BTO Research Report No. 406

Estimating Great Cormorant *Phalacrocorax carbo* Population Change as an Aid to Management

Authors

S. M. Baylis, G. E. Austin, A. J. Musgrove & M. M. Rehfisch

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EXECUTIVE SUMMARY

- Currently, the only long-term data available on wintering Cormorant numbers come from the Wetland Bird Survey (WeBS). They have been used to produce indices of population change for England, Wales, Scotland, Northern Ireland and Great Britain. Data from WeBS have also been extracted and used in a population model to suggest that the proposed level of control should not threaten the sustainability of wintering Cormorant populations in England and Wales.

- This study addresses the issues relating to the applicability and validity of the data used, especially during the early years of Cormorant counting by WeBS between the winters of 1986/1987 and 1991/1992. It aims to produce meaningful indices of wintering Cormorant population change.

- Original WeBS core count recording forms from the above 5 years were scrutinised and checked against values found in the WeBS database. A range of scenarios encountered during this process was described and, in particular, zero values were judged to be either 'null counts' or 'true zeros'. Where counts occurred at complex multi-sector sites, attention was given to the history of the sectors covered as well as the counts themselves, which provided an assessment of completeness.

- Revised indices with consistency intervals were produced for England, Wales, Scotland, Northern Ireland and Great Britain using the validated data and compared with the originals. This followed the Underhill indexing method.

- As an addition to this report, and after the data checking process, data were separately supplied to CSL.

- Data from 1986/1987 were found to be unsuitable for inclusion in the production of the indices. Data from 1987/1988 onwards were used to produce revised indices for England and Wales (indices for Scotland, Northern Ireland and Great Britain are included in Appendices for reference). They show that the increase in wintering Cormorant in England and Wales has been less rapid than suggested by the original indices.

- A list of around 1500 WeBS sites that currently hold the largest numbers of wintering Cormorant in England and Wales was extracted from the database. An assessment of the 370 sites that held the most Cormorants between 1999/2000 and 2003/2004 (the latest years for which WeBS count data have been analysed) showed which of these potentially provided long and near complete runs of data. Of the 370 sites, 123 single count unit sites and 10 multiple-count unit sites were defined as having been well counted from the early years.

- The interpretation of WeBS data and indices are subject to certain caveats. In particular, coverage of estuaries and large freshwater bodies is far better than that of small freshwater lakes and ponds and riverine stretches. Currently, there is no random sampling of sites and no stratification of different types of wetland habitat. Wetland coverage by WeBS is not distributed evenly and, in general, a higher proportion of wetlands in southern and eastern England are counted than those in northern England and Wales.

- The unrepresentative coverage of wetlands by WeBS makes it essential to treat any non-stratified sample with much caution. Without stratification, WeBS estimates of Cormorant population change will be inaccurate unless the population change is broadly constant through time in different wetland types or habitats, which is very unlikely (see Section 4.1 for discussion of issues). Thus, the model used to evaluate the effects of the control on the Cormorant population that is based on determining relationships between population size and change should not be treated as definitive.

- It has been difficult to avoid an element of subjectivity in the data validation process, despite measures being taken to the contrary. This subjectivity may have affected the estimated population increase, probably to a relatively minor extent, but not in a predictable direction.

- The introduction of the planned WeBS online system of data submission over the next 2 years may assist with the early reporting of wintering Cormorant population change. The applicability of this system as an early warning system or "tripwire" will be directly affected by the popularity of on-line reporting amongst observers in general and, at key sites in particular. The uptake rate and site coverage are difficult to predict.

1. INTRODUCTION

Following a ministerial statement and a scientific assessment, Defra is issuing up to 3000 licenses per year that allow Cormorant *Phalacrocorax carbo* control in England and Wales (Defra, 2004).

It is necessary to be able to determine the effect that this control policy has on the Cormorant population to ensure that the species is not threatened nationally and to maintain its Favourable Conservation Status on SSSIs and SPAs where it is a cited species.

At present, the only long-term data available on wintering Cormorant numbers come from the Wetland Bird Survey (WeBS). A full description of WeBS aims, survey methods and data analysis can be found in Pollitt *et al*. 2003.

Figures 1.1 and 1.2 show the Cormorant indices for England and Wales, respectively, produced from WeBS data before the validation exercise presented in this report. During the process of index production any missing WeBS counts have been imputed (estimated mathematically) using the Underhill algorithm (Underhill and Prŷs-Jones, 1994). The indices produced by standard WeBS reporting are only based on sites with 50% coverage over the indexing period i.e. not all WeBS data contribute to the indices. The figures suggest that both the English and Welsh wintering Cormorant populations have undergone rapid and sustained increases since 1986/1987, with particularly rapid increases recorded between 1986/1987 and 1988/1989.

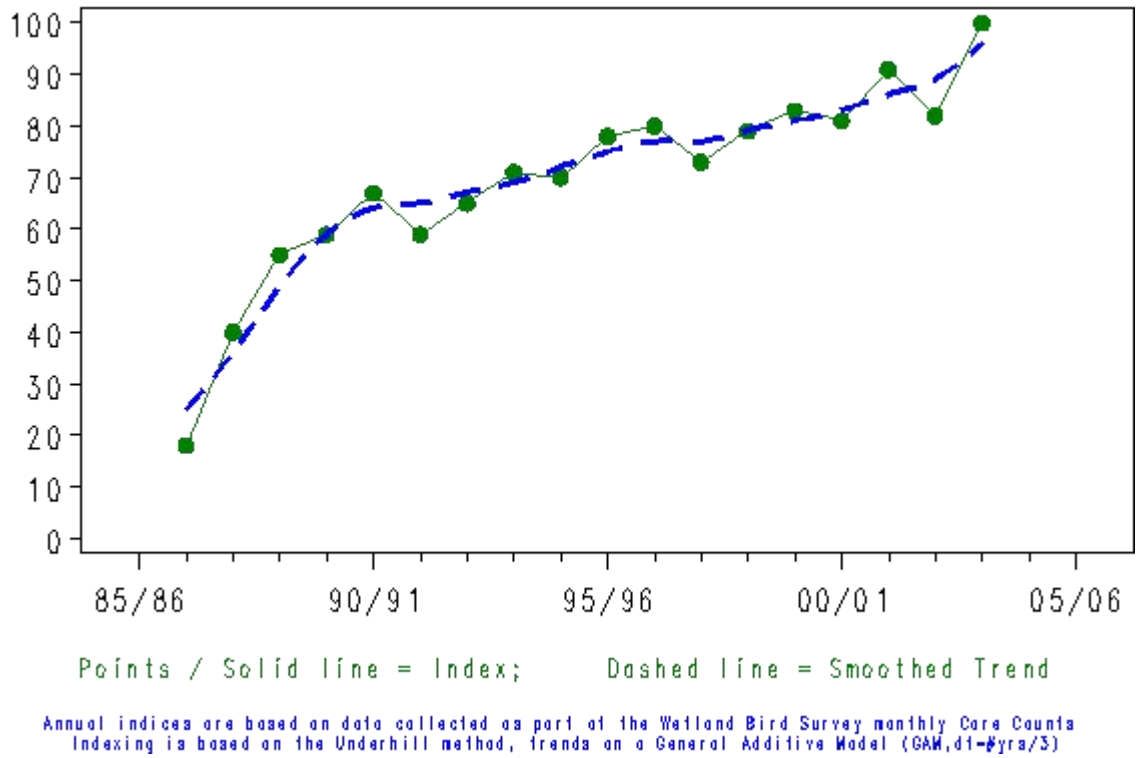

Figure 1.1 Index of wintering Cormorant in England, 1986/1987 to 2003/2004, using unvalidated data.

The basis of the scientific assessment backing up the ministerial statement was based on stochastic models with and without density-dependence developed using unvalidated WeBS data, with no allowance for missing counts, which suggested that the proposed level of control should not threaten the sustainability of the wintering Cormorant population http://www.defra.gov.uk/wildlife-countryside/vertebrates/reports.htm. However, the usefulness of this model as an aid to Cormorant management is highly dependent on the validity of the WeBS data underpinning it.

The primary aim of the work reported on here is to validate WeBS data, to help ensure as robust a model output as possible considering any methodological limitations (Pollitt *et al*. 2003). However, the original stochastic models were based on summarised data extracted from WeBS annual reports. Such summarised data take no account of the number of WeBS sites that submit data and this varies between months and years. Therefore, irrespective of the results of the WeBS data validation process reported on here, the model would have had to be rerun, making allowances for missing counts in some months and years. Clearly, the original model based on

data for individual sites where the site counts are incomplete could have generated very misleading results. For example, if half a site is not counted in the early years, an apparent doubling of Cormorant numbers on the site in later years could just be due to complete coverage of the site, rather than an increase in Cormorant numbers (see below).

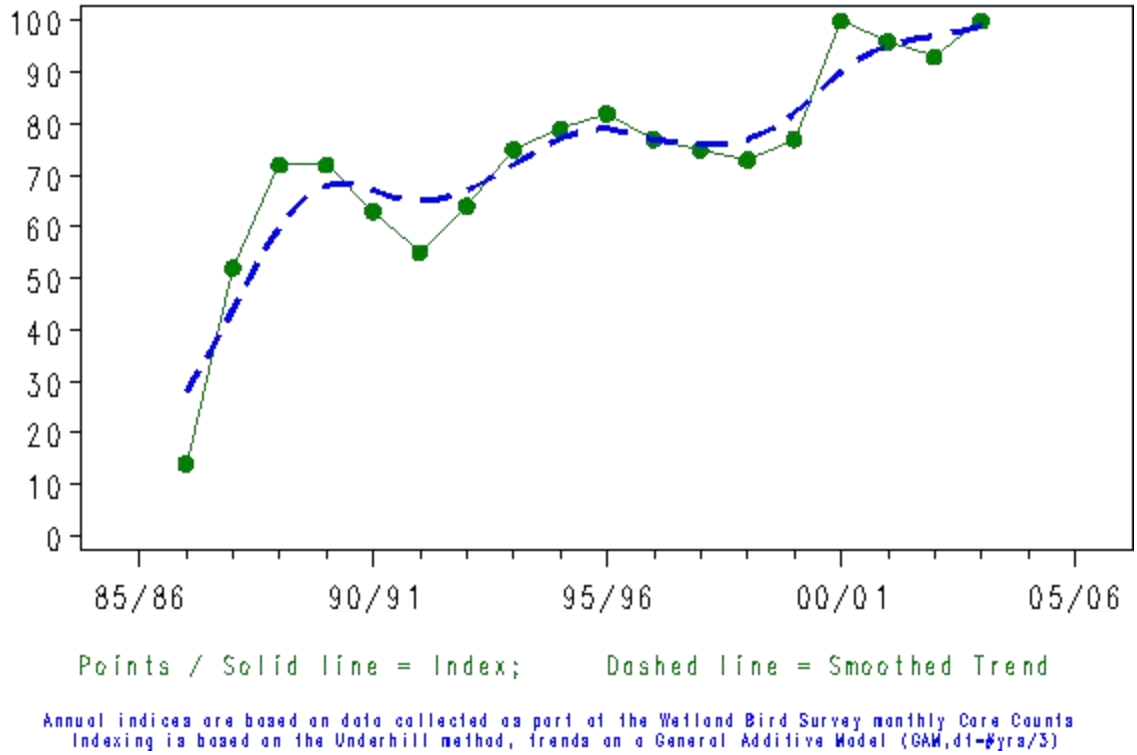

Figure 1.2 Index of wintering Cormorant in Wales, 1986/1987 to 2003/2004, using unvalidated data.

There are, however, issues relating to the validity of the Cormorant counts during the 1980s that this project addresses.

