Counts and breeding success of Black-legged Kittiwakes *Rissa tridactyla* nesting on man-made structures along the River Tyne, northeast England, 1994-2009

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Abstract
Numbers of Black-legged Kittiwakes *Rissa tridactyla* nesting up to 17 km inland on man-made structures along the River Tyne, northeast England, ranged between 72 and 531 successful nests (those raising at least one well-grown chick) from 1994 to 2009, and 465–755 apparently occupied nests in 2000–09. The number of pairs each year was influenced by the availability of suitable nesting sites, in turn affected by man's efforts to deter birds from certain buildings. While breeding success was influenced by local summer weather in some years, being suppressed by heavy rainfall, it compared favourably with natural colony sites along the coast of northeast England.

Introduction
The normal nesting habitat of Black-legged Kittiwakes *Rissa tridactyla* is on narrow ledges on steep, often high sea cliffs (Cramp & Simmons 1983), but in several parts of their range they have colonised structures such as sheds and houses in coastal villages (Norway: Wagner 1958), abandoned military buildings and an island shipwreck (Alaska: Gill & Hatch 2002), and even offshore gas platforms (The Netherlands, offshore: Camphuysen & de Vreeze 2005; Camphuysen & Leopold 2007). In northeast England, Black-legged Kittiwakes (hereafter 'Kittiwakes') have nested successfully on man-made structures along the River Tyne since 1949 (Coulson 1963). At some locations in this urban situation, people have objected to the associated noise and mess and attempts have been made to discourage them nesting on buildings, but despite losing riverside nesting sites through deterrence or redevelopment, Kittiwakes have continued to occupy new locations, sometimes assisted by man. This paper summarises data from a study of the River Tyne Kittiwake population and its breeding success between 1994 and 2009.

Methods
All known Kittiwake colonies along the River Tyne were visited annually in mid July between 1994 and 2009, from Tynemouth to up to 17 km inland (Figure 1), and a single count was made of nests containing young (hereafter 'successful nests', SN) and the number of young at each colony; empty and partial nests were not recorded. New colonies were also searched for up to 21 km inland. From 2000 to 2009, a single count of apparently occupied nests (AON) was also made at each colony in June.

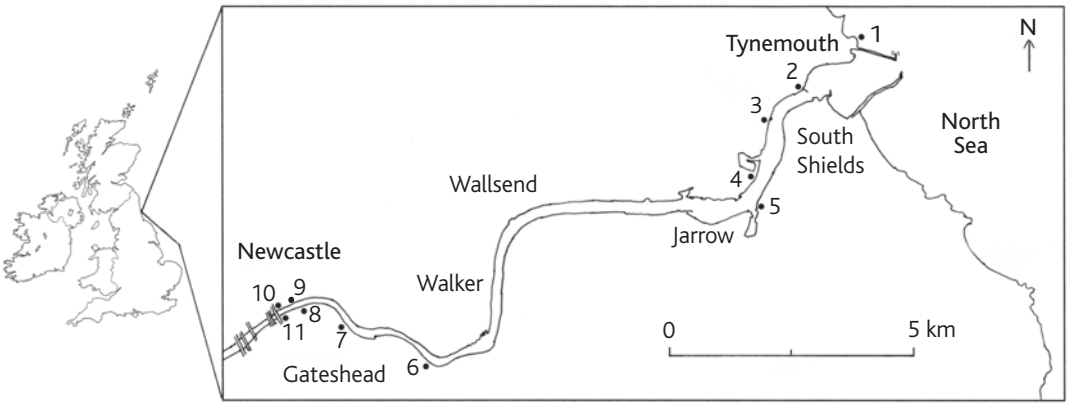

Figure 1. Map showing River Tyne Black-legged Kittiwake *Rissa tridactyla* colonies, 1994–2009. Numbers refer to colonies: 1. Tynemouth cliffs; 2. North Shields Lifeboat House; 3. North Shields Warehouse; 4. Tyne Commission Quay, North Shields; 5. McNulty's, Tyne Dock, South Shields; 6. International Coatings; 7. Kittiwake Tower; 8. Baltic Flour Mill; 9. Newcastle Quayside Buildings; 10. Tyne Bridge, north tower; 11. Tyne Bridge, south tower.

