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The eradication of Brown Rats from Handa Island
Eagle behaviour before and after construction of a windfarm
The biology of a population of Willow Warblers in East Fife

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The 2002 census of the Mute Swan in Scotland

ALLAN W BROWN & LYNDESAY M BROWN

A total of 7,028 swans was recorded in Scotland during the spring of 2002, including 1,012 pairs which bred. The total population had increased by 41% since 1990 but this varied between the north, centre and south of the country. Whilst the majority of birds occurred on still waters, use was made also of rivers, canals and marine shores. The mean altitude at which pairs bred increased from 45m in 1983 to 64m in 2002. Although a few pairs bred at an altitude in excess of 300m in the Borders, 63% of pairs bred at an altitude of 60m or lower. Six flocks which comprised 100 or more non territorial swans were recorded, the largest being 302 on the Outer Hebrides.

Introduction

Almost half a century has passed since the first national census of the Mute Swan *Cygnus olor* was undertaken in Scotland and across Britain in 1955-56 (Rawcliffe 1958, Campbell 1960). Subsequent censuses were held in Scotland in 1978 (Ogilvie 1981), in 1983 (Brown & Brown 1985, Ogilvie 1986), in 1990 (Delany *et al* 1992, Brown & Brown 1993) and the fifth national census was held in 2002. The purpose of the 2002 census was to enable the current size of the population to be quantified, but additionally to enable any changes in its structure and distribution to be identified and long term trends to be monitored. Initially the census was to be held in the spring of 2001. However, due to the widespread ban on public access to the countryside as a consequence of the Foot and Mouth epidemic amongst farm animals, a decision to postpone the census was taken in February 2001 with it being deferred until spring 2002.

As a signatory to international conservation conventions Britain is legally bound to conserve waterfowl, including the Mute Swan, and their habitats. In order to meet those obligations regular species monitoring is necessary and consequently censuses contribute in part to the ongoing, and wider, programmes of waterfowl monitoring in Britain (Pollitt *et al* 2003). There had been an increase in the population in some areas of Scotland (Murray *et al* 1996, Brown & Brown 2002) since the last census held in 1990 and an increase had been identified in the winter population (Pollitt *et al* 2003). Therefore, an update of the 1990 results was deemed necessary to facilitate a review of the national threshold for the Mute Swan which is 1% of the British population.

Within a Scottish context a decrease occurred in the number of swans in Scotland between 1955-56 and 1983 and an increase between 1983 and 1990 (Rawcliffe 1958, Brown & Brown 1985, Brown & Brown 1993). This census was undertaken specifically to determine both recent and long term trends in the population by determining the size of the population with regard to the numbers of territorial and breeding pairs, and the number of non breeding individuals. Moreover, expansion or contraction in specific regions would be investigated in addition to any variation in habitats occupied.

Methods

The census was organised jointly by The Wildfowl and Wetlands Trust, the British Trust for Ornithology, the Scottish Ornithologists' Club

and the Swan Study Group, while the authors coordinated the census in Scotland. As with previous censuses, a team of local organisers coordinated local field workers who voluntarily undertook fieldwork primarily during April and May. A sample of randomly selected 10km squares of the Ordnance Survey national grid for which coverage was essential was allocated to each local organiser. However, in Scotland most local organisers proved extremely supportive of the project and agreed to obtain full coverage in their respective areas to enable a full census of the species to be achieved once again in Scotland. Field workers were requested to locate territorial and breeding pairs of swans, to count all non territorial birds and record the grid reference of each site. Repeat visits to determine whether or not territorial pairs actually nested were encouraged. Whilst non territorial birds were normally counted in mid April some flexibility was necessary due to the relatively short notice regarding commencement of the census following its postponement from the previous year. Additionally, the difficulty in obtaining coverage of all sites at the appropriate time in more remote areas and additional commitments of fieldworkers also necessitated some flexibility.

Observers were requested to identify the type of habitat occupied by swans. This together with the grid reference for each site meant that it was possible to categorise the wetland habitat occupied by swans as canal, river, still water or marine open shore and to estimate their altitude from Ordnance Survey maps scale 1:25,000. In order to facilitate comparison of 2002 results with those for 1983 (Brown & Brown 1985), the habitat occupied by territorial and breeding pairs in 1983 was retrospectively reanalysed and categorised as canal, river, still water or marine open shore and the altitudes determined also. To enable further direct comparison of results with those from previous Scottish censuses, the data were grouped according to the old county boundary system.

For analytical purposes the country was divided into north, centre and south of the country equating, as far as county boundaries allowed, generally with the Highlands and Islands, Central Lowlands and Southern Uplands. The north comprised Orkney, Outer Hebrides, Shetland, Sutherland, Ross and Cromarty, Caithness, Kincardineshire, Angus, Inverness shire, Nairn, Morayshire, Banffshire, Aberdeenshire, Perthshire and Argyll and islands; the centre comprised Stirlingshire, Clackmannan, Kinross, Fife, Midlothian, West Lothian, East Lothian, Arran and Bute and Cumbrae, Dunbartonshire, Renfrewshire and Lanarkshire; the south comprised Ayrshire, Peeblesshire, Roxburghshire, Selkirkshire, Berwickshire, Dumfriesshire, Kirkcudbrightshire and Wigtownshire.

Data analyses were undertaken using Microsoft Excel. Due to the skewed distribution of altitude data it was analysed using the heteroscedastic Type 3 t test (Dytham 1999).

Results

Fieldwork was undertaken in all counties during the census period. Coverage was generally good and for most counties it was considered to be complete. Many local organisers provided an assessment of coverage within their area and their comments are summarised in Appendix 1. Spring 2002 was rather wet and high water levels may have impacted on the number of territorial pairs which progressed to nest but should not have affected the total number of swans observed.

Total number of swans

The total number of swans recorded in Scotland in 2002 was 7,028, a 41% increase since 1990 (Table 1). Notwithstanding, a decrease occurred in 11 counties, whilst an increase occurred in 22, with Kirkcudbrightshire being the only county in which no change was recorded. Although the

north held a total of 3,186 swans or 45% of the Scottish population (Table 2) a 2% decrease occurred there between 1990 and 2002 (Table 3). In contrast a substantial increase occurred in the centre with the total population increasing by 210% to reach 2,188 in 2002. Similarly, in the south the total population increased by 57% and 1,654 swans were recorded there in 2002.

The number of swans recorded in Scotland during the last century was particularly low in 1983, however, numbers recovered by 1990 and subsequently continued to increased to reach their highest recorded total by 2002 (Figure 1). The total population comprised territorial and non territorial swans and as the total number of swans increased from 1983 so the percentage of the population which was territorial decreased from 49% in 1983, to 43% in 1990 and to 39% in 2002.

Territorial pairs

A total of 1,375 pairs held a territory in 2002, a 29% increase since 1990. The total number of territorial pairs comprised pairs which held a territory but did not breed and pairs which held a territory and bred (ie built a substantial nest and probably laid eggs, or cygnets were observed) (Table 1). A 53% increase was recorded between 1990 and 2002 amongst the number of pairs which held a territory but did not breed, but as a percentage of the total population this remained little changed at 10% compared with 10% in 1990 and 11% in 1983. Whilst an increase of 7% occurred in the number of swans which only held a territory in the north between 1990 and 2002, this was low when compared with 157% in the centre and 111% in the south (Table 3). Although the number of pairs which only held a territory decreased from 43 pairs in 1990 to 19 pairs in 2002 on the Outer Hebrides, the most westerly pair recorded in Scotland was found there on the Monach Isles in 2002.

During the censuses conducted in 1955-56 and 1978 there was no attempt to disaggregate the swans which did not breed into those which did or did not hold a territory. Consequently, the number of pairs which held a territory but did not breed was available only from 1983. Figure 2 illustrates the increase since 1983 in the number of pairs which held a territory but did not breed.

Pairs which bred

The breeding population increased by 22% between 1990 and 2002, reaching 1,012 pairs in 2002, the first time that over a thousand pairs has been recorded in Scotland (Figure 2). Whereas no pairs bred in Shetland in 1990, 7 were recorded in 2002 and yet numbers in neighbouring Orkney declined from 163 pairs to 126 pairs during the same period. Scotland's most northerly breeding pair set up home on the Loch of Benston on Mainland, Shetland. The islands of Arran, Bute and Cumbrae held no pairs in 1990 but 16 pairs bred in 2002. However, the greatest change occurred in Fife with an increase from 15 pairs in 1990 to 66 pairs in 2002. Amongst the 34 Scottish counties an increase occurred in 22, a decrease in 10 with no change being recorded in only 2. Whilst the number of breeding pairs decreased by 10% in the north, a substantial increase occurred in both the centre and in the south (Table 3). Since 1983 both the total population and number of pairs which bred increased in number but the percentage of the total population which bred decreased and at 29% in 2002 was similar to that in 1955-6 (Figure 3).