Although WeBS asked counters to start recording Cormorants in 1986/87, prior to the winter of 1987/1988 Cormorant were only sporadically reported by observers during WeBS counts. This was partly because there was no pre-printed line for Cormorant on the recording forms. Additionally, this species didn't easily fit into the 'wildfowl' (swans, geese and ducks) or 'wader' group, the groups of species that were covered in the earlier years of WeBS. There may also have been some reluctance on the part of observers to record them, especially where they occurred in small numbers. There is the perception that they are not a visually attractive species and, during the late 1980s they were not the subject of the conservation attention they currently attract.

WeBS count sites are 'single-sector' or 'complex'. Complex sites, such as estuaries and major conglomerations of gravel pits, are split into more than one count unit or 'sector'. The validity of the data for sites is affected by the history of the count sectors involved. Apparently low counts in some years on a site may simply be due to a site being incompletely counted rather than a real change in numbers on the site. Thus, if the proportion of sites that are fully counted by a survey increases with time, counts that did not allow for this increase in coverage could falsely give the impression of an increase in total bird numbers simply as a result of the more complete counts.

The work that is reported on here aims to ensure that suitable data are used for the scientific assessment of the likely effect of the control policy on the Cormorant population and for surveillance of the Cormorant population. The work thus has the following objectives:

- To assess the quality of the count data for each WeBS site in England and Wales that has recorded Cormorants with particular emphasis on the early years of data collection.

- To determine from what year onwards data of sufficient quality and quantity are available to allow population trends to be assessed nationally and for individual sites.

- To produce a new "clean" Cormorant data set that only includes high quality Cormorant counts.

- To generate a validated Cormorant population index for England and Wales using data for the years and sites deemed to have obtained sufficient high quality coverage.

- To assess whether it is possible to develop an early warning system or "tripwire" that could be used to identify unusual declines in Cormorant numbers before the official annual release of the results of the WeBS counts.

The assessment of count data was made using the methods described in section 2. This exercise was undertaken as objectively as possible, however, on occasion, an element of personal discretion was necessary in order to make an assessment as to the quality of the count data provided by observers. Such decisions were clearly documented so as to leave a clear data audit trail.

2. METHODS

Original WeBS core count recording forms for England and Wales from prior to 1994 were sorted. The individual forms from the years 1986/1987 to 1990/1991 inclusive (five years) were scrutinised and checked against the values found in the WeBS database. These five years were selected for detailed analysis as a preliminary assessment of numerical change in Cormorant in Britain had shown that very obviously larger changes had occurred in the early years than in subsequent years. For Cormorant, the WeBS 'winter' period is defined as being between September and March inclusive (seven months). Therefore, the counts from these months were checked as below.

The counts greater than zero recorded on the core count forms were checked and particular attention given to counts of '1'. This is because Cormorant were occasionally recorded as 'present but not counted' with a 'P' or 'PBNC' notation on the recording forms and in such instances a count of 1 was subsequently entered in the database. Where 'P' counts were found, these were assumed to be 'null counts', a bird count that did not record the numbers of individual Cormorants present (see below).

During data extraction from the WeBS database, zero values were generated on the assumption that where a visit occurred, all species were counted if present. Therefore, the following questions were addressed for each site in each month of every year:

- Was this a 'true zero' where a visit occurred and Cormorants were truly absent?
- Was this a 'null count' where a visit occurred but there was no information recorded on the form as to whether Cormorants were present on the site on the count date, or, if they were recorded as being present (P or PBNC), the number of individuals present was not recorded on the site on the count date.

Some of the common scenarios found during the recording form checking process from each year are described below, and in each case, the assumption made as to whether the zero value generated was null or true is stated.

2.1 Cormorant Count Quality in the Early WeBS Years

2.1.1 1986/1987

In this year, Cormorant were not pre-printed on the recording forms:

- An observer handwrote Cormorant on a blank line and entered a count. On these occasions, especially where the same observer provided all the counts for one winter season, any blanks along the Cormorant row were regarded as true zeros
- An observer handwrote Cormorant and added zeros, 'nil' or a dashed notation along the row. Here, an assumption was made that these were also true zeros
- Where counts occurred on established nature reserves or SSSIs, wardens occasionally conducted counts for their own purposes using their own recording system and forms. These were then forwarded for use by WeBS. At sites where it was obvious that Cormorant were counted, any zeros were considered to be true zeros
- 'Cormorant' was not handwritten on the form in a particular year. Unless there was a good history of the same observer recording them in the previous few years, any zeros in the database attached to this scenario were taken to be null counts

2.1.2 1987/1988

This is the first year when 'Cormorant' was pre-printed on the recording form. Importantly, for this year, an assumption was not automatically made that the count was a true zero where the line was left blank. This was because:

- Observers may have taken a notebook out into the field and transferred counts to the recording form at a later date (sometimes 6-12 months later!). As Cormorants had not previously been required to be counted for WeBS, observers may have 'forgotten' to count them
- Observers were using an old recording form. Where this occurred, the process described in section 2.1.1 applied
- Dashed notation, 'nil' or zeros entered along the Cormorant row were assumed to be true zeros
- Where there was a mix of counts >0 and blanks during the winter at one site or sector, providing the same observer had made all the visits, any blanks were assumed to be true zeros

For the instances where the line was left completely blank across all months, a further examination of the history of the counts and the observer(s) occurred:

- Where the same observer had individually recorded Cormorant numbers in the previous year, or in the previous and subsequent years at the same site, any blanks were assumed to be true zeros
- Where low counts (<6) occurred over the years 1988/1989 to 1990/1991 at a particular site or sector and the same observer was involved, the blanks during 1987/1988 were also taken to be true zeros
- Where counts of ≥6 occurred in the following years on more than 50% of the available count occasions, the blanks during 1987/1988 were taken to be 'null counts'

2.1.3 1988/1989 onwards

These forms were scrutinised as above and the same assumptions applied. The number of forms where a line of blanks occurred without any dashes, 'nils' or zeros decreased with time.

2.2 Complex Sites

Data at the sector level from complex sites were scrutinised as above where available. Where a mix of null counts and true zeros were identified across sectors of a complex site for a given month, the consolidated value (the sum of all individual count sector sites) used to produce the index for that month for that site was taken to be a null count.

During the years 1986/1987 to 1988/1989 inclusive, sector level data (SLD) were not always available. This was because, in the earlier years of WeBS, computer capacity and processing power was not sufficient to cope with large volumes of SLD.

In these cases, the counts were examined at whole site level:

- Where counts at the whole site level appeared to be three times greater (or more) than the previous year, the counts were taken to be incomplete and therefore a null count.
- Where counts at whole site level appeared to decrease, remain the same or increase at a lower rate than above, the counts were assumed to be valid and therefore were included in the index

2.3 Production of Index

Following the standard WeBS approach, the Underhill indexing method (Underhill & Prŷs-Jones 1994, Prŷs-Jones *et al*. 1994) was used to produce an index of wintering Cormorant for England and Wales from the validated, 'cleaned' data. For Cormorant, data from the seven 'winter' months of September to March inclusive are used to produce the standard WeBS indices. Following Underhill and Prŷs-Jones (1994), only the data from the sites where 50% or more of good quality counts exist for the relevant indexing years contribute to the index. Missing or poor quality counts are estimated at the site level by mathematical imputation. See Underhill and Prŷs-Jones (1994) for a detailed description of the imputation methodology.

2.4 Supply of data

As an addition to this report, and after the data cleaning process described above, data were supplied to CSL separately. In particular, the number of bird months behind the index, the mean winter count and the peak winter count were supplied for England, Wales and England/Wales combined.

Additionally, for England, Wales and England/Wales combined, the actual and imputed counts used for indexing were supplied, which consisted of a full matrix of counts from a total of around 670 sites for which there were at least 50% of possible counts.

The complete dataset was supplied summarised by site, year and month for all sites that recorded Cormorants. This dataset was supplied with a proviso that they should not be used as raw data, due to the possibility of duplicate records that are, under normal WeBS procedures, filtered out at a later stage.

2.5 Site Information

A list of the sites that currently hold the largest numbers of wintering Cormorant in England and Wales was extracted from the database. Around 1,500 sites were checked in each year and the sites (complex sites at whole

site level) were ranked according to the mean peak count for the five years ending 2003/2004. Only the 370 sites that held a five-year mean peak value of ≥10 wintering Cormorants were listed. This list, therefore, represents the 370 WeBS count sites where wintering Cormorant are currently most numerous. In the case of complex sites, an indication was made as to whether SLD or whole site data were available for each year. Where SLD were available for examination, an asterisk was marked against those sites where incomplete counts occurred.

An assessment of 'good sites' was made using the following criteria:

- For single-sector sites, a good site was taken to be where counts of ≥1 or true zeros existed for at least 4 of the 5 years 1986/1987 to 1990/1991
- For complex sites, a good site was taken to be where complete sector level data were available for at least 4 of the 5 years 1986/1987 to 1990/1991 and these data were counts of ≥1 or true zeros

3. RESULTS

3.1 Data Validation

The results of the data validation procedure are shown in Table 3.1. The summary shows that the percentage of relevant months when Cormorant were recorded increases from 10% to 89% over 3 years. At the same time, the proportion of null counts fell from 90% to 11%. The most rapid increase in good counts (defined as the sum of counts of ≥1 and true zeros) and the most rapid decrease in null counts occurred between the years of 1986/1987 and 1987/1988.

	1986/1987	1987/1988	1988/1989
Counts of ≥1 and true zeros	1015 (10%)	8614 (80%)	8966 (89%)
Null counts	8944 (90%)	2157 (20%)	1139 (11%)
Total visit months	9959	10771	10105

Table 3.1 Numbers and proportions of null counts and good counts, for all visit months during the years 1986/1987 to 1988/1989 inclusive.

3.2 Indexing

The data for 1986/1987 are unsuitable for inclusion in the indices, owing to the large proportion (90%) of null counts that would have to be imputed. However, the validated data from 1987/1988 onwards have been used to produce the annual indices shown in Figures 3.1 and 3.2. For reference, the indices for Scotland, Northern Ireland and Great Britain are shown in Appendices 1, 2 and 3 respectively.

3.2.1 Annual index for England

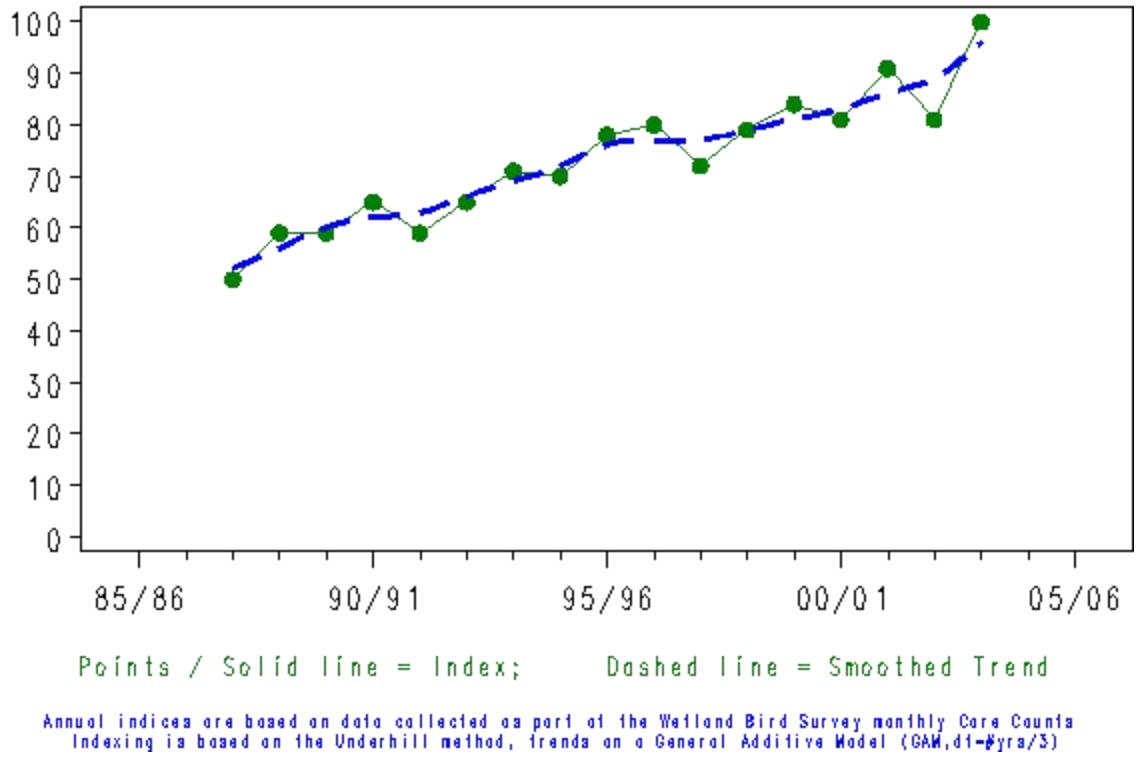

Figure 3.1 Revised wintering Cormorant index for England for the years 1987/1988 to 2003/2004 (17 data points, 16 years), using validated data.

