Urban gulls:

problems and solutions

Peter Rock

ABSTRACT Urban-nesting by Herring *Larus argentatus* and Lesser Black-backed Gulls *L. fuscus* in Britain began in the 1940s, but became established as a national phenomenon in the late 1960s and early 1970s. Since that time, numbers have grown exponentially, fuelled by ample food, high breeding success and apparently limitless habitat. Many towns and cities in Britain & Ireland now support growing colonies and it is estimated that, in 2004, the total population of roof-nesting gulls exceeded 120,000 pairs. Herring and Lesser Black-backed Gulls are opportunistic and omnivorous, taking advantage of a wide range of feeding situations. The urbanbreeding population in the Severn Estuary Region has increased from an estimated 2,632 pairs in 1994 to 23,930 pairs in 2004. Further increases on this scale would see the population in this region exceed 200,000 pairs by 2014 and a national population of more than one million pairs of urban-nesting gulls.

The total costs to the community associated with the problems of urban-nesting gulls in Britain are already considerable, and look set to multiply. Owing to their noisy and aggressive nature, urban gulls are already a major concern for residents, businesses, visitors and those who have to address the problems. Increasing media attention continues to highlight the problems and there is a growing demand for solutions. Lethal methods of deterring gulls from nesting in urban environments are regarded as socially unacceptable, while most non-lethal means have proved largely ineffective. Egg-oiling, a relatively benign but long-term form of management, can improve the situation in terms of noise and aggression within the immediate vicinity of the areas treated, but will not reduce breeding numbers and may simply cause the problem to shift elsewhere. Further research, centred on the well-studied urban populations in Bristol and the Severn Estuary Region, and coupled with studies at feeding sites, is essential to finding effective solutions which are both affordable and socially acceptable. This issue is inevitably going to get worse before it gets better.

Roof-nesting by gulls in Britain

A brief history

Roof-nesting by large gulls in Britain was virtually unknown before the 1940s. Although there were occasional and isolated records of gulls nesting on rooftops before 1940, colonisation began between the early 1940s and the mid 1960s, chiefly in coastal towns (Parslow 1967). It was not until 'Operation Seafarer' (1969-70) that significant numbers of Herring *Larus argentatus* and Lesser Black-backed Gulls *L. fuscus* were discovered breeding at 60 urban locations (Cramp 1971). Gull populations in traditional (i.e. non-urban) colonies also increased rapidly between 1953 and 1972. Although helped by a post-war reduction in persecution, the increase was due mainly to a massive expansion in food availability, mostly from new landfill sites created to dispose of the increasing waste produced by humans in the post-war consumer boom (Parslow 1967; Spaans 1971; Hagemeijer & Blair 1997).

Prior to the 1940s, most household waste was burnt at home, composted, or disposed of as pigswill. Consequently, landfills received a large proportion of inert waste, mostly ash,

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while any organic waste was burnt on site (Institute of Wastes Management *in litt.)*. With little food on offer, municipal tips did not attract gulls. The rise of the 'throw-away society' in the early 1950s saw the opening of many new landfills, to dispose of ever-increasing amounts of household waste, in particular organic waste. Due, in large part, to the sheer quantity of food available at landfills, previously small gull populations began to rise dramatically. However, the Clean Air Act of 1956 was pivotal; it forbade the burning of refuse on site and required that refuse tips be covered with inert material at the end of each day's tipping. Gulls were quick to take advantage of this new, enhanced feeding opportunity (Parslow 1967). In the Severn Estuary Region (SER), the large-gull populations increased 15-fold between the 1940s and the early 1970s (Mudge & Ferns 1980).

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185. Lesser Black-backed Gull *barus fuscus*, Bristol, July 1998. Large gulls do not strike intruders with their beak but instead deliver a raking blow from behind with their claws. Although the claws of urban gulls are slightly less sharp than those of gulls in non-urban colonies (owing to abrasion on concrete and other man-made surfaces), they are still capable of inflicting serious wounds when the victim is hit at approximately 40 mph. Nonetheless, gull attacks in towns are less common than portrayed in the media and are the last resort of four possible threats.The first stage (seldom recognised by humans) is the 'gag call', warning intruders to move away.This is generally followed swiftly by the 'low pass', during which gulls swoop at intruders, but come no closer than a metre or two. The penultimate stage is to defecate, or regurgitate, over intruders; this is delivered with surprising accuracy and is a compelling deterrent. The direct attack is a risky manoeuvre for the gull because if it were to be injured, the breeding attempt would fail.

The dramatic increase in gull populations between the late 1950s and early 1970s was, in turn, matched by an equally dramatic decline during the remainder of the 1970s (and, possibly, into the early 1990s), perhaps due to botulism (Mudge & Ferns 1980). Interestingly, black plastic bags, which are ideal for the proliferation of the poisonous bacterium *Clostridium botulinum*, were introduced as a method of waste disposal in 1972 (Institute of Wastes Management *in litt.)*. Traditional gull colonies in the SER, such as Steep Holm in the Bristol Channel, were badly affected by botulism during this period, with numbers plummeting from c. 8,000 pairs in the early 1970s to just 800 pairs by the early 1990s (A. Parsons pers. comm.). In contrast, urban colonies appeared to be less affected by botulism, and continued to grow uninterrupted throughout this period, slowly at first, then more rapidly as colonies expanded and spread (pers. obs.). For example, in Bristol, the population grew from c. 100 pairs in 1980 to c. 1,000 pairs by the early 1990s. Although some apparently botulitic gulls were recorded in Bristol at this time, numbers were low compared with diose at traditional colonies (pers. obs.).

Since the mid 1990s, with botulism stabilised at low levels, numbers of Herring and Lesser Black-backed Gulls at traditional colonies in the Bristol Channel have recovered, with c. 2,000 pairs now breeding on Steep Holm (A. Parsons pers. comm.) and c. 3,500 pairs on Flat Holm (Bailey 2001), although neither colony has recovered to its pre-botulism level. Before the incidence of botulism, and as a result of dramatic population growth, it seems that traditional colonies were outgrown and prospective breeders sought alternative sites. In short, gulls began to colonise towns and cities and found

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186. Lesser Black-backed Gull *Larus fuscus,* Worcester.April 2003.This male was ringed as a nestling in Bristol in 1994, and first discovered breeding in Worcester (85 km distant) in 2003. It is unusual for males to disperse this far, and it is possible that this bird may have relocated, perhaps following eviction or disturbance from its original breeding site.

distinct advantages over traditional colonies: there are no predators; disturbance is minimal; ambient temperatures in towns are c. 2-6°C warmer than the surrounding countryside, which permits earlier breeding; and street lighting allows gulls to feed at night as well as during the day. Operation Seafarer revealed a total of 1,310 pairs nesting on buildings in 1969-70 (Cramp 1971) and the potential threat caused by increasing urban gull populations was seized upon by the headline writers of the day (Hey 1972).