Non territorial birds

Non territorial swans occurred singly and in flocks and comprised birds which may have been too young or too old to breed, or birds which had not repaired following the loss of a mate. A total of 4,280 was counted in 2002, an increase of 50% since 1990. The number of non territorial swans increased between 1983 and 1990 and again between 1990 and 2002

Table 1 *Counts of Mute Swans in each old Scottish county in 2002.*

Old County	No of pairs which held a territory but did not breed	No of pairs which bred	No of non territorial swans	Total number of swans	% Change in total number of swans from 1990–2002
Shetland	1	7	18	34	330
Orkney	69	126	311	701	-13
Outer Hebrides	19	93	404	628	-24
Caithness	2	16	90	126	-25
Sutherland	0	1	0	2	-88
Ross & Cromarty	4	55	184	302	13
Inverness shire	6	5	40	62	-32
Nairn	1	4	33	43	258
Moray	6	15	36	78	22
Aberdeenshire	18	36	152	260	-20
Banffshire	0	0	0	0	-100
Kincardineshire	2	4	1	13	63
Angus	11	27	235	311	88
Perthshire	16	55	323	463	94
Stirlingshire	8	39	57	151	251
Clackmannanshire	0	15	28	58	480
Kinross	5	9	215	243	406
Fife	19	66	120	290	174
West Lothian	8	31	167	245	240
Midlothian	6	27	228	294	277
East Lothian	3	22	40	90	-28
Ayrshire	10	34	152	240	45
Arran & Bute & Cumbrae	5	16	39	81	913
Peeblesshire	8	7	6	36	260
Berwickshire	13	26	102	180	62
Roxburghshire	36	29	252	382	94
Selkirkshire	3	13	8	40	-11
Argyll and Islands	6	21	109	163	-29
Dunbartonshire	12	28	186	266	171
Renfrewshire	14	32	49	141	244
Lanarkshire	27	71	480	676	271
Dumfriesshire	5	26	51	113	-19
Kirkcudbrightshire	14	42	103	215	0
Wigtownshire	6	14	61	101	58
Total	363	1012	4280	7028	
% of Total population in 2002	10%	29%	61%		
% of Total population in 1990	10%	33%	57%		
% of Total population in 1983	11%	38%	51%		
% Increase between 1990–2002	53%	22%	50%	41%	

Table 2 ***Counts of Mute Swans in the north, centre and south of Scotland in 2002.***

	North		Centre		South	
	Number	% of Scottish Total	Number	% of Scottish Total	Number	% of Scottish Total
Pairs which held a territory but did not breed	161	44	90	25	112	31
Pairs which bred	465	46	312	31	235	23
Non territorial individuals	1936	45	1384	32	960	23
Total swans	3186	45	2188	31	1654	24

Table 3 ***Percentage change in the numbers of Mute Swans in Scotland between 1990 and 2002.***

	Area			
	North	Centre	South	Scotland
Pairs which held a territory but did not breed	7	157	111	53
Pairs which bred	-10	131	34	22
Non territorial individuals	2	279	62	50
Total swans	-2	210	57	41

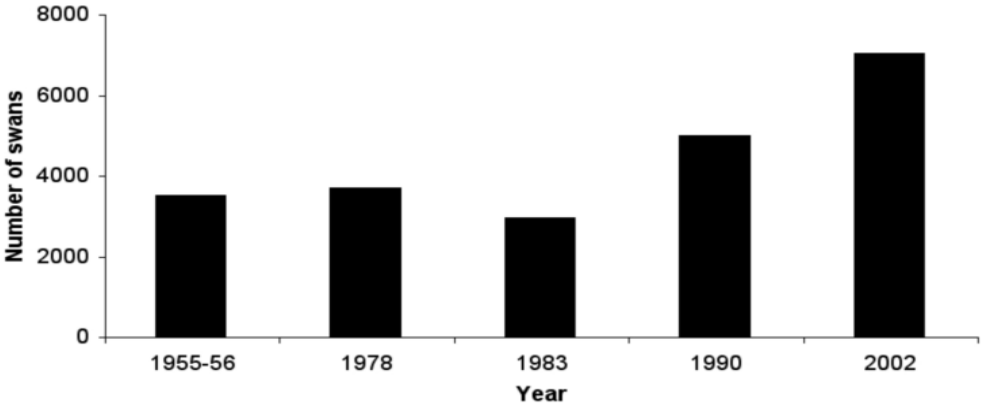

Figure 1. ***Total numbers of Mute Swans recorded in Scotland during national censuses held between 1955–66 and 2002.***

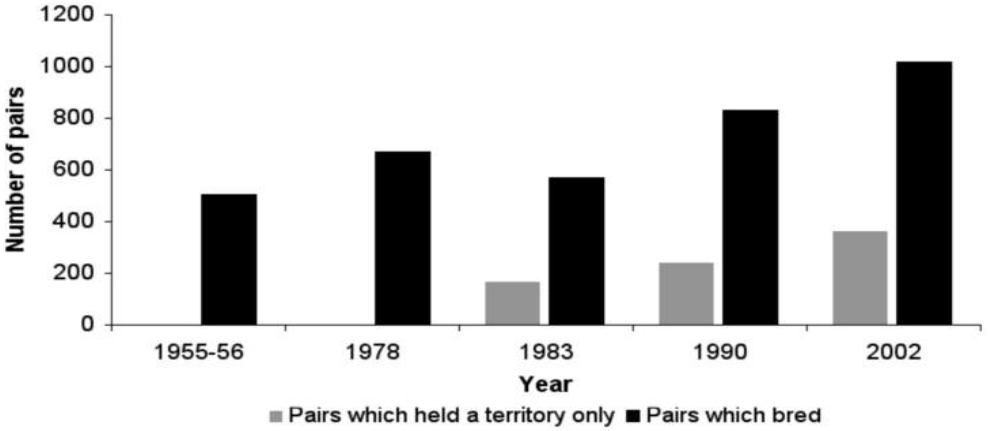

Figure 2 ***The number of pairs of Mute Swans recorded in Scotland during national censuses held between 1955-56 and 2002.***

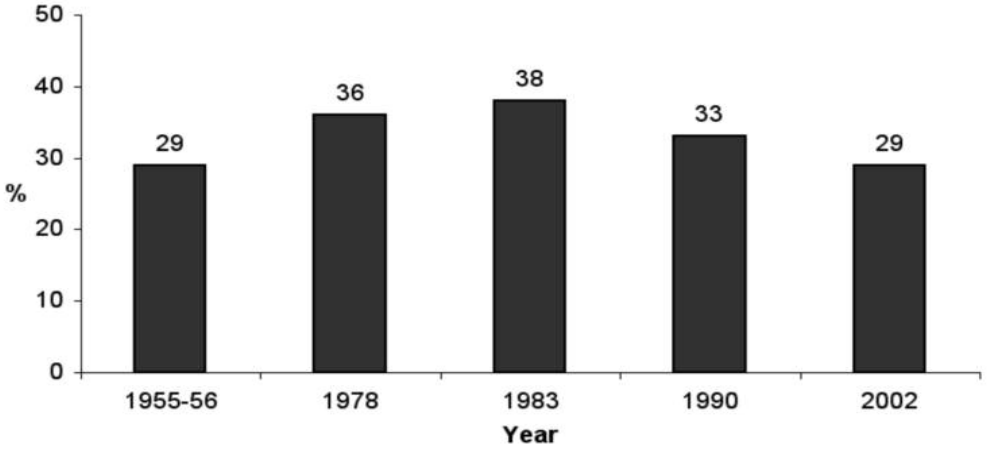

Figure 3 ***Percentage of the total population of Mute Swans which bred in Scotland between 1955–56 and 2002.***

(Figure 4). The percentage of the total population which was non territorial increased from 51% in 1983 to 57% in 1990 and 61% in 2002. At the county level an increase occurred in 23 counties and a decrease in 11 with notable changes occurring in Kinrosshire where numbers increased from 16 in 1990 to 215 in 2002, in Lanarkshire up from 112 to 480 and the Outer Hebrides down from 583 to 404. Only a 2% increase in numbers occurred between 1993 and 2002 in the north but increases were substantially greater in both the centre and in the south (Table 3). The most northerly swans recorded in Scotland were located on Kirkhouse Loch, Mainland, Shetland where 3 non territorial individuals were sighted.

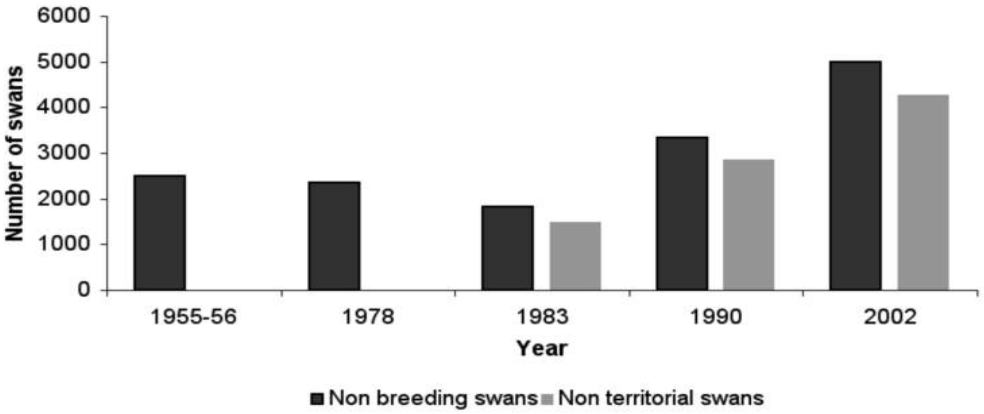

Figure 4 ***Numbers of non breeding and non territorial Mute Swans in Scotland between 1955-56 and 2002.***

A total of 27 flocks which comprised 30 or more swans were located and these accounted for 50% of the non territorial population (Table 4). Whilst 11 of these flocks occurred in the north and 11 in the centre, only 5 occurred in the south. Additionally, of the 6 flocks comprising over 100 birds 3 occurred in the north and 3 in the centre but none in the south. The largest recorded flock of 302 was recorded on Loch Bee in the Outer Hebrides. Between 1990 and 2002 there was a small increase in the number of flocks which held at least 30 swans but, as was the case in 1983, the majority of those flocks continued to hold between 30 and 100 swans (Figure 5).

