



**CORMORANT *PHALACROCORAX*
CARBO IN GREAT BRITAIN: RESULTS
OF THE JANUARY 2003 ROOST SURVEY**

WWT Research Report

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SUMMARY

Evidence for recent increases in Cormorant numbers throughout Europe has originated for the most part from censuses of breeding colonies. Comparatively little is known regarding the numbers and distribution of Cormorants during the winter. Consequently, Wetlands International's Cormorant Research Group organised a European survey of Cormorants in January 2003 to assess winter numbers and distribution. The census involved counting Cormorants at night roosts at both inland and coastal sites throughout Europe and North Africa. This report presents the results of the Cormorant roost survey in Great Britain.

An inventory of Cormorant roost sites in Britain was previously conducted in 1996-1998 and identified 285 sites supporting breeding colonies and inland roost sites in Great Britain. Of these sites, 130 were re-visited in January 2003, and 74 new roosts not previously recorded were identified. The majority of these new sites were located inland (67%) and seem to be a result of infilling rather than expansion of the wintering range. Combined with the previous inventory, the results of the January 2003 survey have provided information on 363 confirmed or potential roost sites in Britain.

Cormorants were counted at roost sites in 61 from a total of 85 WeBS regions in Britain. Count data were available for 202 sites in Britain overall, of which 158 were in England, 29 in Scotland and 15 in Wales. The number of Cormorants recorded at dusk roosts in England was 9,866, in Scotland was 1,193 and in Wales was 490, giving a total count of 11,549 for those sites visited in January 2003.

There is a notable concentration of large roosts in Southern England, particularly at inland sites. In England, the highest numbers of roosts were found on lakes, whereas in Scotland, there was a relatively even distribution between lakes, rivers and estuaries. Of those sites surveyed in Wales, the majority were classified as coastal with 50% found on estuaries. Roosts located on rivers and non estuarine coast tended to be relatively small, while the largest roosts were found most frequently on inland lakes. Those in estuarine habitats most frequently held between 10-50 birds. Roosts at coastal sites were most commonly found on piers/jetties and at ground level, with inland roost sites mostly situated in trees.

The total number of Cormorants counted during this survey represented 71% of the peak count recorded by WeBS in winter 2000/01 and 50% of the estimated population size for Great Britain. Although less than 50 % of sites identified by the 1997/98 inventory were visited in 2003, the total number of birds counted suggests that a full national survey of roost sites would result in a higher number of birds than currently counted by WeBS.

The results of the January 2003 cormorant roost survey has indicated that dusk roost counts are an efficient method of recording numbers of cormorants, however a direct comparison of WeBS counts with roost counts are required to ascertain effectiveness of such counts. Owing to incomplete coverage due to tight deadlines of the European Cormorant roost survey, full coverage in Britain was not achieved. At the very least, a 'mop-up' survey is needed to fully update the Cormorant roost inventory from 1997/98 and to collect count data on the remaining previously recorded roost sites. Efforts to locate unknown roosts should also continue.

The expansion of both inland wintering sites and breeding colonies has led to conflict with inland fisheries. Long term monitoring is essential to ensure that the impacts of site-based control do not compromise the conservation status of the species. A full national roost survey is recommended every nine years to produce a national population estimate, covering all roosts in the UK with updates to the roost inventory occurring annually. In addition to ongoing WeBS counts which provide valuable data on site specific use by Cormorants, a sample of roosts and WeBS sites monitored annually using a random stratified sampling approach would enable national population indices to be produced and help to predict the impacts of site-based control measures on Cormorant numbers.

1 INTRODUCTION

Most Cormorants in the UK belong to the North Atlantic race *Phalacrocorax carbo carbo* which breeds around the coasts of Iceland, Norway, Russia, Northern France, Britain and Ireland. The continental race *Phalacrocorax carbo sinensis* have also been recorded in the UK. This sub species breeds inland in northern Europe, mainly The Netherlands, Denmark, Germany, Poland, Sweden and the Czech republic/Slovakia. Ring recoveries have estimated 2-5% of the UK population is composed of *P.c. sinensis* (Wernham *et al* 1997). However, Kirby *et al* (1995) estimated 5-10% of the wintering population in Britain was composed of *P.c. sinensis* while Newson (2000) found that 20% of Cormorants shot under licence on inland waters in England in the winters of 1997/98 and 1998/99 were of the *sinensis* race.

Wetlands International (Delany & Scott 2002) documented an estimated winter population size for *P.c. carbo* in North West Europe of 120,000 (1% threshold of 1,200) and a north and central European population of *P.c. sinensis* of 275,000-340,000 (1% threshold of 3,100). In Great Britain, Cormorant numbers were estimated at 23,000 based on data from the period 1994/95-1998/99 (Kershaw & Cranswick 2003) and Gregory *et al* (2002) estimated the UK population at 24,900, equating to 21% of the total population. The 1% national threshold for Great Britain is currently 230 but the All Ireland threshold has not been defined (Kershaw & Cranswick 2003). There are 54 nationally important sites for Cormorant in Britain, four in Northern Ireland and one site (Loughs Neagh and Beg) of international importance in the UK (Pollitt *et al* 2003).

Cormorant numbers have increased at the international level. Kershaw & Hughes (1997) estimated increases of 3% per year for *P.c. carbo*, and 17% per year for *P.c. sinensis*. There has been an increase in numbers throughout Europe, partly thought to be because of increased protection brought about by the 1979 EC Birds Directive and an increase in suitable habitat and food availability.

Long-term historical monitoring data for Cormorants in Britain are limited. The Wetland Bird Survey (WeBS) only began recording Cormorants as part of the annual monitoring scheme in winter 1986/87. Ring recoveries prior to this gave some indication of an increasing winter population at inland sites in the 1970s and early 1980s (Wernham *et al* 1997). The Christmas Week Cormorant Survey (CWCS) took place annually in the 1990s and monitored numbers of Cormorants at selected roost sites in Britain (mostly inland), between Christmas and New Year. Most roosts were counted in England, south of a line between the Humber and the Mersey estuaries and in Wales. Prior to this the British Trust for Ornithology conducted a roost survey of wintering Cormorants in the UK in 1985/86. Additional information on breeding colonies is available through the Cormorant Breeding Colony Survey (CBCS), the breeding season equivalent of the CWCS covering inland colonies and approximately 50% of coastal breeding colonies in the 1990s. In addition the establishment of the Seabird Colony Register, following the Seabird Group's Operation Seafarer Survey of 1969-70 provides further data on Cormorants during the breeding season. This has been updated by surveys in 1985-87 and 1999-2002 (Seabird 2000) (Sellers 2004).

The annual maximum counted by WeBS in Britain increased from 1986/87 until 1990/91 (9,500 in 1988/89 to 13,866 in 1990/91). Numbers then climbed again from 1992/93 to 1994/95 and have since remained relatively stable (Pollitt *et al* 2003).

Kershaw & Hughes (1997), as part of an integrated programme of research on fish-eating birds initiated by the UK government, investigated trends in the numbers of Cormorants wintering in Britain in relation to year, region and habitat. They showed a stabilisation in the wintering numbers in most regions of the UK and a decline in numbers in one area of Scotland. This latter decline was of some concern particularly since Scotland currently holds approximately 10% of the world population of *P.c. carbo*. However, in the south west of England and South Wales, numbers were found to be increasing.