Expansion since Operation Seafarer

Within the SER, urban breeding by large gulls was first recorded in Merthyr Tydfil, South Wales, in 1958 (Morrey Salmon 1958), when 45 pairs bred; this was followed by 15-20 pairs breeding in Cardiff in 1962 (Cramp 1971). Both colonies were well established when discovered, and were probably occupied before these dates. Further urban colonies became established during the late 1960s and early 1970s, with breeding noted in Gloucester in 1967 (Owen 1967) and Bristol in 1972 (P. Chadwick pers. comm.). Following a nationwide survey in 1976, Monaghan & Coulson (1977) concluded that both the numbers of gulls nesting on buildings and the numbers of breeding sites had grown significantly since the 1969-70 survey, with a total of 3,291 pairs of Herring and Lesser Black-backed Gulls breeding on rooftops in Britain & Ireland. Expansion continued throughout the 1980s and, in the 1994 survey, Raven & Coulson (1997) recorded 13,591 pairs of the two species (a ten-fold increase since 1970), although they acknowledged that numbers might have been as high as 20,100 pairs. Subsequently, the rate of increase has accelerated and, by 2004, it was estimated that over 100,000 pairs of gulls were nesting on buildings in Britain & Ireland (P. Rock unpubl.).

Urban gulls in the Severn Estuary Region

The Severn Estuary Region (SER) is defined roughly as an area encompassing Birmingham in the north, South Wales in the west, Somerset in the south and Wiltshire in the east (fig. 1).

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187. Butetown, in Cardiff, has the highest breeding density of all large-gull colonies assessed in the Severn Estuary Region.This large roof (over 70 m long) supported 110 pairs of large gulls (mainly Lesser Black-backed *Larus fuscus* but also Herring Gulls L *argentatus)* in 2004 and is typical of roofs in many industrial areas, being of asbestos construction, with a gentle slope and much lichen and moss growth.

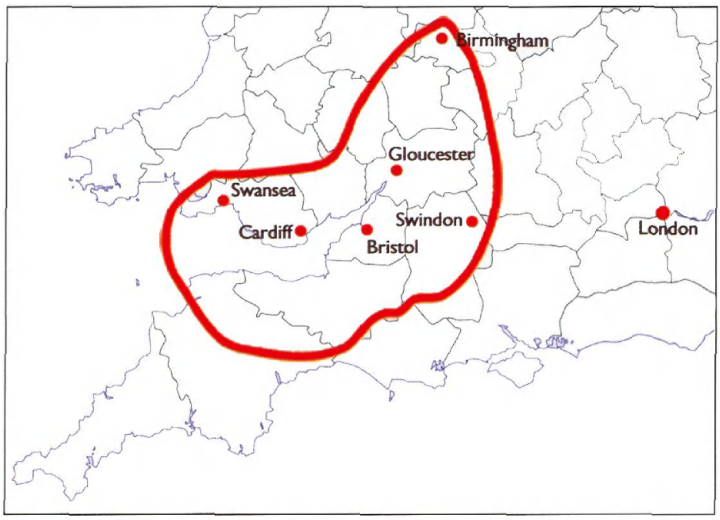

Fig. 1. The Severn Estuary Region.

Population growth in the SER

In 1994, Raven & Coulson (1997) established that the number of pairs of urban-nesting Herring and Lesser Black-backed Gulls in the SER was 1,780. In 2004, counts and estimates for just 22 colonies from a possible 60 amounted to 11,957 pairs (Appendix 1). At least five colonies with estimated populations of c. 1,000 pairs each and at least eight with c. 500 pairs each remained uncounted. It seems likely, therefore, that the total urban-nesting population in the SER in 2004 was of the order of 24,000 pairs. Since Raven & Coulson suggested that their figure was an underestimate, a correction factor may be applied to their totals to show more realistic regional levels. Based upon the ratio between their actual (13,591 pairs) and estimated (20,100 pairs) populations in Britain & Ireland, this correction factor is taken to be 1.48, so the corrected total number of breeding pairs in the SER in 1994 was approximately 2,632 pairs. Using this correction factor, population estimates for 1994-2004 can be derived (table 1).

Survey work during 'Seabird 2000' (1998-2002) found 5,769 AON (apparently occupied nests) of Herring and Lesser Black-backed Gulls on roofs in the SER (Mitchell *et al.* 2004). This figure not only highlights how many colonies were not included in the survey (see table 1), but also underlines the difficulties in making accurate assessments in a complex urban environment. For example, in 2002, a roof-nesting population of 1,345 pairs was counted in Gloucester during a land-based survey (Rock 2002); before the survey, local birders had believed it to be c. 800 pairs, a shortfall of 41%. Interestingly, an aerial survey of Gloucester later in 2001 (Durham 2003) produced a total of 1,299 pairs by counting AON shown on photographs, just 3% lower than the total for the land-based survey.

Driving the exponential population growth in the SER is the startlingly high breeding success enjoyed by urban gulls. In Bristol, for example, most pairs fledge 2-3 offspring per year (pers. obs.), and breeding success is presumably similar in other urban colonies in the region. Annual population increases of over 25% were noted in Gloucester and in Bridgend, South Wales, of 23.5% in Worcester, but of only 13.8% in Cardiff (Rock 2003a, 2004a,b,c).

As colonies expand, annual population growth rates may slow down (Raven & Coulson 1997). This process is, however, complicated by urban redevelopment, especially when certain key buildings are demolished, or where ongoing/extensive maintenance on key roofs occurs early in the breeding season. For example, in Cardiff, one roof holding almost 300 pairs of gulls was demolished during the breeding season in 2003, major maintenance was carried out on another quite important

Table 1. Theoretical growth in numbers of breeding pairs of urban-nesting Herring Lams *argentatus* and Lesser Black-backed Gulls L *fuscus* in the Severn Estuary Region, 1994-2004.These estimates have been derived by applying a correction factor of 1.48 to the actual count in 1994 (Raven & Coulson 1997), and assume an annual growth rate of 24.7%.

Year	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	2,632	3,282	4,093	5,104	6,364	7,936	9,897	12,341	15,389	19,190	23,930

roof at the same time, and two less important roofs were demolished. The resulting disturbance suppressed the city's gull population growth rate and this reduced the annual growth rate, with many birds possibly relocating to other sites within the SER.