Year	Index value	Lower consistency interval	Higher consistency interval
1987/1988	50	45	53
1988/1989	59	53	64
1989/1990	59	53	63
1990/1991	65	59	69
1991/1992	59	53	62
1992/1993	65	59	68
1993/1994	71	65	76
1994/1995	70	65	76
1995/1996	78	75	81
1996/1997	80	77	86
1997/1998	72	67	75
1998/1999	79	74	84
1999/2000	84	78	87
2000/2001	81	76	86
2001/2002	91	86	97
2002/2003	81	77	86
2003/2004	100	94	106

Table 3.2 Revised wintering Cormorant index values for England with lower and higher consistency intervals calculated using the Underhill program.

The index in Figure 3.1 and values in Table 3.2 show that the numbers of English wintering Cormorants counted by WeBS has doubled over 16 years. The index has changed from 50 to 100, an average annual rate of increase of 4.43%. The trend has been steadily upwards, with relatively few peaks and troughs. The three highest counts of Cormorant have all occurred during the most recent five years; in 2003/2004, 2001/2002 and 1999/2000 respectively. Similarly, the four lowest counts all occurred during the first five winters' counts. The increase between the final two years is apparently more rapid than before, but the index value for the final year of data should always be considered with caution. In this instance, an unrealistically high value could be due to a few sites with declining Cormorant numbers submitting their data too late to be incorporated into the index.

3.2.2 Annual index for Wales

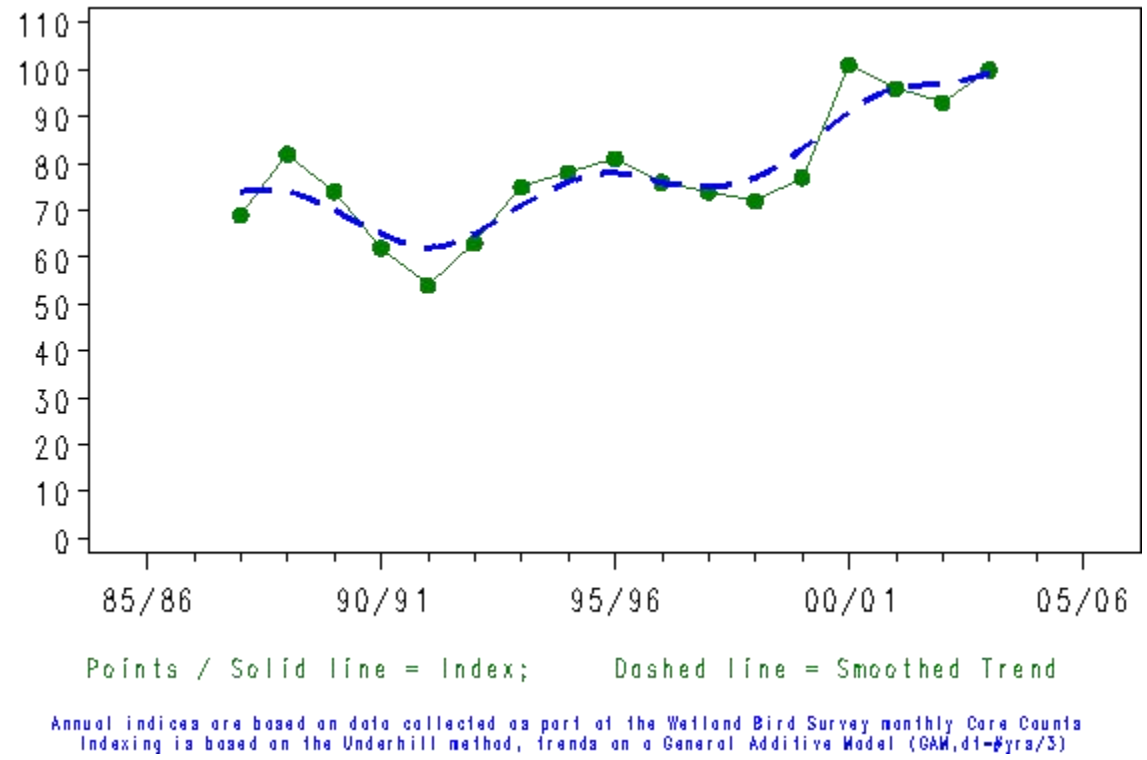

Figure 3.2 Revised wintering Cormorant index for Wales for the years 1987/1988 to 2003/2004 (17 data points, 16 years), using validated data.

Year	Index value	Lower consistency interval	Higher consistency interval
1987/1988	69	62	76
1988/1989	82	71	94
1989/1990	74	64	88
1990/1991	62	57	68
1991/1992	54	45	66
1992/1993	63	56	74
1993/1994	75	66	82
1994/1995	78	72	88
1995/1996	81	72	95
1996/1997	76	67	88
1997/1998	74	67	78
1998/1999	72	67	78
1999/2000	77	73	87
2000/2001	101	80	119
2001/2002	96	87	105
2002/2003	93	77	102
2003/2004	100	91	108

Table 3.3 Revised wintering Cormorant index values for Wales with lower and higher consistency intervals calculated using the Underhill program.

The index in Figure 3.2 and values in Table 3.3 show that the Welsh wintering Cormorant population has increased by 45% over 16 years, having changed from an index value 69 to 100, an average annual rate of increase of 2.35%. Compared to the English trend, the Welsh trend has shown more undulations over the course of the general increase. Despite these apparent peaks and troughs, the highest four counts have all occurred in the most recent four years (2000/2001 to 2003/2004) and the smoothed trend for these years is relatively stable. It is interesting to note that after a big increase in numbers between 1999/2000 and 2000/2001, numbers have levelled off. The lowest number of wintering Cormorant occurred over the winter of 1991/1992 and the next two lowest counts occurred during the previous and following winters respectively.

3.3 Site Information

Table 3.4 shows the results of the analysis of the top 30 sites, ranked in order of the sites that currently hold the largest numbers of wintering Cormorant. A more complete listing of the 370 sites that have a five-year mean peak (years 1999/2000 to 2003/2004 inclusive) of ≥10 wintering Cormorants is shown in Appendix 4.

Of these top 30 sites, nine are single-sector sites and 21 are multi-sector complex sites.

Validated data from at least three of the five early years are available for five of the nine single-sector sites: Queen Mary Reservoir, Rutland Water, Abberton Reservoir, Poole Harbour and Rostherne Mere. Furthermore, data from two years are available for Wraysbury Reservoir and Hanningfield Reservoir. Validated counts for 1988/1989 only exist for Walthamstow Reservoirs (counted as a single-sector site). The only top 30 single-sector site that WeBS didn't cover during the first five years is 'Ness House, Thorpeness Offshore' which is, as the name suggests, an offshore coastal site. Of these top nine single-sector sites, Queen Mary Reservoir, Abberton Reservoir, Poole Harbour and Rostherne Mere can be described as good sites, using the definition in section 2.5.

Of the 21 complex sites, SLD are not available during these early years for Staines Reservoirs, Wraysbury Gravel Pits, Besthorpe and Girton Gravel Pits, Tees Estuary and Ouse Washes. Sector level data (SLD) exist for at least one of the five years at 16 sites. However, of these 16 sites, only one year's counts were entered at sector level for seven of them. Of these top 21 complex sites, only the Thames Estuary and The Wash can be described as good sites, using the definition in section 2.4.

SITE NAME	SLD[1]	CODE[2]	86/87	87/88	88/89	89/90	90/91	98/99[3]	03/04[4]
Wraysbury Reservoir		23101				66	126	16	899
Staines Reservoirs	None	23103		4	3	24	11	26	773
Queen Mary Reservoir		23111		278	438	315	467	59	768
Dee Estuary (England and Wales)	5	45401		210	290	291	456	613	718
Rutland Water		36156			280	250	350	293	655
Wraysbury Gravel Pits	None	28700	20	43	30	39	17	180	607
Solway Estuary	5	59400	525	518	487	574	479	586	591
Thames Estuary	2 to 5	25901	71	183	192	214	155	287	587
Morecambe Bay	1 to 5	57910	302*	305*	729	1497	985	963	539
Blackwater Estuary	5	25948		252	345	219	208	278	473
Alt Estuary	5	46421		95	159	334	502	779	456
Ribble Estuary	4 and 5	57901		170	242	176	172	132	456
The Wash	1 to 5	35901	188	197	274	219	253	279	449
Abberton Reservoir		25121	233	117		570	320	600	420
Exe Estuary	5	11450		66	70	147	83	134	415
Colne Estuary	5	25953		245	108	409	169	155	413
Poole Harbour		12421	349	339	456	232		440	412
Hanningfield Reservoir		25101				100	374	758	411
Besthorpe,Girton Gravel Pits, Fleet	None	37242	3	16	13	69	107	141	364
Walthamstow Reservoirs		24142			180			430	338
Rostherne Mere		45057	58	81	109	214	222	243	306
Medway Estuary	2 to 5	22460		219	415	254*	1216	185	305
Pagham Harbour	5	20412			66	90	102	177	303
Tees Estuary	None	52901		144	113	337	480	444	291
Lee Valley Gravel Pits	1 to 5	26701	46*	57*	58*	69*	64*	229	286
North Norfolk Coast	1 to 5	34905			54*	83	122	310	276
Ouse Washes	None	32355	286	169	182	533	163	426	252
Dungeness Gravel Pits	3 to 5	22291	3	3	31			196	251
Southampton Water	2 to 5	17912		103*	79*	171	171	195	247
Ness House Thorpeness Offshore		33494							239

Table 3.4 Peak winter Cormorant counts of the top 30 sites, single-sector and complex combined, with results of data validation and complex site data availability. Black infill indicates null counts, blanks indicate no visits occurred. Asterisks denote that where SLD counts were examined, an incomplete count occurred.

[1] Where the site is a complex site, sector level data (SLD) are available for the year(s) indicated where year 1 denotes 1986/1987 through to year 5 which denotes 1990/1991
[2] WeBS site code
[3] Five year mean peak for the five years ending 1998/1999
[4] Five year mean peak for the five years ending 2003/2004

3.4 Good Sites

	Good Sites	Not Good	Total
Single-sector Sites	123 (44%)	158 (56%)	281
Complex Sites	10 (11%)	79 (89%)	89
Total	133	237	370

Table 3.5 Summary of the numbers and percentage of good sites (analysed from the 370 sites that have a five-year mean peak, years 1999/2000 to 2003/2004 inclusive, of ≥10), separated into single-sector and complex sites.

Further listings of good sites, single-sector and complex, are shown in Tables 3.6 and 3.7 respectively and a complete list of single-sector good sites is shown in Appendix 5.