Van Eerden & Gregersen (1995) reported that the breeding population of *P.c. sinensis* was rapidly expanding with an estimated increase of 11-30 % per year in Europe (excluding UK), although the population growth rates in some countries supporting major breeding populations began to stabilise from 1993. The *P.c. carbo* breeding population has not increased as rapidly as *P.c. sinensis* with only a 3% annual increase between 1969 and 1987 (Kirby *et al* 1995, Lloyd *et al* 1991).

The results of the Seabird 2000 survey estimated a 7% increase in the UK coastal breeding population of *P.carbo* between 1985-1988 and 1999-2002 compared to previous increase of 35% between 1969-70 and 1985-88. There were substantial regional differences in trends with large increases in some areas, stable numbers in others, and some areas (particularly some areas of Scotland) showing significant declines.

Large increases in the number of inland breeding colonies between 1985-88 and 1999-2002 raises the overall breeding population increase in the UK to 15%. The expansion of tree nesting inland breeding birds is thought to be largely due to colonisation by *P.c. sinensis*. Sightings of colour-ringed birds, identification of sub-species by using the gular pouch characteristics and recent DNA analysis has confirmed that many inland breeding birds are from the continental race (Newson 2000, Sellers *et al* 1997, Sellers 2004).

Despite the current stabilisation of overall numbers of wintering Cormorants in the UK, these are expected to increase owing to a rapidly expanding inland breeding population. There are an estimated 7,100 breeding pairs of *P.c. carbo* in Great Britain comprising 13.4-13.7% of the North West European population respectively (Sellers 2004). These breeding birds are thought to be largely resident but dispersive with the majority of the UK breeding population thought to winter in the UK. The number of breeding pairs of *P.c. sinensis* in Great Britain was estimated at 1,400, comprising 0.4-0.5% of the North West European population. It is estimated that 15% of the total UK breeding population of *P. carbo* nest in inland colonies.

There has been an increasing tendency for Cormorants to winter inland and combined with a rapidly expanding inland breeding population, this has brought the species in to conflict with anglers and inland fisheries. Prior to the 1980s, conflict with fisheries was restricted largely to August to March since breeding almost exclusively occurred on the coast. With the increase in inland breeding birds, damage by fish predation now extends into the summer (Sellers *et al* 1997). Although conflicts have led to the implementation of short term research, such as demographics, movements and foraging behaviour of *P.c. carbo* in the UK, there is a need to focus on long term monitoring and research, to assess national population estimates, investigate site use and movements, and to understand factors affecting trends in numbers both at a national and site-specific scale. The REDCAFE project, funded by the EU, is aimed at reducing the conflict between Cormorants and fisheries on a pan-European scale, involving seven stakeholder groups from 22 countries. The objectives of this project are to investigate ecological and socio-economic factors of Cormorant conflicts with fisheries, to produce and assess the efficacy and cost effectiveness of a set of management tools, from the population level to site specific control. The ultimate aim is to produce a strategy for conflict resolution at local, national and European levels.

Sellers & Hughes (1997) compiled an inventory of Cormorant roost sites in Britain in 1996 which was further updated in 1998 (Hughes & Sellers 1998). This inventory listed both breeding colonies and inland roost sites by using information compiled from CWCS, county bird reports, other published sources and questionnaires sent to county bird recorders, WeBS counters and Cormorant experts. The information gathered during the inventory was largely descriptive, with no count data collected for the listed roost sites.

Evidence for recent increases in Cormorant numbers throughout Europe has originated for the most part from censuses of breeding colonies. Comparatively little is known regarding the numbers and distribution of Cormorants during the winter. Consequently, Wetlands International's Cormorant Research Group organised a European survey of Cormorants in January 2003 to assess winter numbers and distribution. The census involved counting Cormorants at night roosts at both inland and coastal sites throughout Europe and North Africa. The Wildfowl and Wetlands Trust (WWT) were approached by Wetlands International in summer 2002 to co-ordinate the survey in Great Britain. This report presents the results of the Cormorant roost survey in Great Britain in January 2003.

2 METHODS

The 2003 survey in Britain was based on the 1997/1998 inventory of roost sites and involved coverage of those sites known to exist in 1997/98. In addition, information regarding new sites, not previously recorded, was requested from participants.

Local WeBS Organisers were initially contacted to invite them to take part in the survey and organise coverage in their region. In those areas where no Local Organisers were in place, counters were contacted directly. Those volunteers that took part in the 1997/1998 Cormorant roost inventory were also contacted.

Once counters had agreed involvement, they were provided with recording forms, a set of guidance notes, a covering letter explaining the purpose of the survey, a roost inventory questionnaire and details of known roosts in their county collated from the results of the 1997/1998 inventory. Counters were advised to obtain permission for access to any private land that they would need to cross for the purposes of the survey, however in case of difficulty, a letter of introduction to landowners was also provided.

In Europe, the Cormorant census was scheduled for 15 January 2003. In Britain, it was assumed that most counters would prefer to visit their site at the weekend, therefore the dates for the British survey were set for the weekend preceding the European date (11th and 12 January). If counters were unable to visit their site on either of these dates, they were asked to make the count on the following weekend (18th and 19 January), or on the closest possible date.

2.1 Number and distribution of Cormorants

Counters were asked to make a single visit to their chosen site and begin the roost count at least one hour before dusk. If more than one site was covered by an individual, counts were made on additional evenings. A list of sunset times for various cities around Britain for 11 January 2003 was provided as a guide.

Owing to the behaviour of roosting Cormorants (birds often make short flights from and back to the roost), and potential difficulties in viewing flight paths to the roost, counters were asked to count only perched birds within the roost. Counts were made every 15 minutes until light conditions restricted further counting. Counters were requested to return forms with details of the site(s) they visited, even if no Cormorants were present at that site on the count date.

The count form was designed following the standard WeBS Core Count format (appendix 1) and requested the following information;

1. Name and address of counter.
2. Site details: name, county and central grid reference of the roost itself was requested (previous inventories requested the central grid reference of the site rather than the roost, especially if the site itself was large).
3. Date and Method: the appropriate method for the count was already specified, i.e. dusk roost count. Any counts of daytime loafing sites were not used in the data analysis.
4. Cormorant count: the time of each count (using the 24 hour clock) was requested for each count carried out at 15 minute intervals. A box was provided to indicate absence of cormorants. This would allow Nil returns (no birds present) to be distinguished from no counts (birds present but not counted). Counters had the option of recording gross underestimates of numbers by enclosing the count figure in square brackets.
5. Coverage: Counters were asked to give an indication of count accuracy to aid interpretation of count data (OK for a reasonable accurate reflection of Cormorant numbers or LOW if factors prevented the counter from recording a significant number of birds present).
6. Count conditions: The percentage of adjacent wetland covered by ice was requested (if appropriate) and if the site was tidal or close to tidal waters, state of the tide was also requested.
7. Additional information: Space was provided for any relevant additional information regarding the count to be given.

2.2 Cormorant roost inventory

Counters were provided with a roost inventory questionnaire to record information regarding the characteristics of each roost and to update the list of sites collated during the 1997/1998 roost site inventory (see Appendix 2). The questionnaire was based on the 1997/98 roost inventory questionnaire, with only minor modifications, designed to be easy to complete, and consisting largely of a series of check boxes to tick as appropriate.