Small numbers of Great Black-backed Gulls *L. marinus* also breed on rooftops in various parts of Britain (Raven & Coulson 1997; Mitchell *et ah* 2004). Although up to 30 regularly frequent Gloucester landfill (J. Sanders pers. comm.), only one urban-breeding pair has been recorded in the SER, in Bridgend (Rock 2003b). Another pair was suspected to have bred in Bristol in 2003 (pers. obs.). There are no records of any other gull species breeding on rooftops in the SER.

Breeding success *and composition of colonies*

The high breeding success observed in Bristol contrasts markedly with that at some traditional colonies, such as on Skomer, Pembrokeshire, where productivity has been as low as 0.07 fledged young per pair per year (Perrins & Smith 2000). The main reason for such low productivity is probably poor food supply, in turn stemming largely from changes in fishing practices. Small inshore fishing boats, which discarded offal in regular and predictable patterns, have been replaced by much larger vessels, and discards have become unpredictable and often unavailable. The closure of the Haverfordwest landfill site and the difficulties gulls have had in foraging for invertebrates during recent dry summers have also contributed to high chick mortality. Despite poor breeding success, the Skomer gull population is unlikely to decline significantly for some years, owing to high adult survival rates. Nonetheless, continued poor breeding success, coupled with poor recruitment of first-time breeders, will accelerate population decline as adults reach the end of their breeding careers (Dunn 1993), and some evidence of decline on Skomer is already apparent (Brown & Morgan 2004).

Gulls breeding in Bristol clearly manage to obtain sufficient food to fledge their offspring, and birds which lay a clutch of three eggs typically fledge three young successfully (pers. obs.). Little interspecific and intraspecific predation has been noted in Bristol, and aggression by adults towards chicks straying between territories appears to be less prevalent than in traditional colonies, especially those where food is scarce (Spaans 1971). The key to successful breeding is, however, a food supply which is not just ample but dependable (e.g. Belant *et ah* 1998). Gulls breeding in Gloucester, Bristol and Bath show a high degree of awareness of viable and predictable feeding sites, but can also adapt quickly to changes in food availability (Rock 2004d). For example, in a recent study, Gloucester landfill (the largest in the region) was made unavailable to gulls (c. 80% of which were urban gulls; Rock 2004d) for two weeks in the spring of 2004 by using falcons and other methods to deter feeding. It was found that two-thirds of deterred gulls utilised the nearest viable landfill, while the remainder relied on other food sources elsewhere, such as fields, farmland, mudflats, suburban gardens and city streets. But in general, urban gulls enjoy a surfeit of food, in particular the high-quality food necessary for successful breeding, which in turn has fuelled population growth. Urban-nesting gulls now outnumber gulls at non-urban sites by a factor of 4:1 in the SER.

Urban colonies in the SER are dominated by Lesser Black-backed Gulls (Rock 2004a). Of 22 colonies assessed in 2004, only those at Chepstow, Monmouthshire (pers. obs.), and at Aberthaw, South Wales (M. Lobb pers. comm.), had larger numbers of breeding Herring Gulls (although these are both small colonies, with just 60 and 79 pairs of both species respectively). The ratio of Lesser Black-backed:Herring varies among colonies, ranging from parity in Bridgend (Rock 2004a) to 9:1 in Barry, South Wales (pers. obs.), with a regional mean of 3.3:1 (Appendix 1). In the Bristol Channel, Flat Holm is dominated by Lesser Black-backed Gulls (Bailey 2001), but on Steep Holm, Herring Gulls are still more common (A. J. Parsons pers. comm.).

Prior to the incidence of botulism, gull colonies in the SER were dominated by Herring Gulls, with an estimated total population of over 9,000 pairs in 1975, compared with c. 4,500 pairs of Lesser Black-backed Gulls (Mudge & Ferns 1980). Declines in Herring and Lesser Black-backed Gulls in the SER during 1975-80, as a result of botulism, were 66.9% and 29.9% respectively (Mudge & Ferns 1980). Subsequently, Herring Gull numbers have recovered, but not yet reached pre-botulism levels, while numbers of Lesser Black-backs have risen sharply.

Expanding urban gull populations

Increases in Britain & Ireland

Urban-nesting by gulls is now widespread; Seabird 2000 (S2000) found 31,044 pairs of Herring and Lesser Black-backed Gulls (and 83 pairs of Great Black-backed Gulls) nesting on rooftops in Britain & Ireland (Mitchell *et al.* 2004). Clearly, this is a conservative figure. For example, the S2000 estimate for Wales was 2,220 pairs, but 2004 counts (Appendix 1) from just seven colonies in South Wales alone amounted to 5,048 pairs, and several large colonies in South Wales were not assessed in 2004. Evidently, many colonies were missed, or not surveyed, during S2000, and of those that were counted, numbers were mostly underestimated.

If Raven & Coulson's 1994 actual figures for each region are accepted, and a nine-fold increase assumed, then the national population is c. 120,000 pairs. If, however, Raven & Coulson's *corrected* figures are treated in the same way, then the national population is c. 190,000 pairs breeding on rooftops in Britain & Ireland. In the SER, it is the corrected figure which provides the more acceptable picture of the actual situation (table 2). The S2000 figure for the SER in 2002 was 5,769 pairs, compared with my estimate of 15,389 (table 1). Assuming that a similar shortfall applies nationally, then the S2000 figure of 31,044 pairs of urban-nesting gulls in Britain & Ireland should be corrected to 82,825 pairs and, with an annual growth rate of 24.7% (as observed in the SER), to 128,794 pairs in 2004 (cf. table 2). No adjustment for under-recording has been made here, but this will be discussed later.

Unfortunately, few accurate assessments from regions other than the Severn Estuary are available. A total of 3,500 pairs was found in Aberdeen in 2002 (R. Duncan pers. comm.), but only 154 AONs are listed in S2000; while there were 887 pairs in Felixstowe in 2004 (Rock 2004e), the latter colony having increased by 41.3% since 2003. While the population estimates and annual increases discussed above are, of course, open to critical comment, this does not detract from the fact that the issue of urban-nesting gulls has become one of national concern, with an increasingly high profile in the media.

Increases in Europe and elsewhere

Britain is not alone in supporting urban gull populations. It is believed that roof-nesting by large gulls first occurred in Bulgaria between 1890 and 1893 (Nankinov 1992). As in Britain, major colonisation of urban environments in France did not start until the 1970s (Cadiou 1997), and throughout much of continental Europe roof-nesting was recorded for the first time during the 1980s, e.g. in Denmark (Lilleor 2000) and Italy (Benussi *et al.* 1994). In Belgium, urban breeding was not recorded until 1998 (Francois 2002).