During the early censuses a figure for the number of non breeding swans was obtained by summing the number of swans which held a territory but did not breed and the number of non territorial swans. In order to facilitate a long term comparison of this data a similar value has been determined for more recent censuses (Figure 4).

Habitat

Over half of all swans recorded were located on still waters and the percentages of territorial and non territorial swans recorded on such habitat, rather than marine shores or canals or rivers, increased since 1983 (Table 5). Additionally, over 50% of territorial, breeding and non territorial swans in each of the north, centre and south of the country were recorded on still waters (Table 6). These findings suggest that availability of suitable unoccupied still water habitat may have contributed to the growth in the size of the swan population. Large numbers of non territorial swans frequented marine shores in both the north (n=620) and centre (n=146) but they were recorded in greater numbers on river habitat in the south. Whilst the total numbers of territorial, breeding and non breeding swans had increased in those areas since 1983, and their distribution between the different types of habitat had altered, overall they continued to favour still waters.

In the north there was a decrease since 1983 in the percentage of territorial pairs, breeding pairs and non territorial birds on marine shores and an increase on still waters (Table 6). Although the number of non territorial birds on marine shores increased from 342 to 620 there was a comparatively greater increase on still waters. Over half of northern non territorial swans were recorded

Table 4 ***Flocks of 30 or more non territorial Mute Swans recorded in Scotland during the census in 2002.***

Old County	Location	Habitat	Count
Outer Hebrides	Loch Bee	Still water	302
Kinross	The Cut	Still water	186
Orkney	Harray Loch	Still water	172
Angus	Montrose Basin	Marine shore	144
West Lothian	Linlithgow Loch	Still water	144
Lanarkshire	Strathclyde Loch	Still water	106
Lanarkshire	Hogganfield Loch	Still water	103
Ross & Cromarty	Kyle of Sutherland	Marine shore	99
Ayrshire	Ayr Harbour	River	89
Midlothian	R Esk Mouth	Marine shore	71
Kirkcudbrightshire	Milton Loch	Still water	66
Lanarkshire	Lochend Loch	Still water	56
Dunbartonshire	River Leven	River	50
Aberdeenshire	Ythan Estuary	Marine shore	49
Argyll and Islands	Oban Harbour	Marine shore	47
Caithness	Loch Watten	Still water	46
Lanarkshire	Bingham's Pond	Still water	43
Ayrshire	Irvine Harbour	River	43
Perthshire	R Tay Balhepburn	River	41
Aberdeenshire	Loch of Strathbeg	Still water	39
Ross & Cromarty	Nigg Bay	Marine shore	38
Fife	Kincaple	River	38
Midlothian	Cramond	Marine shore	36
Midlothian	Inverleith pond	Still water	35
Renfrewshire	Castle Semple Loch	Still water	35
Inverness shire	Inverness Firth	Marine shore	32
Roxburghshire	Rosebank Kelso	River	30
	Total number of swans		2140

on still waters in 2002 rather than marine shores as in 1983. Although both numbers and percentages on still waters increased, the increase was smallest amongst breeding pairs. However, still waters continued to be the most favoured habitat for breeding swans in the north. In contrast to territorial and breeding pairs, non territorial birds on rivers increased in number.

The numbers of swans recorded in the centre increased substantially between 1983 and 2002. The numbers of territorial birds on both still waters and on rivers increased, additionally marine shores and canals also held territorial birds in 2002. The diversification into a wider range of habitats caused the percentage of territorial swans on still waters to decrease since 1983 while that on rivers, marine shores and canals increased. The increasing size of the territorial population may have caused occupation of marginal territories on rivers which had remained unoccupied until recently. Although the number of breeding birds increased in each habitat still waters continued to be the

Table 5 ***Percentage occupation of different types of habitat by territorial, breeding and non territorial swans in Scotland in 1983 and in 2002.***

	Habitat			
	Marine	**Canal**	**Still Waters**	**River**
Territorial only				
1983	16	0	59	25
2002	5	1	72	21
Breeding				
1983	10	1	80	9
2002	7	3	82	8
Non territorial*				
1983	47	0	39	14
2002	21	1	59	18

* Excludes Outer Hebrides: 1983 data not disaggregated by habitat type

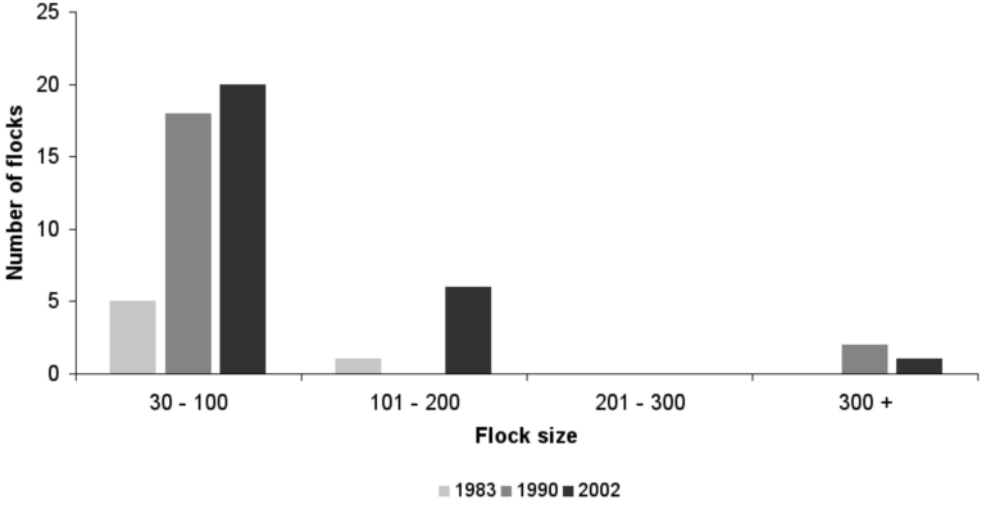

Figure 5 ***The number of flocks of 30 or more Mute Swans recorded during the national census in 1943, 1990 and 2002.***

Table 6 ***Numbers and percentages of Mute Swans which occupied 4 different types of habitats in north, centre and south of Scotland in 1983 and 2002.***

Area	Year	Habitat: Marine Number	%	Canal Number	%	Still waters Number	%	River Number	%	Total Number	%
North											
Territorial	1983	24	23	0	0	61	58	20	19	105	100
	2002	10	3	1	0	275	94	8	3	294	100
Breeding	1983	54	13	0	0	329	81	22	5	405	99
	2002	51	11	1	0	395	85	18	4	465	100
Non territorial*	1983	342	55	0	0	249	40	35	6	626	101
	2002	620	40	0	0	818	53	101	7	1539	100
Centre											
Territorial	1983	0	0	0	0	16	84	3	16	19	100
	2002	3	3	2	2	59	66	25	28	89	99
Breeding	1983	1	1	2	3	60	83	9	13	72	100
	2002	4	1	21	7	257	82	31	10	313	100
Non territorial	1983	79	44	0	0	80	44	21	12	180	100
	2002	146	11	43	3	1105	80	88	6	1382	100
South											
Territorial	1983	3	7	0	0	20	49	18	44	41	100
	2002	6	5	1	1	61	54	44	39	112	99
Breeding	1983	3	3	1	1	81	73	26	23	111	100
	2002	19	8	7	3	175	74	34	14	235	99
Non territorial	1983	92	33	0	0	94	33	97	34	283	100
	2002	43	5	4	0	321	37	489	57	857	99

*Excludes Outer Hebrides, counts not disaggregated.

most frequently occupied habitat amongst breeding swans. An increase occurred in the number of non territorial swans on marine shores from 79 to 146 and whilst non territorial swans were not recorded on canals in 1983 they were present in 2002. Increases were also recorded on still waters and rivers with still waters the most frequently occupied. The greater number of swans recorded on canals in the centre than in the north or south reflects a greater availability of canal habitat in the centre of Scotland.

Numbers of territorial swans increased in each type of habitat in the south but a substantial increase occurred on still waters. Similarly the number of swans which bred on each type of habitat increased but the preference for still waters was again evident. Results indicated a change in distribution of non territorial birds from marine shores to rivers and still waters between 1983 and 2002.