SITE NAME	CODE[1]	86/87	87/88	88/89	89/90	90/91	98/99[2]	03/04[3]
Queen Mary Reservoir	23111		278	438	315	467	59	768
Abberton Reservoir	25121	233	117		570	320	600	420
Rostherne Mere	45057	58	81	109	214	222	243	306
Queen Elizabeth II Reservoir	23122		124	99	138	320	360	218
Grafham Water	32101	158	200	325	74	450	341	193
Chew Valley Lake	14102	38	21	34	99	149	90	170
Ranworth and Cockshoot Broads	34033	267	354	368	325	329	308	168
Attenborough Gravel Pits	37201	114	106	118	127	121	103	154
Fen Drayton Gravel Pits	32207	14	28	38	41	42	81	144
Pitsford Reservoir	30141		24	4	12	7	110	131
Fisherwick and Elford Gravel Pits	43230		1	2	6	15	15	126
Dysynni Estuary	66404		42	37	46	59		125
William Girling Reservoir	24151	116	111		200	232	200	120
Eversley Cross and Yateley Gravel Pits	17743		7	21	18	6	35	117
Farmoor Reservoirs	29121		101	43	72	107	168	109
Fairburn Ings	51003		1	3	2	11	76	93
Swithland Reservoir	36141	1		15	4	15	130	88
Belvide Reservoir	43111		14	26	41	18	52	80
Linford Gravel Pits	27253		10	3	22	27	23	80
Blithfield Reservoir	43156		71	141	135	278	92	78

Table 3.6 Peak winter Cormorant count of the top 20 good sites (single-sector sites). Black infill indicates null counts, grey infill indicates true zeros, blank indicates no visits occurred.

[1] WeBS site code
[2] Five year mean peak for the five years ending 1998/1999
[3] Five year mean peak for the five years ending 2003/2004

SITE NAME	SLD[1]	CODE[2]	86/87	87/88	88/89	89/90	90/91	98/99[3]	03/04[4]
Thames Estuary	2 to 5	25901	71	183	192	214	155	287	587
The Wash	1 to 5	35901	188	197	274	219	253	279	449
Middle Tame Valley Gravel Pits	2 to 5	41751		98	92	122	91	171	168
Swale Estuary	1 to 5	22450	136	301	276	202	263	128	159
Fleet and Wey	1 to 5	12901	65	37	26*	70	58	63	87
Carmarthen Bay	1 to 5	63423	154	120		276	303	50	75
Severn Estuary	1 to 5	15XXX	35*	54	35	71	50	67	55
Cleddau Estuary	1 to 5	63943		82	99	83	44	32	35
Fal Complex	1 to 5	10413		41	36	22	21	14	35
North West Solent	1 to 5	17901		32	27	57	58	33	27

Table 3.7 Peak winter Cormorant counts at good sites (complex sites). Black infill indicates null counts, grey infill indicates true zeros, blank indicates no visits occurred. Asterisks denote an incomplete count occurred.

[1] Where the site is a complex site, sector level data (SLD) are available for the year(s) indicated where year 1 denotes 1986/1987 through to year 5 which denotes 1990/1991
[2] WeBS site code
[3] Five year mean peak for the five years ending 1998/1999
[4] Five year mean peak for the five years ending 2003/2004

Tables 3.5, 3.6 and 3.7 show that 123 of the 133 good sites are single-sector sites. Only 10 of the 89 complex sites examined qualified as good sites.

4. DISCUSSION

4.1 WeBS Caveats and Cautions

The interpretation of these data and indices is subject to the usual caveats that apply to the Wetland Bird Survey which are detailed in Pollitt *et al*. (2003).

In particular, the types of sites counted and the way that they are selected may not necessarily provide the optimal methodology and data analysis procedures for assessing wintering Cormorant population change. Clearly, however, the long-term nature of the datasets and the large number of sites covered provide a valuable resource that can be used to assess the effect of management changes on wintering Cormorant, provided that the implications of any data limitations are considered alongside data analysis.

Count sites are selected by counters and/or the network of WeBS 'Local Organisers' (LOs) and are almost certainly not representative sample of the wetland resources of the UK. The availability of WeBS counters and ease of counting has also affected coverage; higher numbers of volunteers are available in southern and eastern England, as compared to northern England and Wales. Historically, the selection process can be broadly described as targeting sites for counting that held the largest concentrations of wintering. Over the next two years, the process of selecting WeBS sites to be counted according to a randomised stratified sampling strategy will start. The stratification will most likely be based according to wetland size and type, upland and lowland, and geographical. However, currently, and for at least two years, WeBS indices and population size data for certain waterbird species will not necessarily be accurate for the reasons discussed.

Coverage of estuaries and major freshwater bodies by WeBS is excellent. However, a smaller proportion of smaller freshwater lakes and ponds are counted and river and canal stretches are, in general, very poorly represented in the current WeBS counts (*eg* Pollitt *et al*. 2003). This has serious implications for the possible accuracy of Cormorant population estimates, population indices and estimates of population change generated from WeBS data as used in the stochastic density-dependent model used to assess the possible effect of the control policy on Cormorant population size.

If the proportional change in Cormorant numbers were the same on all wetlands irrespective of their habitat type (coastal, estuary, open coast, large inland wetlands, small inland wetlands, rivers, *etc*.) and geographical location then WeBS would provide an accurate estimate of wintering Cormorant population change and therefore reliable indices and estimates of annual population change that could be related to population size for the stochastic density-dependent model.

However, it is recognised that birds prefer certain habitat types for roosting, loafing and feeding. For example, wintering Cormorants prefer undisturbed sites at both coastal estuarine sites and inland at reservoirs and natural lakes. These preferred undisturbed sites are more likely to be geographically larger sites. Feeding sites within close proximity to their night roosts are also preferred (Hughes *et al*. 1999; Wernham *et al.* 1999).

Without shooting, as the Cormorant population increases, it is expected that it will initially increase most quickly on the preferred habitats until they fill up. Thereafter, as the population continues rising, the birds would be expected to start moving into less preferred habitats.

The response of wintering Cormorants following the introduction of control measures is difficult to predict. One possibility is that if the population subsequently declines, as is expected under the present control policy, the Cormorants will first leave the less preferred habitats and concentrate once again on the preferred habitats. The preferred habitats are likely to be the relatively undisturbed large inland wetlands and estuaries that are well covered by the WeBS counts. Under this scenario, the largest Cormorant declines would occur on the smaller wetlands that are poorly covered by WeBS, and thus the decline in numbers could be underestimated.

Another possible response of wintering Cormorants to increased disturbance resulting from shooting that would occur predominantly on large sites, is a move away from these to smaller less disturbed sites where less shooting occurs. Despite intensive shooting over the winters of 1996/1997 to 2001/2002 in Bavaria, Keller and Lanz (2003) reported that Cormorant numbers remained stable. Over the same period in the same area, there was an increase in the number of sites holding small numbers of Cormorants and a decrease in the number of sites holding large numbers. It seemed likely that dispersal was occurring, away from the disturbed, larger sites to the smaller, less disturbed sites. Under this scenario, the largest Cormorant declines would occur on the larger wetlands that are well covered by WeBS, and thus the decline in numbers could be overestimated.

As WeBS site coverage is currently not stratified and the smaller sites are less well covered than the larger ones, if either of the above scenarios were to occur, WeBS data could provide misleading estimates of Cormorant population change.

Thus, until stratification of the WeBS data has been implemented, population change estimates for Cormorants may be unreliable, and the WeBS data, in their current unstratified format, do not provide the optimum inputs for the stochastic model used. The implications of this are that the outputs of the model, when used to predict or assess the effect of any control policy on wintering Cormorant numbers, are of limited value and must be viewed with extreme caution.

4.2 Data Validation

During the recording form checking process, efforts were made to introduce objectivity into the procedure wherever possible as described in sections 2.1.1 to 2.1.3. An element of subjectivity was unavoidable because volunteer counters sometimes develop their own way of recording and describing counts and do not necessarily always follow the recommendations of the WeBS organisers. There are two possible outcomes of this subjectivity:

- The data checking exercise followed a precautionary principle and erred on the side of caution. This would have meant that the proportion of null counts may have been overestimated which would lead to an underestimate of the population increase.

- The data checking exercise gave the benefit of the doubt regarding blanks against the Cormorant row on the recording forms. This would have meant that the proportion of true zeros was overestimated which would lead to an overestimate of the population increase

Although, broadly, the precautionary principle was employed, the above two scenarios are not mutually exclusive. On occasions, blanks on the form were assumed to be true zeros, especially where there was no site history of counts or counters to provide supporting evidence. On the other hand, especially with regard to complex sites, caution was employed because of the large number of sites where sector level data were unavailable. On balance, however, there can be confidence in the procedures employed to check the data.

4.3 The Indices

The high proportion (90%) of null counts for the year 1986/1987 precludes the use of that year's dataset in the production of the indices (Table 3.1). There is, however, justification in using the 1987/1988 data in that the most rapid rate of increase in the counts of ≥1 and true zeros occurred between the years 1986/1987 and 1987/1988. This large increase suggests that most counters did truly count and record Cormorant if present during 1987/1988.

4.3.1 Wintering Cormorant indices for England – before and after validation

The steady increase in wintering Cormorant in England, using validated data (Figure 3.1) is in contrast to the remarkably rapid increase between 1986/1987 and 1988/1989 shown by the original index produced using data that have not been validated (Figure 1.1). The doubling of the wintering Cormorant population is much lower than the apparent four-fold increase shown by original index. The index is of most value when viewed over the long-term. Therefore, the apparent rapid increase between the most recent two data points should be viewed with caution, especially when the smoothed trend line shows a less rapid increase. The rapid increase may be due to the late submission of counts from some sites that witnessed a slower rate of Cormorant increase.

4.3.2 Wintering Cormorant indices for Wales – before and after validation

The coverage of wetland sites in Wales, as compared to England, is less complete. This is reflected in the peaks and troughs produced by both the original and validated Welsh indices (Figures 1.2 and 3.2 respectively). Again, the graph based on unvalidated data shows a remarkably high rate of population growth between 1986/1987 and 1988/1989. The rate of increase between 1986/1987 and 2003/2004 shown by the validated index has also been steadier, rather than rapid, reflecting a more realistic picture of likely wintering Cormorant population change at Welsh WeBS sites.

4.4 Site Information

The list of 370 WeBS sites where wintering Cormorant are currently most numerous should be viewed having taken into account the caveats described in section 4.1. It is possible that there are other sites that hold many

Cormorants that are not covered by WeBS. In particular, lakes and reservoirs on private land (possibly operating as members-only fishing clubs) are not well covered.

Counts from around 1,500 sites were checked and the top 370 listed. The complete listings including the remaining 1100 sites will be provided in spreadsheet form if requested.

The definitions of good sites (section 2.4) that have been used to create the lists in Tables 3.6 and 3.7 reflect the sites where the most complete datasets exist and for where the highest level of confidence can be attached to the data (subject to the caveats and cautions already discussed). Clearly, the definitions could be amended and more sites included, which may be justifiable if long-term data exist for that site. The more complete list in Appendix 4 can be used as an indicator of which sites are most likely to have the longest running datasets, although it should be borne in mind that this project only looked at the earlier years and has not assessed whether sites have been counted in more recent years.

The broad precautionary approach taken with both the data validation exercise and the good site definitions results in just 10 complex sites being classified as good sites. This is justified, however, because of the history of some of the multi-sector sites in terms of completeness of coverage and the nature of the sites. Furthermore, as some of these sites currently hold large numbers of wintering Cormorant (for example, the Dee Estuary and Wraysbury Gravel Pits), any overestimation of true zeros and complete counts may have a significant effect on the production of the indices and population change.

5. EARLY WARNING OF POPULATION CHANGE – THE TRIPWIRE

5.1 Background

As part of the ongoing strategic development of WeBS, the reporting year has recently changed from April - March to July – June, commencing July 2005 to June 2006. The seven months used to produce the wintering Cormorant indices will remain September to March inclusive.