Roof-nesting now extends along the western seaboard of continental Europe from Tromso, northern Norway (M. Helberg pers. comm.), to Porto, northern Portugal (pers. obs.). All coastal countries between Norway and Portugal now support roof-nesting populations of varying sizes. To the east, roof-nesting also occurs regularly in many coastal countries, including Finland (A. Lindholm pers. comm.), Estonia (K. Rattiste pers. comm.), Latvia (Viksne 1989) and Bulgaria (Nankinov 1992), while Croatia supports a few pairs on the Istrian Peninsula (J. Kralj pers. comm.). Until recently, small numbers bred on an abandoned fortress in Serbia & Montenegro but it has now been reoccupied by the military (A. Zuljevic pers. comm.).

Within a European context, there are few recent national estimates, and populations are

Table 2. Seven regions in Britain & Ireland, as defined by Raven & Coulson (1997), with actual counts (1994 actual) and estimates (1994 max), derived using a correction factor of 1.48 (see text), from the 1994 survey. The nine-fold increase observed in the Severn Estuary Region is applied to both columns to derive the estimated number of pairs breeding in each region in 2004.

Region	1994 actual	1994 max	2004 estimate	2004 estimate max
East Britain	2,825	4,178	25,425	37,602
SE England	1,620	2,396	14,580	21,564
SW England	1,500	3,718	13,500	33,462
Severn Estuary	1,780	2,632	16,020	23,688
West Britain	2,342	3,464	21,078	31,176
NE Scotland	3,233	4,781	29,097	43,029
Subtotal Britain	13,300	21,169	119,700	190,521
Ireland	154	228	1,386	2,052
Total Britain & Ireland	13,454	21,397	121,086	192,573

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188. In residential areas, gulls will utilise the space available among groups of chimney pots on older houses.

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189. Herring Gull *Laws argentatus* nest in a trailer park at Felixstowe, Suffolk, May 2002. Several urban colonies have ground-nesting pairs, some of them in public areas, and these pairs are generally highly aggressive to passers-by.

believed to be small in comparison with those in Britain & Ireland. France is believed to have a total population of approximately 11,700 urban pairs (Cadiou *et al.* 2004), and Spain has more than 50 urban colonies, although no estimates of population size are available (Marti & Del Moral 2003). All urban populations are, however, increasing. As in Britain, Herring and Lesser Black-backed Gulls are the most frequently recorded urban-nesting gulls elsewhere in Europe. There are, however, small urban populations of Great Black-backed and Yellow-legged Gulls *L. cachinnans* of both the nominate form and *L. c. michahellis*, while Common Gulls *L. canus* now breed regularly on buildings in Norway (N-H. Lorentzen pers. comm.) and Sweden (K. Bengtsson pers. comm.). Farther afield, American Herring Gulls' *L. a. smithsonianus* and Ring-billed Gulls *L. delawarensis* have bred on rooftops around the Great Lakes, USA, since 1978, and in Ontario, Canada, since the early 1970s (Dwyer *et al.* 1996). Similarly, in British Columbia, Canada, Glaucous-winged Gulls *L. glaucescens* have been recorded nesting on rooftops since 1986 (Vermeer 1992). In Australia, Silver Gulls *L. novaehollandiae* nest regularly on rooftops (Temby 2000).

Preferred breeding sites

The vast majority of urban-nesting gulls in the SER (and probably nationally) breed in industrial areas, where roofing is flat or gently sloping, and corrugated (pers. obs.). Commercial and residential areas are also colonised where roofs are suitable. Asbestos roofing is particularly favoured, especially when it has been colonised by lichens and then successively by mosses and other plants, while roof sections joined with bolts which project up to 40 mm above the roof surface provide secure anchorage for nests. In recent years, particularly where established colonies have expanded, pressed-steel roofing has also become increasingly favoured. The latter was originally thought to be unsuitable for gulls owing to high daytime surface temperatures and being slippery when wet, but this has proved not to be the case.

Expansion into commercial districts in towns and cities has accompanied the growing industrial roof-nesting habit. Here, buildings are typified by large, often flat roofs, usually supporting air-conditioning systems, ducting, stink pipes, etc. and often with substantial parapets surrounding the perimeter. Large roofs of

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190. During the ringing operation, the nestlings remain calm in heavy cotton bank bags.The high parapets of this commercial roof prevent nestlings from jumping and make it an ideal site for ringing. Bristol-scheme colour rings are large, always on the right leg and show two engraved letters (latterly separated by a colon).These Lesser Black-backed Gulls *Larus fuscus* were ringed in Cheltenham in July 2002.

this nature can, especially where disturbance is low, support many breeding pairs in close proximity, with Bristol's largest such colony exceeding 60 pairs. Breeding in residential areas in the SER is still uncommon, mainly because of a lack of suitable nesting surfaces. In Bath, however, chimney stacks on Georgian houses are large, sometimes with up to 12 chimney pots. With enough space between pots to locate nests, it is not unusual for three young per pair to be reared in these situations (Rock 1995). In the Grangetown, Riverside and Canton districts in Cardiff, where housing is mostly terraced, 83 pairs nested on residential roofs in 2004, amounting to 2.7% of the urban population.

Nest locations in urban situations often reflect the two species' preferences in non-urban colonies, where Herring Gulls tend to prefer rocky, cliff-like situations, while Lesser Black-backed Gulls tend to prefer dunes or vegetated areas (as on Steep Holm and Flat Holm, as mentioned earlier; these islands' topography reflects their name). In urban colonies, it is not unusual to see Herring Gulls nesting between chimney pots, or in complex roof structures, and Lesser Black-backed Gulls nesting on flat, or sloping, roofs. This is not always the case, however, and some pairs of both species will hide their nests in cramped spaces between buildings and under, or even inside, industrial plant.

The Bristol scheme

Colour-ringing of urban gulls started in Bristol in 1980. Since 2001, other sites (Bath, Cheltenham, Worcester, Cardiff and Bridgend) have been included in this scheme to help us to gain a better understanding of recruitment patterns. In total, some 5,000 Herring and Lesser Black-backed Gull nestlings have been colour-ringed using large (37 mm high), brightly coloured plastic rings showing a two-letter code. These colour rings can be read at distances of up to 500 m using a telescope. The colours of Bristol-scheme rings are changed annually, enabling all birds to be aged by their cohort ring (Appendix 2).

Through resightings of birds, colour-ringing allows recovery rates of over 70%, compared with 3-5% using metal rings alone (Rock 1999), and over 30,000 post-fledging records of Bristol-scheme birds have been generated.