Chicks were mostly 2–4 weeks old and relatively easily counted on the July visits, timed to record as many chicks as possible just before first fledging. The dates of July visits advanced by several days over the 15-year period; fledged juveniles still present at the colonies were counted, but not included in calculating minimum productivity (defined as total chicks / SN), but were used in calculating minimum breeding success (defined as total chicks / June count of AON) in 2000–09. Note that breeding success would be over-estimated if some chicks counted in July died before fledging, and that multiple visits (rather than two per season) may have been made to other colonies in northeast England, with which River Tyne breeding success is compared.

To investigate any influence of weather on breeding performance, data on rainfall (mm) and daily maximum temperature (°C) were obtained from the Meteorological Office at Newcastle Weather Centre for the period 1 June to mid July, the main period for incubation and chicks up to 2–4 weeks old.

Results

Colony locations and sizes: The following 11 breeding locations were used during the study period (Figure 1, Table 1). Distance inland refers to the distance along the river from its mouth.

1. Tynemouth cliffs. Located 100 m north of Tynemouth pier this is the only natural nesting site in the study area, on 30 m high sandstone and limestone cliffs. Numbers of SN were highest in 1995 (96), while AON increased from < 100 in 2000–04 to a peak of in 152 in 2007.

2. North Shields Lifeboat House (1 km inland). Standing on piles in the river bed, this building had four wooden nesting ledges fixed to both its east and west faces in the early 1990s and there were up to 36 SN in 1994–97, after which the structure was demolished.

3. North Shields Warehouse (2 km inland). Two buildings have been used. A former riverside brewery warehouse, colonised in 1949 and the first artificial site on the Tyne, was the subject of long-term study by Durham University and held 72–104 nests between 1962 and 1990 (Coulson & Coulson 2008). In the early 1990s window ledges were progressively covered with wire mesh to deter nesting, and numbers declined to 11 AON in 2000, after which the building was converted into luxury apartments and all possible nest sites made inaccessible. There was a small overspill from the warehouse onto an adjacent five-storey building now used as apartments, a café and shop, and a few pairs (maximum 13 AON in 2009) continue to nest on its roof guttering and window ledges.

4. Tyne Commission Quay, North Shields (3 km inland). A small colony was established in 1985 (pers. obs.). Kittiwakes nested on both faces of a gantry, the southwest face of which could only be viewed from private, inacessible land; staff indicated that a similar number of Kittiwakes nested on each side of the structure but counts refer to nests on the northeast face only. The structure was demolished in late 1998.

5. McNulty Offshore, Tyne Dock, South Shields (4 km inland). Nesting apparently took place from about 1997 on window and other ledges on this brick-built building (Figure 2), but no counts were made until 2002. The number of AON ranged from 29 to 42.

6. International Coatings, Felling (13 km inland). Kittiwakes have nested on ledges on these low factory buildings since at least 1990, but the first counts were only made in 1997. Three long wooden ledges were fixed there in about 1996 and numbers grew rapidly to a peak of 215 AON in 2002. Possible predation by Carrion Crows *Corvus corone* in 2007, the placing of metal spikes on one nesting ledge, and the removal of the wooden ledges after the 2008 breeding season all probably contributed to a recent decline.

7. Gateshead Kittiwake Tower (15–16 km inland). This was built by Gateshead Council in winter 1997/98 to cater for birds displaced from the Baltic Flour Mill (see below) during its development into an Arts Centre. The three-sided, metal-framed structure has 24 wooden nesting ledges starting at 8 m above ground (Figure 3). Kittiwakes were lured to the tower by clay decoys and disused nests placed on the ledges, 18 AON were present in 1998, and 131 by 2000. In winter 2000/01 the structure was relocated 1 km downstream to allow further developments at the Arts Centre. Kittiwakes followed the tower, with 112 AON in 2001 and a peak of 143 in 2007.