The questionnaire requested information on the following for each roost site;

1. Name and address of counter.
2. Site details: name, county and central grid reference of the roost itself.
3. Site type: counters were asked to specify habitat type from the following choices: lake (including natural lakes, reservoirs and gravel pits), river, non-estuarine coast, estuary, non-wetland and 'other'. Open coast and estuarine habitats are jointly referred to as coastal, and rivers and lakes as inland. It should be noted that some roosts referred to as inland may in fact be short distances from the coast.
4. Island/non-island: counters were requested to indicate whether the roost was located on an island (surrounded by water) or on land not surrounded by water.
5. Roost structure: information regarding the structure on which the birds roost was requested using a series of tick boxes (tree (live or dead), ground, Pier/jetty, Water tower, raft/buoy, pylon/wires, navigation post, cliff or other). If more than one structure was used, the percentage of birds using each structure was requested to facilitate analysis of roost site characteristics.
6. Height of roost: counters were asked to specify the height at which the birds roost on the relevant structure (ground level, 1-5 m, 6-10 m and over 10 m). If more than one height level was used, the percentage of birds using each level was requested.
7. Exposure rating: counters were asked to give an indication of the degree to which the roost affords shelter to the birds (exposed, partially sheltered or entirely sheltered).
8. Number of birds usually present in winter: an estimate of the number of birds usually using the site in winter was requested (<10, 10-50, 51-100, >100, don't know). This was particularly useful if no count was possible at the site on the survey date(s).
9. Frequency of roost usage: information on whether the roost is used regularly all year round, regularly during winter or irregularly was requested.
10. Heronry/rookery present: previous research has suggested that Cormorant roosts often occur in or near heronries or rookeries. Counters were asked to indicate whether one or both of these were present at the site.
11. Evidence of breeding at the site: if the counter was aware of breeding attempts at the site, an estimate of the number of breeding pairs typically present in recent years was requested.
12. Practicality of reading colour rings: counters were asked to indicate whether they were close enough to the roosting birds to read colour ring inscriptions using a telescope. This gave some indication of the proximity of the nearest vantage point.
13. Additional information: any relevant information regarding the roost site or maps of the site were requested.

3 RESULTS

3.1 Extent of coverage

A total of 214 sites in Britain were visited during the January 2003 Cormorant roost survey. Completed count forms were received for 202 of these sites, and completed inventory questionnaires were received for 179 sites. A small number of sites had completed inventories but no count data supplied, and vice versa.

Cormorants were counted at roost sites in 61 from a total of 85 WeBS regions in Britain. In England, only the Isle of Wight, West Yorkshire and Durham had no coverage for the 2003 survey. Four out of ten regions had coverage in Wales and in Scotland 13 out of 27 regions were included in the survey.

The 1997/98 inventory provided details on 285 sites in Britain, 130 of these were re-visited in 2003 (Table 1). Information on 84 new sites that previously had not been recorded was also obtained. Information on 369 confirmed or potential roost sites in Britain are now available as a result of the 1997/98 roost inventory and the 2003 Cormorant roost survey.

Table 1. Extent of coverage of January 2003 roost survey (of those sites where count data are available).

Estimated number of birds in roost	Number of roosts in 1997/98	Number of roosts re-visited in 2003	% of roosts re-visited in 2003	Number of new roosts identified in 2003
<10	33	12	36	24
10-50	92	43	47	28
51-100	38	24	63	13
>100	49	31	63	6
unknown	73	20	27	13
Total	285	130	46	84

3.2 Numbers and distribution of roost sites visited in January 2003

Count data were available for 202 sites in Britain overall, of which 158 were in England, 29 in Scotland and 15 in Wales. The number of Cormorants recorded at roosts in England was 9,866, in Scotland was 1,193 and in Wales was 490, giving a total count of 11,549 for those sites visited in January 2003 (Table 2). Less than 4% of counts were considered to have low accuracy due to weather conditions or efficacy of counting from the nearest vantage point. A total of 31 sites (15%) had more than 50% of adjacent wetland covered with ice on the count date which may have influenced Cormorant distribution at this time.

The size and distribution of roosts counted during the survey throughout Britain are illustrated in Fig. 1 and Table 3. There is a notable concentration of large roosts in Southern England, particularly at inland sites. The highest total counts by region were recorded in Cambridgeshire, Essex, Greater London, Kent and Norfolk (>500 birds). The largest roosts (>300 birds) were recorded at Little Paxton gravel pits in Cambridgeshire (TL1963); Abberton reservoir, Essex (TL9617); Walthamstow reservoir, Greater London (TQ3589); and Queen Elizabeth II reservoir, Surrey (TQ1267). Roosts holding between 200 and 300 birds were recorded at Rostherne Mere, Cheshire (SU7484); Dungeness RSPB reserve, Kent (TR0718); Rutland Water, Leicestershire (SK5513); Besthorpe and Attenborough reservoirs, Nottinghamshire (SK5234 and SK8805); and South Stoke, West Sussex (TQ0110).

Table 2. Number of roost sites counted in January 2003 showing total number of Cormorants and size range of roost by region. Figures in brackets give the number of sites identified during the 1997/98 inventory.

WeBS region	Number of sites counted	Total Cormorant numbers	Number of birds per roost (range)
England			
Avon	3 (5)	79	6-55
Bedfordshire	4 (4)	149	25-75
Berkshire	6 (5)	348	0-121
Buckinghamshire	2 (6)	126	56-70
Cambridgeshire	9 (2)	658	0-362
Cheshire	4 (2)	389	18-286
Cleveland	2 (5)	136	2-134
Cornwall	1 (1)	7	
Cumbria North	5 (7)	145	0-61
Cumbria South	2 (4)	119	3-116
Derbyshire	2 (3)	138	17-121
Devon	1 (4)	45	
Dorset	2 (5)	131	34-97
Durham	0 (0)		
East Sussex	7 (4)	202	0-121
Essex	2 (7)	732	189-543
Gloucestershire	6 (10)	180	0-126
Greater London	4 (9)	791	0-515
Greater Manchester	2 (2)	34	14-20
Hampshire	5 (5)	186	3-69
Hereford & Worcestershire	9 (8)	194	0-44
Hertfordshire	1 (3)	4	
Humberside	2 (3)	49	17-32
Isle of Wight	0 (1)		
Kent	3 (70)	328	21-235
Lancashire	1 (4)	2	
Leicestershire	3 (3)	388	16-259
Lincolnshire	1 (3)	0	
Merseyside	1 (1)	497	
Norfolk	5 (9)	523	3-256
North Yorkshire	2 (0)	154	48-106
Northamptonshire	6 (8)	329	0-169
Northumberland	12 (7)	265	0-113
Nottinghamshire	4 (4)	439	1-225
Oxfordshire	4 (10)	270	0-151
Shropshire	4 (6)	84	0-84
Somerset	3 (5)	195	34-103
South Yorkshire	2 (6)	27	0-27
Staffordshire	5 (1)	148	0-62
Suffolk	1 (5)	92	
Surrey	3 (2)	378	13-308
Tyne & Wear	4 (3)	175	0-104
Warwickshire	1 (1)	125	
West Midlands	1 (1)	9	
West Sussex	5 (6)	479	18-248
West Yorkshire	0 (2)		
Wiltshire	5 (5)	72	2-27
English total	158 (204)	9,866	
Scotland			
Angus	0 (0)		