Colour-ringing is thus a powerful tool for investigating the lives of gulls, and many Bristol gulls have documented life histories of more than 50 events, with the most frequently seen bird notching up over 300 events. Bristol-scheme gulls have provided many data relevant to the issue of urban-nesting by large gulls, some of which are summarised below.

1. Urban gulls rarely recruit into traditional colonies. Less than 1% of Bristol-ringed gulls are known to have recruited into non-urban colonies when old enough to breed. It also appears that few birds from traditional colonies recruit into urban colonies any more. During 24 surveys at various urban colonies in the SER between 1995 and 2004, only 14 colour-ringed birds from traditional colonies were observed. In particular, the Cardiff surveys in 2003 and 2004 revealed just three ringed birds from Flat Holm breeding in the city, despite the fact that Flat Holm is just 13 km distant and 100 gulls have been colour-ringed there annually since 1989 (B. Bailey pers. comm.). Although the original recruits to urban sites between the 1940s and 1970 certainly originated from traditional colonies, urban populations in the SER (and probably the majority of urban populations in Britain) appear to be self-sustaining.

2. Measurements of Bristol-scheme nestlings (head + bill length, bill depth and wing length) have been taken since 1992. The 1993 and 1994 cohorts were sexed using DNA samples (Griffiths 1991) and, using multivariate analysis, a formula was devised which would enable all measured birds to be sexed (J. Cobby pers. comm.). Some 3,000 birds have been sexed in this way, and this study has confirmed that male Herring and Lesser Black-backed Gulls typically return to their natal colonies (and often to the same roof) while females disperse to other urban colonies to breed for the first time (P. Rock unpubl.). Bristol-ringed birds now breed in almost all other urban colonies within the SER (and possibly beyond), and the vast majority of these are females (pers. obs.).

3. In colonies at or near carrying capacity, immatures (those showing any brown plumage) find it difficult to obtain a territory (Coulson *et al.* 1982) and are actively prevented from breeding by adults (pers. obs.). When opportunities do arise, however, such as during the Isle of May, Fife, post-cull period (Duncan 1978), the percentage of third-summer birds breeding for the first time rises sharply. In the SER, where space is plentiful and there is no serious competition for nest-sites, third-summer birds breed commonly in urban colonies (pers. obs.), and a small number of second-summer birds also breed. This suggests that most of these urban colonies are probably well below carrying capacity. First-time breeders tend to be less successful than more experienced birds, possibly owing to competition for nest-sites and food, but this appears not to be true of third-summer breeders in Bristol (P. Rock unpubl. data).

4. Disruption to breeding in urban areas (such as demolition of breeding sites) forces gulls to relocate. Such relocations are poorly understood, but one key building in Bristol, supporting 130 breeding pairs, was demolished in 1997. The site supported 43 colour-ringed breeders, which enabled some of the birds' post-demolition wanderings to be followed. Only five displaced birds were relocated breeding on buildings in the immediate vicinity (although few suitable roofs were available). A further 14 relocated to other parts of Bristol, at distances of 1-6 km from the original site. Six colour-ringed birds have not been seen subsequently, while the remaining 18 (42%) were never seen again in Bristol (though they were recorded elsewhere). In 2003, the first of these birds to be located at a breeding colony (a male Lesser Black-backed Gull) was found in Chippenham, Wiltshire, some 32 km from Bristol (Rock 2003c). If this bird had bred in Chippenham in 1998, it would have been one of the town's first colonists; it may be that such forced relocations contribute to the establishment of new colonies.

5. Prior to the 1940s, all British Lesser Black-backed Gulls spent the winter in Iberia and North Africa and, even in the early 1950s, few were recorded in Britain in winter (Barnes 1952). The most recent estimate of the wintering population, in 1993, was 60,830 (Burton *et al.* 2003), but numbers are believed to have increased substantially since then. Bristol-ringed Lesser Black-backed Gulls have been recorded in Britain each

winter since 1986, although it was not until the mid 1990s that larger numbers were observed. During the winters of 2002/03 and 2003/04, considerable extra effort was made to locate Bristol-ringed Lesser Black-backed Gulls. It is clear that a significant and increasing percentage of adults (estimated at 22%) is either returning extremely early or not migrating at all and, from preliminary analyses, it appears that overwintering may be more prevalent among urban gulls (Rock in prep.). Small numbers of Lesser Black-backed Gulls are often seen on rooftops in Bristol in winter, especially on fine days. These birds are not particularly territorial but their presence nonetheless signals their claim to preferred territories, and they can occupy territories earlier in the season than migrants (pers. obs.).

6. Intermittent breeding among several longer-lived species is known to occur (e.g. Wooller *et al.* 1992), and is well documented among Herring and Lesser Black-backed Gulls on the Isle of May (Calladine & Harris 1997). The factors involved may include food availability, breeding experience and breeding success in the previous season. With urban gull numbers growing exponentially, these factors would be expected not to apply to urban breeders, yet intermittent breeding does apparently occur in Bristol. There is little direct evidence of experienced Bristol-scheme gulls remaining in the wintering areas, but some birds do appear to be intermittent breeders. For example, Herring Gull white2 SJ, having wintered in Britain, was at Gloucester landfill on 19th March 2003, at Tampere, Finland, on 16th-17th May 2003, and back in Bristol on 1st July 2003. This is a most interesting case, not only because of the bird's anomalous movement, but also because arriving back in Bristol on 1st July, it was too late to attempt breeding in the 2003 breeding season. It began breeding in Bristol in 1995, but has not been recorded in every season since and is suspected (along with other individuals) to be an intermittent breeder.

The urban gull issue

The perceived problems associated with roof-nesting gulls are noise, mess and aggression, in that order, as shown by the increasing levels of complaints to local authorities (S. Harwood pers. comm.). Gull droppings can be costly to remove from windows and masonry, particularly if not removed quickly, and will pit car paintwork if not attended to promptly. Displacement behaviour in an urban setting is not confined to grass pulling (Tinbergen 1953), but may involve the destruction of insulating material on roofs, or even lead flashing, while rain-washed nests create blockages in gutters. Less tangible are the indirect losses when gulls domi-

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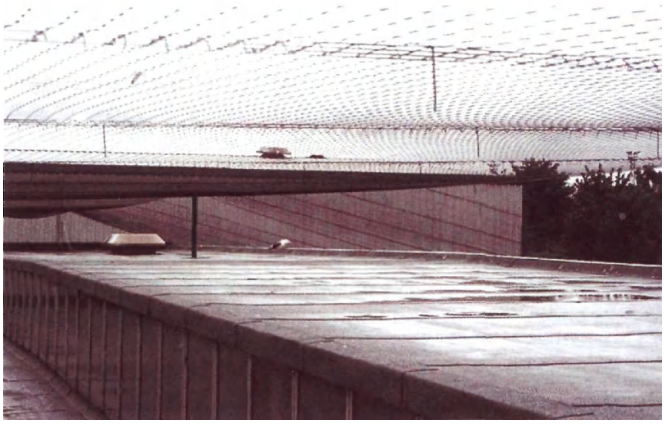
191 & 192. Displacement behaviour in towns results in damage not only to insulation material but also to roofing felt and even lead flashing.This kind of damage is seen commonly on many rooftops in urban colonies and is sometimes extensive (Worcester, April 2003). All urban colonies are liberally spattered with gull droppings, which are strongly alkaline. Large-scale cleaning of windows, masonry and pavements can be costly (Bristol, July 2003).