8. Baltic Flour Mill, Gateshead (16 km inland). Kittiwakes have probably nested here since the late 1960s (Durham County Bird Reports for 1970 and 1971), and this colony held the largest number of SN in this study (245 in 1995). After the 1997 breeding season, a large part of the building and all the main nesting ledges were covered with fine mesh netting. A few breeders evaded these measures (27 AON in 2000) until the site was completely 'sanitised' against possible nesting attempts.

Table 1. Counts of Black-legged Kittiwake *Rissa tridactyla* nests and chicks at 11 locations in the River Tyne study area. For each location, upper line (bold): apparently occupied nests (AON) in early June and breeding success (chicks present in mid July, including fledged / June AON); lower line: nests containing chicks in mid July (successful nests, SN) and productivity (chicks in nests in mid July, excluding fledged / SN). **n/c** = not counted, colony unknown to author; X = structure demolished between breeding seasons; **n/a** = not available due to deterrence measures. Totals, mean figures, and visit dates refer to locations 2-11 only (man-made structures). Total AONb excludes location 5 (McNulty's, Tyne Dock). Rainfall data are for Newcastle (see Methods).

Location	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
1. Tynemouth cliffs	-	-	-	-	-	-	***92; 1.20***	***83; 0.81***
	66; 1.64	*96; 1.72*	*69; 1.70*	*28; 1.18*	*8; 1.50*	*34+; 1.47*	*72; 1.51*	*53; 1.26*
2. N. Shields Lifeboat H.	12; 1.33	35; 1.63	36; 1.50	9; 1.00	**X**			
3. N. Shields Warehouse	-	-	-	-	-	-	**24; 0.83**	**9; 1.00**
	25+; 1.44	17; 1.41	11; 1.27	12; 1.08	7; 1.29	10; 1.30	12; 1.67	6; 1.50
4. Tyne Commision Quay	21; 1.43	21; 1.71	13; 1.38	7; 1.00	4; 1.25	**X**		
6. International Coatings	-	-	-	-	-	-	**188; 1.27**	**199; 1.15**
	n/c	n/c	n/c	40; 1.20	24; 1.25	88+; 1.32	134+; 1.49	150; 1.52
7. Kittiwake Tower					-	-	**131; 0.94**	**112; 0.55**
					18; 1.17	61+; 1.18	75+; 1.35	45; 1.38
8. Baltic Flour Mill	-	-	-	-	-	-	**27; 1.15**	**n/a**
	143+; 1.27	245; 1.60	209+; 1.51	141; 1.29	1; 1.00	8+; 1.25	21; 1.48	n/a
9. Newcastle Quayside	-	-	-	-	-	-	**20; 1.35**	**11; 0.91**
	26+; 1.38	61; 1.62	55; 1.35	49; 1.24	5; 1.20	9+; 1.22	16; 1.56	7; 1.43
10. Tyne bridge, N. Tower	-	-	-	-	-	-	**115; 1.06**	**134; 0.84**
			0; 0	2; 1.00	13; 1.23	39+; 1.18	82; 1.37	73; 1.55
Total AON	**-**	**-**	**-**	**-**	**-**	**-**	**505**	**465**
Total successful nests (SN)	227+	379	324+	260	72	215+	340+	281
Total chicks in nests	300	607	476	322	87	268	489	422
Fledged juveniles	34	2	27	1	0	0	72	0
Mean chicks / AON ± SE	**-**	**-**	**-**	**-**	**-**	**-**	**1.10 ± 0.08**	**0.89 ± 0.10**
Mean chicks / SN ± SE	1.37 ± 0.03	1.59 ± 0.05	1.40 ± 0.05	1.12 ±0.05	1.20 ± 0.04	1.24 ± 0.02	1.49 ± 0.05	1.48 ± 0.03
June visit dates	-	-	-	-	-	-	4–5	6–9
July visit dates	18–22	16–17	13–20	6–20	5–21	11–18	17–18	12–20
June/July rainfall (mm)	27.4	52.6	32.6	195.8	151.8	71.4	77.0	88.4

Table 1. continued.

