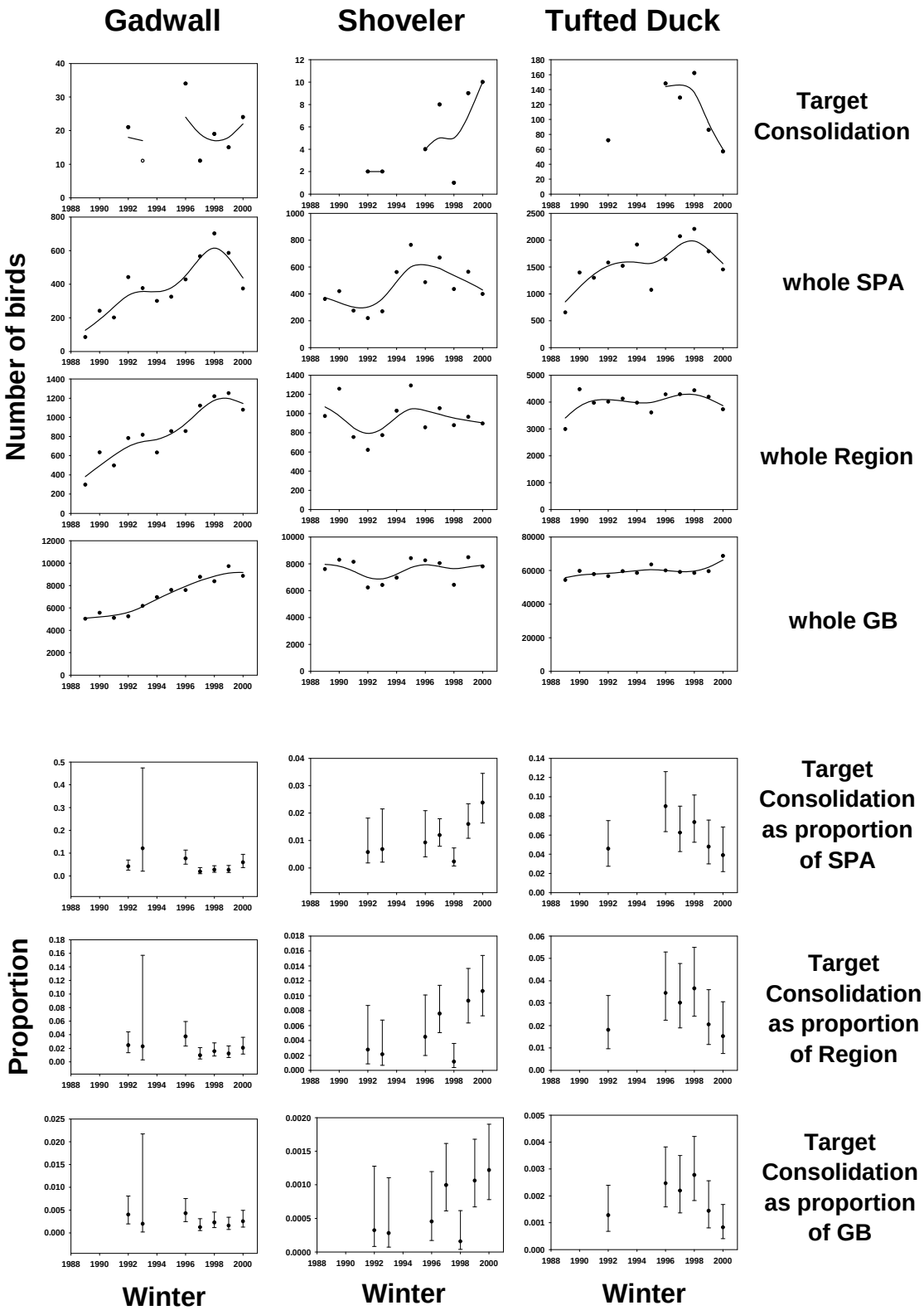

Figure 3.1.10 Wraysbury Number 1 Gravel Pit (North). Site trends ('Target consolidation') shown for GA, SV and TU, with SPA, regional and national trends for comparison (top four graphs). The bottom three graphs show bird numbers with confidence limits at the site as a proportion of SPA, regional and national totals, as predicted by logistic models.

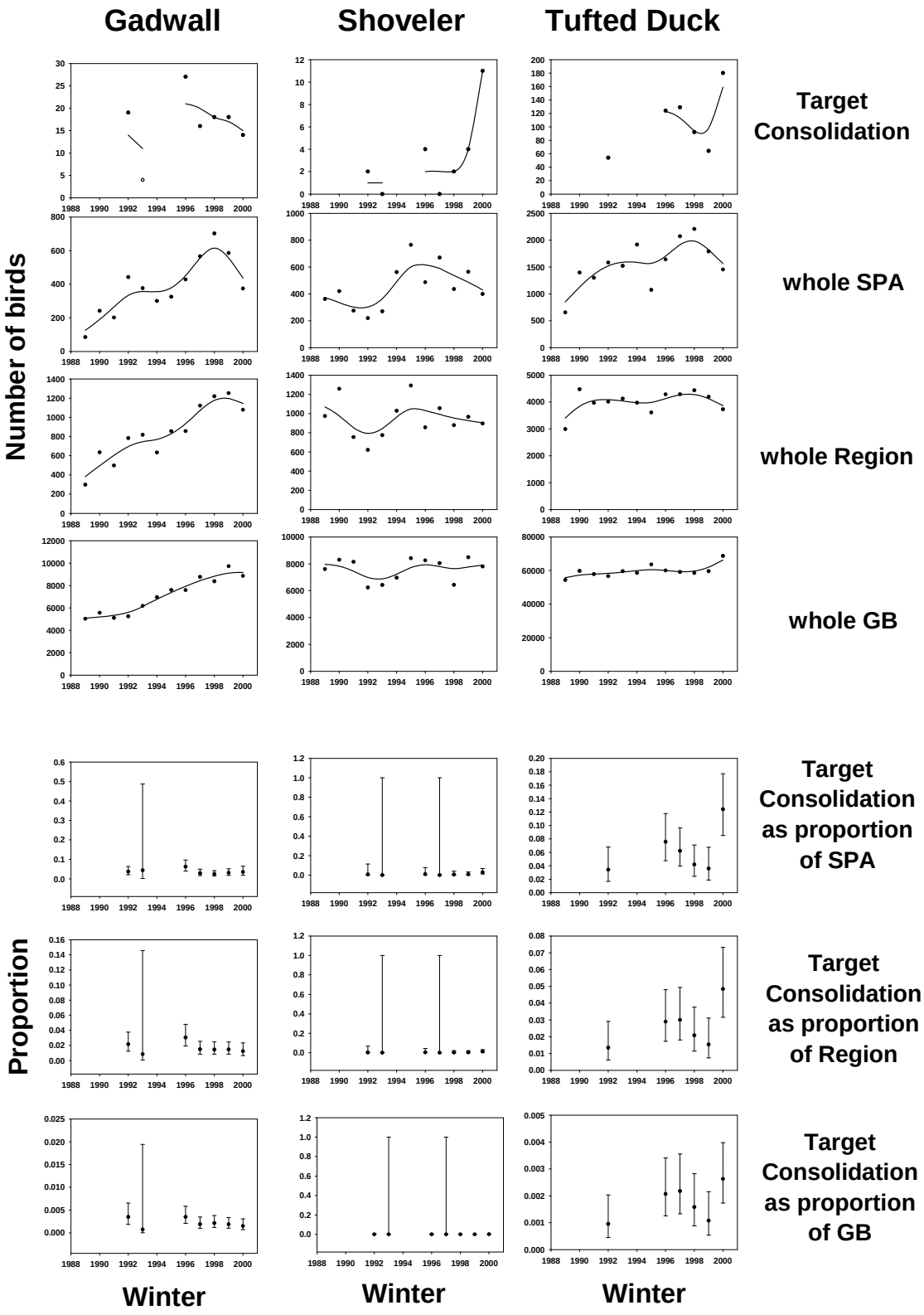

Figure 3.1.11 Wraysbury Number 1 Gravel Pit (South). Site trends ('Target consolidation') shown for GA, SV and TU, with SPA, regional and national trends for comparison (top four graphs). The bottom three graphs show bird numbers with confidence limits at the site as a proportion of SPA, regional and national totals, as predicted by logistic models.

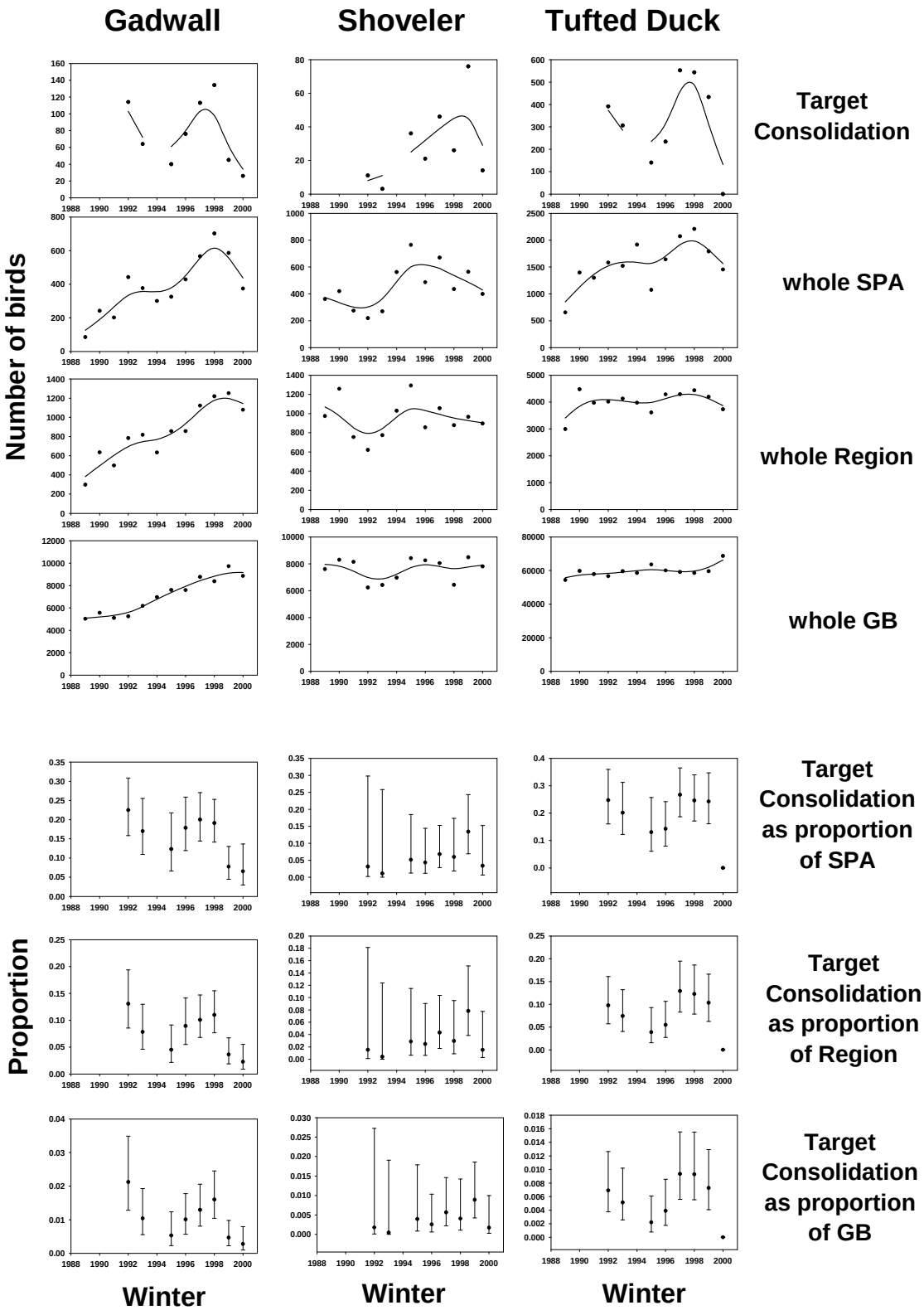

Figure 3.1.12 Wraysbury II (North) Gravel Pit. Site trends ('Target consolidation') shown for GA, SV and TU, with SPA, regional and national trends for comparison (top four graphs). The bottom three graphs show bird numbers with confidence limits at the site as a proportion of SPA, regional and national totals, as predicted by logistic models.

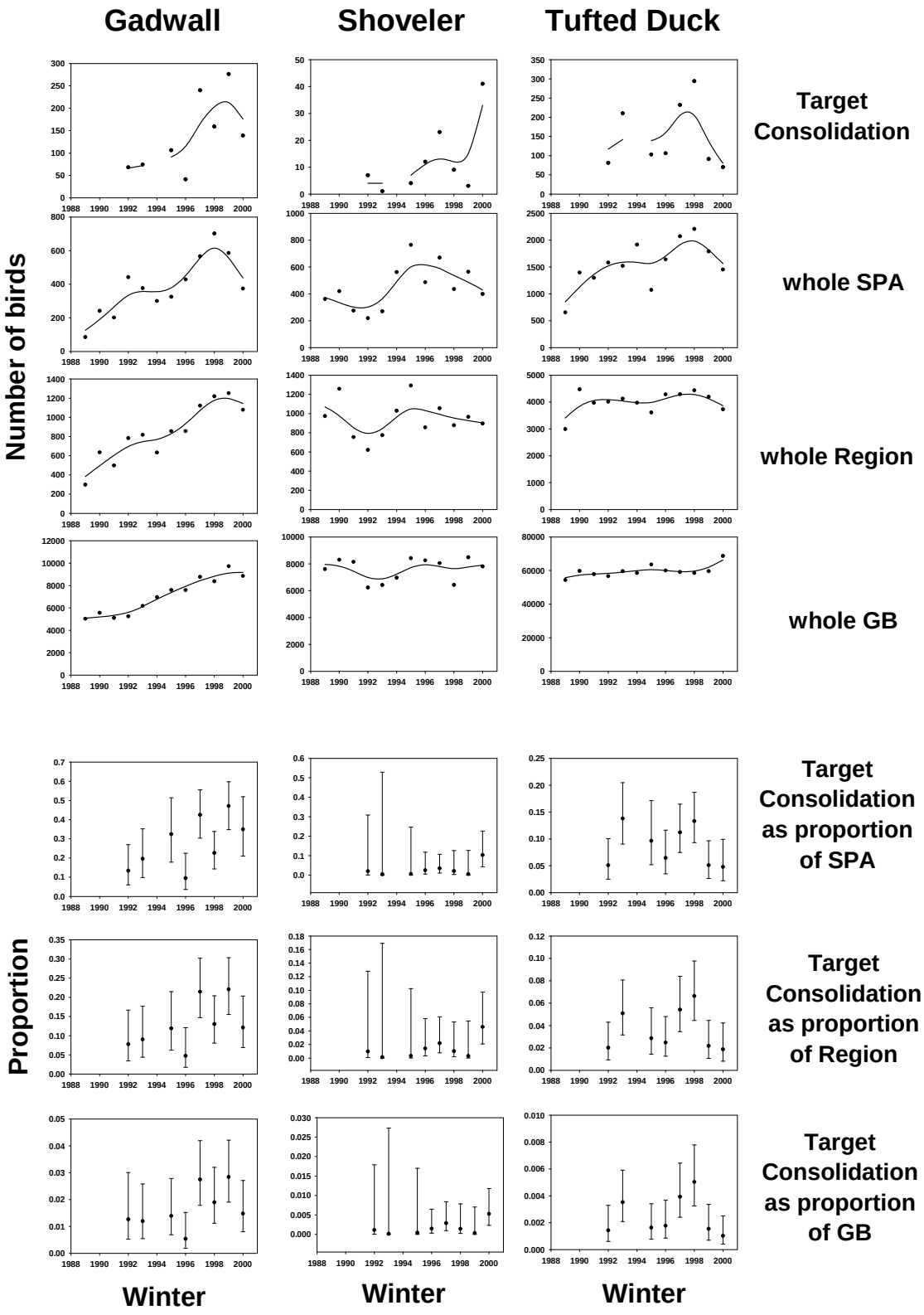

Figure 3.1.13 Wraysbury II (South) Gravel Pit. Site trends ('Target consolidation') shown for GA, SV and TU, with SPA, regional and national trends for comparison (top four graphs). The bottom three graphs show bird numbers with confidence limits at the site as a proportion of SPA, regional and national totals, as predicted by logistic models.