WeBS region	Number of sites counted	Total Cormorant numbers	Number of birds per roost (range)
Argyll West Mainland	0 (2)		
Ayrshire & Arran	3 (7)	185	4-120
Berwickshire	1 (2)	2	
Central	2 (2)	19	0-19
Dumbarton/SE Argyll	1 (1)	57	
Dumfries & Galloway East	2 (3)	174	12-162
Dumfries & Galloway West	0 (3)		
Fife	0 (2)		
Grampian Moray	0 (3)		
Grampian South East	1 (3)	29	
Highland North	1 (1)	0	
Highland South East	0 (3)		
Highland South West	0 (2)		
Islay/Jura/Colonsay	1 (0)	2	
Lanarkshire/Strathkelvin	3 (2)	164	12-97
Lothians	1 (1)	46	
Mull/Lismore/Coll/Tiree	0 (0)		
Orkney	4 (1)	248	0-160
Perth & Kinross	6 (9)	212	0-108
Renfrew	3 (2)	55	5-33
Roxburgh	0 (0)		
Shetland	0 (6)		
Skye	0 (0)		
Tweeddale/Etrick & Lauderdale	0 (0)		
Western Isles (north)	0 (0)		
Western Isles (south)	0 (0)		
Scotland total	29 (55)	1,193	
Wales			
Anglesey	0 (0)		
Caernarvon	0 (0)		
Clwyd	0 (2)		
Dyfed	1 (7)	7	
Gwent	3 (4)	121	30-64
Merioneth	0 (5)		
Mid & South Glamorgan	0 (0)		
Powys North	0 (1)		
Powys South	2 (3)	65	18-47
West Glamorgan	9 (4)	297	3-74
Welsh total	15 (26)	490	
Great Britain total	202 (285)	11,549	

Table 3. Size of roosts (where birds were present and count data are available) in Great Britain.

Country	Number of Birds present				Total
	<10	10-50	51-100	>100	
England	31	46	23	33	133
Scotland	7	7	5	3	22
Wales	3	8	5	1	17
Great Britain	41	61	33	37	172*

* total number of sites excludes 21 sites in England and 3 in Scotland where zero counts of birds were recorded.

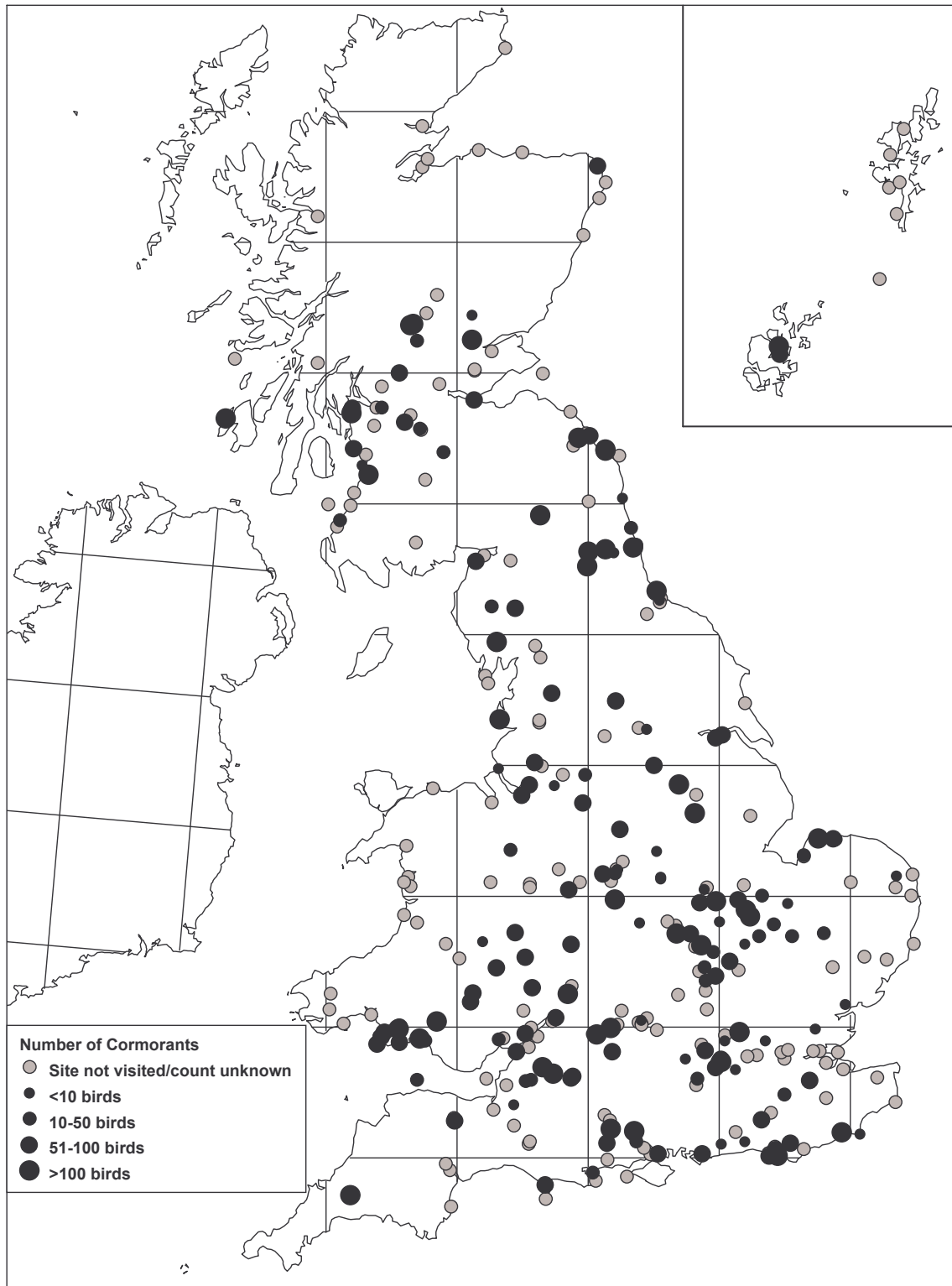


Figure 1. Numbers of Cormorants recorded at roosts in Britain in January 2003

3.3 New roosts identified in 2003

A total of 84 sites not previously recorded but thought to hold Cormorants (based on counter observations) were visited in January 2003. Counts were carried out at 83 of these sites and 74 sites held roosts at dusk (Table 4). Nine sites had no birds present on the count date. A total of 2,471 birds were counted at these 74 roost sites, the distribution of which are shown in Fig. 2.

Table 4. Number of new roosts identified in January 2003

County	Number of sites visited	Number of Cormorants
Avon	1	no count performed
Berkshire	1	11
Berwickshire	1	2
Cambridgeshire	7	232
Central	1	19
Cheshire	2	58
Cumbria South	1	116
Dumbarton/SE Argyll	1	57
Dyfed	1	7
East Sussex	5	81
Gloucestershire	2	132
Greater Manchester	2	34
Gwent	1	64
Hampshire	4	117
Hereford & Worcestershire	1	44
Highland North	1	0
Islay/Jura/Colonsay	1	2
Kent	1	21
Lanarkshire/Strathkelvin	3	73
Lancashire	1	2
Leicestershire	1	259
Norfolk	2	98
North Yorkshire	2	106
Northamptonshire	1	0
Northumberland	10	48
Nottinghamshire	1	7
Orkney	4	248
Perth & Kinross	2	13
Renfrew	3	55
Somerset	3	195
South Yorkshire	1	27
Staffordshire	4	109
Surrey	1	0
Tyne & Wear	1	3
West Glamorgan	5	163
West Sussex	1	18
Wiltshire	4	50
Total	84	2,471