Location	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
1. Tynemouth cliffs	***93; 1.25***	***76; 0.61***	***75; 0.48***	***103; 0.76***	***126; 1.07***	***152; 0.74***	***120; 0.58***	***134; 0.94***
	75; 1.55	*34; 1.35*	*34; 1.06*	*57; 1.37*	*90; 1.50*	*86; 1.31*	*61; 1.13*	*93; 1.35*
3. N. Shields Warehouse	**11; 1.27**	**7; 1.29**	**8; 0.75**	**8; 1.13**	**8; 1.63**	**11; 1.09**	**12; 0.58**	**13; 1.54**
	9; 1.56	4; 2.25	5; 1.20	6; 1.50	8; 1.63	9; 1.33	6; 1.17	11; 1.82
5. McNulty, Tyne Dock	**40; 1.13**	**41; 1.12**	**29; 0.66**	**39; 0.67**	**38; 1.32**	**41; 1.05**	**42; 0.71**	**41; 1.41**
	30; 1.50	33; 1.36	16; 1.19	20; 1.30	32; 1.56	33; 1.30	28; 1.07	37; 1.54
6. International Coatings	**215; 1.19**	**194; 0.88**	**178; 0.69**	**160; 0.92**	**182; 1.26**	**205; 0.60**	**149; 0.48**	**116; 1.23**
	175; 1.44	123; 1.38	102; 1.20	114; 1.28	151; 1.51	88; 1.39	58; 1.24	95; 1.49
7. Kittiwake Tower	**101; 0.98**	**88; 0.72**	**73; 0.75**	**88; 0.86**	**105; 1.06**	**143; 0.93**	**120; 0.30**	**110; 1.05**
	74; 1.34	45; 1.40	48; 1.15	53; 1.43	84; 1.32	101; 1.32	34; 1.06	82; 1.41
8. Baltic Flour Mill	**n/a**	**n/a**	**2; 0.00**	**2; 0.50**	**6; 1.67**	**17; 0.71**	**22; 0.73**	**27; 1.30**
	n/a	n/a	0; (0)	1; 1.00	6; 1.67	10; 1.20	14; 1.14	25; 1.32
9 Newcastle Quayside	**13; 1.15**	**5; 1.00**	**8; 0.88**	**18; 1.06**	**19; 0.95**	**33; 0.88**	**36; 0.64**	**47; 1.45**
	10; 1.50	4; 1.25	7; 1.00	15; 1.27	11; 1.64	24; 1.21	21; 1.10	42; 1.62
10. Tyne Bridge, N. Tower	**152; 1.20**	**142; 1.06**	**176; 0.70**	**195; 0.95**	**228; 1.00**	**264; 1.05**	**274; 0.69**	**268; 1.10**
	120; 1.47	104; 1.41	107; 1.15	139; 1.29	159; 1.36	198; 1.34	154; 1.18	202; 1.45
11. Tyne Bridge, S. Tower	**9; 0.67**	**9; 0.67**	**10; 0.80**	**13; 1.00**	**28; 1.14**	**41; 0.90**	**37; 0.62**	**42; 1.31**
	5; 1.20	4; 1.50	8; 1.00	10.; 1.30	26; 1.23	30; 1.23	21; 1.10	37; 1.49
Total AONa	**541**	**486**	**484**	**523**	**614**	**755**	**692**	**664**
Total AONb	501	445	455	484	576	714	650	623
Total successful nests (SN)	423	317	293	358	477	493	336	531
Total chicks in nests	607	445	340	470	679	654	389	783
Fledged juveniles	9	4	0	6	13	10	6	8
Mean chicks / AON ± SE	**1.08 ± 0.08**	**0.96 ± 0.08**	**0.65 ± 0.10**	**0.89 ± 0.07**	**1.25 ± 0.10**	**0.90 ± 0.06**	**0.59 ± 0.05**	**1.30 ± 0.06**
Mean chicks / SN ± SE	1.43 ± 0.05	1.51 ± 0.13	1.13 ± 0.03	1.30 ± 0.05	1.49 ± 0.06	1.29 ± 0.02	1.13 ± 0.02	1.52 ± 0.05
June visit dates	3–11	4–6	7–8	6–11	5–10	6–8	5–6	4–8
July visit dates	15	14–16	12–17	11–15	13–14	11–13	9–10	9–11
June / July rainfall (mm)	95.6	87.4	134.6	100.8	33.0	181.8	131.8	131.0