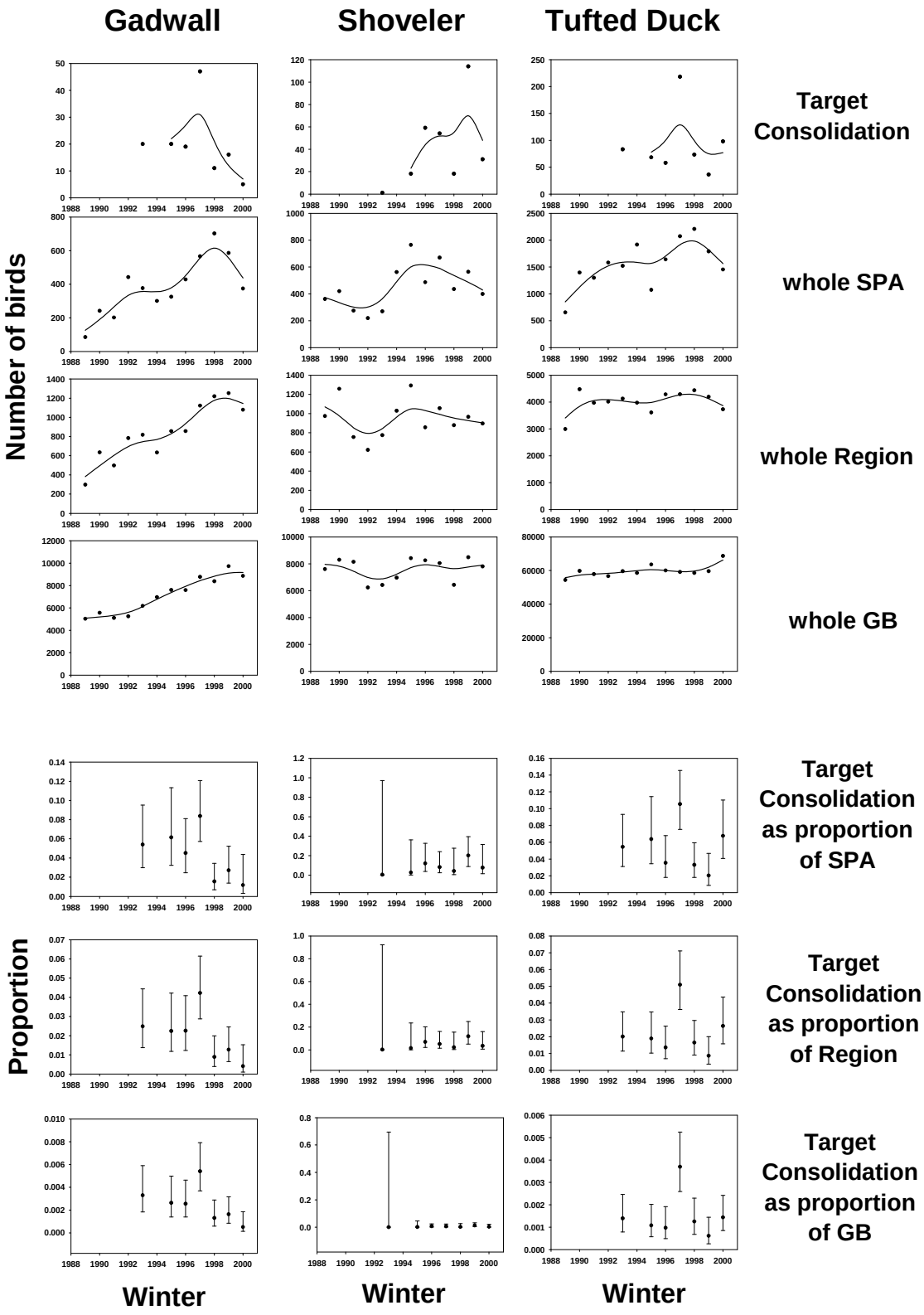

Figure 3.1.14 Yeoveney Lake. Site trends ('Target consolidation') shown for GA, SV and TU, with SPA, regional and national trends for comparison (top four graphs). The bottom three graphs show bird numbers with confidence limits at the site as a proportion of SPA, regional and national totals, as predicted by logistic models.

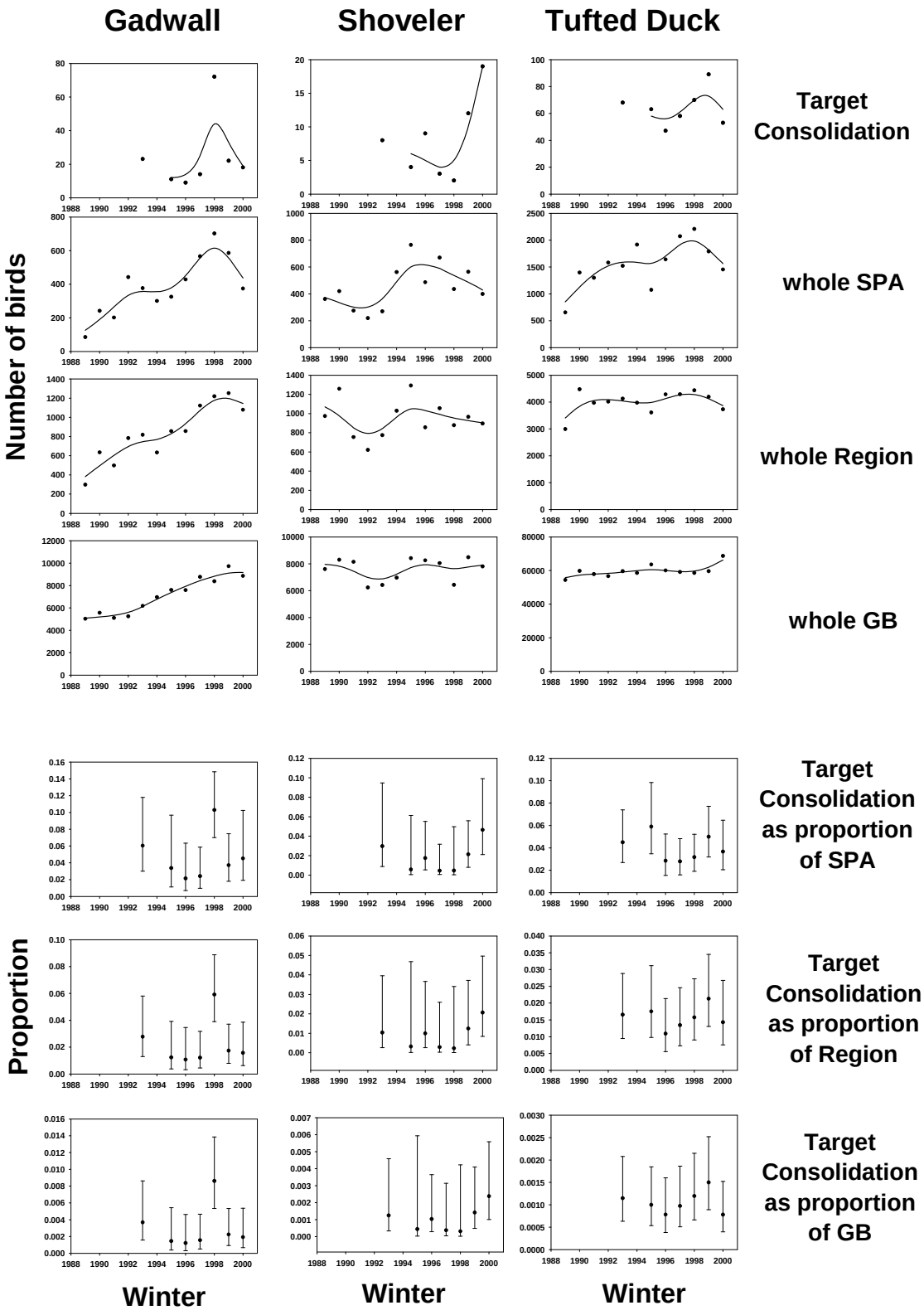

Figure 3.1.15 County Ditch Lake. Site trends ('Target consolidation') shown for GA, SV and TU, with SPA, regional and national trends for comparison (top four graphs). The bottom three graphs show bird numbers with confidence limits at the site as a proportion of SPA, regional and national totals, as predicted by logistic models.

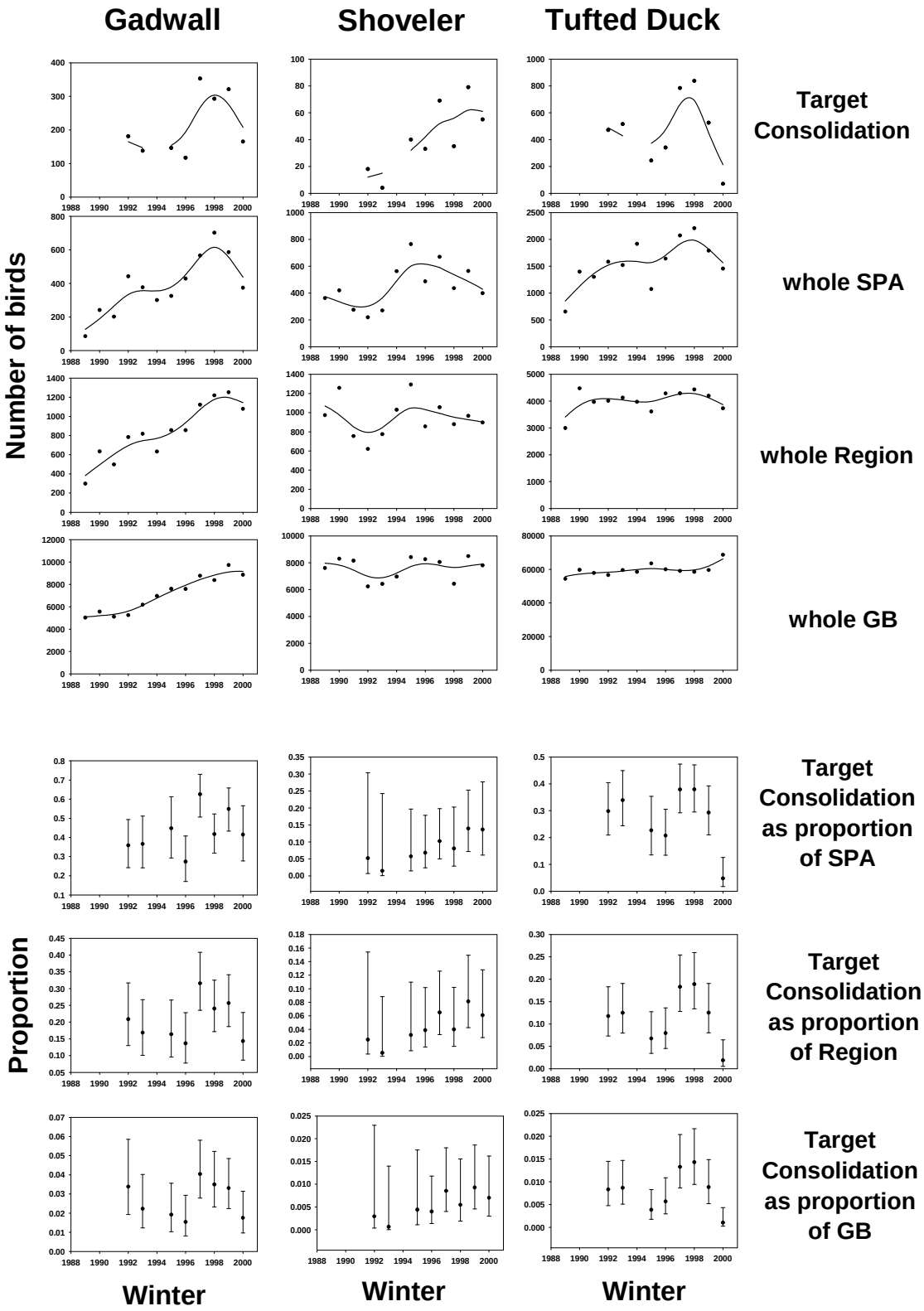

Figure 3.1.16 Wraysbury & Hythe End Gravel Pits (SPA sectors only). Site trends ('Target consolidation') shown for GA, SV and TU, with SPA, regional and national trends for comparison (top four graphs). The bottom three graphs show bird numbers with confidence limits at the site as a proportion of SPA, regional and national totals, as predicted by logistic models.

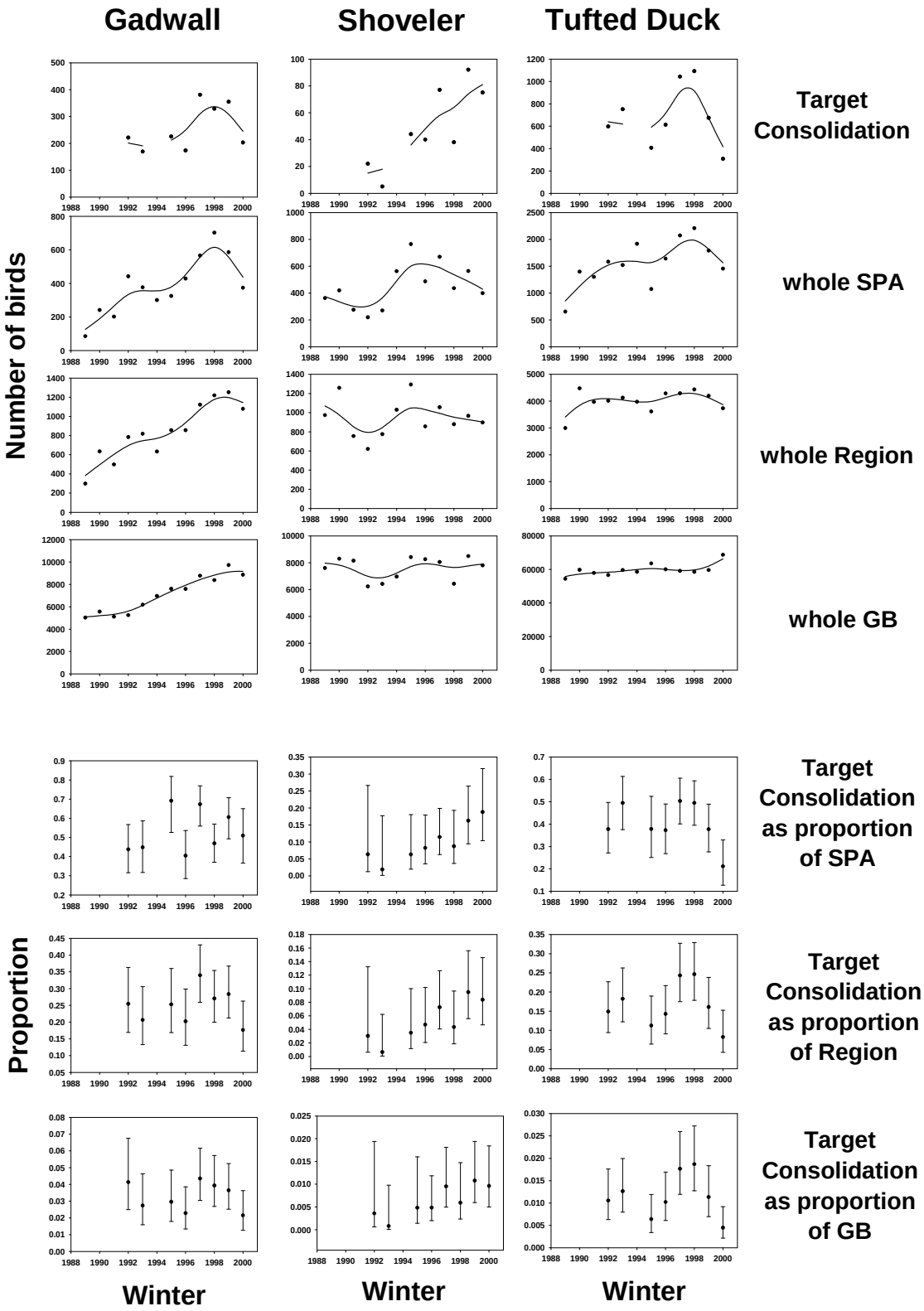

Figure 3.1.17 Wraysbury & Hythe End North & South and Wraysbury No. 1 Gravel Pits. Site trends ('Target consolidation') shown for GA, SV and TU, with SPA, regional and national trends for comparison (top four graphs). The bottom three graphs show bird numbers with confidence limits at the site as a proportion of SPA, regional and national totals, as predicted by logistic models.