As part of the same development process, the website for WeBS is currently being updated to include an on-line reporting system for counters and local organisers and an on-line data extraction service for different groups of users. Broadly, the proposed timetable is as follows:

- September 2005 to June 2006 – pilot the on-line reporting system with selected groups of users: counters, local organisers and data users

- July 2006 onwards – live on-line facilities available for all users

5.2 On-line Data Submission

On-line data submission will speed up the reporting and data validation process (section 5.3) and could potentially be used as part of an early warning system of wintering Cormorant population change. Ideally, counters will enter their counts promptly after the count date instead of waiting until the end of the reporting year (or winter period) before sending in completed paper forms. Experience from other on-line reporting facilities, such as for the BTO Breeding Bird Survey (BBS), shows that volunteers are generally prompt and respond to email requests for data submission.

The provision of data at site or country level could therefore be more timely than at present, although it is likely that the data would only be available sometime after at the end of the reporting year (June) rather than at the end of the seven-month winter period (March).

There are, however, several issues that may arise:

- The popularity of the on-line reporting system with counters and local organisers

Whilst many counters have made requests to use electronic reporting facilities (and some already email spreadsheets of counts), other feedback from volunteers suggest there are small numbers that either do not have computer facilities or do not wish to use this system. There will be no compulsion to use the system, at least during the short and medium-term. Uptake rate is therefore difficult to predict for both the first and subsequent years.

- The technology and ease of use

The popularity of the system will, in part, be affected by the ease of use and the reliability of the technology. The BTO has undoubted expertise in this area. Direct, in-house experience has been gained from the design and implementation of the BBS system and this will ensure that the WeBS on-line facilities will be both dependable and user-friendly. The system will also be encouraged and supported by ongoing publicity directed to the counters.

5.3 Validation Procedures

At present, count data are scrutinised and validated before final loading into the database. This is a lengthy but necessary process and takes the form of running programs that produce lists of ‘unusual’ counts and scenarios that then need checking. This checking usually involves scrutinising the original forms and/or contacting counters for verification.

The on-line system will include a series of built-in checks that will reduce, but not eliminate this process. However, if prompt Cormorant data are required from key sites, it may be possible to supply unchecked counts as long as these are reported as unvalidated. Cormorant are generally not miscounted or misidentified and, as such, counts are seldom subject to verification with counters. Where very large numbers occur, however, the usual WeBS cautions apply.

5.4 Key Sites

It may be possible to encourage counters from key sites to submit winter counts of all species promptly, whether this is via electronic or paper format. Incentives could take the form of a 'top 10' of sites, reported in the WeBS newsletter during the summer following the end of the reporting year. Such prompt feedback is of high value for surveys that rely on volunteers and could encourage early submission by more counters. Verification could be prioritised for these sites and, if enough counters and local organisers were involved, useable data could be supplied within 6 months of the end of March. It must be stressed that this may fall outside the remit of WeBS and, as such, be subject to extra funding and agreement with all the WeBS partners. Furthermore, there would be no compulsion on counters to be involved in the early reporting of Cormorant data. Finally, unless the selected sites are collected according to a randomised-stratification, the results of the early warning system or "tripwire" could be misleading (see discussion of importance of stratification in section 4.1).

5.5 Early Warning Systems or Tripwire

In a manner similar to WeBS Alerts (Austin *et al*. 2004), the tripwire for population change could operate at either a site, region or country level and be set at 25%. This follows protocols that currently exist for amber-listing criteria and WeBS Alerts.

6. CONCLUSIONS

The data validation exercise resulted in a marked change to the indices both for England and Wales. Rather than a rapid increase, wintering Cormorant at WeBS sites have increased at a somewhat slower rate than previously thought (England: Figures 1.1 *cf* 3.1; Wales Figures 1.2 *cf* 3.2), resulting in a doubling of the population over 16 years in England and a 45% increase in Wales over the same period. The data from 1986/1987 were considered unuseable, so 17 data points exist for the years 1987/1988 to 2003/2004 inclusive.

An element of subjectivity remained during the checking of the original recording forms, although measures to minimise this were taken. The process was as objective as possible, bearing in mind that the counts were carried out almost twenty years ago.

Coverage of estuaries and large freshwater bodies was good. However, the value of these counts was affected by the history of how the count sectors were covered. Often, completeness of counts could not be assessed because sector level data was unavailable. More single-sector sites produced counts thought to be more complete than did complex sites.

WeBS coverage of small freshwater bodies and riverine stretches is patchy. This is very important and should always be borne in mind when analysing and discussing the distribution and abundance of wintering Cormorant. Furthermore, the arbitrary rather than random nature of the choice of WeBS count sites and the absence of stratified coverage (to be introduced over the next two years) restricts the value of the data for assessing Cormorant population size and change and thus for modelling the likely effects of Cormorant control using a stochastic density-dependent model (see section 4.1).

A randomised stratified tripwire to provide an early warning system to detect wintering Cormorant population decline could potentially be provided sometime after the WeBS online reporting system goes live during the reporting year July 2006 to June 2007. The rate and popularity of uptake amongst WeBS counters is difficult to predict and will affect the usefulness of this system as a way of providing an early warning system. Any early reporting of counts may be subject to funding, data validation and agreement with WeBS partners.

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Glossary of WeBS terminology

Complex site
A WeBS site that consists of two or more **sectors**.

Consolidated count
The sum of the count values from more than one **sector** of a **complex site**. Used to report values at whole site level for **complex sites**.

Core counts
The WeBS counts that monitor wetlands throughout the UK once per month on priority dates. Used to determine population estimates and trends and identify important sites.

Counter
A volunteer bird watcher who undertakes WeBS **Core Counts** and/or **Low Tide counts**. Usually, they are known to **local organisers**, who confirm that counters have good UK waterbird identification skill levels.

Five-year mean peak
Produced when the highest value month's counts from a particular year are taken from five defined years, summed and divided by five. The value that is commonly reported in WeBS reports and used to designate site importance

Indexing months
For Cormorant, this comprises the months of September to March inclusive.

Local organiser
Person responsible for co-ordinating counters and counts at a local level, normally a county or large estuary, and the usual point of contact with WeBS partners.

Low Tide counts
WeBS counts made at low tide to assess the relative importance of different parts of individual estuaries as feeding areas for intertidal **waterbirds**.

Reporting year
The calendar months in which WeBS counts are collected and WeBS data presented. Up to July 2005, this ran from April through to March. From July 2005, the reporting year will change to July through to June.

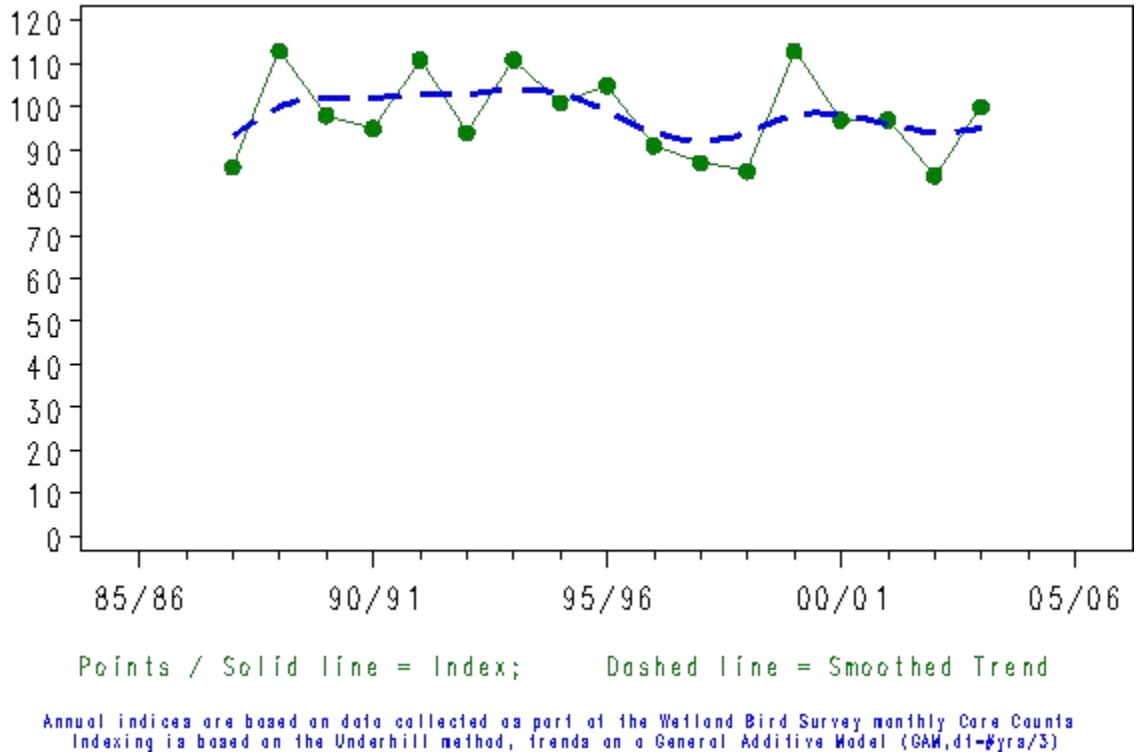
Sector
The unit of division of complex sites into areas that can be counted by one person in a reasonable time period. They are often demarcated by geographic features to facilitate recognition of the boundary by **counters**. The finest level at which count data are stored.

Single-sector site
A WeBS site that consists of one **sector**.

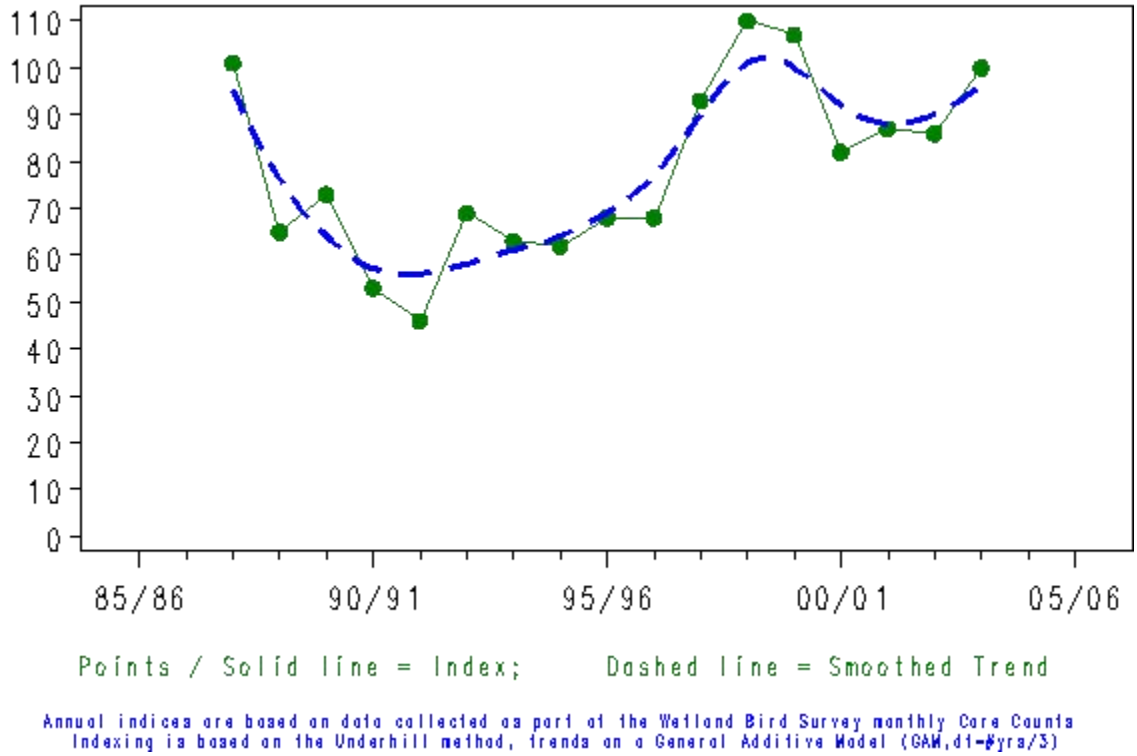
Waterbirds
WeBS follows the definition adopted by Wetlands International. This includes a large number of families, those occurring regularly in the UK being divers, grebes, cormorants, herons, storks, ibises and spoonbills, wildfowl, cranes, rails, waders and gulls and terns.