Figure 2. McNulty Offshore, Tyne Dock, South Shields, 7 June 2007. Nest material can accumulate from one breeding season to the next. © *Daniel M. Turner*

Figure 3. The Kittiwake Tower, Gateshead, 9 & 10 July 2009. © *Daniel M. Turner*

In recent years, some netting has been removed and some ledges made accessible again and a few breeding pairs have returned, in increasing numbers (Figure 4).

9. Newcastle Quayside Buildings (16.7–17 km inland). Various old buildings on Newcastle quayside up to 150 metres east of the Tyne Bridge have been used before and during this study, and numbers have fluctuated as individual buildings have been refurbished or demolished, had metal spikes fixed to ledges (Figure 5), or been draped in netting (beginning in 1995/96, but especially so in 1997/98). In 2007, birds began nesting on window ledges on the Guildhall, just west of the Tyne Bridge, with 26 AON in 2009 (Figure 6).

10. Tyne Bridge, North Tower, Newcastle (17 km inland). This was colonised in 1996, with three AON on 8 June, but no young were recorded on 20 July. There were two SN in 1997, after which the colony grew rapidly to 115 AON in 2000 and 274 AON in 2008 (Figure 7). This colony probably formed due to the demise of the Baltic Flour Mill site, netting of ledges on the Newcastle Quayside buildings, and movement of breeding birds to this nearby location. Newcastle City Council received many complaints about the noise and dirt from this colony, with calls for deterrent measures (Turner 2002), but lobbying by local and national birdwatching and conservation groups, along with media attention, resulted in a more positive attitude within the Council, which erected a Kittiwake information panel beneath the bridge in summer 2005. There has been little change in numbers since 2007, and potential for further increase may now be limited, which may account for the colonisation of the adjacent Guildhall in 2007.

11. Tyne Bridge, South Tower, Gateshead (17 km inland). The South Tower was colonised in 2002, with an increase to 42 AON in 2009, and room for future expansion.

Breeding numbers: With nesting being simultaneously discouraged, tolerated, and encouraged at different locations, it has been difficult to follow the size of, or trends in, the total Kittiwake population breeding along the Tyne, particularly since only successful nests were counted in 1994–99. However, numbers probably fluctuated between 450 and 550 pairs during 1994–2005, followed by a marked (44%) increase to 755 AON in 2007, and then a slight (12%) decrease to 2009, which mainly occurred at the International Coatings factory (Figure 8). There was some increase in numbers between 2005 and 2007 at all eight breeding locations, suggesting that natural environmental conditions encouraged either a higher rate of nesting among the existing, potential breeding population, or an influx of new recruits into the river system. Between 2005 and 2007 Tynemouth cliffs colony increased by 48% and the Marsden colony (5 km south of the river mouth) increased by 12% (from 2,199 to 2,474 AON; J. C. Coulson pers. comm.), while numbers at Coquet Island and the Farne Islands (36 and 69 km north of the river mouth, respectively) increased by 29% (122 to 157 AON) and declined by 13% (5,375 to 4,669 AON), respectively, over the same period (Steel 2006; Coulson & Coulson 2008; Fisher & Holliday 2008; Steel 2008).

Breeding productivity/success: Before June AON counts began in 2000, which allowed breeding success to be calculated, chick productivity was relatively high in 1994–96, and relatively low in 1997–99 (Table 1). Breeding success at five Kittiwake colonies in northeast England monitored for the JNCC Seabird Monitoring Programme (SMP) (including some at Gateshead monitored by B. Little) was relatively high in 1994–96, particularly in 1996 at 1.22 (± 0.02 SE) chicks fledged / AON (Thompson *et al*. 1997), and in each of these years productivity at Tynemouth cliffs was higher than at any river site (Table 1). The relatively low number of SN and low productivity at riverside colonies in 1997–99 was probably due to a combination of three factors, the first being weather.