	Gadwall			Shoveler			Tufted Duck		
	5-Year	**10-Year**	**All Time**	**5-Year**	**10-Year**	**All Time**	**5-Year**	**10-Year**	**All Time**
Staines Moor	226	130	158	*-43*	8	-15	-4	*-34*	*-35*
Knight & Bessborough Reservoirs	229*	x	>1000*	**-63**	x	152	x	x	54
Thorpe Park Number 1 Gravel Pit	-24	x	**-61**	100*	x	0*	31	x	0
Kempton Park Reservoirs	-7	382	382	>1000*	x	**	**-80**	**-80**	**-80**
Wraysbury Reservoir	150*	400*	400*	**-97**	**-95**	**-92**	88	*-25*	76
Wraysbury & Hythe End Gravel Pits[1]	27	363	588	-22	>1000	>1000	*-46*	-10	-4
Wraysbury Number 1 Gravel Pits	*-26*	x	0	233*	x	567*	-2	x	36
Wraysbury Number 1 Gravel Pits (North)	x	x	22*	x	x	400	x	x	-18
Wraysbury Number 1 Gravel Pits (South)	x	x	7*	x	x	1000	x	x	189
Wraysbury II (North) Gravel Pit	*-44*	x	**-67**	16	x	263	**	x	****
Wraysbury II (South) Gravel Pit	93	x	167	371*	x	725*	*-42*	x	*-32*
Yeoveney Lake	**-68***	x	**-63***	109	x	>1000	-1	x	-1
County Ditch Lake	58*	x	-10*	217*	x	138*	9	x	-7
Wraysbury & Hythe End Gravel Pits[2]	35	x	26	91	x	408	*-43*	x	**-56**
Wraysbury & Hythe End N & S and Wraysbury Number 1 Gravel Pits	16	x	22	125	x	440	*-30*	x	*-35*
South West London Waterbodies SPA	16	201	388	*-30*	39	29	*-7*	52	75

Table 3.1.1 Table of Alerts for 15 site consolidations and the SPA as a whole. Figures are percentage change in smoothed index. A cross appears where data were insufficient for analysis. Figures in italics show Medium Alerts (a decline of 25%-50%), whilst bold figures show High Alerts (>50% declines). All Time refers to the period 1989/90-2000/2001.

*indicates calculations based on a total average count of less than 25 birds, that should be interpreted with caution.
** indicates that an Alert cannot be generated as the initial or final index value was zero.
[1]Includes Yeoveney Lake and County Ditch Lake.
[2]Excludes Yeoveney Lake and County Ditch Lake.

3.2 Timing of Counts

Figures 3.2.1 – 3.2.15 show average monthly counts of Gadwall, Shoveler and Tufted Duck. Where possible, these have been plotted for months outside of those used for standard WeBS indexing, to allow analysis of changes in timing of site usage. Plots have been produced for each year, and for each site consolidation (note there are no additional data available at SPA level).

Those species triggering Medium or High Alerts at any site consolidation are discussed below. It should be remembered that all Alerts for all species over the five-year period, and Medium Alerts for Gadwall over ten years, are subject to cautious interpretation, according to the biological filter. The remaining site / species combinations are assumed to show stable or increasing trends and thus there is no need to examine changes in relation to phenology.

3.2.1 Staines Moor

Medium Alerts were fired for Shoveler over five years, and Tufted Duck for ten years and 'all time'. Figure 3.2.1 reveals little evidence that peak mean Shoveler numbers have consistently shifted to months outside of the standard index months (September and October). A large influx of birds occurred in November 1995, but this is more likely to be an isolated passage movement than a long-term phenological shift.

Apparent declines in Tufted Duck are also unlikely to be due to changes in phenology. Although high numbers of these ducks are counted outside of the standard index months (November-February), the majority of these are in July and August. These are likely to be re-dispersed breeding birds or possibly moult migrants (Wernham *et al*. 2002).

3.2.2 Knight and Bessborough Reservoirs

Only one Alert was triggered at this SSSI, a High Alert for Shoveler over the five-year period. Peak mean counts tended to be within the standard index window, and there is little consistent trend for earlier or later peak counts (Figure 3.2.2).

3.2.3 Thorpe Park Number 1 Gravel Pit

Gadwall were issued with an 'all time' High Alert at this SSSI. As Gadwall is indexed on seven months' data, there is little scope for additional counts, and Thorpe Park was not counted from April to August (Figure 3.2.3).

3.2.4 Kempton Park Reservoirs

High Alerts were fired for all three time periods for Tufted Duck at Kempton Park. For some years (1990, 1991, 1994, 1995, 1997), substantial counts of Tufted Duck occurred in October, which could reflect earlier arriving migrants from Fennoscandia. However, there are too frequent missing counts to allow accurate comparison, and available data suggest that peak mean counts still fall inside the standard index months (Figure 3.2.4).

3.2.5 Wraysbury Reservoir

High Alerts over all three time periods indicate a potentially serious decline of Shoveler at Wraysbury Reservoir. Occasional large counts were made in November and December (e.g. 1989), which potentially could reflect passage migrants using the SSSI in later months than those used for indexing (Figure 3.2.5). However, there is no long-term pattern of this, and as the SPA trend is largely stable (except over the five-year period), it seems more likely that declines at Wraysbury Reservoir are attributable to re-dispersal within the SPA.

The ten-year Medium Alert fired for Tufted Duck is not considered likely to be due to a shift in bird movements. Peaks occurring in late summer and early autumn may reflect productive breeding seasons, as more juveniles may be included in WeBS counts.

3.2.6 Wraysbury & Hythe End Gravel Pits (including Yeoveney Lake and County Ditch Lake)

A five-year Medium Alert status was triggered by Tufted Duck at this SSSI. There is no evidence that this is due to a temporal change in peak counts, as the peak occurred within the index months in all years except 1993 (Figure 3.2.6).

3.2.7 Wraysbury Number 1 Gravel Pit

Gadwall, subject to a five-year Medium Alert, were counted in very small numbers or absent outside of the standard alerting months (Figure 3.2.7). The Alert was considered likely to have been triggered by a return to stable levels from a five-year peak. Therefore there is no suggestion that this decline could be due to timing of counts.

3.2.8 Wraysbury Number 1 Gravel Pit (North)

No alerts were fired at this sector, largely due to the patchiness of count data (Figure 3.2.8).

3.2.9 Wraysbury Number 1 Gravel Pit (South)

As above, no alerts were fired at this sector, largely due to the patchiness of count data (Figure 3.2.9).

3.2.10 Wraysbury II (North) Gravel Pit

Five year Medium Alerts and 'all time' High Alerts were triggered for Gadwall at this sector. Smoothed trends for the species show fluctuations (Figure 3.1.12), but this is not due to temporal changes; counts outwith the standard index months are small in comparison (Figure 3.2.10)..

3.2.11 Wraysbury II (South) Gravel Pit

Medium Alerts were fired for Tufted Duck at this gravel pit for the five-year period, and for 'all time'. Figure 3.2.11 suggests that peak mean counts predominately occur within standard index months, with only isolated peaks outside this period.

3.2.12 Yeoveney Lake

The High Alerts issued for Gadwall at Yeoveney Lake should be interpreted parsimoniously, as they are based on average yearly counts of below 25 birds. Figure 3.2.12 displays a trend for relatively large counts in August (where counted). This may represent increased counting of juvenile birds after increases in the native breeding population (Fox 1988, Gibbons *et al.* 1993).

3.2.13 County Ditch Lake

No alerts were fired at this site, largely due to the patchiness of count data (Figure 3.2.13).

3.2.14 Wraysbury & Hythe End Gravel Pits (excluding Yeoveney Lake and County Ditch Lake)

Tufted Duck were issued Medium Alert status for the five-year period and High Alert status for 'all time', subject to caveats (section 3.1.16). Figure 3.2.14 shows no clear pattern of temporal change, although interestingly the plots for 1999 and 2000 do suggest a drop-off in numbers during the indexed months. It should be noted that the scales differ substantially between these plots, implying that the population size is variable and subject to fluctuation.

3.2.15 Wraysbury & Hythe End Gravel Pits (North & South) and Wraysbury Number 1 Gravel Pits

This sector combination was issued with Medium Alerts for Tufted Duck, again over the five-year and 'all time' periods. The wintering population of Tufted Duck usually peaks in December or January, and so there is little reason to suppose that changes in phenology are directly causative of species decline.

3.2.16 South West London Waterbodies SPA

As there are no data available for months outside the standard index window, it was not possible to perform a similar analysis for the SPA. However, it was possible to compare the months in which peak counts occurred with those at the national level. These data are available in a companion spreadsheet (Peak count months.xls).

For Gadwall, five of the 12 years analysed (1994, 1995, 1996, 1998 and 2000) showed that peak counts occurred in the same months at the SPA and national levels. Of the remaining seven years, three SPA peak counts occurred within one month of the national peak.

Shoveler peak counts were made in the same months at the SPA and national levels in nine of the 12 years analysed. This is perhaps unsurprising in that this species is only indexed on two months, September and October.

Six peak counts of Tufted Duck occurred in the same months for both SPA and national scales, with a further four peak counts within one month of each other. Tufted Duck is indexed on four months (November-February) and so there is scope for differences in timing of peak counts in this species.

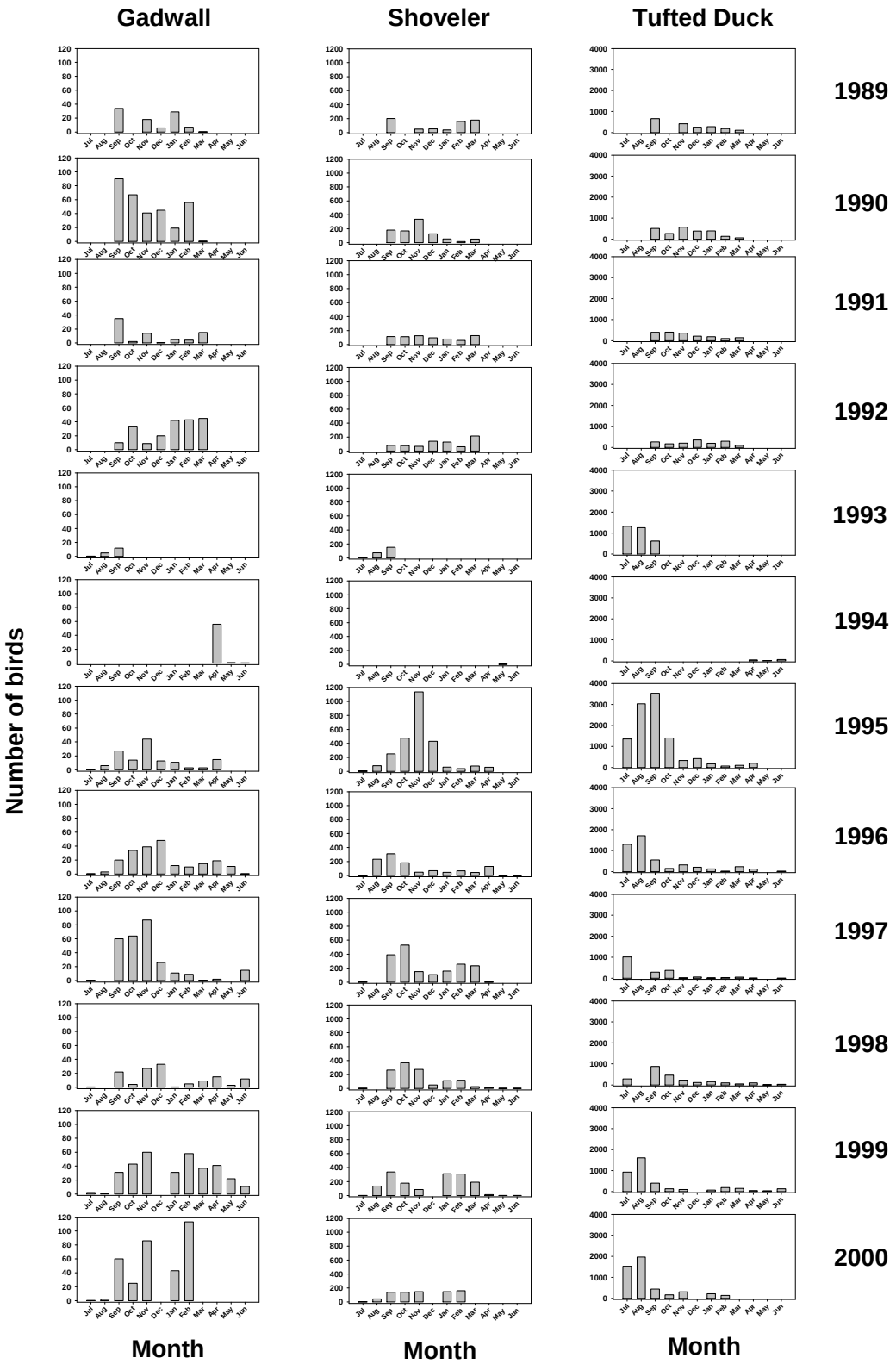

Figure 3.2.1 Staines Moor. Histograms show average counts for all months visited. A blank corresponds to an unvisited month. Standard index months: GA – Sept-March; SV – Sept-Oct; TU – Nov-Feb.