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193 & 194. Roof-netting can be effective in preventing large gulls from nesting, but it is also extremely expensive (the netting for the roof shown in plate 193 cost £60,000). Furthermore, preventing gulls from breeding on a particular roof forces them to relocate and, although forced relocations are imperfectly understood, it is clear that some birds will move considerable distances to resume breeding. Note that one Lesser Black-backed Gull *Lams fuscus* is trapped inside, but was subsequently freed (Bristol,June 1999). Mesh size is critical and, as can be seen in plate 194, birds may become trapped by their carpal joints, and probably take several days to die. This situation *h,* unfortunately, all too common, and the netting used on the majority of roofs to deter gulls has clearly not been specifically designed for this use (Worcester.April 2004).

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195. Plastic owls are seen commonly in urban colonies, the theory being that they will deter breeding gulls. Several companies are still recommending and selling these items (Bridgend, April 2003).

nate a town - if shoppers and tourists actively avoid areas where gulls are aggressive and noisy.

It has long been established that gull droppings affect water supplies (e.g. Jones *et al.* 1977, Gould & Fletcher 1978) and that gulls may be agents for the transmission of *Salmonella* to livestock (e.g. Coulson *et al.* 1983). These findings may have encouraged some of the pest control agencies to claim that urban gulls are carriers of disease, but the facts are less clear. Monaghan *et al.* (1985) demonstrated that *Salmonella* carriage rates among Herring Gulls in the Clyde region of Scotland were less than 10% and that the highest rates were found in birds which habitually fed at sewage outfalls. The study concluded that the proportion of gulls carrying salmonellae and the incidence of salmonellosis in the local human population were positively correlated, and that carriage rates in gulls reflected the level of contamination in the environment. In Sweden, Palmgren *et al.* (2002) showed that *Salmonella* carriage rates among Black-headed Gulls *L. ridibundus* were 2.7% and also that carriage rates reflected environmental contamination. It is more likely that humans are infecting gulls, rather than vice versa. In both studies, gulls carrying salmonellae appeared not to be affected by the bacterium. Furthermore, Girdwood *et al.* (1985) established that carriage lasted 2-4 days; therefore the chances of contracting salmonellosis, or other diseases, from gulls are, in reality, extremely low.

Gull control measures

Non-lethal methods

The pest control industry provides a wide range of equipment and services for counteracting perceived threats and nuisance from urban gulls. None of these techniques is particularly effective, however, and some are patently ludicrous; for example, those large plastic owls which often adorn the rooftops in all but the smallest colonies, or helium-filled balloons showing roundels purporting to replicate the eye of a Great Black-backed Gull! Tensioned wires, waving wires, spikes and other fixed equipment are designed to prevent birds from landing on roofs. These techniques may be effective in deterring Feral Pigeons *Columba livia*, but have been adapted for gulls by pest control companies without much thought, and most are simply ignored by the gulls.

At airports and, to a lesser extent, at landfills, distress calls and loud noises (in conjunction with other methods) are effective in deterring gulls (e.g. Baxter 2000, Civil Aviation Authority 2002). In residential areas, these methods are, at best, ineffective and often generate further complaints from residents about the extra noise (M. Gillies, Worcester City Council, pers. comm.). Distress calls do create mayhem among gulls when first employed, but the birds soon habituate (pers. obs.). A typical problem is that far-too-frequently copied tapes simply produce an unrecognisable cacophony, or that static positioning of speakers enables gulls to get used to even the best recordings. Even where best practice is followed, using high-quality recordings, varying the speaker positions and changing the frequency and duration of broadcasts, gulls still learn quickly to ignore what is, in effect, no real threat. Nests located next to speakers are not uncommon.

The use of trained falcons, and other raptors, has been claimed to be effective in reducing or removing breeding gulls from particular urban areas. Independent evidence for such claims suggests otherwise. The assumption that the gulls' fear of large falcons will result in breeding attempts being abandoned may be true for some pairs, but aggressive behaviour by colonial-breeding Herring and Lesser Black-backed Gulls can be overwhelming. Away from breeding sites, the use of falcons at Gloucester landfill during the spring of 2004 was highly effective in deterring gulls from feeding (Rock 2004d). On at least two occasions, however, falcons were attacked, brought down and injured by Lesser Black-backed Gulls. Aggression of this severity is unusual at feeding localities (pers. obs.) but, in this case, the closest breeding roofs were less than 500 m from the landfill site.

Roof-netting (the most expensive option available) can prevent gulls nesting on a particular roof, if it is well designed and correctly installed. If the netting chosen is inappropriate, or installed incorrectly, however, it can result in deaths. For example, a netted roof in Cardiff was found to hold 13 dead gulls, although five nests were active, either under or on top of the same netting (Rock 2004c). The most common problem with netting is that the mesh size has not been adapted to suit gulls, which can lead to birds becoming trapped by their carpal joints and unable to escape. Roof-netting is typically out of sight and gulls caught in it face a lingering death over several days. Furthermore, roof-netting forces gulls to relocate, and this may exacerbate existing problems, or create new ones, elsewhere. The use of roof-netting does not require a licence and appears to be unregulated, and this situation needs urgent review. More generally, there is little or no regulation within the pest control industry as a whole, and the necessary equipment can be purchased from suppliers with little difficulty and with no understanding of the problems involved, in particular those relating to animal welfare.

Lethal deterrents

The use of poisons to kill birds has long been illegal. Until recently, the stupefying bait Seconal (in combination with Alphachloralose) could be used under licence to control gulls. In North Yorkshire, between 1978 and 1990, stupefying baits were used in Scarborough, Whitby and Staithes and populations fell by 65% (T. Fenter, Scarborough Council, *in litt.*). Four further licence applications made in 1994-97 were refused, largely owing to a determined and articulate lobby pressurising the council. Since 2002, however, the use of Seconal for this purpose has been withdrawn. If the law should ever be revised, similar lobby groups would doubtless be formed quickly, since the potential dangers to human health of using poisons in an urban setting (if, for example, a moribund gull was picked up) are all too clear. Some councils (e.g. Gloucester and Bath) have already declared that lethal methods within

their areas are out of the question.