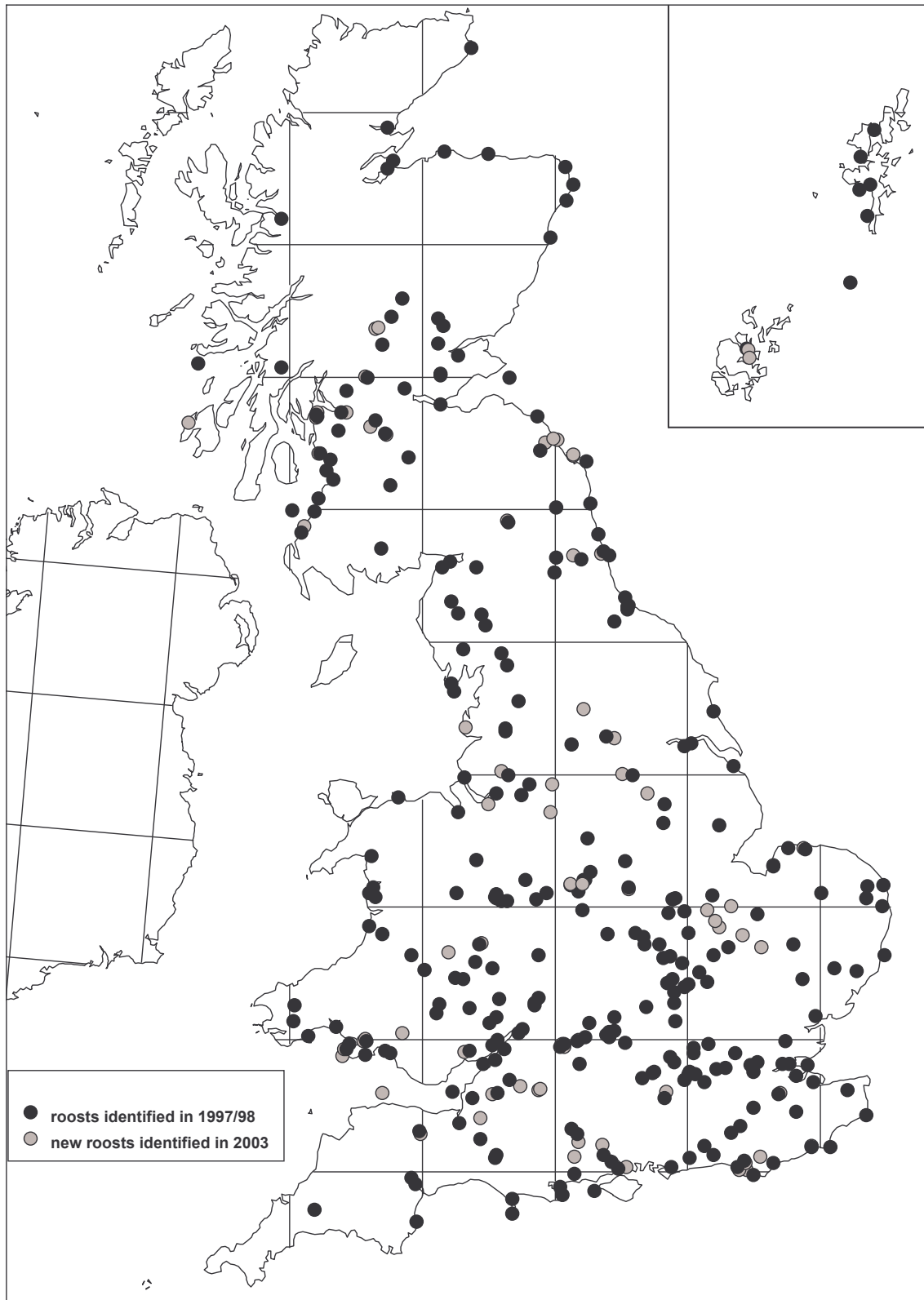


Figure 2. Distribution of Cormorant roosts identified in 2003 and 1997/98.

3.4 Characteristics of roost sites visited in January 2003

Roost inventory questionnaires were received for a total of 179 sites in 58 WeBS regions in Britain. Although the majority of returns had completed sections relating to site type and structure, additional sections referring to other roost characteristics were returned with varying degrees of completeness. Therefore, not all sites for which a questionnaire was received have a full set of roost site information.

3.4.1 Site type

Site type information was available for all 179 sites for which a questionnaire was received. Of these sites, 26% were classed as coastal sites (open coast and estuary) and 74% as inland sites (lake and river), with 75% of inland sites situated on lakes. In England, the highest numbers of roosts were found on lakes, whereas in Scotland, there was a relatively even distribution between lakes, rivers and estuaries (Table 5). Of those sites surveyed in Wales, the majority were classified as coastal with 50% found on estuaries. Of the 74 new roosts that were identified in this survey, 20% were found on non-estuarine coast, 13% on estuaries, 21% on rivers and 46% on lakes.

Table 5. Habitat type of roost sites visited in January 2003 by region (figures in brackets represent percentage of totals).

County	Non-estuarine coast	Estuary	Lake	River	Other	Total
England						
Avon			1	2		3
Bedfordshire			4			4
Berkshire			2			2
Buckinghamshire			2			2
Cambridgeshire			4		5	9
Cheshire		1	2		2	5
Cleveland	1	1				2
Cornwall			1			1
Cumbria North		1	4			5
Cumbria South	1		1			2
Derbyshire			2			2
Devon			1			1
Dorset			1		2	3
East Sussex	2	1	3	1	1	8
Essex			2	1		3
Gloucestershire			2	1		3
Greater London			5	1		6
Greater Manchester			1		1	2
Hampshire		1	2	4	1	8
Hereford & Worcestershire			2	5		7
Humberside		2				2
Kent			3			3
Lancashire			2			2
Leicestershire			3			3
Lincolnshire		1				1
Merseyside		1			1	2
Norfolk		1	2		3	6
North Yorkshire			2			2
Northamptonshire			3			3
Northumberland	2	4	2	2	1	11

County	Non-estuarine coast	Estuary	Lake	River	Other	Total
Nottinghamshire			3	1		4
Oxfordshire			2			2
Shropshire			2	1		3
Somerset			3		1	4
South Yorkshire			2			2
Staffordshire			1			1
Suffolk			1			1
Surrey			2			2
Tyne & Wear	1	2	1			4
Warwickshire			1			1
West Midlands			1			1
West Sussex			3	1	1	5
Wiltshire			2	3		5
England total	7 (5)	16 (11)	83 (56)	23 (16)	19 (13)	148
Scotland						
Ayrshire & Arran	2					2
Berwickshire				1		1
Central			1			1
Dumbarton/SE Argyll		1				1
Dumfries & Galloway East		2	1			3
Highland North		1				1
Islay/Jura/Colonsay			1			1
Lanarkshire/Strathkelvin				4		4
Orkney	4					4
Perth & Kinross			4	2		6
Renfrew	1	2				3
Scotland total	7 (26)	6 (22)	7 (26)	7 (26)	0 (0)	27
Wales						
Dyfed		1				1
Gwent		1		1		2
Powys South			2			2
West Glamorgan	3	5	1			9
Wales total	3 (21)	7 (50)	3 (21)	1 (7)	0 (0)	14
Total***	17 (9)	29 (16)	93* (52)	31 (17)	19** (11)	189

*1 record specified both lake and estuary as site type.

**9 records specified both other and a second category as site type.

*** percentages for totals calculated by omitting the above duplicates (total sites visited is 179).

Differences in roost size were seen across the different habitats. Roosts located on rivers and non estuarine coast tended to be relatively small, while the largest roosts were found most frequently on inland lakes. Those in estuarine habitats most frequently held between 10-50 birds (Table 6).

Table 6. Size of Cormorant roosts on different habitats in Great Britain (figures in brackets represent percentage of totals).