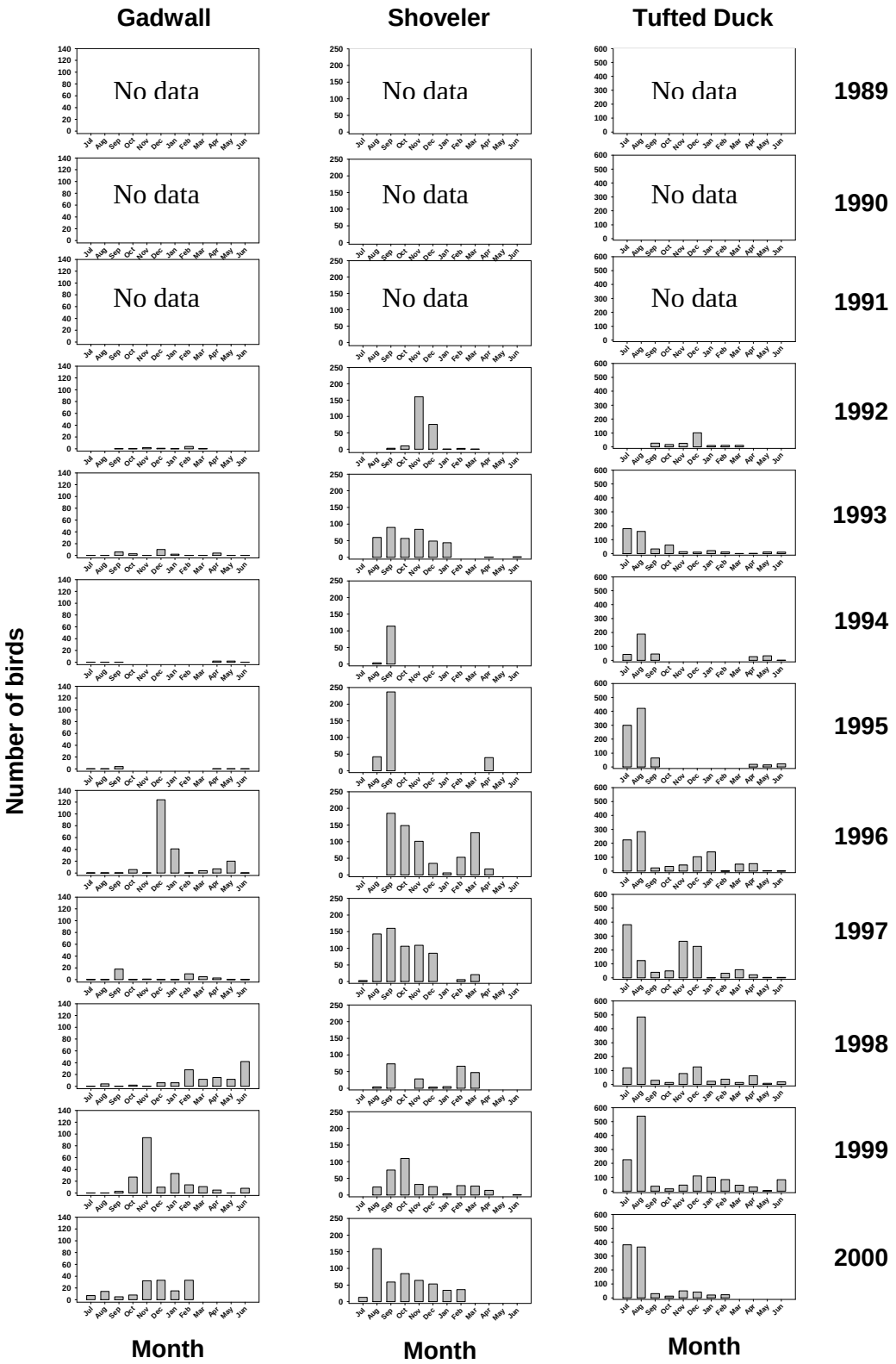

Figure 3.2.2 Knight & Bessborough Reservoirs. Histograms show average counts for all months visited. A blank corresponds to an unvisited month. Standard index months: GA – Sept-March; SV – Sept-Oct; TU – Nov-Feb.

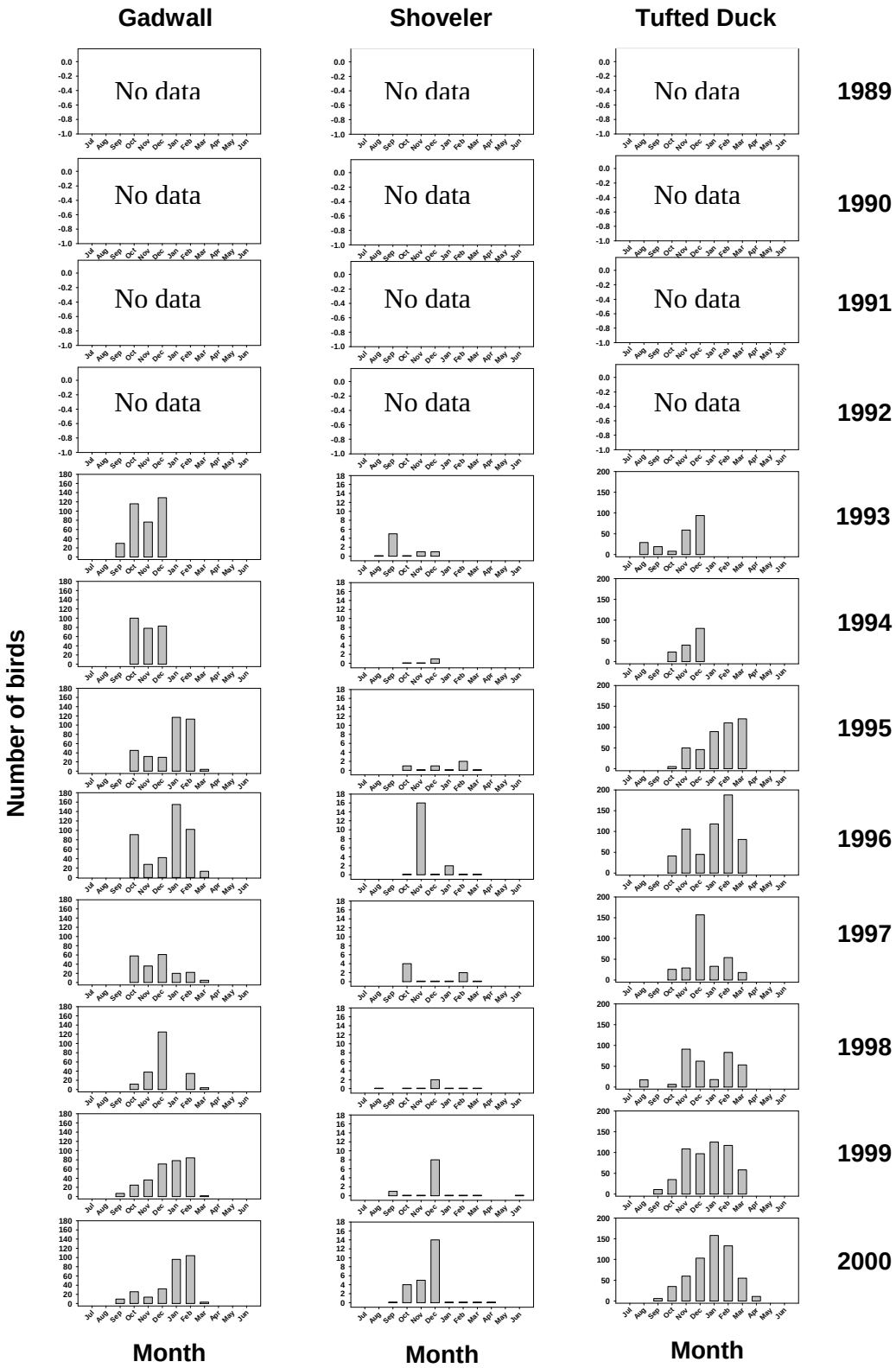

Figure 3.2.3 Thorpe Park Number 1. Histograms show average counts for all months visited. A blank corresponds to an unvisited month. Standard index months: GA – Sept-March; SV – Sept-Oct; TU – Nov-Feb.

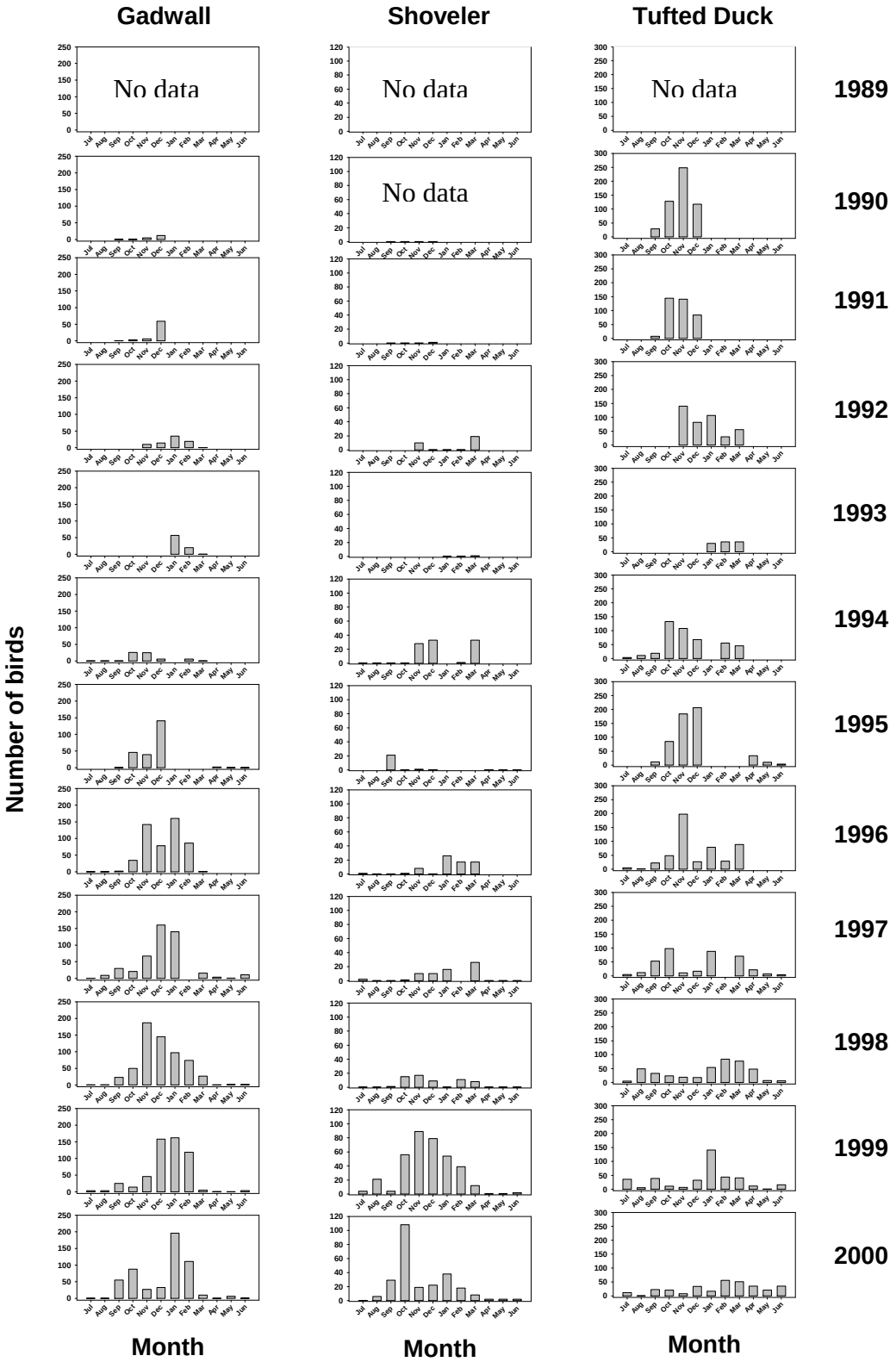

Figure 3.2.4 Kempton Park Reservoirs. Histograms show average counts for all months visited. A blank corresponds to an unvisited month. Standard index months: GA – Sept-March; SV – Sept-Oct; TU – Nov-Feb.

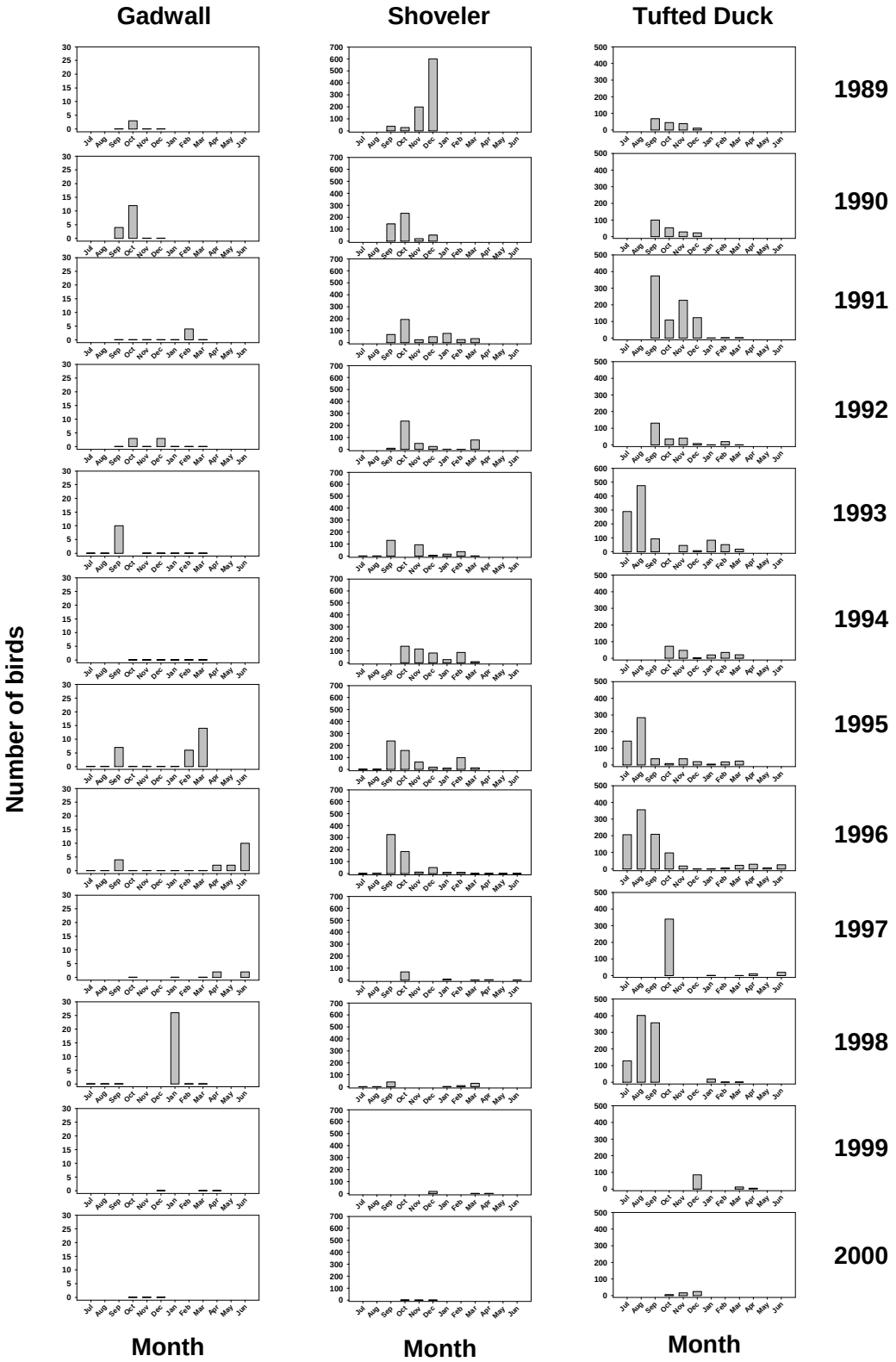

Figure 3.2.5 Wraysbury Reservoir. Histograms show average counts for all months visited. A blank corresponds to an unvisited month. Standard index months: GA – Sept-March; SV – Sept-Oct; TU – Nov-Feb.