Apart from isolated incidents involving air rifles, it is known that contracted shooting has taken place at some urban colonies with, on at least one occasion, more than 1,000 gulls claimed to have been culled (although details are curiously hard to confirm). Dealing with a large colony (comprised of breeding and non-breeding birds) by shooting would require an army of marksmen, and the risks of damage to property, or even human life, in an urban environment is generally agreed to be prohibitive. It is extraordinary that some pest control agencies are still advocating shooting.

Egg-oiling

Perhaps the most effective means of management involves egg-oiling. Large gulls are particularly noisy and aggressive during chick-rearing, and the vast majority of complaints to local authorities arrive after chicks hatch (S. Harwood pers. comm.). During incubation, however, urban gulls are distinctly quieter and often rather secretive (pers. obs.). In situations where roof-nesting gulls create persistent problems, egg-oiling appears to help not only by preventing eggs from hatching, but also in prolonging incubation slightly before the breeding attempt is abandoned, while the noise and aggression associated with chick-rearing are avoided.

In Brest, France, large-scale egg sterilisation, of between 800 and 2,000 eggs per year, had an immediate effect, significantly reducing noise pollution in certain parts of the town (Cadiou *et al.* 2003). In the ten years since the process began, these areas have also seen a 75% reduction in the number of breeding pairs. Unsuccessful pairs appear to have occupied other sites in the town, however, and the overall population has not declined (B. Cadiou pers. comm.), and it is not known how many of these displaced pairs have contributed to swelling populations elsewhere in Brittany. Nonetheless, while the urban gull population of Brest did not decline, it has not maintained the expected 15% per annum rate of increase (B. Cadiou pers. comm.).

At present, egg-oiling is thought to be the best way forward by those who have espoused it. It requires long-term commitment, however, and is not cheap; in Brest, the programme costs around £30,000 per year, or approximately £12.50 per egg (Cadiou *et al.* 2003).

Predicting future population trends

Existing urban colonies are nowhere near their maximum carrying capacity and many suitable roofs within even the largest have yet to be colonised. Those towns and cities which, so far, have not been colonised present even more opportunities, and it seems unlikely that future populations will be limited by habitat shortage, at least for the foreseeable future. Given that the mean annual growth rate of urban gull populations in the SER has been 24.7% during the past decade, and that the population in 2004 was estimated to be approximately 24,000 pairs, numbers could reach 218,000 pairs by 2014. Extrapolating the same logic, and rates of growth, to the national situation, it is possible to predict a national urban-nesting gull population of more than one million pairs by 2014 (based on the figures in table 2).

What seems clear is that some truly massive urban gull colonies will develop, and that many new ones will become established. The key question is whether or not sufficient food supplies will be available to sustain such phenomenal annual growth rates of 20-25%; but it seems likely that they will. At present, the growth rates reflect more than adequate food availability during the last ten years (and may also be a major contributory factor in overwintering by Lesser Black-backed Gulls). Such levels of increase will not be maintained if demand for food exceeds supply in the next ten years. With both breeding success and survival rates having been high during the last four years, however, and assuming that first breeding generally occurs at four years old, population growth rates should not change significantly before 2009, since the next four generations are already in the population and heading towards maturity. With no reason to suppose that breeding success will alter drastically in the next four years, annual growth rates are likely to remain similar to those currently observed for the next decade, unless limits on food supplies are encountered.

Feeding requirements

It has often been suggested that gulls have moved into towns and cities because there is so much litter on the streets, with discarded take-away meals in particular providing an easy living. But while food of this nature is readily available, it tends to appear sporadically, and mostly at weekends. Its significance is, fhere-

fore, believed to be low. Gulls are opportunistic feeders and can be found foraging in towns and suburbs, both during the day and at night. Opportunistic feeding is believed to be a sensible strategy for identifying all potential (and dependable) food resources in their home range. The vast majority of urban-breeding gulls, however, move out of towns to forage and some move considerable distances (pers. obs.).

Spaans (1971) proposed that captive Herring Gulls require 100-200 g of food per day, depending upon the quality, in order to maintain their body weight. Different individuals (especially wild birds), require different daily quantities of food depending upon their condition and energy expenditure. Baxter & Flack (2003) found that wild Black-headed Gulls could survive on a daily food intake of 43 g (or approximately 15% of body weight). Using this information, and taking 900 g as the mean weight of a Herring Gull (Cramp & Simmons 1983), then the minimum daily requirement per bird would be about 135 g.

Gloucester landfill accepts around 1,000 tonnes of organic waste daily (G. Ricketts, Cory Environmental, *in litt).* Waste compaction is continuous throughout the day and it is believed that foraging gulls, despite their speed and daring, will be prevented from taking advantage of much of the food potentially available. Nonetheless, even if gulls were capable of retrieving 1% of organic waste (c. 10 tonnes), this would be enough to support over 70,000 birds with a daily requirement of 140 g. Baxter & Flack (2003) established that Black-headed Gulls were able to fulfil their daily feeding requirements at landfills in only 20 minutes.

Gull counts at Gloucester landfill vary seasonally, ranging between 2,000 and 10,000 birds (J. Sanders pers. comm.). Of course, spot counts do not reveal the actual numbers utilising the site daily; at Gloucester landfill, the total number of birds using the site is thought to be at least three times higher than spot counts suggest (pers. obs.). During the breeding season, spot counts at Gloucester landfill range between 3,000 and 5,000 birds. Even if, in reality, 15,000 birds are using the site daily, the potential exists for at least four times as many birds to fulfil their daily requirements here. This suggests that landfills alone could support at least a quadrupling of the present population (and this assumes that gulls are taking just 1% of the organic waste dumped).

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196. Gloucester landfill is the most important landfill in the Severn Estuary Region with counts frequently as high as 10,000 large gulls. Working at landfills necessitates high-visibility clothing, a hard hat and safety boots, together with an awareness of vehicle movements, as well as the necessary ornithological skills.This photograph shows John Sanders, perhaps the most prolific ring-reader in Britain, hard at work in March 2004.

Are landfills essential to urban gulls?