Northeast England experienced severe northeast gales, heavy seas, heavy rain and low temperatures in late June 1997, which contributed to breeding success of only 0.59 (± 0.12 SE) chicks fledged / AON at the five SMP monitored colonies (Thompson *et al*. 1998), while heavy rain in June 1998 again affected breeding success (0.48 ± 0.16 SE) at these colonies (Thompson *et al*. 1999; Walton & Maher 1999). For River Tyne colonies, no significant relationship was found between local June/July temperature and Kittiwake productivity in 1994–2009 (July chicks per successful nest) or breeding success in 2000–09 (July chicks per June AON), or between June/July rainfall and 2000–09 breeding success, but there was a

Table 2. Black-legged Kittiwake *Rissa tridactyla* breeding success (chicks assumed fledged per AON, total AON in brackets) along the River Tyne and at Tynemouth (this study), compared to four other colonies in northeast England (data from JNCC Seabird Monitoring Programme). Differences between River Tyne, Tynemouth and other colonies were tested by paired sample Student's t-test; differences where P < 0. 05 in bold.

Year	Farne Is.	Coquet Is.	Tynemouth	River Tyne	Saltburn	Bempton
2000	1.08 (643)	1.10 (80)	1.20 (92)	1.10 (505)	0.75 (192)	-
2001	0.71 (724)	1.30 (66)	0.81 (83)	0.89 (465)	0.79 (170)	1.10 (161)
2002	0.79 (644)	1.20 (81)	1.25 (93)	1.01 (541)	0.67 (243)	0.76 (277)
2003	0.86 (638)	1.69 (84)	0.61 (76)	0.96 (486)	0.80 (182)	0.25 (297)
2004	0.10 (551)	1.11 (85)	0.48 (75)	0.65 (484)	0.26 (130)	0.17 (313)
2005	0.63 (590)	1.08 (127)	0.76 (103)	0.89 (523)	0.52 (247)	0.62 (303)
2006	0.57 (568)	1.37 (162)	1.07 (126)	1.25 (614)	0.82 (298)	0.82 (309)
2007	0.25 (606)	0.96 (30)	0.74 (152)	0.90 (755)	0.62 (299)	0.83 (316)
2008	0.32 (616)	0.40 (30)	0.58 (120)	0.59 (692)	0.36 (145)	0.83 (319)
2009	1.18 (593)	1.50 (45)	0.94 (134)	1.30 (664)	-	0.97 (550)
Mean ± SE	**0.65 ± 0.11**	**1.17 ± 0.11**	**0.84 ± 0.08**	**0.95 ± 0.07**	**0.62 ± 0.07**	**0.71 ± 0.10**
Percentage	**-32%**	**+23%**	-12%		**-35%**	-25%
difference	***t* = -4.079**	***t* = 2.640**	*t* = -1.877		***t* = -7.956**	*t* = -2.224
River Tyne	**P = 0.003**	**P = 0.027**	P = 0.093		**P < 0.001**	P = 0.056
Percentage	-23%	**+39%**			**-26%**	-15%
difference	*t* = -2.219	***t* = 2.687**			***t* = -2.842**	*t* = -1.070
Tynemouth	P = 0.054	**P = 0.025**			**P = 0.022**	P = 0.316

Figure 4. The Baltic Flour Mill, Gateshead, 9 July 2009. Nesting resumed at this site in 2004 after a gap of three years. © *Daniel M. Turner*

Figure 5. Queen Street, Newcastle Quayside, 8 June 2007. Nests continue to be built, despite the sharp metal spikes placed on ledges. © *Daniel M. Turner*

significant negative correlation between rainfall and the longer data set on productivity (Pearson Correlation r = -0.608, P = 0.013; Table 1), and heavy rainfall was believed to have contributed to low chick survival at the Tyne Commission Quay and International Coatings colonies in particular in 1998 (pers. obs.).