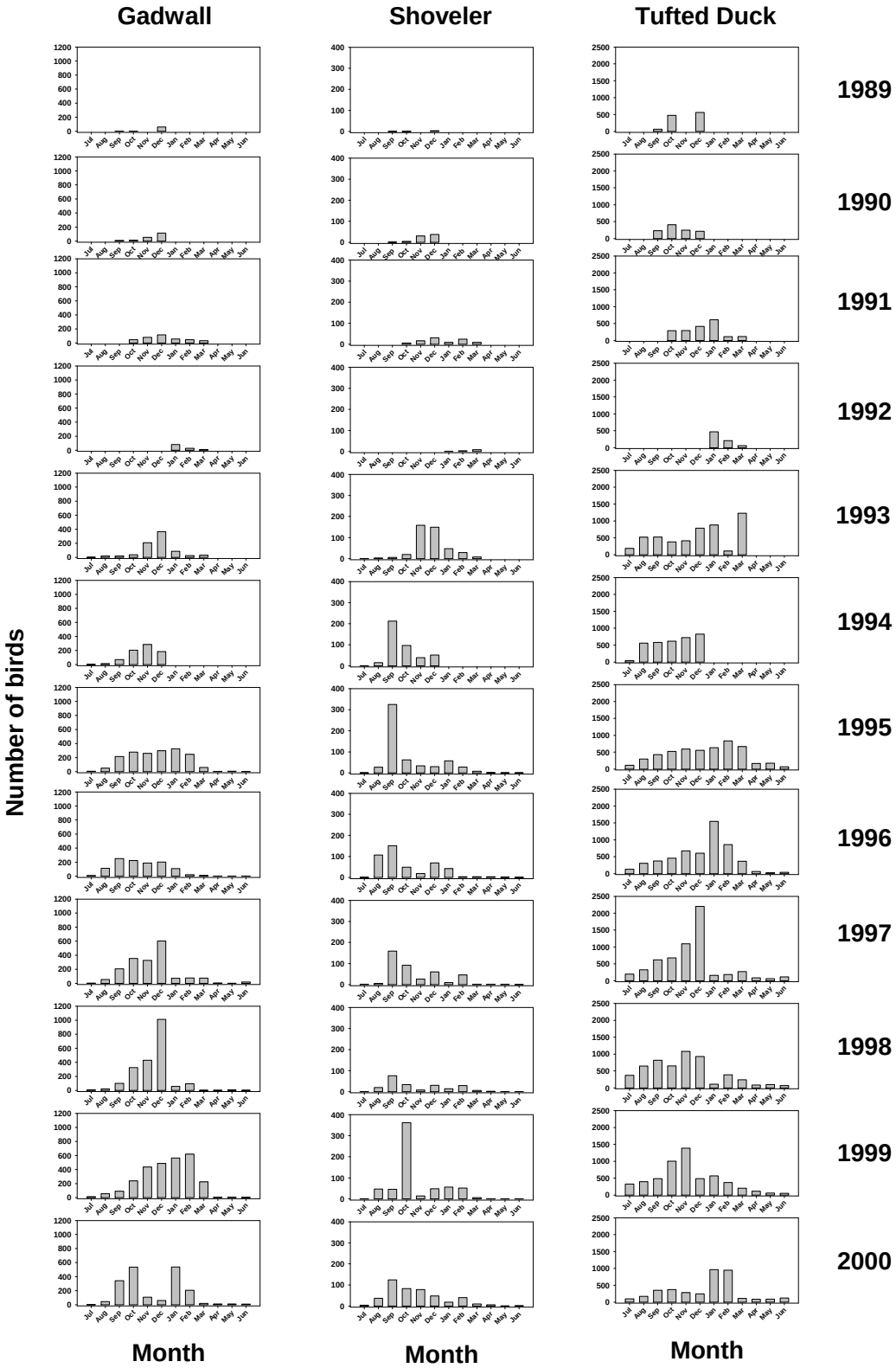

Figure 3.2.6 Wraysbury & Hythe End Gravel Pits (complete). Histograms show average counts for all months visited. A blank corresponds to an unvisited month. Standard index months: GA – Sept-March; SV – Sept-Oct; TU – Nov-Feb.

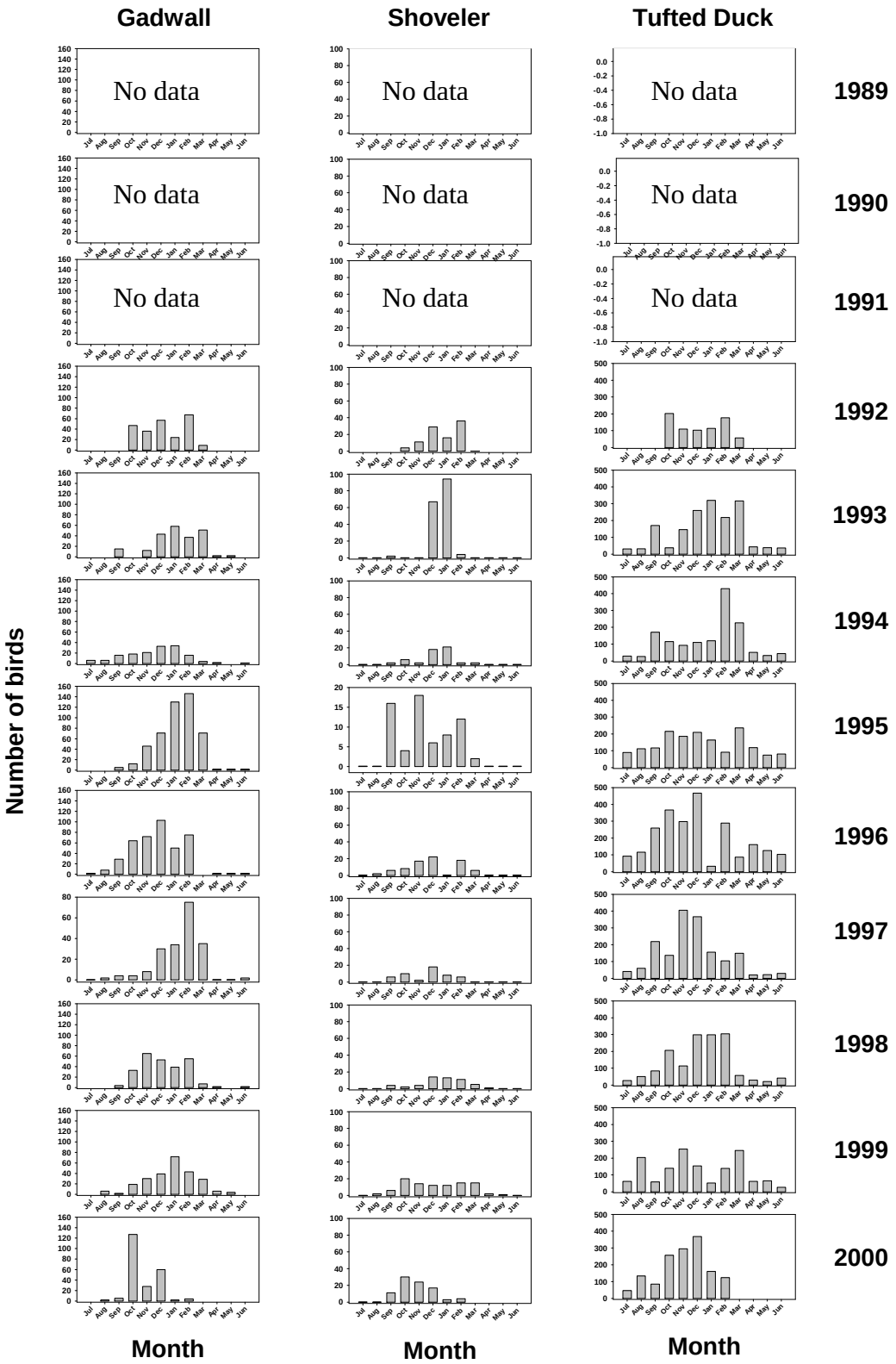

Figure 3.2.7 Wraysbury Number 1 Gravel Pits. Histograms show average counts for all months visited. A blank corresponds to an unvisited month. Standard index months: GA – Sept-March; SV – Sept-Oct; TU – Nov-Feb.

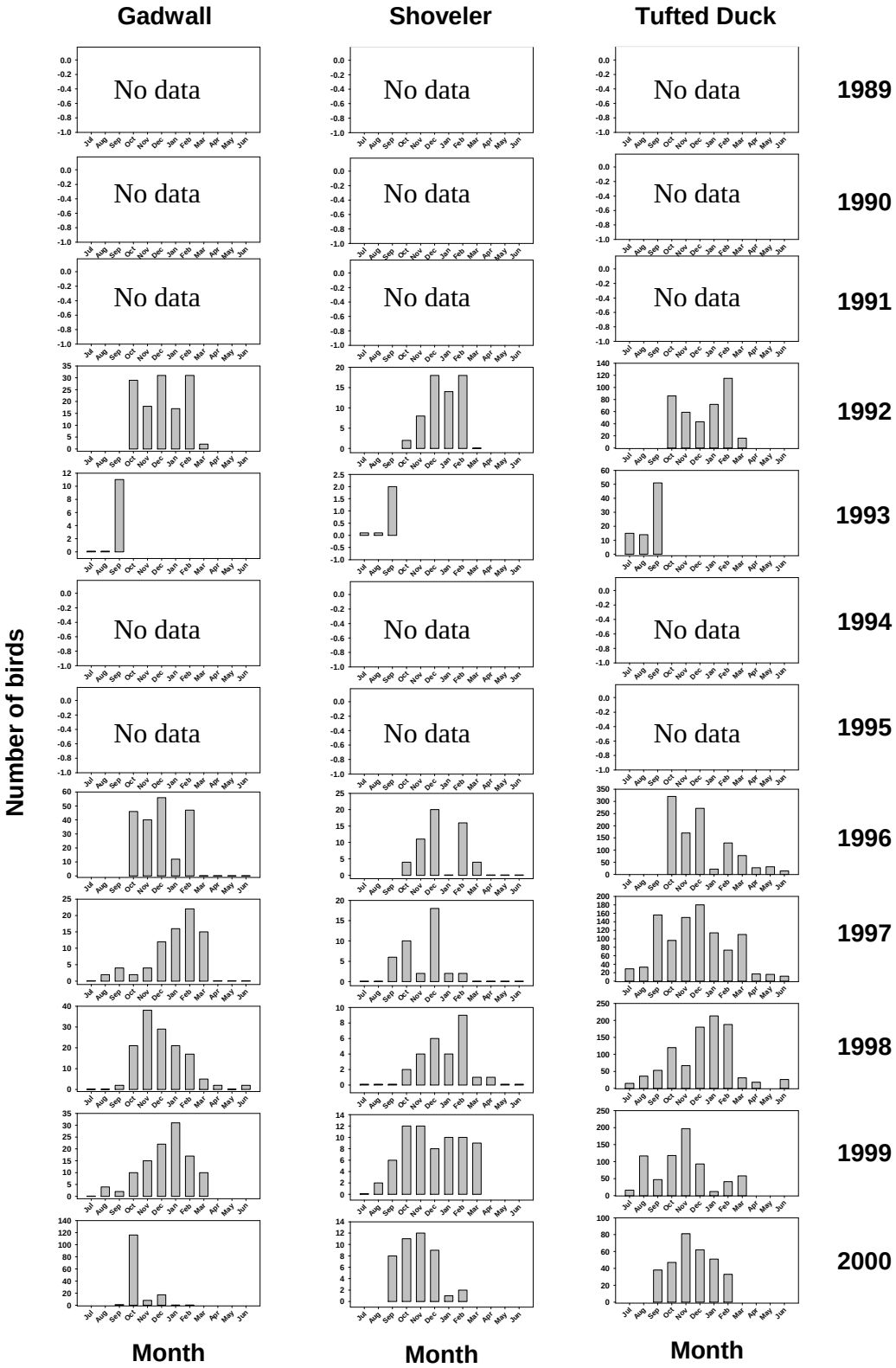

Figure 3.2.8 Wraysbury Number 1 Gravel Pits (North). Histograms show average counts for all months visited. A blank corresponds to an unvisited month. Standard index months: GA – Sept-March; SV – Sept-Oct; TU – Nov-Feb.

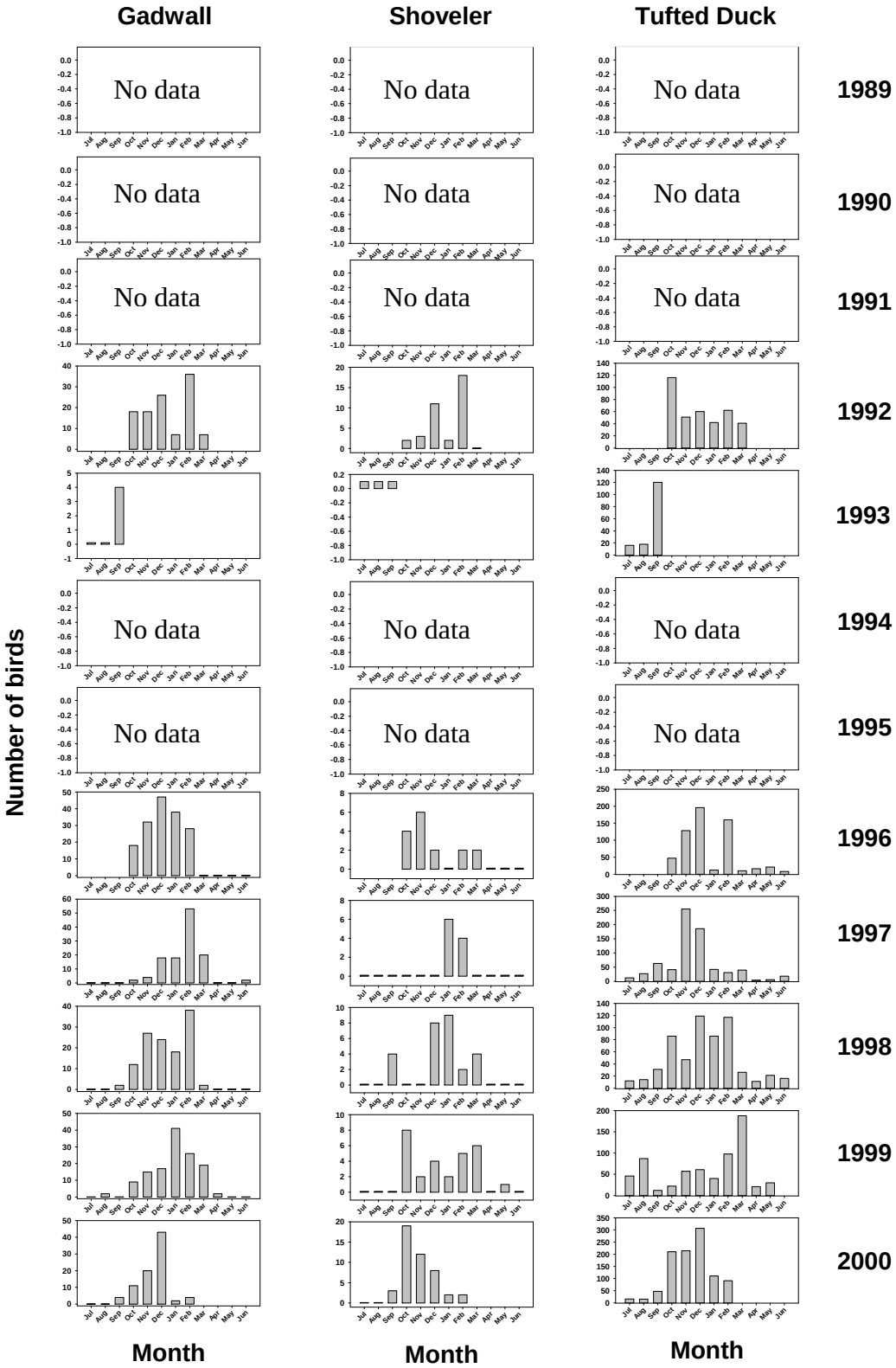

Figure 3.2.9 Wraysbury Number 1 Gravel Pits (South). Histograms show average counts for all months visited. A blank corresponds to an unvisited month. Standard index months: GA – Sept-March; SV – Sept-Oct; TU – Nov-Feb.