Habitat	Number of birds present				Total
	<10	10-50	51-100	>100	
Lake	15	28	14	25	82 (57)
River	8	9	3	1	21 (15)
Non-estuarine coast	5	4	3	3	15 (10)
Estuary	5	10	7	4	26 (18)
Total	33 (23)	51 (35)	27 (19)	33 (23)	144

3.4.2 Location of roost sites surveyed in January 2003

Information regarding the structures on which the Cormorant roosts were located was available for all 179 sites for which an inventory form was received. In England, Scotland and Wales, roosts were overall most frequently located in trees. Roosts at coastal sites were most commonly found on piers/jetties (29%) and at ground level (19%) with other structures such as buoys, pylons, navigation posts and cliffs also frequently used. Inland roost sites were most commonly situated in trees (80%) with ground roost, jetties, rafts, pylons and water towers used to a lesser extent (Fig. 3).

3.4.3 Roost characteristics

Roost characteristic information was not available for every site for which a questionnaire was received.

Coastal roosts were generally located in exposed positions (85%) whereas inland sites afforded more shelter with 58% of roosts found in partially sheltered locations (n=170). Inland sites were equally divided between island and non-island positions while on coastal sites, non-island roosts predominated (n=163). Roost sites on open coast and estuaries were found to use structures at all height categories (ground to over 10 m), while inland roosts over 6 m predominated, probably reflecting the use of trees as favoured roost structures (n=140) (Fig. 4).

Very few coastal roosts were located close to heronries or rookeries but 16% of inland roosts were adjacent to heronries, 9% had a rookery present and 7% had both present in the immediate area (n=165).

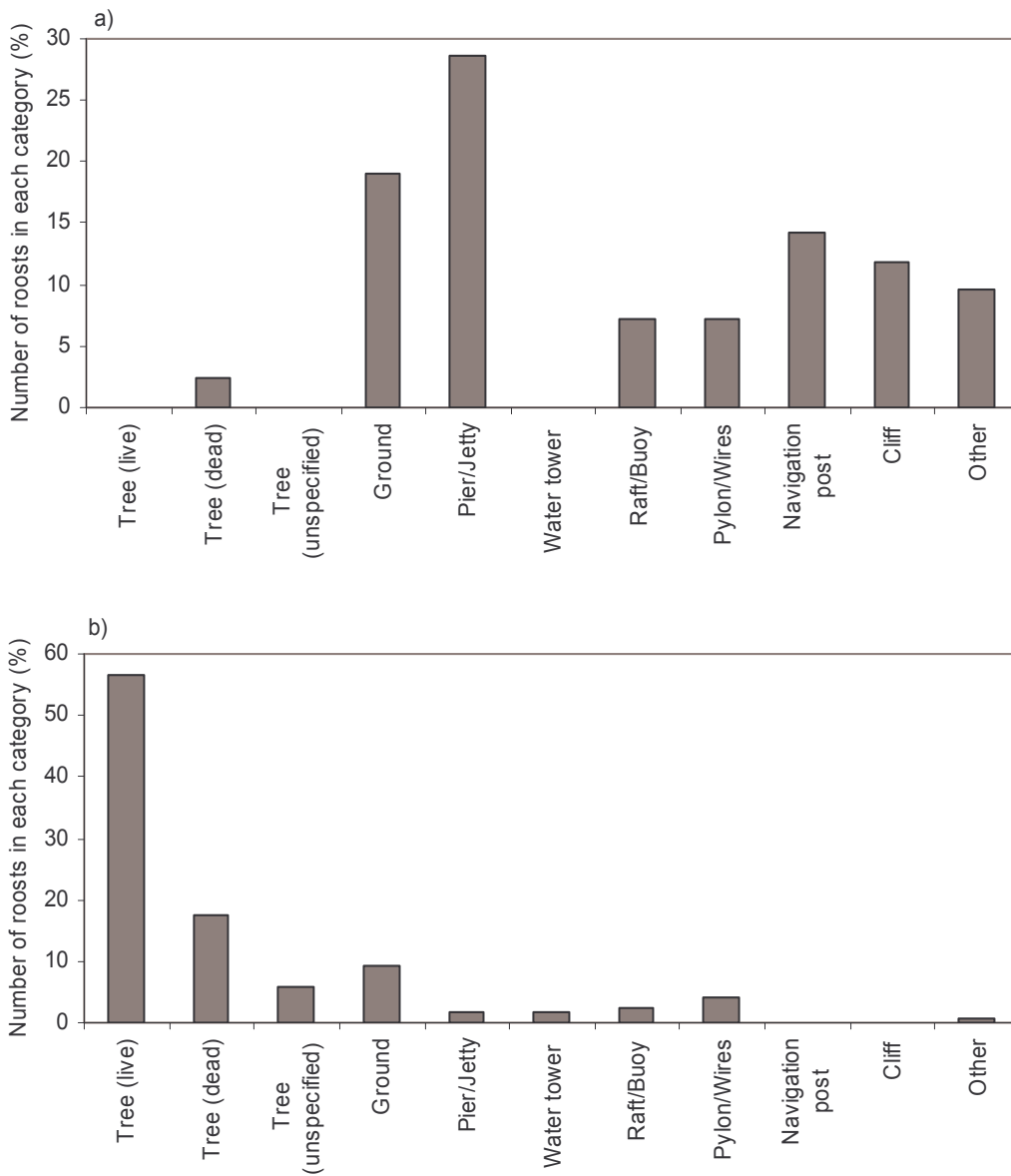


Figure 3. Location of roost sites surveyed in January 2003; a) coastal roosts (n=42), b) inland roosts (n=120).

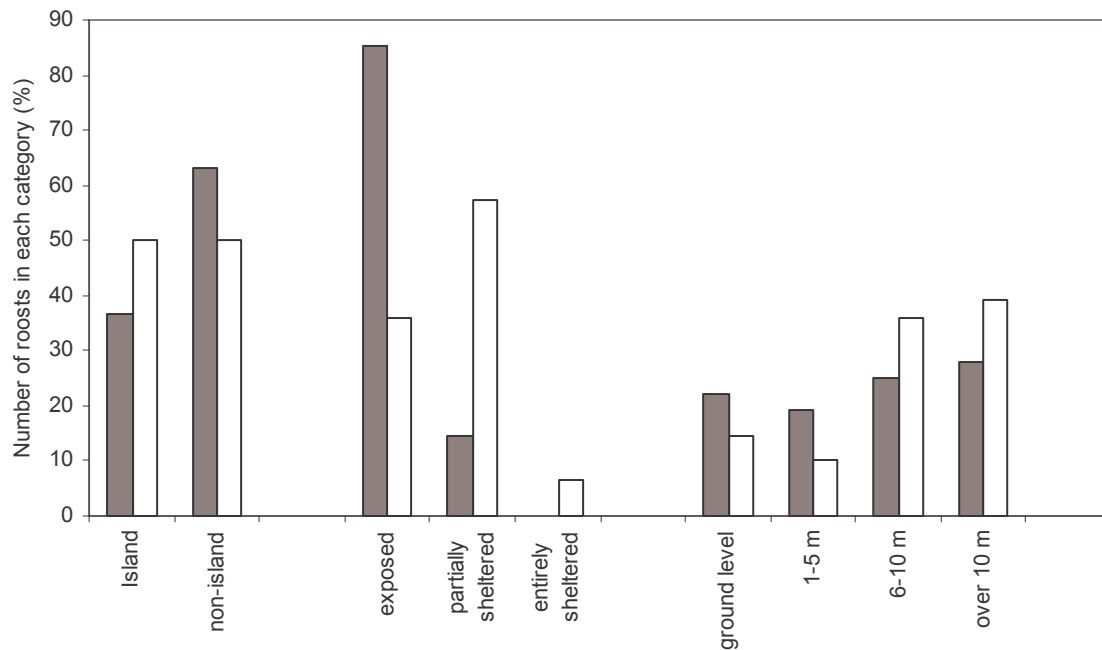


Figure 4. Characteristics of coastal roosts (grey columns) and inland roosts (white columns) visited in January 2003.