Table 7 ***Altitude of breeding and territorial pairs of Mute Swans in Scotland in 1983 and 2002.***

	Year	Altitude Mean	Range
Territorial Pairs	1983	58	3-259
	2002	61	3-335
Breeding Pairs	1983	45*	3-274
	2002	64*	3-366

* significant difference

Table 8 ***Altitude of breeding pairs of Mute Swans in the north, centre and south of Scotland in 1983 and 2002.***

Area	Year	Altitude Mean	Range
North	1983	27*	3-229
	2002	35*	3-287
Centre	1983	77	3-244
	2002	82	3-274
South	1983	90	3-274
	2002	106	3-366

* significant difference

The principal habitat for Mute Swans in Scotland was still waters with numbers of territorial, breeding and non territorial birds all increasing on that type of habitat since 1983. Additionally, large numbers of non territorial birds occurred on marine shores in the north and centre but on rivers in the south. Canal habitat increased in importance for breeding and non territorial birds in the centre.

Altitude

Analysis of altitude data was restricted to territorial and breeding pairs on still waters. This was due to the inherently consistent altitude of marine shore habitat, the inherent requirement for minimal altitudinal variability of canals while the altitudinal range of river territories was small. The mean altitude of still waters territories occupied by pairs which held a territory but did not breed and pairs which did breed increased between 1983 and 2002 (Table 7). In 1983 the mean altitude for breeding pairs was lower than the mean for territorial pairs which did not breed, however, results showed that by 2002 the converse was true. As the breeding population increased in number there was a significant vertical expansion in its distribution (t test, df = 1014, p <0.001). This increase was significant in the north (t test, df = 682, p 0.013), although it was not significant in the centre (t test, df = 98, p 0.547) or south (t test, df = 167, p 0.152) of the country (Table 8). The change nationally is apparent from Figure 6 which shows that in 1983 63% (n = 437) of pairs nested at an altitude up to 30m compared with only 47% (n = 829) in 2002. At sequentially higher altitudes the 2002 percentages were generally greater than those for 1983. Of the pairs which nested up to 30m in 2002, 70% bred at or below 15m (Figure 7) which indicated a preference for low altitude still water territories. That compared with 88% in 1983 which suggested that when the breeding population was low in number, and there were more vacant territories, breeding pairs had greater choice of territory and preferred to nest at a low altitude.

Although the north of Scotland contains some of the highest land masses and associated water bodies in Scotland the altitude of the highest pairs of swans were recorded in the south. Requirements in terms of vegetation for adequate shelter and a supply of food are determined by water chemistry and ultimately by the underlying geology which varies from the north to the south of the country. The highest breeding pairs during

2002 were recorded at 335m at Acremore Loch, Selkirkshire and at 366m at Kingside Loch, Roxburghshire. Swans recorded at an altitude of over 300m comprised 2 pairs which held a territory only, 4 pairs which bred and 4 non territorial birds, all of which were located in Peeblesshire, Roxburghshire and Selkirkshire.

Discussion

The Mute Swan population in Scotland increased by 41% between 1990 and 2002 to number 7,028 individuals, but as a percentage it was less than the 70% increase which occurred between 1983 and 1990. Similarly, the breeding population increased by 47% between 1983 and 1990 but by only 22% between 1990 and 2002. These findings suggest that, while the population may continue to increase in the future, the rate of increase may be slowing and numbers may be beginning to level off. Whilst large increases were found in the centre and south of Scotland those in the north, where 45% of the population occurred, showed relatively little change and may be closer to reaching an upper plateau. Construction of reservoirs for agricultural

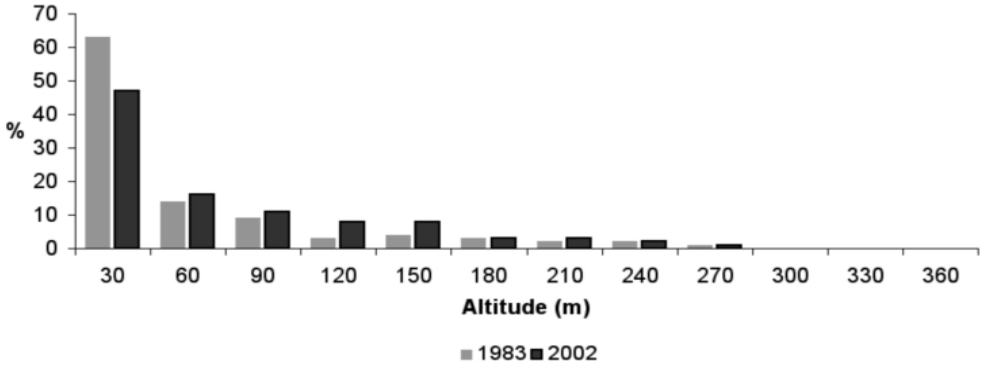

Figure 6 ***The percentage of breeding pairs of Mute Swans on still waters, relative to altitude, in Scotland in 1983 and 2002.***

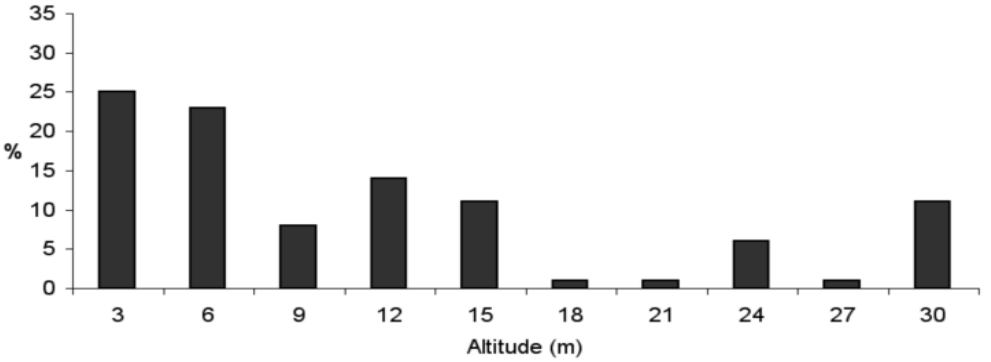

Figure 7 ***The percentage of breeding pairs of Mute Swans on still waters up to an altitude of 30m in Scotland in 2002.***

irrigation, as has occurred in the Lothians (pers obs), has provided additional still water territories for swans. A long run of mild winters with no recurrence of severe winter weather and high mortality which occurred for example in 1962-63 (Boyd & Ogilvie 1964) has also undoubtedly benefited the species. Autumn sown cereals and oilseed rape frequently provide sources of food during the winter in lowland agricultural areas. Changes at a more local scale may be related to cyclical fluctuations in vegetation growth as occurred with Canadian Pondweed in Orkney (Meek 1993). In addition, and in particular in the centre, the increasing swan population has seen flocks developing in urban areas where supplementary feeding by humans probably helps to sustain swans during spells of adverse weather (pers obs). A decrease in availability of food may be the outcome of increased processing of sewage waste water with discharges of relatively cleaner water at discharge points on marine shores.

As the population increased in number from 1983 changes occurred in the demography of the population. The percentage of the total population which was territorial decreased from 49% in 1983 to 39% in 2002 and conversely the percentage of the total population which was non territorial increased from 51% to 61%. A similar trend was identified in the Lothians during the same period (Brown & Brown 2002). The percentage of the total population which held a territory but did not breed remained little changed at 10% during the past 2 decades and was lower than the figure of 14% recorded in the Lothians with no significant change occurring there also (Brown & Brown 2002). The percentage of the total population which bred decreased from 38% in 1983 to 29% in 2002 which was similar to that in 1955-6.

Six flocks of 30 or more swans were recorded in 1983 (Outer Hebrides not counted), increasing to 20 in 1990 and 27 in 2002. Additionally, flocks of over 100 swans increased from one or 2 in 1983 and 1990, to 7 in 2002. Such a substantial reserve of swans suggests that an increase in the breeding population may be being constrained by a lack of breeding territories causing birds with the potential to hold a territory to remain in non territorial flocks. It may also be indicative of the species potential to sustain a large breeding population at least in the immediate future.

Increased numbers of non territorial swans were found on canal habitats especially in the centre of Scotland. Moreover, large numbers were found on rivers and marine shores which demonstrated the species' ability to occupy a range of habitats. Mute Swans are able to frequent and feed on marine habitats due to the presence of salt glands situated above the eyes which extract excess salt from the blood and excrete salt through the nostrils. However, still waters were found to be the principal habitat for territorial, breeding and non breeding swans across the country. That preference appeared to have been sustained by occupation of territories at a higher altitude than in 1983, and of the 1012 pairs which bred in Scotland 4 pairs bred at an altitude in excess of 305m, all in the Borders. Rawcliffe (1958) noted that of the 463 nests recorded in 1955-56, 3 nests were above 305m, all situated in the Borders. As the percentage of pairs which nested above 305m did not increase in line with the increase in the breeding population the vertical expansion of the population may in the future be constrained by lack of suitable territories.

Acknowledgements
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Appendix

Assessment of coverage in each county

The Great Britain survey methodology was based on a sampling approach including a random selection of 10 km squares. The aim of this was to ensure that results were not biased by observers only visiting those squares known to hold swans. However, in order to avoid asking too many observers to visit negative squares rather than squares known to hold birds, the selection of random squares was concentrated on all of those squares which held 50 or more birds in 1990 and those considered more likely to hold birds. Coverage of these squares had to be guaranteed for analysis of the Great Britain results.