Although landfills have long been known to be food sources for breeding and migrant gulls (Cramp & Simmons 1983), their importance to breeding gulls has been questioned. Belant *et al.* (1993) considered them to be of minimal benefit where alternative, higher-quality food (e.g. fish) was available. Conversely, Bertellotti & Yorio (1999) suggested that, although the consumption of garbage by Kelp Gulls *L. dominicanus* differed significantly in various locations, a higher proportion appeared in the diets of gulls nesting closer to landfills. Sibly & McCleery (1983) demonstrated that, when deprived of access to landfills, Herring Gulls did not breed at Walney Island, Cumbria. Following the closure of a landfill in Brittany, France, breeding success in the local Herring Gull population fell by 61% and the number of breeding pairs fell by 11.5%, although there was no decrease in adult survival rates (Pons 1992; Pons &Migot 1995).

Landfill closures in the old county of Avon (seven since 1980) do not appear to have affected the breeding gull population in Bristol, which increased from c. 100 pairs to almost 2,000 pairs in the same period, although growth rates may have been higher if those landfills had remained open. Clearly, Bristol gulls are highly mobile when foraging, and their knowledge of feeding opportunities within a radius of approximately 100 km is considerable (Rock 2004d). Movements between landfills as far apart as 85 km are more frequent than was suspected and birds may alternate between landfills on different days and, sometimes, on the same day (J. Sanders, M. Coller and P. Stewart pers. comm.).

In stark contrast to the situation in Britain, there are several landfills (with no avian deterrents) in Portugal which accept large quantities of household organic waste, located near important gull migration staging and wintering areas, but which do not support gulls. Three of these sites, in the provinces of Douro Litoral, Beira Litoral and Algarve, have been visited by the author at times when numbers of Lesser Black-backed Gulls within 10 km have exceeded the RAMSAR 1% level of 5,300 (Delaney & Scott 2002), and numbers of Yellow-legged Gulls were also high (pers. obs.). These particular landfills have been positively rejected as feeding sites; for example, the landfill at Vila Nova de Gaia (Suldouro) is within 7 km of Portugal's most important fishing port, at Matosinhos, and just 3 km from the massive low-tide roost at Afurada, which can hold up to 25,000 gulls. Clearly, if some of these Portuguese landfills do not hold any attraction for gulls, understanding the reasons would undoubtedly have considerable implications for British landfills, and might present a sensible and sensitive solution to the problems faced by British landfills. In a climate of care for our wild birds, benign management would appear to be preferable to more aggressive methods of control.

In conclusion, it seems likely that food supplies in Britain are likely to remain adequate for the foreseeable future and that annual growth rates will not change significantly. If, however, circumstances were to change dramatically in the next ten years, the projected figures for the predicted increase would require revision. Even if growth rates were reduced by 50%, we would still be left with a population of over 500,000 pairs of urban gulls (still enough to see urban gulls outnumbering those at traditional colonies by at least 2:1). Whatever the scenario, it is clear that without research we will not even begin to be able to manage the issue of roof-nesting gulls in Britain.

The necessity for further research

While we know a great deal about the biology of Herring and Lesser Black-backed Gulls, almost all of this information has been derived from studies at traditional colonies, and sheds little light on the issue of roof-nesting. There are few relevant and current published studies discussing the ecology of urban gulls, and addressing this is an urgent priority.

This paper proposes much larger estimates for regional and national populations of urban-nesting gulls than were previously thought possible. It is quite clear that urban gulls are easily obtaining sufficient food in order to be able to breed successfully and although it has been shown that landfills do play an important role, there are obviously many other food sources which gulls take advantage of. Precise knowledge of the feeding regimes and home ranges of urban gulls, in conjunction with food-type analysis, is essential if we are to arrive at a secure understanding.

Bristol (with 25 years of observation) is the most-studied urban colony in the world and has the highest proportion of individually marked birds within its population. Other urban colonies in the SER also have many indi-

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197. Be warned - roof-nesting is not confined to buildings! This Lesser Black-backed Gull *Larus fuscus* nest, in Gloucester in May 2004, was constructed between 7.00 and 9.00 am, and by 10.00 am contained one egg.

vidually marked birds (mostly Bristol-ringed) in their populations. This is the obvious population for further research because the number of marked birds (and their life histories) will contribute immensely to an understanding of how urban gulls function on a daily and seasonal basis. Proper research is the only way to develop sensible management strategies, and until we understand the ecology of urban gulls more fully, pushing ahead with concerted control measures appears to be premature.

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Appendix i. Details of the number of Herring *Laws argentatus* and Lesser Black-backed Gulls *L fuscus* breeding at 22 of c. 60 urban colonies in the Severn Estuary Region in 2004 (*denotes 2003 count).

Colony	No. pairs	LB	HG	Colony	No. pairs	LB	HG
Melksham	39	33	6	Cheltenham	151*	124	27
Chippenham	50	41	9	Avonmouth	320	192	128
Hereford	50	49	1	Worcester	342	295	47
Maesteg	52	37	15	Barry	400	360	40
Chepstow	60	11	49	Bath	536	363	173
Devizes	73	60	13	Bridgend	554	274	280
Aberthaw	79	10	69	Newport	800	600	200
Westbury	84	60	24	Quedgeley	1,000+	820	180
Swindon	87	65	22	Bristol	1,933	1,329	604
Yate	100	84	16	Gloucester	1,996	1,663	333
Trowbridge	148	125	23	Cardiff	3,103	2,594	509
				Totals	11,957+	9,189	2,768

Appendix 2. Details of colour rings used on nestling Herring *Larus argentatus* and Lesser Black-backed Gulls L *fuscus* in Bristol (and elsewhere) since 1980. Nestlings have also been colour-ringed in Bath since 2001, in Cheltenham since 2002, and in Worcester, Cardiff and Bridgend since 2003. Bristol-scheme colour rings are 37 mm tall and always on the right leg (metal ring on left leg).They show two engraved letters, latterly with a colon between letters. Please send any sightings of colour-ringed birds to: Peter Rock, 7 Parkside Avenue.Winterbourne, Bristol BS36 ILU; e-mail: pete.rock@blueyonder.co.uk

Year	Ring colour	Letter colour	Note
1980	yellow	black	-
1981	orange	black	-
1982	white	black	-
1983	sky blue	black	-
1984	green	white	-
1985	mauve	white	-
1986	black	white	-
1987	red	white	-
1988	pale green	black	-
1989	mid blue	white	-
1990	brown	white	-
1991	orange	white	-
1992	white	red	-
1993	yellow	black	-
1994	black	yellow	-
1995	orange	black	-
1996	green	white	-
1997	white	blue	-
1998	dark blue	white	-
1999	red	white	Stop. between letters
2000	orange	green	Colon: between letters
2001	yellow	black	Colon: between letters
2002	pale green	black	Colon: between letters
2003	white	green	Colon: between letters
2004	blue	orange	Colon: between letters