A second factor contributing to the reduction in SN in 1998 was the extensive netting of the Baltic Flour Mill and Newcastle Quayside sites after the 1997 breeding season, and the effects of deterrent measures at these sites continued well into the next decade. A third factor likely to have affected riverside-nesting Kittiwakes negatively in the late 1990s was exceptional mortality of adults at sea off the mouth of the River Tyne in the summers of 1996 and 1997, thought to have been caused by toxic algal blooms linked to the dumping of raw sewage (Coulson & Strowger 1999). An estimated 15,000 birds may have died, with adult females predominating in the mortality but, surprisingly, few chicks died in nests during these incidents. The Marsden colony declined from 5,767 to 1,632 AON between 1992 and 1998, and 26% of sites in 1998 were occupied by males only. Adults nesting along the River Tyne must have been involved in this mortality, but to what extent remains unknown in the absence of June counts of AON at the time. Despite these negative factors, it is noteworthy that all known locations along the Tyne produced at least some SN in 1994–99, except for the Tyne Bridge North Tower in its year of colonisation (1996, three AON failed).

Mean breeding success at the River Tyne colonies in 2000–09 ranged from 0.59 chicks per AON (2008) to 1.30 (2009), averaging a respectable 0.95 ± SE 0.07 (Table 2). These colonies, and that at Tynemouth cliffs have been monitored in the same manner, and while mean annual success at the riverside colonies averaged 12% higher than at Tynemouth, this difference was not significant (Table 2). Neither was there any difference between success at Tynemouth and the Tyne Bridge North Tower colony (0.97 ± 0.05, t = 2.088, P = 0.066), the furthest inland. Some riverside colonies used in this comparison were very small or becoming established, but there was no difference between mean (0.95 ± 0.07) and sum annual success (0.95 ± 0.06), while sum success averaged significantly (just) higher than at Tynemouth (t = -2.287, P = 0.048).

Comparison with other colonies in northeast England monitored for the SMP is more difficult because of probable differences in the frequency of observations. Harris (1987) calculated that visiting a colony only twice per season (as in this study from 2000) rather than every three or four days overestimated Kittiwake breeding success by 13% (on the Isle of May, Firth of Forth in 1986, a 'good' breeding season), a difference which will be compounded if AON are only counted (as in this study) rather than marked on photographs (Walsh *et al*. 1995). Coquet Island has been the most productive monitored colony in the region over the past decade (Table 2), but even allowing for differences in methodology the River Tyne colonies have performed relatively well, particularly in comparison with those on the Farne Islands and at Saltburn.

Figure 6. The Guildhall, Newcastle Quayside, 5 June 2009. Nesting began here in 2007, right in the city centre. © *Daniel M. Turner*

Discussion

In contrast to the increase and spread of *Larus* gulls nesting on man-made structures (Raven & Coulson 1997), instances of Kittiwakes colonising buildings remain scarce in Britain and Ireland, and the situation along the River Tyne is unique in the British Isles in terms of the number of birds involved, their ability to colonise new structures in response to deterrence measures or the loss of their former sites, and the distance they have spread inland. Colonisation of River Tyne buildings in the 1950s began at a time of Kittiwake population increase, in northeast England and the British Isles generally (Coulson 1963). Between the 1969-1970 Operation Seafarer and 1985–88 Seabird Colony Register censuses, breeding numbers in northeast England more than doubled, from 43,400 to 115,900 AON (Lloyd *et al*. 1991), so there was clearly no shortage of natural nest sites in the region.

Choosing to breed on riverside buildings, rather than in cliff colonies such as at Marsden, may have both benefits and downsides. Benefits could include greater protection from severe, onshore weather, and a reduced risk of loss of eggs or chicks to certain avian predators. On the other hand, Kittiwakes are adapted to utilising the varied topography of cliff nest sites, with rock overhangs and side-walls providing protection from predators such as gulls and corvids (Regehr *et al*. 1998), and from weather events such as heavy rain to which nests on, for example, the open ledges of the Baltic Flour Mill would seem exposed. Another downside might be the stress of unintentional human disturbance in an urban environment affecting breeding performance (Beale & Monaghan 2004).