Winter
For Cormorant, winter comprises the months of September to March inclusive.

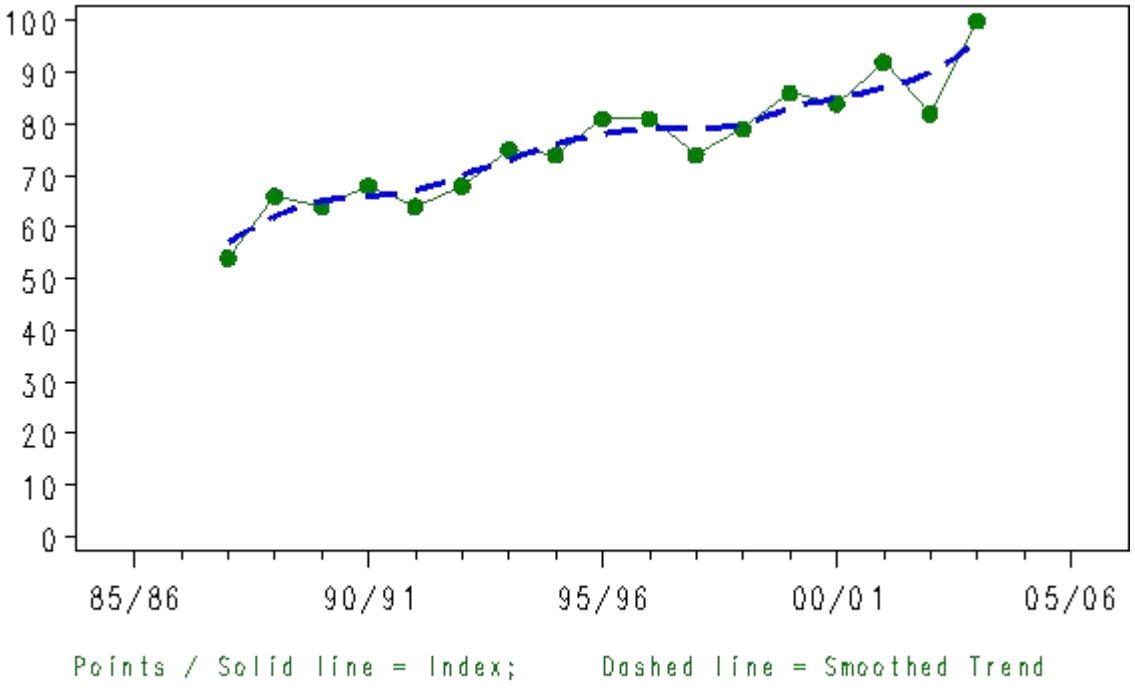
APPENDIX 1 Revised wintering Cormorant index for Scotland for the years 1987/1988 to 2003/2004, using validated data.



APPENDIX 2 Revised wintering Cormorant index for Northern Ireland for the years 1987/1988 to 2003/2004, using validated data.



APPENDIX 3 Revised wintering Cormorant index for Great Britain for the years 1987/1988 to 2003/2004, using validated data.



Annual indices are based on data collected as part of the Wetland Bird Survey monthly Core Counts
Indexing is based on the Underhill method, trends on a General Additive Model (GAM,df=#yrs/3)

APPENDIX 4 Peak winter Cormorant counts and 5 year mean peaks for the periods 1994/1998 to 1998/1999 inclusive and 1999/2000 to 2003/2004 inclusive at the top 370 sites, simple and complex combined.

The results of data validation and complex site data availability are as follows: black infill indicates null counts, grey infill indicates true zeros, blank indicates no visits occurred. Asterisks denote that where sector level data (SLD) were available and examined, an incomplete count occurred.

Sites are ranked by 5-year mean peak for the 5 years ending 2003/2004

1 = winter of 1986/1987, 2 = winter of 1987/1988, 3 = winter of 1988/1989, 4 = winter of 1989/1990, 5 = winter of 1990/1991

SITE NAME	SLD?	CODE	86/87	87/88	88/89	89/90	90/91	98/99	03/04
Wraysbury Reservoir		23101				66	126	16	899
Staines Reservoirs	no	23103		4	3	24	11	26	773
Queen Mary Reservoir		23111		278	438	315	467	59	768
Dee Estuary (England and Wales)	5	45401		210	290	291	456	613	718
Rutland Water		36156			280	250	350	293	655
Wraysbury Gravel Pits	no	28700	20	43	30	39	17	180	607
Solway Estuary	5	59400	525	518	487	574	479	586	591
Thames Estuary	2 to 5	25901	71	183	192	214	155	287	587
Morecambe Bay	1 to 5	57910	302*	305*	729	1497	985	963	539
Blackwater Estuary	5	25948		252	345	219	208	278	473
Alt Estuary	5	46421		95	159	334	502	779	456
Ribble Estuary	4 and 5	57901		170	242	176	172	132	456
The Wash	1 to 5	35901	188	197	274	219	253	279	449
Abberton Reservoir		25121	233	117		570	320	600	420
Exe Estuary	5	11450		66	70	147	83	134	415
Colne Estuary	5	25953		245	108	409	169	155	413
Poole Harbour		12421	349	339	456	232		440	412
Hanningfield Reservoir		25101				100	374	758	411
Besthorpe and Girton Gravel Pits and Fleet	no	37242	3	16	13	69	107	141	364
Walthamstow Reservoirs		24142			180			430	338
Rostherne Mere		45057	58	81	109	214	222	243	306
Medway Estuary	2 to 5	22460		219	415	254*	1216	185	305
Pagham Harbour	5	20412			66	90	102	177	303
Tees Estuary	no	52901		144	113	337	480	444	291
Lee Valley Gravel Pits	1 to 5	26701	46*	57*	58*	69*	64*	229	286
North Norfolk Coast	1 to 5	34905			54*	83	122	310	276
Ouse Washes	no	32355	286	169	182	533	163	426	252
Dungeness Gravel Pits	3 to 5	22291	3	3	31			196	251
Southampton Water	2 to 5	17912		103*	79*	171	171	195	247
Ness House Thorpeness Offshore		33494							239
Mersey Estuary	no	45421				29	69	53	230
Duddon Estuary	5	58XXX	157		148	59	121	130	220
Queen Elizabeth II Reservoir		23122		124	99	138	320	360	218
Rye Harbour and Pett Level	2 to 5	21420		16*	42	61	45	126	207
Grafham Water		32101	158	200	325	74	450	341	193
Hornsea Mere		38051		110	93	127		93	193
Chew Valley Lake		14102	38	21	34	99	149	90	170
Middle Tame Valley Gravel Pits	2 to 5	41751		98	92	122	91	171	168
Ranworth and Cockshoot Broads		34033	267	354	368	325	329	308	168
Chichester Gravel Pits	no	20201	12	40	19	43	47	92	160

APPENDIX 4 Continued.

SITE NAME	SLD?	CODE	86/87	87/88	88/89	89/90	90/91	98/99	03/04
Swale Estuary	1 to 5	22450	136	301	276	202	263	128	159
Attenborough Gravel Pits		37201	114	106	118	127	121	103	154
River Avon - Fordingbridge to Ringwood	5	17304		9	51	89	87	54	149
Fen Drayton Gravel Pits		32207	14	28	38	41	42	81	144
Cotswold Water Park (West)	2 to 5	15220		32*	32*	26*	71*	81	140
Burry Inlet	2 to 5	63400		7*	10*	47*	74*	90	139
Thrapston Gravel Pits	no	30251		21	26	41	47	46	132
Earls Barton Gravel Pits	no	30242			8	21	1	66	131
Pitsford Reservoir		30141		24	4	12	7	110	131
Stour Estuary	5	25481		209	244	162	124	123	129
Fisherwick and Elford Gravel Pits		43230		1	2	6	15	15	126
Dysynni Estuary		66404		42	37	46	59		125
Somerset Levels	2 to 5	13300		35	11*	9*	28	61	123
William Girling Reservoir		24151	116	111		200	232	200	120
Eversley Cross and Yateley Gravel Pits		17743		7	21	18	6	35	117
Tyne Estuary		54475						138	115
Ellesmere Lakes	no	44076		111	23	29	44	71	112
Stanwick Gravel Pits Consolidated	no	30700			1	8	10	14	112
Humber Estuary	1 to 5	38950	45*	77*	54*	128	133	127	110
Farmoor Reservoirs		29121		101	43	72	107	168	109
Trinity Broads	no	34501		30	21	56	60	171	107
Alde Complex	no	33480	104	117	115	78	84	104	106
Stodmarsh NNR and Collards Lagoon		22072				73	104	112	104
Windermere		58031				84	50		102
Chichester Harbour	no	20401		133	111	151	136	62	101
Colne Valley Gravel Pits	no	26702	40	15	21	30	34	73	100
Lower Windrush Valley Gravel Pits	2 to 5	29290		64*	68*	53*	69*	63	100
Clwyd Estuary		69403			54	76	41	50	99
Taw-Torridge Estuary	4 and 5	11XX1		92	82	71	47	46	98
Draycote Water		41112			4	24	37	33	97
Fairburn Ings		51003		1	3	2	11	76	93
Stubbers Complex		24538							92
Breydon Water and Berney Marshes	4 and 5	34901	87	114	129	188	165	116	90
Spade Oak Gravel Pit (Little Marlow)		27222						49	88
Swithland Reservoir		36141	1		15	4	15	130	88
Fleet and Wey	1 to 5	12901	65	37	26*	70	58	63	87
Willen Lake		27132			24	26	13	29	87
Christchurch Harbour		12431			106	74	108		86
Tamar Complex	2 to 5	10460	20*	29*	40*	126	163	71	85
Barleycroft Gravel Pit (Earith)		32222						55	82
Coquet Estuary		55442			36	39	58	69	82
Portsmouth Harbour	5	17421		42	41	64	58	54	81
Belvide Reservoir		43111		14	26	41	18	52	80
Linford Gravel Pits		27253		10	3	22	27	23	80
Langstone Harbour	5	17431		99	166	134	132	43	79
Blithfield Reservoir		43156		71	141	135	278	92	78
Thorpe Water Park	no	23211		19				50	78
Orwell Estuary	no	33902	174	172	141	155		150	77
Lindisfarne		55481					720	83	76
Carmarthen Bay	1 to 5	63423	154	120		276	303	50	75

APPENDIX 4 Continued.