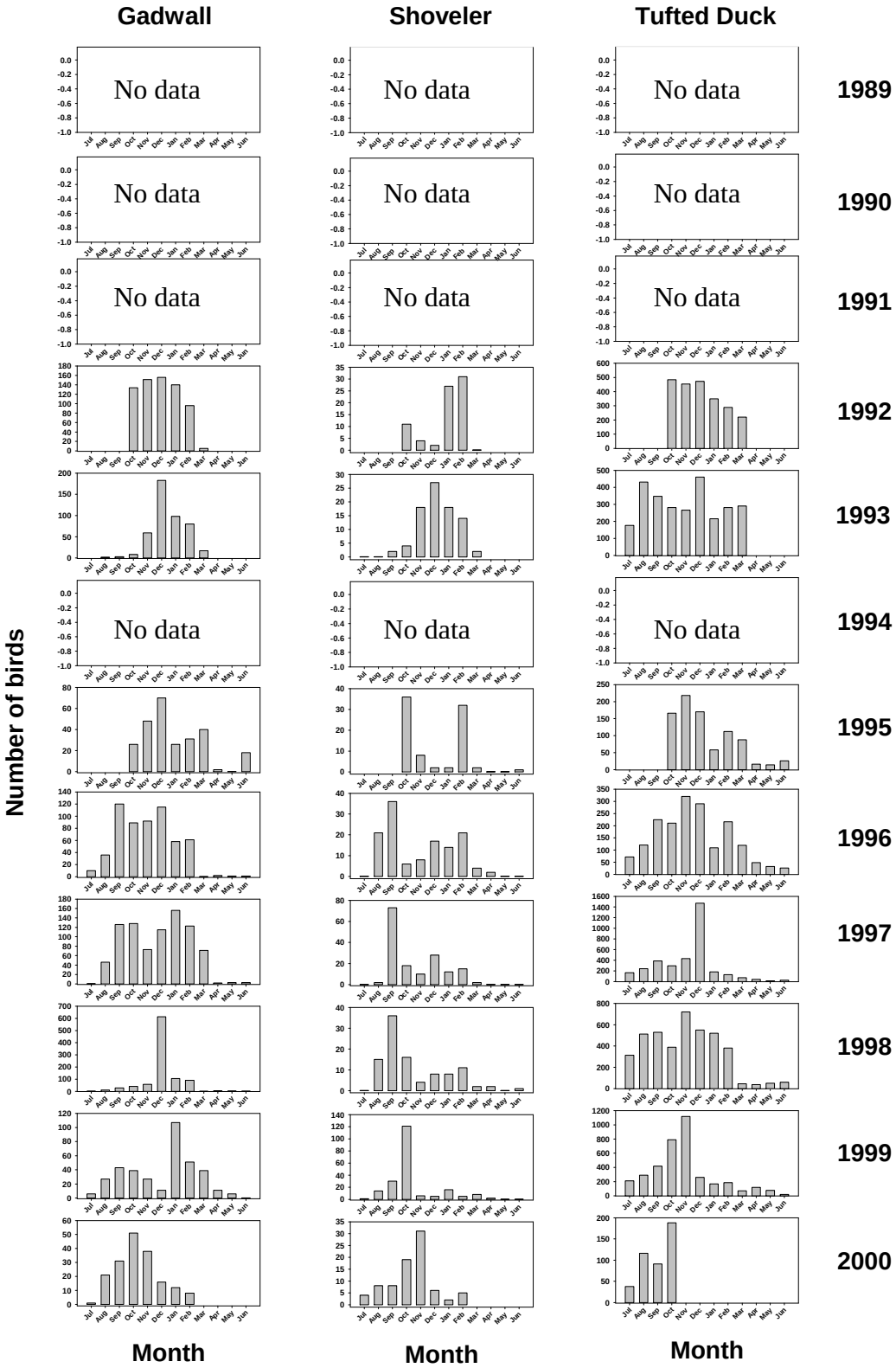

Figure 3.2.10 Wraysbury Number 2 Gravel Pit (North). Histograms show average counts for all months visited. A blank corresponds to an unvisited month. Standard index months: GA – Sept-March; SV – Sept-Oct; TU – Nov-Feb.

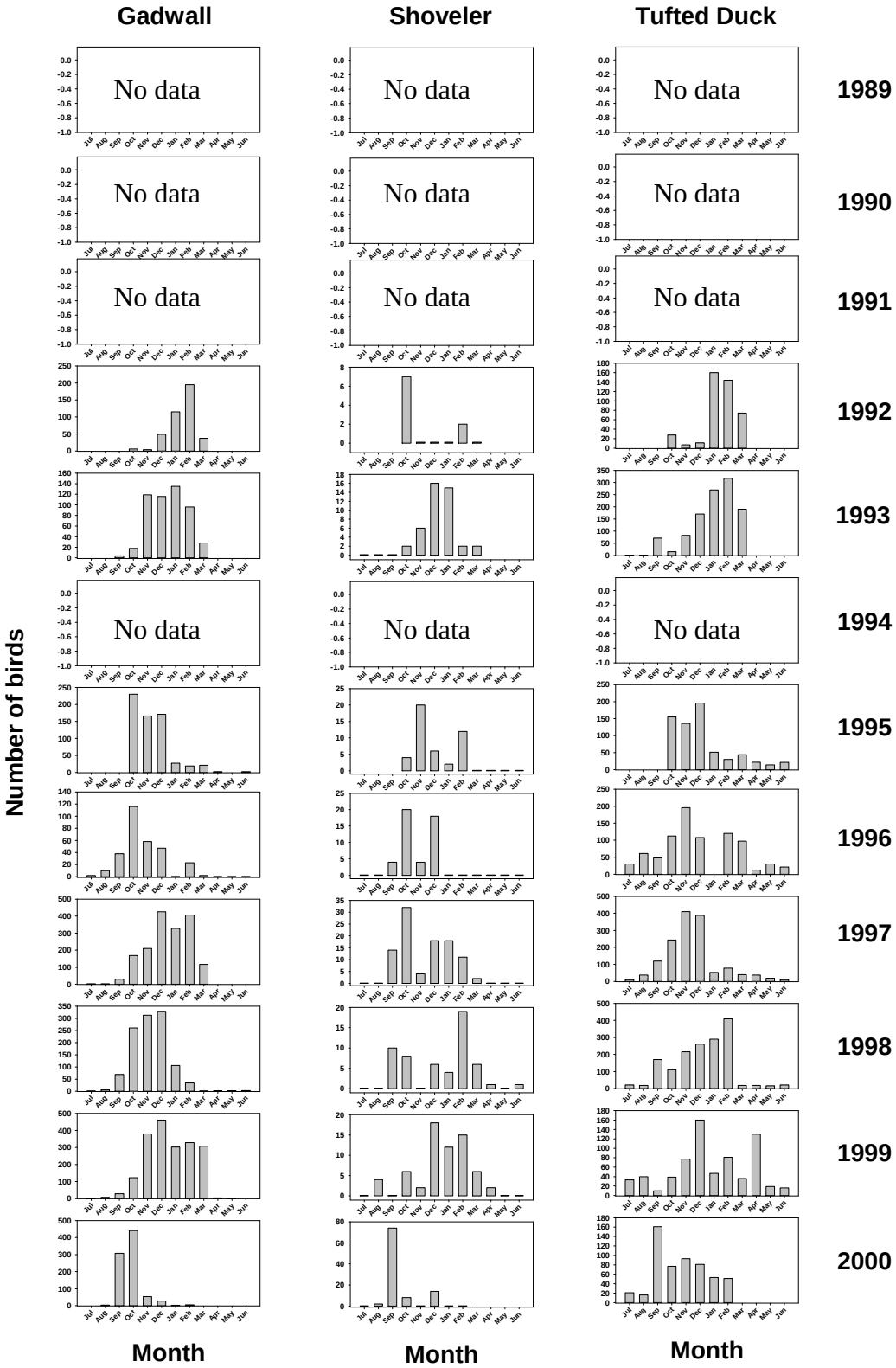

Figure 3.2.11 Wraysbury Number 2 Gravel Pit (South). Histograms show average counts for all months visited. A blank corresponds to an unvisited month. Standard index months: GA – Sept-March; SV – Sept-Oct; TU – Nov-Feb.

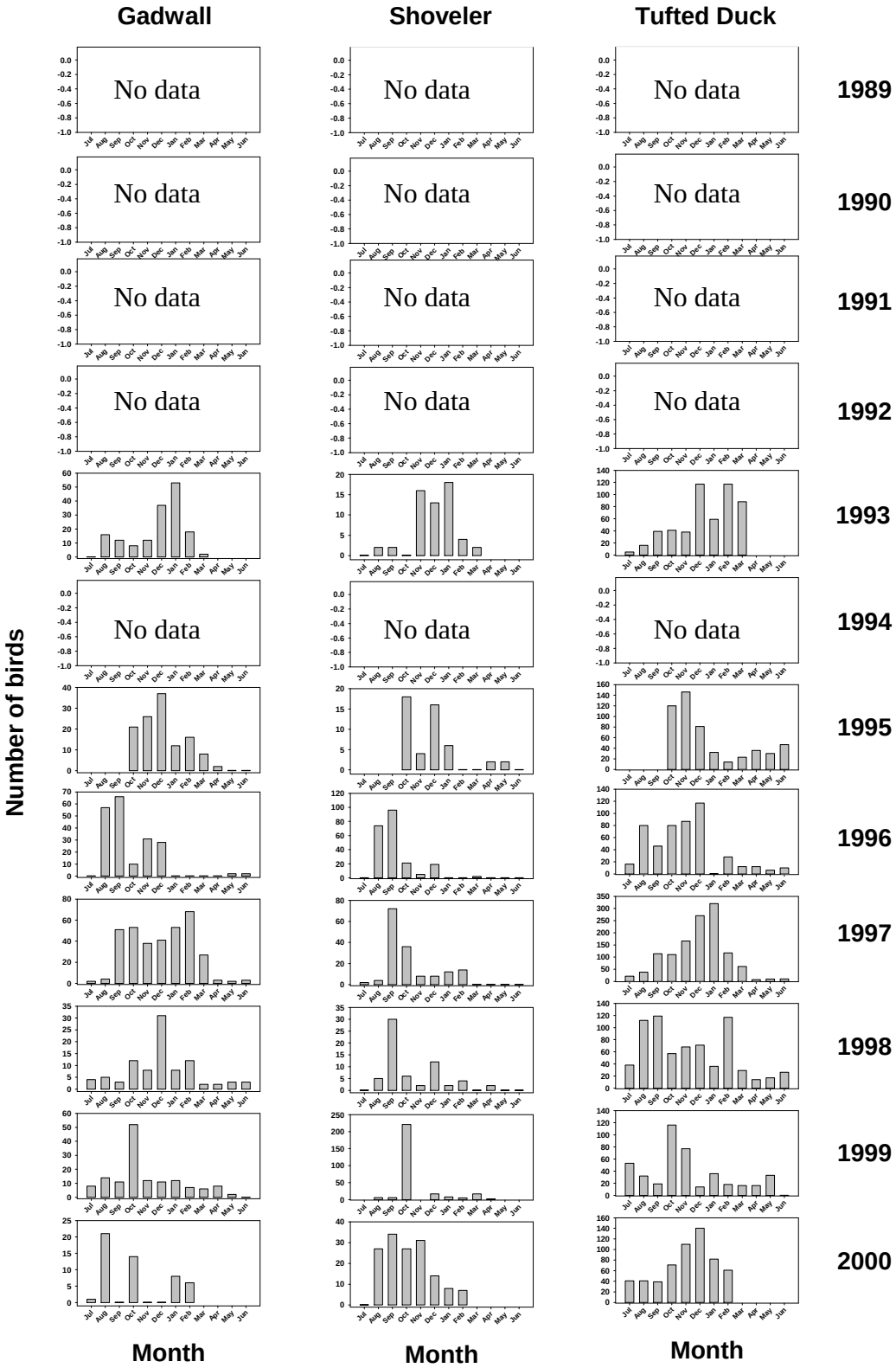

Figure 3.2.12 Yeoveney Lake. Histograms show average counts for all months visited. A blank corresponds to an unvisited month. Standard index months: GA – Sept-March; SV – Sept-Oct; TU – Nov-Feb.

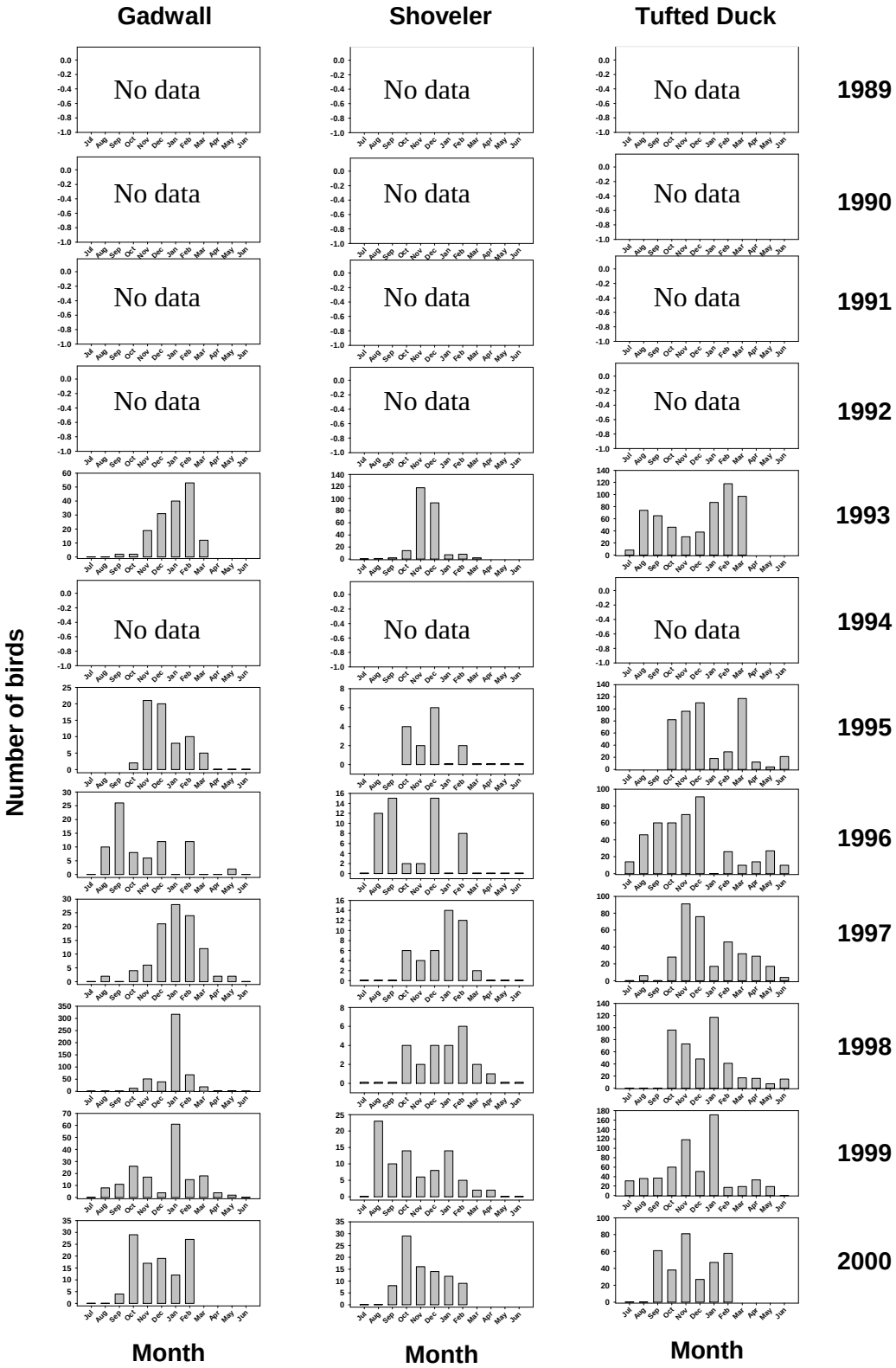

Figure 3.2.13 County Ditch Lake. Histograms show average counts for all months visited. A blank corresponds to an unvisited month. Standard index months: GA – Sept-March; SV – Sept-Oct; TU – Nov-Feb.