Negative relationships have been found between high levels of infestation of the parasitic tick *Ixodes uriae* in Kittiwake colonies and demographic parameters such as breeding success and recruitment (Cadiou *et al*. 1993; Boulinier & Danchin 1996), and where nests are not removed by man a considerable amount of material can accumulate on some buildings (Figure 2), perhaps providing a greater refuge for ticks between breeding seasons than on sea cliffs washed by winter storms. In fact, of 208 chicks and 37 adults examined at the North Shields Warehouse and the Baltic Flour Mill colonies in 1987 and 1988, no chicks carried ticks and only one adult had a single tick (Danchin 1992). This contrasted with ticks being found on some chicks in all 21 areas sampled at 12 colonies on natural substrate in Scotland and northwest England in the same years (Boulinier & Danchin 1996). Danchin (1992) believed that buildings do not have sufficiently deep crevices for ticks to survive the winter, one potential advantage as a breeding site over natural cliff locations.

Perhaps the greatest potential downside to nesting along the Tyne is that almost all Kittiwakes doing so feed at sea, rather than in the river (Raven & Coulson 2001), although some fed at a fish factory outflow upstream from the Smith's Brewery Warehouse in the late 1970s (J. Chardine pers. comm.), and a small flock of adults (maximum 62, May 2005) has been found feeding regularly in spring and summer since 2002 at the treated water discharge from the Howdon sewage works, between McNulty's and Tyne Commission Quay (Figure 1, pers. obs.). For birds nesting at Newcastle Quayside and the Tyne Bridge (over half the riverside population in 2009) marine foraging involves a 17 km flight to the river mouth. The normal foraging range of breeding Kittiwakes in years of high availability of preferred prey will depend upon colony location, but has been reported as < 5 km in Shetland (Hamer *et al*. 1993), and 20 km and 35–45 km at two colonies in Alaska (Suryan *et al*. 2000), although in years of food scarcity the Shetland birds extended this to > 80 km and the Alaskan birds to 65–70 km. Pearson (1968) calculated that Kittiwakes feeding chicks on the Farne Islands in 1961–63 had a maximum foraging range of 35 miles (56 km), while those on the Isle of May had a maximum foraging range of 73 ± 9 km in 1999 (Daunt *et al*. 2002). Kittiwakes breeding at the North Shields Warehouse and Marsden colonies in 1968–1973 fed mainly on sandeels (Ammodytidae), Herring *Clupea harengus* and Sprat *Sprattus sprattus* (Coulson & Thomas 1985). How far offshore they foraged is unknown, but daytime foraging trips of adults feeding chicks averaged 2.8 hours in 1968–1974 (Coulson & Johnson 1993), similar to the 2.6 hours recorded on the Farne Islands in 1961–63 (Pearson 1968). Environmental conditions may have changed since these early studies, but the fact that the Tyne Bridge South Tower Kittiwakes achieved breeding success of 1.31 chicks / AON in 2009 suggests the c. 50 minute, 34 km round trip to and from the river mouth currently poses no additional burden. As at other North Sea colonies (Harris *et al*. 2007), pipefish (Sygnathinae) appeared in the diet of Tynemouth and River Tyne Kittiwakes in 2007, with 260 counted on the ground below the Tyne Bridge North Tower on 13 July. Several were also seen there in 2008, but not in 2009.

Figure 7. Tyne Bridge North Tower, 8 June 2007, 17 km from the river mouth. © *Daniel M. Turner*

There is probably limited scope for further growth of the River Tyne Kittiwake breeding population unless suitable sites can be augmented with specially provided ledges and another Kittiwake Tower can be funded and built. Hopefully, breeding numbers and success of this specialised group of birds will be maintained in future. Newcastle City Council have been persuaded to accept the presence of the Tyne Bridge colony in recent years, but a new report (March 2011) means the city council are considering removing the colony.

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