In Scotland, however, as in 1983 and 1990, regional organisers were encouraged to ensure as full coverage as possible of their area. This entailed coverage of all of the randomly selected squares which required guaranteed coverage, all other squares which recorded swans in the 1990 census and coverage of all other squares known to

hold or with the potential to hold swans. On this basis it was considered that coverage would be thorough and all organisers agreed to undertake this process. The results as presented in this paper are based entirely on the actual data submitted and no estimates have been made of possible under recording. The regional organisers were asked to give an indication of the extent of coverage obtained and to provide their view on any trends they were aware of for the Mute Swan population in their area since the 1990 census, including breeding numbers and changes in or establishment of non breeding flocks. Where provided these comments have been referred to in the following county summaries, otherwise the summaries are based on an assessment of the level of coverage obtained and comparisons with previous surveys. To facilitate comparison with the 1983 and 1990 surveys coverage has been assessed as good, moderate or poor.

Shetland:
Good - Full coverage was obtained. Breeding first occurred in 1992 since when the population has continued to show a slow expansion with 3 to 5 pairs present. The 2002 results were the best ever count of breeding and non breeding birds. The origins of these birds may be from Orkney.

Orkney:
Good - Full coverage was obtained. The non territorial count for Loch Harray/Stenness (172) was mid May rather than mid April and this contrasted with a count of 491 birds there in March 2002. Allowing for breeding and territorial birds this suggests that ca 140-150 birds were missing. However, over 30 dead birds were recorded on the May count suggesting that there had been some mortality for whatever reason, which may have forced many birds to disperse elsewhere (Eric Meek, pers comm). The decline in the population at Loch of Harray & Stenness in 1992 (Meek, 1993) owing to the loss of the Canadian Pondweed (*Elodea canadensis*) food source was followed by further decline and then stabilisation at ca 175 birds until numbers started to recover by 1998 when ca. 420 were present (all counts in May) (Eric Meek, pers comm).

Outer Hebrides:
Moderate to Good - Nil return for Harris and Lewis where Mute Swans are rare vagrants (C Reynolds, pers comm). The local organiser regarded 2002 as a poor season in the Uists and Barra due to cold and wet weather which resulted in some birds not nesting at all due to high water levels. In addition stormy winter conditions are thought to have affected feeding and thus birds attaining breeding condition, as well as resulting in higher than usual mortality of young birds. Indeed it was felt that 2002 "was the worst and most unpredictable for Mute Swans in the Uists in 20 years". The appearance of late broods in July suggested that some pairs may have been overlooked in the remoter parts of North Uist and non breeding counts, other than for Loch Bee, were fewer than would have been expected. The overall impression was that the population was relatively stable with distribution similar to previous surveys.

Caithness:
Good

Sutherland:
Good - Full coverage was obtained.

Ross & Cromarty:
Good - Full coverage was obtained. The local organiser considered overall numbers of breeding pairs had remained stable or even increased slightly.

Inverness shire:
Good - Full coverage was obtained of all known squares containing breeding birds.

Nairn and Moray:
Good - All known breeding sites checked including vacant sites east of Moray which still appeared to be suitable.

Aberdeenshire & Banffshire:
Moderate to Good

Angus & Kincardineshire:
Moderate to Good - The regional organiser considered coverage was not as good as they would have liked. Additional data were obtained through the local recorder, Dan Carmichael, and this is thought to have filled in most of the gaps.

Perthshire:
Good - Full coverage was obtained.

Stirlingshire & Clackmannanshire:
Good - Full coverage was obtained.

Fife & Kinross:
Good - Full coverage was obtained with that in Fife being part of an annual census commenced in 1991 and which has shown a rapid increase in the territorial population (Brown & Brown, unpublished reports).

West, Mid & East Lothian:
Good - Full coverage was obtained as part of an annual census commenced in 1978. Both breeding and non breeding populations have increased steadily and reached their highest recorded levels in 2002. (Brown & Brown, Lothian Bird Reports 1982 to 2002).

Ayrshire:
Good - The Regional Organiser considered that the wet weather in the spring resulted in birds either not nesting or nests being abandoned due to high water levels, and sites checked in May which usually had pairs had been abandoned.

Arran & Bute & Cumbrae:
Good - Full coverage was obtained. The Regional Organiser for Arran commented that "all our swans are coastal and definitely on the increase. From one pair which bred successfully about 5 years ago, after a gap going back to war years, we now have 7 breeding pairs. The increase is due mainly to the establishment of a feeding station (at a hotel) at Whiting Bay". The Bute organiser stated that "there has nearly always been a pair of swans on most of the lochs on Bute, with a slight increase since 1990". On Cumbrae the organiser advised that "the number of breeding pairs on this island has fluctuated around the present figure for some time".

Peeblesshire, Berwickshire, Roxburghshire & Selkirkshire:
Good - Some additional data were received from the local recorder, Ray Murray.

Argyll and Islands:
Good

Dunbartonshire, Renfrewshire & Lanarkshire:
Good - Full coverage was obtained.

Dumfriesshire:
Good - Full coverage was obtained.

Kirkcudbrightshire:
Good - Full coverage was obtained.

Wigtownshire:
Good - Full coverage was obtained.

The eradication of Brown Rats from Handa Island, Sutherland

J STONEMAN & B ZONFRILLO

Burrow nesting seabirds declined after Brown Rats arrived on Handa Island some time after 1848. The eradication of Brown Rats in 1997 led to a rapid rise in numbers of some breeding seabirds while others increased their breeding areas or bred for the first time in living memory. The methods are based on modern commercial poisons and make the complete eradication of Brown Rats possible from the Scottish islands they have colonised, usually through the agency of man.

Introduction

Handa Island is located on the north west coast of Sutherland, just south of Cape Wrath, about 0.5km from the nearest mainland and is a privately owned nature reserve managed by the Scottish Wildlife Trust. It is internationally important for seabirds, holding the largest Common Guillemot *Uria aalge* and Razorbill *Alca torda* colonies in Britain and Ireland (9.4% and 8.6% of the British and Irish population, respectively), as well as having nationally important numbers of Great *Stercorarius skua* and Arctic Skuas *Stercorarius parasiticus* (1.9% and 1.0% respectively) and Black-legged Kittiwakes *Rissa tridactyla* (1.4%) (Handa Management Group, 1999).

Seabirds thrive on predator free islands but when predators such as American Mink *Mustela vison* or rats *Rattus sp* get ashore, breeding seabirds decline or desert completely and burrow nesting species in particular tend to rapidly vanish. (Craik, 1995; Zonfrillo 2002a & b)

The history of Brown Rats on Handa

Both the Brown Rat *Rattus norvegicus* and the Black Rat *Rattus rattus* are introduced species to most of Europe. Their origins are fairly well documented. In the British Isles the Black Rat arrived via ancient trade routes from China and South East Asia, probably around the eleventh century; the Brown Rat arrived much later, around the year 1728, via shipping from present day Russia (Corbet and Southern, 1977). While the Black Rat has largely died out, the Brown Rat has continued to spread. In Scotland, the Brown Rat spread at first rather slowly, and by 1855 even some remote areas had been colonised (Matheson, 1962). However, with

Map 1 ***Map of Handa showing place names and spread of Atlantic Puffins on the main island with dates of colonisation following eradication of rats in 1997.***

farming practices and shipping contributing to its spread, it is now easier to name areas and islands that have no rats than those that have.

It is not clear when Brown Rats first arrived on Handa, but they were certainly well established by the 1880's. There is no mention of rats by Charles St John (1849), who visited the island just a few weeks after the last permanent inhabitants left in 1848. He wrote of the tameness of the Atlantic Puffins *Fratercula arctica* that alighted so close to him, at the cliff tops, that he could have 'knocked them down with a walking stick'. The earliest reference to the presence of rats comes from Harvie-Brown and Buckley (1887) who blamed rats for reducing numbers of Black Guillemots *Cepphus grille* and for driving Atlantic Puffins 'off the tops at Handa into more secure crevices in the face and slopes'. In 1904 Harvie-Brown and MacPherson stated that rats 'simply swarm over the best ground' and again attribute rats for displacing Atlantic Puffins from the tops of the cliffs, compared to their visit in 1867. They also reported that Duncan McIver, a local to the area who accompanied them on their trip, commented that about 20 years earlier ie in the early 1880s, there were so many rats on the island that he was under the impression that they were 'migrating'. It therefore can be deduced that rats colonised Handa sometime between 1848 and 1867, a period when the island was farmed for sheep. Rats may have been introduced during transportation of animals and their feed from the mainland.