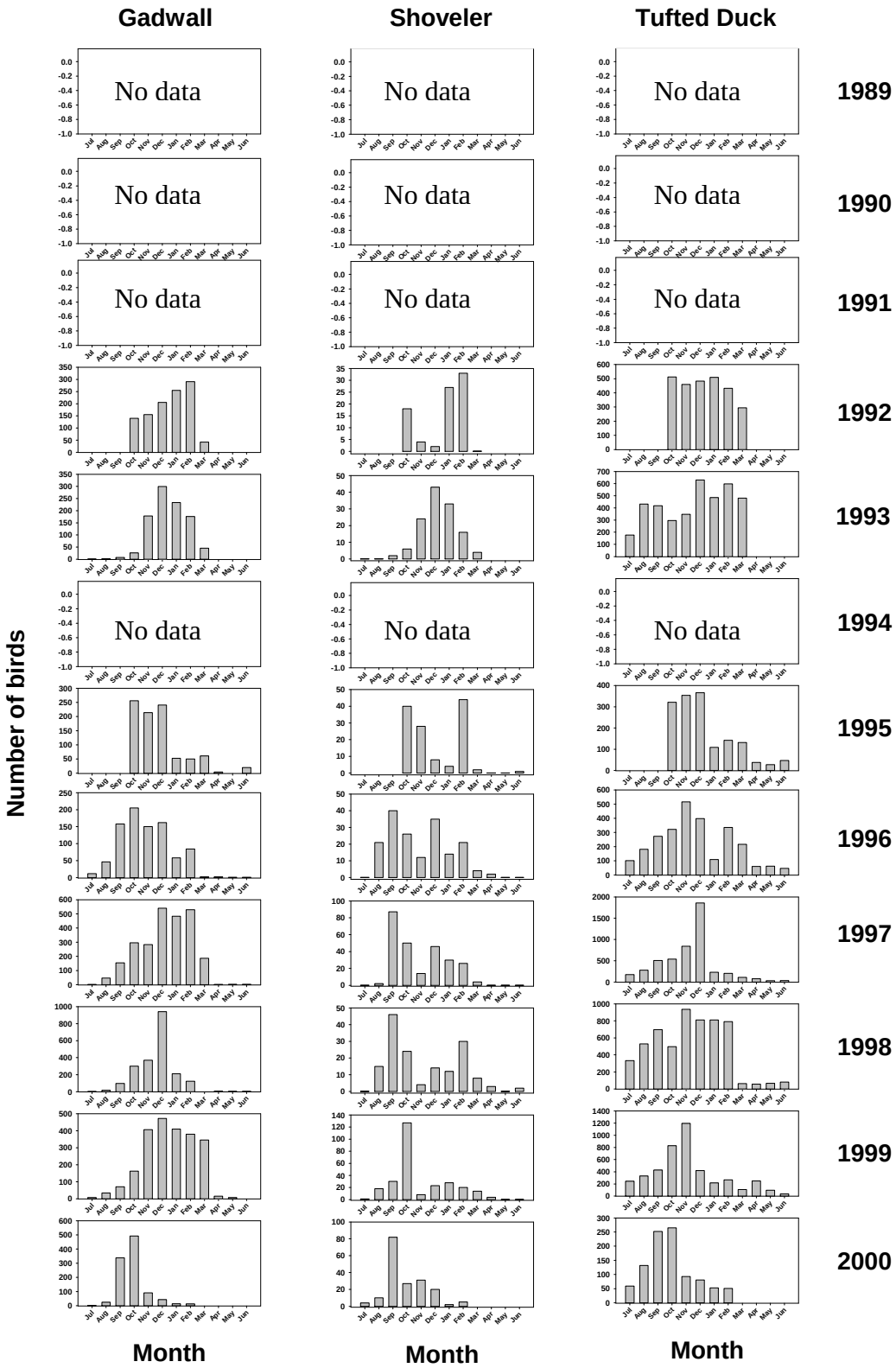

Figure 3.2.14 Wraysbury & Hythe End Gravel Pits (SPA only). Histograms show average counts for all months visited. A blank corresponds to an unvisited month. Standard index months: GA – Sept-March; SV – Sept-Oct; TU – Nov-Feb.

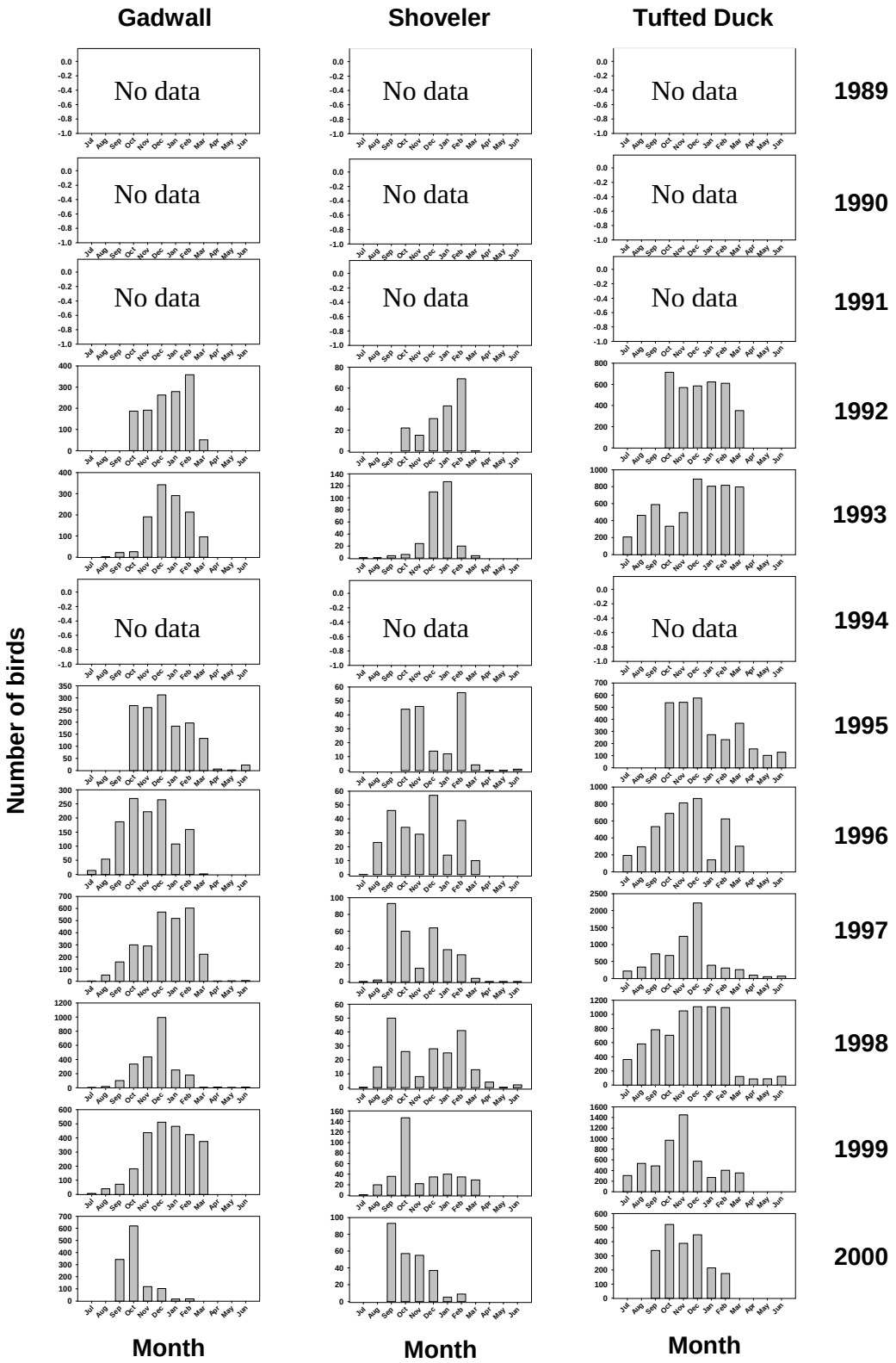

Figure 3.2.15 Wraysbury & Hythe End Gravel Pits and Wraysbury Number 1 Gravel Pits. Histograms show average counts for all months visited. A blank corresponds to an unvisited month. Standard index months: GA – Sept-March; SV – Sept-Oct; TU – Nov-Feb.

4. CONCLUSIONS

4.1 SPA Species Trends

Smoothed indices for Gadwall, Shoveler and Tufted Duck were generated for the SPA as a whole. Long-term trends indicate that all three species are increasing in the SPA. During the period 1989-2000, Gadwall showed a 388% increase, Shoveler a 29% increase and Tufted Duck a 75% increase. At the SPA level, Gadwall show a steady increase before a downturn in 1999. A similar trend is seen at the regional level, whilst the drop-off is less pronounced at the GB level. SPA, regional and national trends for Shoveler are broadly similar, with some fluctuation about a reasonably stable trend line. Tufted Duck go against regional and national trends only in the last two years of analysis; it is impossible to tell at this stage if this is 'natural' fluctuation or the beginnings of a real decline. Of the time periods analysed, the only Alert issued was for Shoveler over a five-year period. This Alert status agrees broadly with a recent study of the same SPA (Wetlands Advisory Service 2003), although the reported declines in Tufted Duck were not supported by our analysis; a small decline of 7% since 1995 should be considered within the 'normal' range of fluctuation.

It should be noted that the WeBS Alert system now incorporates a 'biological filter' to compensate for false Alerts triggered by species prone to natural fluctuation within 'healthy' populations (Austin *et al.* 2004). Short-term (i.e. five-year) Medium and High Alerts for Shoveler would be subject to this caveat, as they would for the other two species analysed, on the basis of known 'normal' population fluctuation within the short-term period. Medium Alerts for Gadwall over ten years should also be cautiously interpreted for the same reason. The long-term trend for Shoveler certainly seems to fluctuate between years, with decreases possibly associated with cold winters (Kirby & Mitchell 1993), and so the apparent five-year decline in this species should be interpreted cautiously.

4.2 SSSI, Sector Level and Site Combination Trends

It should be noted that as the SPA trends for all species were stable or increasing over the 'all time' period, declines at these component sites were counterbalanced by increases at other sites. This could represent re-dispersal within the SPA, or influxes of birds from other sites. However, it is possible that local issues such as eutrophication or disturbance could be leading to this redistribution.

No site or site combination triggered Alerts in all three species. However, Alerts of particular note were fired for two sites: Wraysbury Reservoir and Wraysbury II (North) Gravel Pit. At the former, declines of over 90% were recorded for Shoveler over all time periods reviewed. This is of particular concern given that between 1990 and 1996, the estimated proportion of the SPA total held by this site was between 20% and 50%. However, applying the biological filter, short-term declines should be treated cautiously. Furthermore, as the SPA trend seems largely stable, longer-term declines could be related to re-dispersal within the SPA. Declines in Gadwall and, although Alerts could not justifiably be calculated, Tufted Duck at Wraysbury II (North) are consistent with the findings of the Wetlands Advisory Service (2003). Although the Medium Alerts for Gadwall over five years should be interpreted parsimoniously, the 'all time' High Alerts for the same species is of concern; proportional plots imply that regional species trends do not explain those at the sector. However, similar declines are not recorded at either the SPA or relevant SSSI level, and therefore it is possible that birds may have redistributed at a wider spatial scale, or that birds formerly using the gravel pit have been compensated by influxes to other component SSSI and SPA waterbodies. Human disturbance, predominantly shore-based activities, was found to increase through the winter at Wraysbury II (Wetland Advisory Service 2003), which would be expected to affect the trends of Gadwall and Tufted Duck more than Shoveler, as the latter is indexed early in the winter. Gadwall numbers may be partially compensated by increases at Wraysbury II (South), where the proportion of the SPA total held increased concurrent to the opposite trend at Wraysbury II (North); indeed, trends at Wraysbury & Hythe End SSSI, of which these two lakes are components, do not reveal declines in Gadwall numbers. Tufted Duck appears to be in long-term decline at both component sectors, but only short-term decline at the SSSI level.

Potential causes of declines at Wraysbury Reservoir are somewhat unclear, as the waterbody is likely used as a loafing area only, and is subject to little recreational disturbance (birdwatchers being considered to be the sole pressure). It may be that Shoveler formerly using the site to loaf have moved elsewhere, or that temporal use of the reservoir has altered. Nocturnal counts of Shoveler are relatively high at some component sites of the SPA (Wetlands Advisory Service 2003), so it could be that birds move in to use the reservoir at night, when they are not counted by WeBS. This behaviour could be indicative of the birds avoiding any diurnal disturbance. Alternatively, proportional plots suggest that changes are in step with regional trends. Therefore effects at wider spatial scales (e.g. poor breeding season, harsh winter conditions) may contribute to the measured local effects.

'All time' High Alerts for Gadwall were also fired at Thorpe Park and Yeoveney Lake (although this site Alert issued with a caveat because of small numbers of birds). Declines were found at Thorpe Park by the Wetlands Advisory Service (2003), which could in part be attributable to human disturbance such as water-sports, bird watching or dog walking. 40% of birds left the site in response to a disturbance event, although high levels of human disturbance were not recorded in the sectors most frequently used by Gadwall. Also, restrictions are imposed on the usage of the Thorpe Park Gravel Pit by watercraft and fishermen during the wintering period (late October to mid-March), so this factor may have relatively minor impact. Furthermore, proportional plots suggest that sector-level trends could be consistent with regional trends for the species, at least for the past six years of analysis.

High Alerts for Shoveler, in addition to those at Wraysbury Reservoir, were triggered at Knight & Bessborough Reservoirs. However, as this was over the short-term period, this trend may be considered within the range of 'normal' fluctuation (if the biological filter was used).

Tufted Duck showed declines consistent with High Alert status for all time periods reviewed at Kempton Park Reservoirs. Although the numbers of this species did not exceed a proportion of 15% of the SPA total, the declines of 80% are potentially serious. Wraysbury & Hythe End Gravel Pits (SPA sectors only) showed a 56% decline in Tufted Duck over 'all time', also enough to trigger a High Alert. However, the species trend fluctuated somewhat, so judgment on the longevity of the decline should perhaps be reserved. Proportional plots for both sector combinations indicate that the estimated proportions of the regional totals are consistent, implying that these trends are within the range of regional-level population change. Recreational disturbance is not considered an issue at Kempton Park Reservoirs, but could be at Wraysbury & Hythe End Gravel Pits.