Completed questionnaires gave information on the frequency of roost site use for 139 sites and details for 164 roosts were given regarding attempted breeding at these sites. Many of the sites visited were thought to be used regularly all year (69% of coastal roosts and 60% of inland roosts). A higher proportion of inland compared to coastal roosts were used regularly in the winter only (Fig. 5). Very few sites were used only irregularly.

At only 15% of coastal roosts and 17% of inland roosts was breeding known to be attempted. The size and distribution of these sites identified in this survey are shown in Fig. 6. The largest breeding colonies identified from the inventory questionnaires during this survey (>100 pairs) were at Walthamstow reservoir, Greater London; Abberton reservoir, Essex; Rutland Water, Leicestershire; Marsden Rock, Tyne and Wear and Holm of Boray, Orkney. Dungeness RSPB reserve, Kent; Paxton Pits and Chain Corner, Cambridgeshire; Besthorpe gravel pits, Nottinghamshire; Drakelow Wildfowl reserve, Derbyshire; and Horse Island, Renfrew also held large colonies (51-100 pairs).

Seven new inland breeding sites were identified since 1997/98: Queen Elizabeth II reservoir, Surrey; Harrold/Odell gravel pit, Bedfordshire, Swithlands reservoir, Leicestershire; Coombe Abbey Country Park, Warwickshire; Drakelow Wildlife Reserve, Derbyshire; RSPB Fairburn Ings, North Yorkshire and Derwent water, Northumberland.

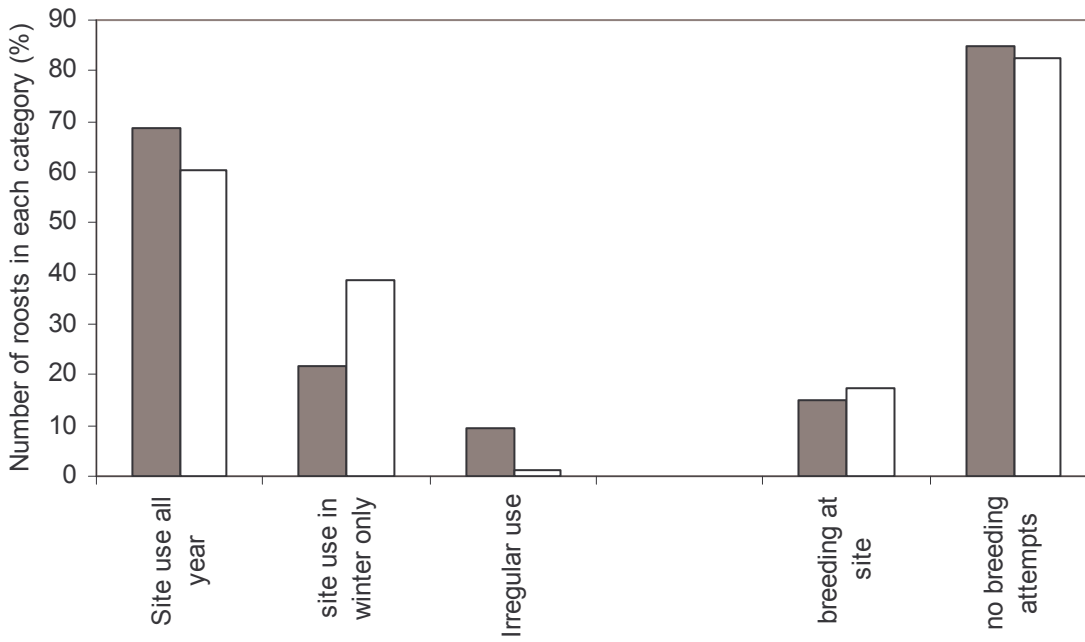


Figure 5. Frequency of winter use and breeding attempts at roost sites surveyed in January 2003: a) coastal roosts (grey columns) b) inland roosts (white columns).

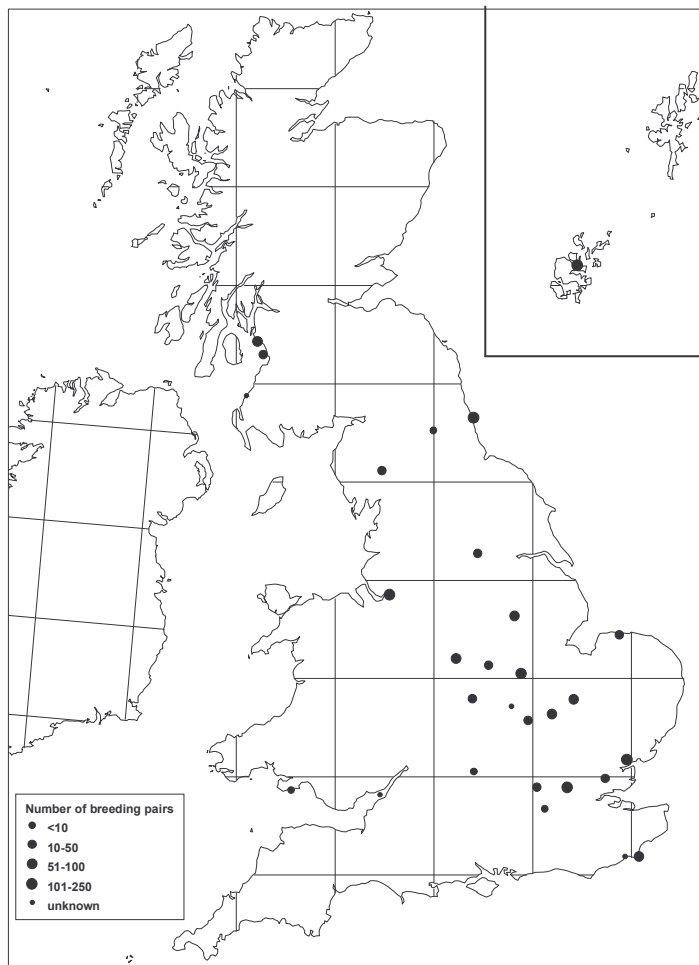


Figure 6. Size and distribution of breeding colonies as identified by the 2003 roost inventory.

4 DISCUSSION

4.1 Extent of coverage of January 2003 survey

Count and inventory information was received for 214 sites in Britain. Of these, 130 were re-visits to sites listed in the previous inventory, while details of 84 sites not previously surveyed were received. However, 19% of the re-visited sites had no birds present at dusk which suggested that these sites may be day time loafs rather than night roosts. The 1997/98 inventory may not have distinguished between day and night use in all cases.

Although volunteers from a total of 85 WeBS regions participated in the survey, overall coverage for the 2003 survey was relatively poor, and only 46% of sites listed in the 1997/98 inventory were revisited. Coverage in Wales and Scotland in particular was patchy. Organisation of a national survey requires much time and planning to attain full coverage. Unfortunately owing to the restricted timeframe to which the European Survey was working, the extent of volunteer recruitment, and coverage achieved, was limited. Coastal roosts were poorly represented regarding information concerning both roost counts and site characteristics. This could be in part due to the practicalities and safety considerations of surveying remote, coastal sites at dusk as well as the paucity of birdwatchers in more remote areas.