In 1962 Handa Island became a nature reserve, and from 1972 a warden has resided on the island each year from April to September. Wildlife observations from wardens' reports from 1974 to 1996 show that a population of rats persisted, particularly around the coast and at the Bothy, the only habitable building on the island. (See map)

Evidence for rats causing declines to seabirds

From circumstantial evidence Harvie-Brown and MacPherson (1904) suggested that Brown Rats were the cause for declines in Atlantic Puffins and Black Guillemots some time after 1867. In recent times, seabird monitoring since 1962 has shown that populations of most cliff nesting seabird species were either stable or increasing (Stoneman & Willcox 1995). A situation had been reached where Brown Rats were not causing further declines in seabird numbers, but were still impacting on the populations by inhibiting expansion, in the case of Atlantic Puffins, or recolonisation, for Black Guillemots and other burrow or hole nesting species. The absence of other ground or burrow nesting seabirds such as the European Storm-petrel *Hydrobates pelagicus* and Manx Shearwater, *Puffinus puffinus* in what appears to be suitable habitat, may also have been due to the presence of rats. In winter, with few birds present, it was highly likely that rats were sustained by feeding on the introduced Rabbits *Oryctolagus cuniculus* that were also confined to the coastal fringes of the island.

To make a scientific assessment of the possible impact that rats could be having on seabird numbers on the island, a 3 year research programme was initiated in 1994 (Aragundi 1994, Wardens' Reports 1994, 1995, 1996). A brief summary of the results of the research is listed below:

1 Rat distribution The rat population was almost exclusively based around the island's rim apart from at the only habitable house on the island, the Bothy. This was established by noting locations of latrines, runs etc and monitoring with chewstick[1] stations throughout the island. The incisor chewing marks on the sticks can thus establish the presence or absence of rats.

1. Chewsticks are wooden spatulas impregnated with melted lard or margarine and firmly fixed at ground level.

2 ***Effect on burrow or hole nesting birds*** Rats could find and decimate nests of ground nesting seabirds in any suitable breeding habitat. This was demonstrated by setting up a number of 'false nests', utilising chicken eggs, some waxed, some on a layer of fine, wetted peat, set up in apparent Atlantic Puffin, Black Guillemot and European Storm-petrel habitat. The predation of the eggs, indicated by tooth marks on the waxed eggs and footprints in the peat, revealed rat activity.

3 ***Other species*** There was no firm case that rats were affecting Northern Fulmar *Fulmaris glacialis* breeding success on the cliffs. This was deduced by observing the survival of chicks in different habitats. However there were no inland or ground nesting Northern Fulmars on Handa, as is common in Shetland and Orkney. Both species of skua appeared not to suffer from rat predation. There were few breeding waders and no large gull colonies.

4 ***Atlantic Puffins*** Puffins nested largely in rat free areas. Counting individuals above and below the cliff tops showed this. On offshore stacks, 94% of Puffins counted were found on the top, compared to just 6% of those recorded on the vertical main island cliffs.

Eradication

A campaign to eradicate rats from Handa was instigated and the anti coagulant poison, Warfarin, was chosen to eliminate the rats. Since rat numbers were calculated to be at their lowest from late winter to early spring, and is the time before many birds return to breed, this period became a window of opportunity to execute the programme. Eradication of the Handa Brown Rat population took place from 23 to 29 March 1997. The baiting team comprised 12 people; the authors, 2 members of Scottish Wildlife Trust staff and a team of 8 volunteers, including 2 skilled climbers. JS was also a member of the SWT staff at the time of the project.

Two tonnes of 0.05% Warfarin on a whole wheat base were brought to the island by boat wrapped in PVC and stored in a shelter on pallets ready for use. Baiters worked in groups of 2 to 3 and distributed the bait around the coast and at the Bothy ie where any rat activity had been confirmed. Maps were used to monitor bait distribution and to avoid duplication of effort.

Bait was put down burrows and under rocks thus avoiding any chance of secondary or collateral poisoning to birds. Two climbers delivered and distributed bait to areas otherwise inaccessible without ropes, especially at the base of gullies above the high tide line, where rats were likely to forage. Where there were no crevices or burrows available, or in areas used by Otters *Lutra lutra* for 'lie up' sites and holts, bait was placed under weighted plastic fish boxes, with the handles sawn out to allow rats to enter. One hundred kgs of bait was stored on the island for back up baiting.

Assessing impact

Following baiting, several aspects of monitoring were continued or initiated to assess the impact and success of rat eradication.

1. Presence of rats was monitored through chew stick stations set up around the coast and at the Bothy, a few weeks after baiting was completed.

2. Monitoring of Atlantic Puffins continued according to Walsh *et al* 1995.

3. New areas, if any, colonised by Atlantic Puffins were mapped.

4. Common *Sterna hirundo* and Arctic Tern *Sterna paradisea* populations and breeding success were monitored according to Walsh *et al* (1995).

5. Annual searches were made for breeding Black Guillemots.

6. A search for breeding European Storm-petrels according to Walsh *et al* (1995) was carried out.

7. A study of chick survival of Northern Fulmars was initiated.

8. Observations were made of other wildlife and changes that might be attributable to rats and noted in wardens' reports.

Results

1 Monitoring rats post 1997

Since 1997 no live rat has been seen on the island, though in 1998 the check in mid April showed strong evidence of 'rat like' activity at Port an Eilean and Chapel Bay, where chewing and 'rat like' prints were found. Bait was distributed in the area, after which there were no further signs.

Some activity at chewsticks after this period was thought to be due to young Rabbits. The absence of rat droppings and presence of Rabbit droppings alongside the chewsticks appeared to confirm this.

If by chance rats were getting ashore from the mainland their spread to the best areas of feeding might go unnoticed, at least in the short term. To address this, bait boxes were set up around the coast in 2001 to provide a permanent source of bait all around the island during summer. This complemented the monitoring system already in place. The warden regularly replaces bait during the summer months.

2 Atlantic Puffin monitoring and Puffin distribution

Atlantic Puffins had been monitored since 1977 by counting peak numbers of individuals in late July, both on the Great Stack and for the whole island. This method involved counting wandering non breeding birds as well as potential breeders and was changed when Walsh *et al* 1995 was published, which recommended that counts should be made in late April when only breeding birds will be at the colony. A steady increase in numbers since monitoring began was noted, and this has continued after rat eradication. However there was no monitoring of breeding success since burrows were generally inaccessible. Presumably many of the birds visiting in July, that were deterred from breeding by rats, can now be absorbed into the colony. Atlantic Puffin breeding numbers will now depend, for example, on food supply in future years and not in avoiding rat predation.

The expansion of the Atlantic Puffin colony was first recorded in 1999, when between 20 and 50 occupied burrows were counted on the main island immediately west of the Great Stack. This area remains occupied by Atlantic Puffins and further colonisations have been noted (see map). One new area was above a recent rockfall (1996) at the top of the west cliffs.

With Atlantic Puffins already breeding on the island, their expansion to new areas was rapid, in contrast to Ailsa Craig, Ayrshire where Atlantic Puffins took 10 years to recolonise (Zonfrillo 2002a).

3 Tern monitoring

Terns nest on Handa on the skerries at Port an Eilean, islets that are cut off from the main island at high tide. This is a relatively undisturbed area that is not generally frequented by visitors. Despite this, numbers of nesting terns had been generally low up to rat eradication with only 8 pairs of Common Terns, and 5 pairs of Arctics nesting. In 1988, 30 pairs of terns were reported to be breeding at Glas Leac, an adjacent small island but farther offshore. The maximum number of tern chicks known to have fledged since records started was 8 in 1990.

In 1998, the year after eradication, there was a marked increase in the nesting tern population with 58 pairs recorded, of which at least 25 fledged young. Since then the success of the tern colony has been variable (see Figure 1), but high numbers have been recorded in 1999 and 2001, when a new colony of Arctic Terns was

established at the west end of Traigh Shourie, a bay near Otter Point. The figures probably indicate that rat eradication has enabled the colony to thrive when conditions are good, but other external factors, such as food supply or weather, may be having an adverse impact on the colony in some years. Abandoned eggs show that they have not been predated. Longer term monitoring should clarify the situation.

4 Searches for Black Guillemots

Since rat eradication there has been no evidence of Black Guillemots breeding on the island. There were some indications that they were at least prospecting from 1999 to 2001, when birds were heard calling either nearby or in a cave at Na Geodaichean Dubha, a little visited area in the north east of the island. However, from 2002 to 2004 such behaviour has not been recorded.

5 Searches for European Storm-petrels

A European Storm-petrel survey in 1999 by A R Mainwood, conducted by playing recorded calls into burrows and crevices in apparently suitable habitat, failed to locate birds. However, European Storm-petrels have been mist netted in 2001 (BZ, JS and T P Daniels) and 2003 and 2004 (Highland Ringing Group). In 2004, 20% of the 96 birds netted had brood patches - one bird was a recapture from 2003. This suggests that European Storm-petrels might be breeding locally. In addition, European Storm-petrel remains were found in 4 Great Skua pellets in the same year (E Williams, *pers comm*). Further investigation is needed to confirm whether the birds could be breeding on Handa.

6 Northern Fulmar chick survival

In 1996 a simple Northern Fulmar chick survival monitoring plot was established at the cliffs to see if chick survival would improve following eradication. This involved counting chicks at the end of August, when the chicks were near to fledging. Chick survival appears to differ from year to year, for reasons as yet not understood. In the past, rats may not have found these chicks easy prey on their cliff sites; hence so far there is no apparent increase that can be attributed directly to the eradication of rats.