Long-term Medium Alerts are also of concern and were triggered for Tufted Duck at Staines Moor, Wraysbury II (South) and Wraysbury & Hythe End (North and South) with Wraysbury Number 1 Gravel Pits.

Changes in bird numbers may be related to any substantial changes in water levels at the various component SSSIs. Shoveler numbers at a reservoir in southeast England were significantly negatively correlated with increasing water depth, whilst Tufted Duck were significantly positively correlated with the same changes in water levels. Gadwall showed no significant correlation (Banks, unpublished data).

4.3 Timing of Peak Counts

Using standard WeBS indexing months, it was possible to examine whether peak mean counts at the SSSI level and below occurred in different months between years. This would have been of particular concern if the peaks had occurred outside of the window in which species indices were created. For the SPA, no additional counts were available outside of the indexing period, and problems with site consolidation restrict simple combination of the component SSSI data; however, from the indexed SPA, national and regional trends it is possible to compare whether species trends are 'in step'.

Comparing the months in which peak counts occurred at the SPA and national scales, there was little pattern of major difference. 67% of Gadwall peak counts at the SPA were made in the same month or one month either side of the national peak counts, whilst the figure was 83% for Tufted Duck. As Shoveler is indexed on only two months, comparisons of timing are restricted, but 75% of peak counts coincided at SPA and national levels. It should be noted that the functioning of WeBS Alerts should not be affected by variation in timing of peak counts within the standard index months, as the monthly averages are themselves averaged into a yearly mean count to produce the annual species index. Shifting in timing of peak counts would only be problematic if peak counts began to appear outside of the months used for indexing.

At the SSSI level and for site combinations, there is little evidence that seasonal phenology can serve to explain species declines at any of the sites reviewed. Increases in counts of ducks before the first index month (September) are likely to be due to successful breeding seasons or mass moult migrations. Few site / species combinations revealed peak mean counts outside of the months upon which the species are indexed, and therefore it seems safe to assume that the standard index months incorporate the majority of the peak count months.

4.4 Future Research

Further monitoring of the SPA is recommended, to assess whether the High Alert issued for Shoveler over five years marks the beginning of a period of sustained decline. Additional recent downturns in the trends of Gadwall and Tufted Duck may represent 'normal' fluctuations or the beginnings of real declines. Specifically the application of WeBS Alerting procedures to the data would allow objective and consistent analysis of the long-term waterbird trends. This monitoring will be carried out as part of the standard WeBS Alerting procedure for Gadwall and Shoveler.

Additional counts on the component sites within the SPA during months outside of the standard index months would allow greater precision in the analysis of potential phenological changes and temporal shifts in peak counts. However, encouraging enough counters to obtain these data may prove difficult.

Finally, detailed research at the component SSSIs issued with species Alerts in this report may help to explain any causative factors behind the long-term declines at sites. For instance, information on water levels, vegetative growth and chemical composition could prove useful, as would further quantification of recreational disturbance. Furthermore, assessment of movements of wildfowl both within component sites of the SPA and to areas beyond the SPA boundaries would facilitate greater understanding of waterbird trends. Colour ringing schemes and / or radio tracking of individuals could prove beneficial.

4.5 Specific Conclusions in Relation to Aims

- Smoothed trends for all three species examined did not show any long-term declines at the SPA level. One Medium Alert was fired, for Shoveler over five years, but this should be interpreted with caution as the WeBS Alert system biological filter suggests that such variation is within the range of 'normal' variation.
- At the SSSI / sector combination level, High Alerts for 'all time' were fired for Gadwall on three sites, Shoveler on one site and Tufted Duck on two sites, in response to declines greater than 50%. Various shorter-term High Alerts and several Medium Alerts were also triggered at specific sites.
- Various caveats should be considered during interpretation. Short-term Alerts for all three species, plus ten-year Alerts for Gadwall, are subject to caution according to the WeBS Alert biological filter, which accounts for 'acceptable' population fluctuations. Also, declines should be viewed in the light of SPA and (where applicable) SSSI trends.

- Histograms of the occurrence of peak mean counts across all SSSIs revealed little evidence of shifts in timing of peak counts. Most peak counts occurred inside the standard WeBS index window, therefore apparent declines are unlikely to be due to excluded data.
- Calculation of the timing of peak mean counts at SPA and national levels showed that within the standard indexing months, there was little difference between timings of peak counts over the period assessed.
- Although not directly inferred from this report, negative effects of human disturbance on waterbirds cannot be ruled out. Recreational disturbance measured by the Wetlands Advisory Service (2003) at Thorpe Park and Wraysbury II Gravel Pits is a consideration in interpreting species trends at these waterbodies.

Acknowledgments

We wish to thank Sam King at English Nature for project guidance. We are very grateful to Niall Burton for comments, and Heidi Mellan for secretarial support.

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Appendix 1. Summary table of site names and codes. Sites in italics are excluded from the SPA.

SSSI	WeBS Subsite	WeBS code	Grid Reference
Staines Moor	King George VI Reservoir	23102	TQ0473
	Staines Reservoirs: North Basin	23106	TQ050736
	Staines Reservoirs: South Basin	23107	TQ053727
Knight & Bessborough	Knight & Bessborough Reservoirs	23118	TQ121681
Thorpe Park No. 1 Gravel Pit	Thorpe Park: 1	23717	TQ030680
	Thorpe Park: 7	23712	TQ026685
	Thorpe Park: 6 & 9	23718	TQ025684
Kempton Park Reservoirs	Kempton Reservoir East	24103	TQ118708
	Redhouse Reservoir	24104	TQ121702
Wraysbury Reservoir	Wraysbury Reservoir	23101	TQ025745
Wraysbury & Hythe End Gravel Pits	Wraysbury II (North) Gravel Pit	28209	TQ010738
	Wraysbury II (South) Gravel Pit	28210	TQ008733
	Yeoveney Lake	28717	TQ018732
	County Ditch Lake	28716	TQ019732
Wraysbury No. 1 Gravel Pits	Wraysbury I Gravel Pit (North)	28207	TQ002750
	Wraysbury I Gravel Pit (South)	28208	TQ005745

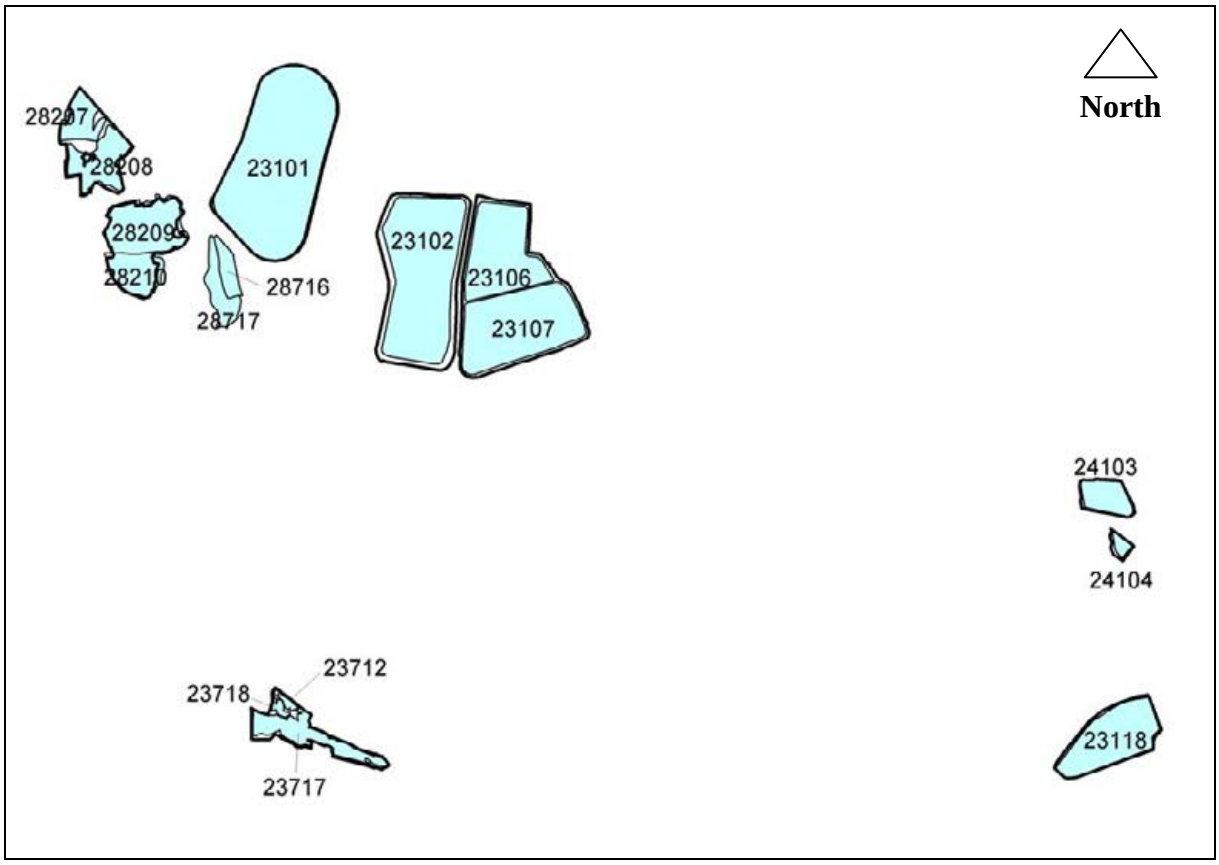
Appendix 2. All counties and administration areas intersecting the EA Thames region. Those areas included in analysis marked 'Y', those excluded marked 'N'.

County	District	Included?
Bedfordshire	South Bedfordshire	N
Bracknell Forest		Y
Buckinghamshire	Aylesbury Vale	Y
Buckinghamshire	Chiltern	Y
Buckinghamshire	South Bucks	Y
Buckinghamshire	Wycombe	Y
Essex	Brentwood	Y
Essex	Epping Forest	Y
Essex	Harlow	Y
Essex	Uttlesford	Y
Gloucestershire	Cheltenham	N
Gloucestershire	Cotswold	N
Gloucestershire	Tewkesbury	N
Greater London	Barking & Dagenham	Y
Greater London	Barnet	Y
Greater London	Bexley	Y
Greater London	Brent	Y
Greater London	Bromley	Y
Greater London	Camden	Y
Greater London	City of London	Y
Greater London	City of Westminster	Y
Greater London	Croydon	Y
Greater London	Ealing	Y
Greater London	Enfield	Y
Greater London	Greenwich	Y
Greater London	Hackney	Y
Greater London	Hammersmith & Fulham	Y
Greater London	Haringey	Y
Greater London	Harrow	Y
Greater London	Havering	Y
Greater London	Hillingdon	Y
Greater London	Hounslow	Y
Greater London	Islington	Y
Greater London	Kensington & Chelsea	Y
Greater London	Kingston upon Thames	Y
Greater London	Lambeth	Y
Greater London	Lewisham	Y
Greater London	Merton	Y
Greater London	Newham	Y
Greater London	Redbridge	Y
Greater London	Richmond upon Thames	Y
Greater London	Southwark	Y
Greater London	Sutton	Y
Greater London	Tower Hamlets	Y
Greater London	Waltham Forest	Y
Greater London	Wandsworth	Y

Appendix 2. Continued.

County	District	Included?
Hampshire	Basingstoke & Deane	N
Hampshire	East Hampshire	N
Hampshire	Hart	Y
Hampshire	Rushmoor	Y
Hampshire	Winchester	N
Hertfordshire	Broxbourne	Y
Hertfordshire	Dacorum	Y
Hertfordshire	East Hertfordshire	Y
Hertfordshire	Hertsmere	Y
Hertfordshire	North Hertfordshire	N
Hertfordshire	St Albans	Y
Hertfordshire	Stevenage	Y
Hertfordshire	Three Rivers	Y
Hertfordshire	Watford	Y
Hertfordshire	Welwyn Hatfield	Y
Luton		N
Northamptonshire	Daventry	N
Northamptonshire	South Northamptonshire	N
Oxfordshire	Cherwell	N
Oxfordshire	Oxford	N
Oxfordshire	South Oxfordshire	N
Oxfordshire	Vale of White Horse	N
Oxfordshire	West Oxfordshire	N
Reading		Y
Slough		Y
Surrey	Elmbridge	Y
Surrey	Epsom & Ewell	Y
Surrey	Guildford	Y
Surrey	Mole Valley	Y
Surrey	Reigate & Banstead	Y
Surrey	Runnymede	Y
Surrey	Spelthorne	Y
Surrey	Surrey Heath	Y
Surrey	Tandridge	Y
Surrey	Waverley	Y
Surrey	Woking	Y
Swindon		N
Thurrock		N
Warwickshire	Stratford-on-Avon	N
West Berkshire		N
West Sussex	Chichester	N
West Sussex	Crawley	N
West Sussex	Horsham	N
West Sussex	Mid Sussex	N
Wiltshire	Kennet	N
Wiltshire	North Wiltshire	N
Windsor and Maidenhead		Y
Wokingham		Y

Appendix 3. Site map of South West London Waterbodies SPA. Component SSSIs numbered by WeBS codes, as outlined in Appendix 1.



Appendix 4. Table of Alerts based on all data from the months September – March, for 15 site consolidations. Figures are percentage change in smoothed index.

	GADWALL			SHOVELER			TUFTED DUCK		
	FiveYear	TenYear	AllTime	FiveYear	TenYear	AllTime	FiveYear	TenYear	AllTime
Staines Moor	226	130	158	*-32*	45	45	**-63**	-24	*-27*
Knight & Bessborough Reservoirs	229*	x	>1000*	**-72**	x	22	*-36*	x	42
Thorpe Park Number 1 Gravel Pit	-24	x	**-61**	400*	x	x	21	x	-7
Kempton Park Reservoirs	-7	382	382	336*	>1000	**	**-73**	**-75**	**-75**
Wraysbury Reservoir	150*	400*	400*	**-91**	**-92**	**-95**	-23	*-40*	-6
Wraysbury & Hythe End Gravel Pits[1]	27	363	588	5	386	750	*-34*	0	24
Wraysbury Number 1 Gravel Pits	*-26*	x	0	50*	x	-21*	-7	x	31
Wraysbury Number 1 Gravel Pits (North)	x	x	22*	x	x	x	x	x	x
Wraysbury Number 1 Gravel Pits (South)	x	x	7*	x	x	60	x	x	88
Wraysbury II (North) Gravel Pit	*-44*	x	**-67**	7	x	33	*-25*	x	**-56**
Wraysbury II (South) Gravel Pit	93	x	167	100*	x	367*	*-34*	x	-15
Yeoveney Lake	**-68***	x	**-63***	127	x	257	-1	x	3
County Ditch Lake	58*	x	-10*	180*	x	**-59***	-10	x	-20
Wraysbury & Hythe End Gravel Pits[2]	35	x	26	36	x	100	*-28*	x	*-48*
Wraysbury & Hythe End N & S and Wraysbury Number 1 Gravel Pits	16	x	22	32	x	32	-21	x	*-29*

Shaded figures indicate changes in Alert status when compared with standard Alerts. A cross appears where data were insufficient for analysis. Figures in italics show Medium Alerts (a decline of 25%-50%), whilst bold figures show High Alerts (>50% declines). All Time refers to the period 1989/90-2000/2001.

*indicates calculations based on a total average count of less than 25 birds, that should be interpreted with caution.
** indicates that an Alert cannot be generated as the initial or final index value was zero.
[1]Includes Yeoveney Lake and County Ditch Lake.
[2]Excludes Yeoveney Lake and County Ditch Lake.