SITE NAME	SLD?	CODE	86/87	87/88	88/89	89/90	90/91	98/99	03/04
Tophill Low Reservoirs		38151		8	11	61	13	14	75
Deben Estuary	no	33911	145	147	100	64		69	72
Eyebrook Reservoir		36151	54	24	45	21	6	32	70
Hamford Water and Naze Combined	5	25971		29	35	51	45	51	67
Ullswater		59026	51	56		23	49	64	67
Hampton and Kempton Reservoirs		24101	14					13	65
Knight and Bessborough Reservoirs		23118						82	65
Tyttenhanger Gravel Pits		26205				3	6	10	65
Cassington and Yarnton Gravel Pits	no	29234						9	64
Ravensthorpe Reservoir		30121		1	23	3		32	64
WWT Martin Mere		57011						8	64
Pugneys Country Park Lakes		50054		1				38	62
Tring Reservoirs		26121		4	11	d	19	33	62
Arun Valley	1 to 5	20800		25*	27*	23	28	67	61
Bassenthwaite Lake		59035	52	57	16	28	36	34	61
Fleet Pond		17065		3	26	27	14	61	61
Blenheim Park Lake		29025		1	10	5	6	62	59
Great Pool Westwood Park		40051		4	8	11	19	72	58
Aqualate Mere		43061	20	32	38	23	41	46	57
Blagdon Lake		14101	14	6	8	19	24	67	57
Blyth Estuary (Northumberland)		55403			186		93	82	57
Llangorse Lake		64031	28	66	67	42	57	66	57
Pennington Flash		47009		42				42	55
Severn Estuary	1 to 5	15XXX	35*	54	35	71	50	67	55
Coombe Country Park		41051				31		32	53
Southill Lake		31045			1	9	5	9	52
Apex Pit - North Hykeham		35270						34	50
Bewl Water		21151		14	16	28	49	80	50
Chilham and Chartham Gravel Pits		22260						21	50
Fiddlers Ferry Power Station Lagoons		45251			3	3	1	42	50
Lindley Wood Reservoir		51101			3	2		2	50
Lonsdale Road Reservoir		24111		10	11	21	19	54	50
River Test - Broadlands Estate		17319		27	13	28	35	50	50
Groby Pool		36006						11	49
Kingsbridge Estuary		11427	50	50	44	39	34	37	49
Leisure Lakes		57016						1	49
Weybread Pits		33250							48
Ditchford Gravel Pits	no	30246		1		15	4	31	47
River Thames - Putney to Barnes		24301		1	7	5	18	27	47
Sonning Eye Gravel Pit		29202					27	161	47
Thanet Coast	no	22931						17	47
Talybont Reservoir		64114		56	95	94	23		46
Brading Harbour		18301	50	77	33	37	35	36	45
Gatton Park		23080			1	2	3	28	45
Stanford Reservoir		36101	6	2	4	2		21	45
Dart Estuary		11935	14	9	16		2	8	44
Clumber Park Lake		37077				3	1	29	43
Covenham Reservoir		35171		32	20	13	48		43
Old Moor		49046				1		14	43
Aston On Trent Gravel Pits		48239							41

APPENDIX 4 Continued.

SITE NAME	SLD?	CODE	86/87	87/88	88/89	89/90	90/91	98/99	03/04
Dee Flood Meadows		45805						17	41
Dockacres Gravel Pits (Whole Complex)	5	57291		5	6	16	5	17	41
River Teme - Criftin Ford Bridge		40822						22	41
Dyfi Estuary	5	63499	48	76	30	61	44	58	40
Barcombe Mills Reservoir		21111		10	4	13	48	92	39
Middle Yare Marshes	no	34301	8	22	14	13	19	144	38
Bredon`s Hardwick Gravel Pits		40260							37
Godmanchester Gravel Pit		32213			12	12	13		37
River Thames - Battersea Bridge to Vauxhall Bridge		24419							37
Barton Broad		34013			5		38		36
Foreland		18406	9	25	7			10	36
Ogston Reservoir		48131			6	15	35		36
River Cam - Kingfishers Bridge		32344						9	36
Cleddau Estuary	1 to 5	63943		82	99	83	44	32	35
Durleigh Reservoir		13117		11	28	10	24		35
Fal Complex	1 to 5	10413		41	36	22	21	14	35
King`s Bromley Gravel Pits		43221		22	33	38	72	49	35
River Avon - Ringwood to Christchurch	no	17805	39	26	12	188	139	20	35
Wimbleball Lake		13110		9	11	18	7	33	35
Barn Elms Reservoirs		24115		80	183	160	147	5	33
Caldecotte Gravel Pits		27250				2	7	27	33
Barton Pits		43262						62	32
Cotswold Water Park (East)	4 and 5	15741	3	9	20	22	31	62	32
Fairlop Gravel Pits		24261		7	4	16	3		32
Tabley Mere		45074		9	3	12	10	9	32
Tweed Estuary		55491		113	40	2	34	32	32
Ardingly Reservoir		20101		8	32	37	28	11	31
Bough Beech Reservoir		22101		28		39	44		31
Derwent Water		59031		81			27	48	31
Island Barn Reservoir		23123		11	70	17	11		31
Newport Pagnell Gravel Pits		27254		8	3	6		22	31
Priory Country Park (Barkers Lane Gravel Pit)		31323		1	4	51	5	22	31
River Medway - M2 to Chatham Maritime		22955						27	31
Climping		20451						30	30
Croxall Pits		43225				5	21	35	30
Iford Brooks		21312						21	30
Wigan Flashes		47503						4	30
Brogborough Clay Pit		31221		13	4	41	66	10	29
Chillington Hall Pool		43051		17	30	36	24	19	29
Foremark Reservoir		48101	5	9	8	17		36	29
Heath Pond (Petersfield)		17052				1		11	29
Lakenheath Fen		33010						10	29
Lavan Sands	no	67412		9	23	11	1	7	29
Nene Washes	no	32803			9	25	26	33	29
Roath Park Lake		61090							29
Venus Pool		44024			5	1	5	6	29
Camel Estuary	4 and 5	10XXX			61	31	31	53	28
Clifford Hill Gravel Pits Consolidated	no	30727		1	4		1	49	28
Dunstable Sewage Farm		31301						8	28
Sale Water Park and Broad Ees Dole		47711						30	28

APPENDIX 4 Continued.

SITE NAME	SLD?	CODE	86/87	87/88	88/89	89/90	90/91	98/99	03/04
Sutton Place		23258							28
Woolston Eyes		45381		1	1	10	4	13	28
Bolton-on-Swale Gravel Pits		51251		33	26		34	54	27
Dorchester Gravel Pits	no	29221			3	7	2	15	27
Exeter River Valley Park		11370							27
Frays Wildfowl Lake		24213							27
Hollowell Reservoir		30122			5	16	2	36	27
Leach Pool		40031						2	27
North West Solent	1 to 5	17901		32	27	57	58	33	27
Pegwell Bay	no	22412		27	32	45	45	8	27
Thornton Reservoir		36121						2	27
Watermead Gravel Pits		36202			1			11	27
Welbeck Great Lake		37072			1				27
Wicken Fen		32041						41	27
Longleat Ponds		16006			2		1	5	26
Meadow Lane Gravel Pits St Ives		32221			10	6	21	45	26
Radwell Gravel Pits		31245				2	1	19	26
Afan Estuary and Port Talbot Harbour		62405						27	25
Castle Island (Ashington)		55310							25
Colwyn Bay		69900			17	11	14	30	25
Combermere		45001		16	32	33	34	48	25
Harrold and Odell Gravel Pits		31241			1	4	3	20	25
Roadford Reservoir		11105				2	9	18	25
Shipton On Cherwell Quarry		29243			6	3		1	25
Beaulieu Estuary		17405		11	26	26	14	12	24
Chelker Reservoir		51115							24
Colt Crag Reservoir		55141		7	10	16			24
Derwent Reservoir		53131	4	6	19	9	9	15	24
Eccup Reservoir		50189		1				4	24
Frampton Pools		15201		11	25	30	19	18	24
Langford Lowfields Gravel Pits		37220						1	24
Loe Pool		10022			5	4	4	31	24
Nosterfield Gravel Pits		51239						1	24
Rother Valley Country Park	no	49007			1				24
Wanlip Gravel Pits		36201			1	6	9		24
Warnham Mill Pond		20071		1	1	3	11	8	24
Weirwood Reservoir		21101		13	36	33	52	46	24
Whisby Gravel Pits	no	35271						17	24
Arlington Reservoir		21131		4	3	5	10	24	23
Bittell Reservoirs		40101				1	3	5	23
Bodenham Gravel Pit		40210						14	23
Harewood Lake		50061						4	23
Ringstead Gravel Pits Consolidated	no	30726		1	5	1	9		23
Boulmer to Howick		55447				13	12	5	22
Coniston Water		58071		64	50	56	9		22
Farnham Gravel Pits		51224		2	4	5	7		22
Foryd Bay		67421			10	6	6	15	22
Hardingstone Gravel Pits		30238						4	22
Hill Ridware Lake		43524						11	22
Hollow Pond (Whipps Cross)		24080						2	22

APPENDIX 4 Continued.

SITE NAME	SLD?	CODE	86/87	87/88	88/89	89/90	90/91	98/99	03/04
Holme Pierrepont Gravel Pits	no	37202	14	116	77	55	76	71	22
Llys-y-fran Reservoir		63121	6	9	7	7		11	22
Nunnery Lakes		34074						8	22
Old Slade Reserve		27200						4	22
River Irwell		47364						9	22
Willington Gravel Pits		48212		3	9	11	16	33	22
Belhus Woods Country Park		24539							21
Berwick Little Beach		55454						450	21
Branston Water Park plus pits west of canal		43247							21
Cresswell Pond		55053							21
Papercourt Gravel Pits	no	23232			2			6	21
Trent Valley Pit		36231		19	16	16	7	31	21
Adur Levels		20311			28	50	98	28	20
Cemlyn Bay and Lagoon		68421							20
Crouch-Roach Estuary	5	25931		29	26	15	36	21	20
Dengie Flats	5	25441		39	78	51	43	18	20
Llyn Brenig		69111						18	20
Osterley Park Lakes		24014						24	20
South Forty Foot Drain - Swineshead Bridge		35314							20
Swillington Ings		50011			2			9	20
Killington Reservoir		58101	9	14		13	30	5	19
Rivers Eamont and Eden - Honeypot to Edenhall		59370						6	19
Teifi Estuary	no	63491			16	21	23	12	19
Wilsham Road Gravel Pit (Formerly Abingdon Sf)		29306							19
Alton Water		33101		69		34	208	90	18
Chelmarsh Reservoir		44121					9		18
Dagenham Chase GP		24251							18
Doddington Pool		45007		8	11	26	25	11	18
Eglwys Nunydd Reservoir		62101		12	7	16	8	18	18
Esthwaite Water		58036		37	17	20	32	25	18
Inland Sea, Beddmanarch Bay, Alaw Estuary	no	68901		16	16	16	9	16	18
Llyn Alaw		68121		6	9	12	16	15	18
Priory Water		36042						8	18
Sennowe Park Lake Guist		34058							18
Woburn Park Lakes		31011				18	1	8	18
Avon Valley - Salisbury to Fordingbridge	no	16800		10	11	6	26	11	17
Beadnell to Seahouses		55452			8	8	9	14	17
Chard Reservoir		13101		2	5	2	3	21	17
Dogmersfield Lake		17070						4	17
Gerrans Bay		10470							17
Mayesbrook Park Lakes		24075						1	17
Minsmere		33071		33	14	17		9	17
Sherborne Lake		12012						25	17
Wykeham Lakes	no	38281					2	1	17
Ampton Water		33022							16
Brandon Marsh Nature Reserve		41352			1		5	13	16
Hilfield Park Reservoir		26101		1	1	4	3	52	16
Revesby Reservoir		35121						10	16
Slapton Ley		11011		14	14	14	26	8	16
Batemill Sand Quarry		45040						2	15

APPENDIX 4 Continued.