Other wildlife observations following the eradication of rats

- A pair of Common Shelduck *Tadorna tadorna* bred in 1997 and 1998; this burrow nesting species has never been recorded breeding on the island prior to this.
- Eurasian Oystercatchers *Haematopus ostralegus* and Ringed Plovers *Charadrius hiaticula* have bred successfully every year since 1998 - this was rarely reported before 1997.
- Sightings of Pygmy Shrew *Sorex minutus* have increased eg during 1998, 10 were counted; in the 10 year period prior to that, there were only 8 sightings in total. There is now a shrew family resident in or under the warden's accommodation.
- A pair of Common Redshanks *Tringa totanus* colonised Otter Point in 2001 and continues to breed there.
- Rock Pigeon *Columia livia* probably colonised the north east coast of Handa in 2001, although the breeding location has not yet been confirmed.
- A second colony of Mew Gulls *Larus canus* was established on the west side of Port an Eilean in 2002 and has thus doubled the island's Mew Gull population. (See Figure 2)

Discussion

Some species have increased in numbers or extended their breeding range on the island. Other species have arrived and bred successfully for the first time. Indigenous mammals such as the Pygmy Shrew, whose population was always low, have now become more common. The poison used to target the rats appears to have had no detrimental effects on breeding birds or any other indigenous wildlife. The techniques here used for eliminating and monitoring rats can also be applied to many

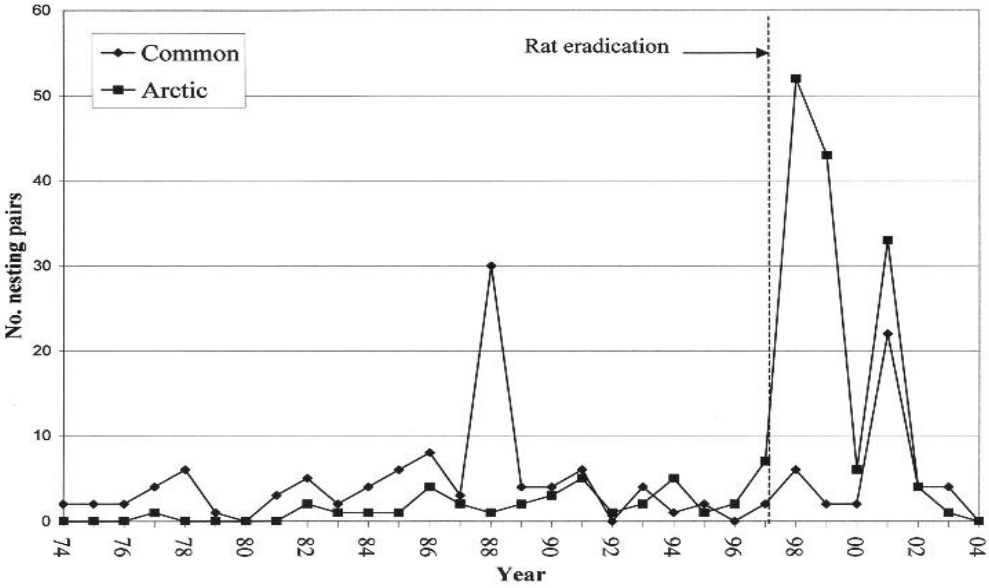

Figure 1 ***Fluctuation in breeding terns from 1974 to 2003.***

other small islands in Scotland. Other creatures and plants that may have been suppressed by the activities of rats will be monitored for the foreseeable future on Handa Island.

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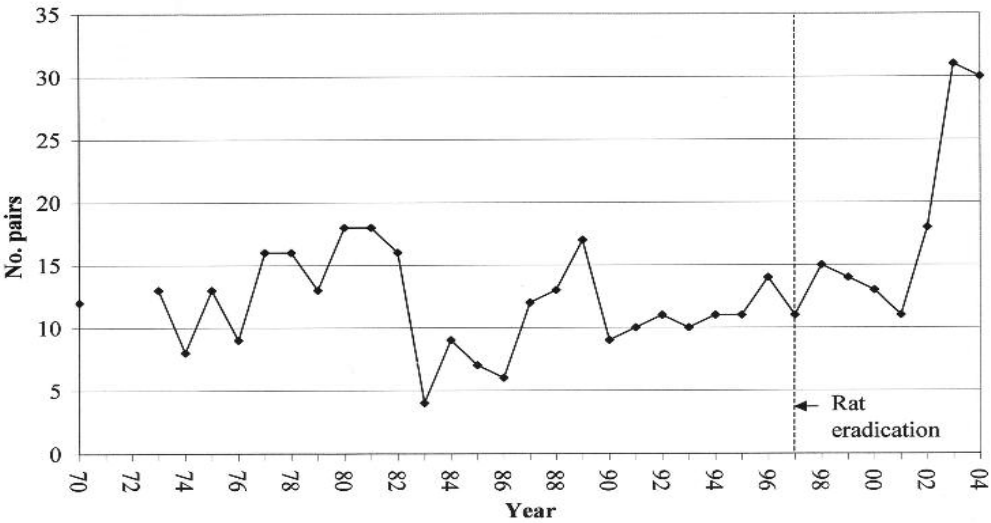

Figure 2 ***Fluctuation in breeding Mew Gulls 1970 to 2003.***

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Resident Golden Eagle ranging behaviour before and after construction of a windfarm in Argyll

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Resident Golden Eagle ranging behaviour was monitored over 776 observation hours before and after construction of a windfarm in Argyll, western Scotland between 1997 and 2004. Overall size of the eagle range that was potentially affected by the windfarm (for male, female and both eagles) was similar before and after construction. Eagles appeared to change their ranging to avoid the windfarm site. Once built the windfarm was over flown mostly when other eagles intruded on the territory. An area of plantation forestry was felled with the aim of mitigating the potential loss of foraging habitat to the windfarm, and drawing eagles away from the windfarm thereby reducing collision risk. Eagles were seen in the tree cleared area 3 times more often after felling than before felling, and the shift in ranging was away from the windfarm and in the direction of the felled area. These findings are from a single pair and should be used cautiously when applied to other, similar, situations. However, they are an important first step in understanding the likely effects of windfarms on eagles.

Introduction

In the UK in 2004, 253 MW of new, wind generated electricity was added to the national grid, 5 times the annual amount in the 1990s and double the 2003 figure. In Scotland, 11 schemes are under construction and due to come on line by the end of 2005. Many more developments are being planned in Scotland, and 70% of onshore schemes being considered for planning approval in the UK are located there (British Wind Energy Association 2004). Prospecting for new, commercially viable sites continues.

Scotland holds virtually all breeding pairs of Golden Eagles *Aquila chrysaetos* in the United Kingdom. Windfarms located within the range of Golden Eagles can cause eagle deaths due to collisions (Hunt 2002), and it has been thought that eagles may alter their ranging behaviour to avoid turbines, thus rendering the habitat within the windfarm area unavailable to foraging eagles. In Scotland these possible impacts have led to the adoption of a cautious approach to the siting of windfarms with regards to the location of territorial eagles.

A 46 turbine windfarm, the Beinn an Tuirc windfarm, was constructed during 2001 within an occupied eagle territory in Argyll. In addition, another windfarm, the Deucheran Hills windfarm, was built in 2001 (9 turbines) about 6.4 km to the north of the Beinn an Tuirc site, and is more peripheral to the home range of the eagles. To mitigate the potential habitat loss resulting from the Beinn an Turic windfarm, a habitat management plan was implemented that included forest clearance and management of existing Heather (*Calluna vulgaris*) moorland to increase the abundance of potential eagle prey (eg Willow Ptarmigan *Lagopus lagopus scoticus* and Black Grouse *Tetrao tetrix*). The creation of new areas of foraging habitat away from the windfarm was also thought likely to reduce the risk of eagle collisions with the turbines. An on going programme of eagle monitoring was

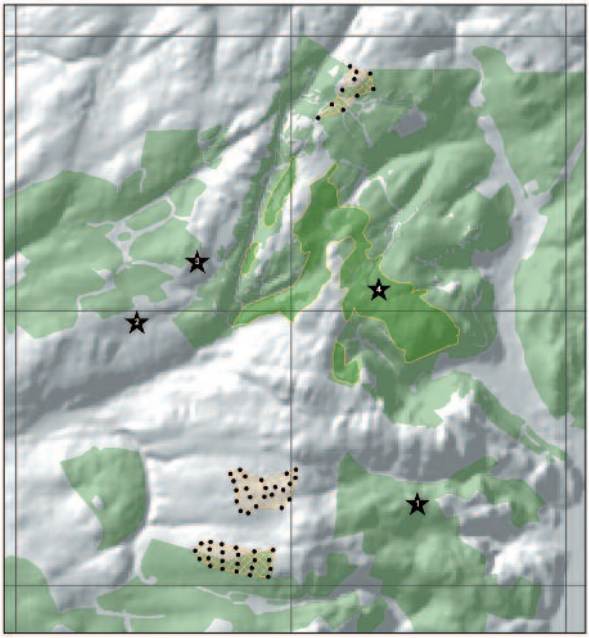
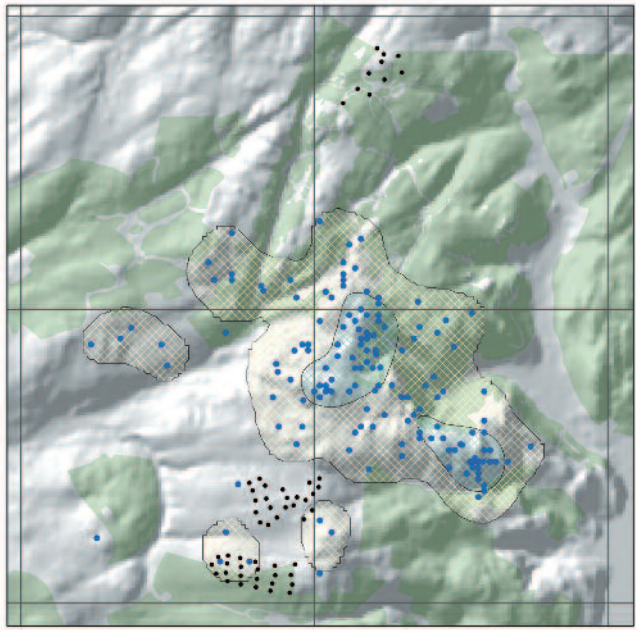