Although not all roosts identified in 1997/98 could be re-visited in 2003, coverage of large roosts (>100 birds) compared to small roosts (<10 birds) was relatively good. Only 36% of existing small roosts were revisited in 2003 but 63% of roosts holding more than 50 birds were re-visited.

The results of the January 2003 survey have however, allowed confirmation of 107 night roosts identified in 1997/98 (for which count data was collected), and have identified 74 new sites not previously recorded. A total of 27 sites visited were found to no longer exist or were used as a day time loaf only. The remaining previously documented roosts need to be visited to fully update the Cormorant roost inventory and to record counts of birds using these sites.

4.2 Numbers and distribution of wintering Cormorants in Britain

The previous roost inventory did not attempt to collect count data for individual sites, although for some, an estimate of the number of Cormorants usually using the sites was given. This survey has allowed count data to be collected for 202 sites in Britain.

Surveys of Cormorants concentrated at roost sites has previously been shown to give higher counts rather than day time counts when the birds disperse to feeding and loafing areas (Ulenaers *et al* 1997, Sellers & Hughes 1997). Dusk counts have been suggested to be more accurate than dawn counts since there is evidence in the UK that birds may start dispersing from the roost site before sunrise (Kershaw & Hughes 1997).

The total number of Cormorants counted during this survey was 11,549 representing 71% of the peak count recorded by WeBS in winter 2000/01 (16,315) (Pollitt *et al* 2003) and 50% of the estimated population size for Great Britain (23,000) estimated by Kershaw & Cranswick (2003). Although less than 50% of sites identified by the 1997/98 inventory were visited in 2003, the total number of birds counted suggests that a full national survey of roost sites would result in a higher number of birds than currently counted by WeBS and suggests that the current population estimate may be realistic.

The majority of Cormorant roosts were located in England and south Wales with few records in the north of Scotland. Although poor coverage was a potential issue in Scotland, it is believed there are genuinely few winter roosts in this region (Sellers & Hughes 1997). In this survey, 74 new roosts were identified as night roosts, 67% of which were located inland. Many of these sites are located close to those colonies in existence in 1997/98 and therefore appears that these new sites are a result of infilling rather than expansion of the wintering range. Cambridgeshire and Northamptonshire, in particular, have a number of new sites, all in the vicinity of Paxton Pits, Marsh lane and Thrapston gravel pits. It is also possible that these roosts may have been overlooked in the previous roost inventory.

4.3 Roost site characteristics

Sellers & Hughes (1997) estimated approximately 12,000 Cormorants were wintering inland in England in 1997/98, with fewer in Wales and Scotland. England held more large roosts than Scotland or Wales and the south east bias in distribution was found to reflect the distribution of gravel pits. Indeed the 2003 survey has found a bias towards lakes (including reservoirs and gravel pits) in England as the most commonly associated habitat. A proportion of this bias may be attributable to the difficulty of locating and surveying coastal sites and rivers. The latter in particular are likely to hold relatively small roosts which may be easily overlooked.

This survey counted 7,939 Cormorants on inland sites and 2,384 on coastal sites (where habitat details were available) with an overall count of 11,549 on all habitats. Kershaw & Hughes (1997) found that numbers of Cormorants wintering at inland sites in the UK increased mainly during the 1970s and 1980s with an overall stabilisation in numbers from 1990/91. However, sustained increases continued in south west England and south Wales. Numbers on gravel pits and reservoirs continued to increase while numbers on other inland habitats stabilised. Despite this stabilisation in many areas, Kershaw & Hughes (1997) found that the number of WeBS count sites occupied by Cormorants had increased, suggesting that birds have become more mobile, moving between a number of sites throughout the winter over recent years. Despite total counts on coastal habitats being lower than on inland sites as recorded by this survey, the majority of birds probably still winter on the coast (Kershaw & Hughes 1997). Such a result is largely attributable to poor coverage of coastal sites in January 2003 and the potential difficulties in locating and surveying such sites.

The expansion of inland wintering sites has been coincident with the steady increase in numbers of inland breeding birds, particularly since the mid 1980s (Thompson *et al* 1998, Sellers 2004). Inland breeding colonies have become established at former winter roosts, suggesting that the availability of food resources, safety from predators and low disturbance govern choice of both winter and breeding sites. Abberton reservoir was the first inland site where inland breeding was recorded in 1981, and rapid growth of this colony occurred. Numbers stabilized in 1989-1991, coinciding with the establishment of three new colonies at Paxton Pits, Bestorpe and Walthamstow reservoirs (Sellers *et al* 1997). Initial colonization of satellite colonies is thought to be largely by immature and first time breeders (Sellers *et al* 1997). Differences in the productivity and survival of inland breeding birds may have contributed to the growth of inland colonies. Studies at Abberton reservoir have indicated that first winter survival is high at this site, as is average brood size compared to coastal sites (Sellers & Hughes 1997, Sellers 2004). Although coastal bred birds of the *carbo* race have been recorded breeding at inland sites, Newson (2000) found that a significant proportion of inland breeding birds belonged to the *sinensis* race.

The expansion of both inland wintering sites and breeding colonies has implications for inland fisheries, and has brought this species into conflict with anglers and commercial fisheries. Hughes *et al* (1999) found that 68% of the feeding sites of 18 radio-tagged Cormorants were located less than ten km from the nearest roost and 84% less than 15 km from the nearest roost, with all feeding sites within 26 km. Cormorants have been found to be site faithful to specific feeding and roosting sites, feeding as close as possible to roosting and breeding sites to minimize energy expenditure. The impact on inland fisheries therefore is dependent on the size and location of nearby roosts. Conflict with inland fisheries has led to the development of an action plan for management for *P.c. sinensis* throughout the African-Eurasian flyway under the Bonn convention to reduce conflict. This specifically recommends that long term monitoring is essential to ensure that the impacts of control do not compromise the conservation status of the species.

4.4 Recommendations

Although much data is available through the CWCS and WeBS for winter distribution and numbers, and CBCS, Seabird Monitoring Program and Seabird Colony Register for the breeding season, coverage by any one scheme is incomplete. Although WeBS coverage of estuaries and inland water bodies is good, coverage of non-estuarine coastal areas and rivers is generally poor. These latter areas are important habitats for Cormorants and a substantial number of birds may be under-recorded as a result.

The results of the January 2003 Cormorant roost survey has indicated that dusk roost counts are an efficient method of recording numbers of cormorants, although a direct comparison of WeBS counts with roost counts

are required to ascertain effectiveness of such counts. Owing to incomplete coverage, in part due to short notice of the European survey, not all previously recorded roosts could be visited in January 2003. Although a comprehensive roost site survey with complete coverage is obviously preferential, at the very least a 'mop-up' survey is needed to fully update the Cormorant roost inventory from 1997/98 to collect count data on the remaining previously recorded roost sites and efforts to locate unknown roosts should continue.

Robinson *et al* (2000) made a number of recommendations to improve population monitoring during the non-breeding season. A full national roost survey was recommended every nine years to produce a national population estimate, covering all roosts in the UK with updates to the roost inventory occurring annually. In addition to ongoing WeBS counts which provide valuable data on site specific use by Cormorants, a sample of roosts and WeBS sites monitored annually using a random stratified sampling approach, would enable national population indices to be produced, and these should incorporate river and non-estuarine coastal habitats where possible.

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