SITE NAME	SLD?	CODE	86/87	87/88	88/89	89/90	90/91	98/99	03/04
Burton Mill Pond		20017						8	15
Cheddar Reservoir		13121		14	7	16	20	17	15
Cropston Reservoir		36116				2	6	8	15
Daventry Reservoir		30111		4	1	1	1	20	15
Elton Reservoir		47118						8	15
Hardley Flood		34030	16	18	6	9	17		15
Haweswater Reservoir		59111		21	22	13	14	24	15
Holmethorpe Complex	no	23245		6	4	4	2	1	15
Reedham Water		34010							15
Spittal to Cocklawburn		55455						12	15
St Mary`s Island		55401			10		50	25	15
Wyboston GP		31284							15
Cuckmere Estuary		21421		1	16	11	8	9	14
Ogmore Estuary		61451						28	14
Port Talbot Old Docks		62104			8	13	13	14	14
Sandbach Flashes		45523		4	7	16	14	8	14
Thrybergh Country Park		49162						22	14
Upton Warren Local Nature Reserve		40056			5		1	12	14
Whitlingham Country Park		34023						12	14
Alresford Pond		17043						11	13
Barrow Gurney Reservoir		14105		7	8	55	22	19	13
Bramshill Park Lake		17075						9	13
Copmere		43066				3	1	7	13
Crummock Water		59034		14	15	9	13	14	13
Kielder Water and Bakethin Reservoir		55681		9	7	7	8		13
Kirkby-on-Bain Gravel Pits		35266	2			1		23	13
River Ribble Trough House		57080							13
River Test - Fullerton to Stockbridge		17310						1	13
River Trent and Selford Manor Pastures and Burton Meadows Area		37376					12	12	13
River Wear - McNeils Bottom		53325				16	5	5	13
Stoke Newington Reservoirs		24141		2	3	4	9	8	13
Winsford Bottom Flash		45028		6		17	37	7	13
Wootton Creek		18404			6	9	8		13
Bosherston Lakes		63002		5	10	10		11	12
Brightlingsea and Moverons and Alresford and Wivenhoe Gravel Pits		25261							12
Hallington Reservoir		55131		10	16	22			12
Hennock Reservoirs		11141						7	12
Llanishen and Lisvane Reservoirs		61101						22	12
Newtown Estuary		18402	1	4	7	4	8	8	12
North Warren and Thorpness Mere		33352						12	12
Pevensey Levels	no	21320				27	5	37	12
Pulfin Bog		38285				9		15	12
River Roding - Ilford - A13		24360							12
Roding Meadows and New Barns Lake		25078							12
Wellington Gravel Pits		40211						27	12
Wintersett Country Park Lake		50220						13	12
Borth Bay		63994							11
Bowood Lake		16023				1		5	11
Broadwater Lake (Sussex)		21038						10	11

APPENDIX 4 Continued.

SITE NAME	SLD?	CODE	86/87	87/88	88/89	89/90	90/91	98/99	03/04
Cambois to Newbiggin		55905			21	25	19	5	11
Cuttmill Ponds		23037						2	11
Dunham Park - Dunham Massey		47016							11
Forest Mere		20004						20	11
Fowey Estuary		10433				3		13	11
Glynde Levels		21301			3	3	6	7	11
Hampstead and Highgate Ponds		24026							11
Holland Marshes		25341				4		5	11
Leighton and Roundhill Reservoirs		51131		3	3			3	11
Llynnau Y Fali		68070	5	5	3	8	3	10	11
LNER Ballast Pits Lincoln		35292						3	11
Longside Lake		23261						4	11
Radford Lake		11002						1	11
River Mersey		47365						10	11
Roxton Gravel Pits		31280							11
Seahouses to Budle Point		55453				17		12	11
Stewartby Lake		31225		18	42	23	67	9	11
Whitley Bay		54481							11
Wotton Underwood Lakes		27031			3		1		11
Buttermere		59033		2	1	1	2		10
Colliford Reservoir		10122		10	27	20	18	12	10
Fallowfield Pond		47032							10
Kenfig Pool		61071			3	6	3	7	10
King George V Reservoirs		24152		3	54		100	70	10
Langtoft West End Gravel Pits		35236	2	1	3	10	7	3	10
Leybourne and New Hythe Gravel Pits		22218		70		89	94		10
Lockwood Beck Reservoir		52102							10
Rainham Quarry		24541							10
Shinewater Lake		21039						10	10
South Muskham Sugar Beet Factory		37234				37			10
Swansea Bay	4 and 5	62410	18		5	6	37	13	10

APPENDIX 5 Peak winter Cormorant counts and 5 year mean peaks for the periods 1994/1998 to 1998/1999 inclusive and 1999/2000 to 2003/2004 inclusive at single-sector sites that are defined as good sites.

The results of data validation and complex site data availability are as follows: black infill indicates null counts, grey infill indicates true zeros, blank indicates no visits occurred.

Sites are ranked by 5-year mean peak for the 5 years ending 2003/2004

SITE NAME	CODE	89/87	87/88	88/89	89/90	90/91	98/99	03/04
Queen Mary Reservoir	23111		278	438	315	467	59	768
Abberton Reservoir	25121	233	117		570	320	600	420
Rostherne Mere	45057	58	81	109	214	222	243	306
Queen Elizabeth II Reservoir	23122		124	99	138	320	360	218
Grafham Water	32101	158	200	325	74	450	341	193
Chew Valley Lake	14102	38	21	34	99	149	90	170
Ranworth and Cockshoot Broads	34033	267	354	368	325	329	308	168
Attenborough Gravel Pits	37201	114	106	118	127	121	103	154
Fen Drayton Gravel Pits	32207	14	28	38	41	42	81	144
Pitsford Reservoir	30141		24	4	12	7	110	131
Fisherwick and Elford Gravel Pits	43230		1	2	6	15	15	126
Dysynni Estuary	66404		42	37	46	59		125
William Girling Reservoir	24151	116	111		200	232	200	120
Eversley Cross and Yateley Gravel Pits	17743		7	21	18	6	35	117
Farmoor Reservoirs	29121		101	43	72	107	168	109
Fairburn Ings	51003		1	3	2	11	76	93
Swithland Reservoir	36141	1		15	4	15	130	88
Belvide Reservoir	43111		14	26	41	18	52	80
Linford Gravel Pits	27253		10	3	22	27	23	80
Blithfield Reservoir	43156		71	141	135	278	92	78
Tophill Low Reservoirs	38151		8	11	61	13	14	75
Ullswater	59026	51	56		23	49	64	67
Tring Reservoirs	26121		4	11	d	19	33	62
Bassenthwaite Lake	59035	52	57	16	28	36	34	61
Fleet Pond	17065		3	26	27	14	61	61
Blenheim Park Lake	29025		1	10	5	6	62	59
Great Pool Westwood Park	40051		4	8	11	19	72	58
Aqualate Mere	43061	20	32	38	23	41	46	57
Blagdon Lake	14101	14	6	8	19	24	67	57
Llangorse Lake	64031	28	66	67	42	57	66	57
Bewl Water	21151		14	16	28	49	80	50
Fiddlers Ferry Power Station Lagoons	45251			3	3	1	42	50
Lindley Wood Reservoir	51101			3	2		2	50
Lonsdale Road Reservoir	24111		10	11	21	19	54	50
River Test - Broadlands Estate	17319		27	13	28	35	50	50
Groby Pool	36006						11	49
Kingsbridge Estuary	11427	50	50	44	39	34	37	49
River Thames - Putney to Barnes	24301		1	7	5	18	27	47
Talybont Reservoir	64114		56	95	94	23		46
Brading Harbour	18301	50	77	33	37	35	36	45
Gatton Park	23080			1	2	3	28	45
Stanford Reservoir	36101	6	2	4	2		21	45
Dart Estuary	11935	14	9	16		2	8	44

APPENDIX 5 Continued.

SITE NAME	CODE	89/87	87/88	88/89	89/90	90/91	98/99	03/04
Clumber Park Lake	37077				3	1	29	43
Covenham Reservoir	35171		32	20	13	48		43
Barcombe Mills Reservoir	21111		10	4	13	48	92	39
Durleigh Reservoir	13117		11	28	10	24		35
King`s Bromley Gravel Pits	43221		22	33	38	72	49	35
Wimbleball Lake	13110		9	11	18	7	33	35
Barn Elms Reservoirs	24115		80	183	160	147	5	33
Fairlop Gravel Pits	24261		7	4	16	3		32
Tabley Mere	45074		9	3	12	10	9	32
Tweed Estuary	55491		113	40	2	34	32	32
Ardingly Reservoir	20101		8	32	37	28	11	31
Island Barn Reservoir	23123		11	70	17	11		31
Newport Pagnell Gravel Pits	27254		8	3	6		22	31
Priory Country Park (Barkers Lane Gravel Pit)	31323		1	4	51	5	22	31
Brogborough Clay Pit	31221		13	4	41	66	10	29
Chillington Hall Pool	43051		17	30	36	24	19	29
Foremark Reservoir	48101	5	9	8	17		36	29
Venus Pool	44024			5	1	5	6	29
Woolston Eyes	45381		1	1	10	4	13	28
Bolton-on-Swale Gravel Pits	51251		33	26		34	54	27
Hollowell Reservoir	30122			5	16	2	36	27
Thornton Reservoir	36121						2	27
Longleat Ponds	16006			2		1	5	26
Meadow Lane Gravel Pits St Ives	32221			10	6	21	45	26
Radwell Gravel Pits	31245				2	1	19	26
Combermere	45001		16	32	33	34	48	25
Beaulieu Estuary	17405		11	26	26	14	12	24
Derwent Reservoir	53131	4	6	19	9	9	15	24
Eccup Reservoir	50189		1				4	24
Frampton Pools	15201		11	25	30	19	18	24
Warnham Mill Pond	20071		1	1	3	11	8	24
Weirwood Reservoir	21101		13	36	33	52	46	24
Arlington Reservoir	21131		4	3	5	10	24	23
Bittell Reservoirs	40101				1	3	5	23
Harewood Lake	50061						4	23
Coniston Water	58071		64	50	56	9		22
Farnham Gravel Pits	51224		2	4	5	7		22
Hardingstone Gravel Pits	30238						4	22
Llys-y-fran Reservoir	63121	6	9	7	7		11	22
Willington Gravel Pits	48212		3	9	11	16	33	22
Trent Valley Pit	36231		19	16	16	7	31	21
Killington Reservoir	58101	9	14		13	30	5	19
Doddington Pool	45007		8	11	26	25	11	18
Eglwys Nunydd Reservoir	62101		12	7	16	8	18	18
Esthwaite Water	58036		37	17	20	32	25	18
Llyn Alaw	68121		6	9	12	16	15	18
Chard Reservoir	13101		2	5	2	3	21	17
Brandon Marsh Nature Reserve	41352			1		5	13	16
Hilfield Park Reservoir	26101		1	1	4	3	52	16
Slapton Ley	11011		14	14	14	26	8	16

APPENDIX 5 Continued.

SITE NAME	CODE	89/87	87/88	88/89	89/90	90/91	98/99	03/04
Cheddar Reservoir	13121		14	7	16	20	17	15
Daventry Reservoir	30111		4	1	1	1	20	15
Hardley Flood	34030	16	18	6	9	17		15
Haweswater Reservoir	59111		21	22	13	14	24	15
Cuckmere Estuary	21421		1	16	11	8	9	14
Sandbach Flashes	45523		4	7	16	14	8	14
Thrybergh Country Park	49162						22	14
Upton Warren Local Nature Reserve	40056			5		1	12	14
Alresford Pond	17043						11	13
Barrow Gurney Reservoir	14105		7	8	55	22	19	13
Bramshill Park Lake	17075						9	13
Crummock Water	59034		14	15	9	13	14	13
Kielder Water and Bakethin Reservoir	55681		9	7	7	8		13
Kirkby-on-Bain Gravel Pits	35266	2			1		23	13
Stoke Newington Reservoirs	24141		2	3	4	9	8	13
Newtown Estuary	18402	1	4	7	4	8	8	12
Wintersett Country Park Lake	50220						13	12
Bowood Lake	16023				1		5	11
Cuttmill Ponds	23037						2	11
Hampstead and Highgate Ponds	24026							11
Holland Marshes	25341				4		5	11
Leighton and Roundhill Reservoirs	51131		3	3			3	11
Llynnau Y Fali	68070	5	5	3	8	3	10	11
Stewartby Lake	31225		18	42	23	67	9	11
Wotton Underwood Lakes	27031			3		1		11
Buttermere	59033		2	1	1	2		10
Colliford Reservoir	10122		10	27	20	18	12	10
Kenfig Pool	61071			3	6	3	7	10
Langtoft West End Gravel Pits	35236	2	1	3	10	7	3	10
Lockwood Beck Reservoir	52102							10