Figure 1 ***Study area. Grid lines are 5 km x 5 km.***

Figure 2 ***Kernel analysis of resident eagle movement (n=154) 1997-2004.***



undertaken from 1997 to assess effects of the Beinn an Tuirc windfarm and the habitat management plan on Golden Eagle ranging and breeding performance.

The Golden Eagle is a species of medium conservation concern in Britain (Gibbons *et al* 1996). In Argyll habitat changes that adversely influence foraging potential (eg upland afforestation and overgrazing of Heather areas) have affected territories adjacent to the one studied by us (Watson *et al* 1987). In spite of the similar loss of much land to plantation forest within the estimated eagle home range that includes the Beinn an Tuirc windfarm, there remains an extensive area of open land with modest populations of important prey species such as Willow Ptarmigan. Because of this the home range continues to be potentially viable for breeding eagles.

Study area

The Beinn an Tuirc windfarm (255 ha) and eagle monitoring area (ca 57 km^2) straddle the main ridge (Figure 1), which is generally below 300m above sea level, though there are peaks of ca 450m. The eastern slopes of this ridge, to a distance of about 3 km, are characterized by deeply cut valleys, with rock outcrops that provide a number of suitable eagle nest sites. To the west of the main ridge for a distance of about 8 km the terrain is gentler, characterized by wide, rounded ridges and shallow incised stream courses that run to the sea. This east west pattern extends both north and south of the study area.

Landcover within the monitoring area includes commercial forestry blocks, mostly Sitka Spruce *Picea sitchensis* of varying age, and open hill, dominated by grass and Heather; open areas include both grazed and ungrazed habitats, which are mostly acidic grasslands with some areas of shrub heath and areas of blanket bog on the higher slopes. Between October 1999 and June 2001 an area of forest (ca 280 ha) was felled to the north east of the main open area as part of the habitat management plan. Eagle monitoring focused on an area of ca 34 km^2 of open hill, which is bounded on the north and south by forest, but also includes ca 7 km^2 of open ridges within forest blocks to the north.

The diversity of natural fauna is limited, and a number of species, such as Mountain Hare *Lepus timidus* and Golden Plover *Pluvialis apricaria*, no longer occur locally as breeders. Mammals include small numbers of Rabbits *Oryctolagus cuniculus* around the fringe of the monitoring area, occasional Brown Hares *Lepus europaeus* towards its western edge, Sika *Cervus nippon* and Roe *Capreolus capreolus* Deer in the plantations and Foxes *Vulpes vulpes*. The birds are typical of upland areas in western Scotland (Ratcliffe 1990). Birds breeding on or using the area include diurnal and nocturnal raptors, Red-throated Divers *Gavia stellata*, small numbers of Mallard *Anas platyrhynchos*, Eurasian Teal *A. crecca* and Mew Gulls *Larus canus*. The forest avifauna is dominated by passerines such as European Robin *Erithacus rubecula* and Chaffinch *Fringella coelebs*, and corvids *Corvus* spp. Black Grouse are present in 3 to 4 areas of the younger plantations, but also occur on the open hill. The open hill holds a scattered population of Willow Ptarmigan, which are mostly associated with areas of Heather moorland. Small numbers of Common Snipe *Gallinago gallinago* and Eurasian Curlew *Numenius arquata* occur in grass dominated wet flushes.

The Beinn an Tuirc windfarm contains 46 – 660kW turbines that are divided evenly into 2 groups (north and south); within these groups the turbines are > 150 m apart. At its narrowest point the gap between the north and south areas is about 670 m. The Beinn an Tuirc windfarm itself is located in the central southern section of the

main block of open area with plantation forestry bordering its southern edge. Some plantation forestry (ca 50 ha) was removed to accommodate the southern section of the windfarm.

Human activity in the study area prior to windfarm construction mostly comprised shepherding on the open hill, deer stalking within the forests and ecological project survey work throughout the area. Forest operations, eg felling and planting, are ongoing, but the location, timing and extent of these are controlled, especially during the breeding season, to lessen potential impact on the eagles. Since construction, regular maintenance of the wind turbines has been added to the list of human activities in the area. Human visitor pressure on the open hill by hill walkers, both before and after construction, was very limited and mostly associated with accessing the highest summit.

Methods

Observations of eagle movements were made from 4 vantage points (VP). From these we monitored range occupancy, habitat use and foraging effort by the individual eagles, and collected information on eagle behaviour. Two VPs have been in use since 1997, a third was added in 1998 and a fourth in 1999. The Beinn an Tuirc windfarm area and main open area have been monitored since 1997; the addition of the last 2 VPs allowed us a better view of an area of forestry felled in mitigation of the windfarm. Collectively, the area viewed from the VPs comprises the eagle monitoring area, and VPs are located around the perimeter of this area so that the greatest continuous panorama is under observation, while reducing any potential influence of observer presence on eagle behaviour.

Observations were made 8 times per year (twice per quarter) from each VP between November 1997 and April 2004 except during March to December 2001, when fieldwork was curtailed by Foot and Mouth Disease access restrictions. Within each quarter all 4 VPs were visited; the order of visits was arbitrary. Weather could affect the area viewed from any particular VP and the duration of any particular watch period. Observation periods were chosen to avoid periods of continuous heavy rain, snow or dense fog, and ideally were 4 hours in length. Where possible, watches affected by poor weather conditions were extended to achieve 4 hours of observation time. While weather conditions could affect VP visibility they did not influence choice of VP, and all VPs were visited in a variety of conditions. While most watches tended to cover the middle of the daylight period, observations occurred at all times of the day. A total of 392 hrs of observation were made before construction, 68 during construction and 316 hrs after construction.

A single, experienced observer (DW) made all observations. The viewing area was kept under continuous observation for the full watch period by above skyline scanning without optical aids, binocular scanning of all areas and regular telescopic checks of known and potential perches. In so doing bias in observer effort towards specific locations within the viewing field was minimized.

When an eagle was seen, the time of first contact was recorded to the nearest second, and the bird's flight path was plotted on a paper map. Simple flights were synchronously plotted in the field, prolonged flights were plotted in sections that were drawn synchronously or nearly so, and fast or short flights were plotted immediately after they occurred. Final plotting of more complex flight lines was completed as soon as was possible after the watch period. In this way a complete activity log of eagle behaviour and location was kept for each VP session. An estimation of altitude above the ground (in range

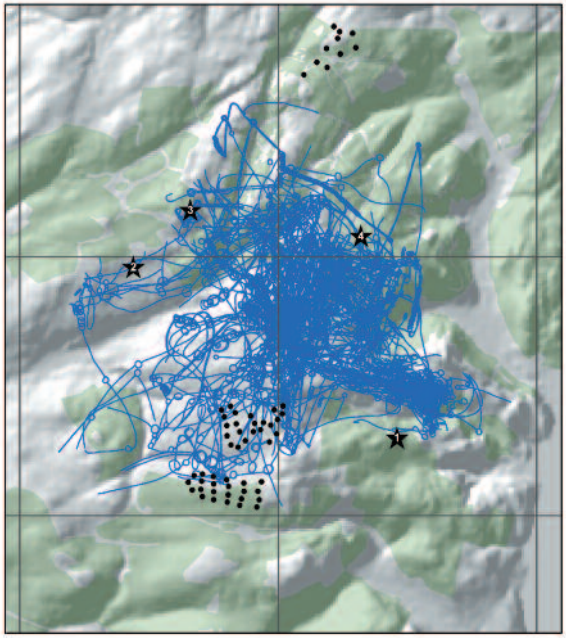
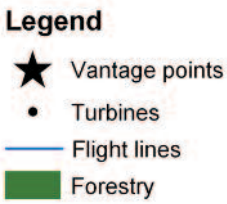
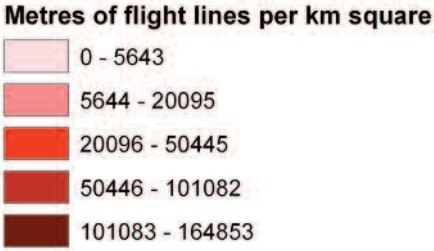
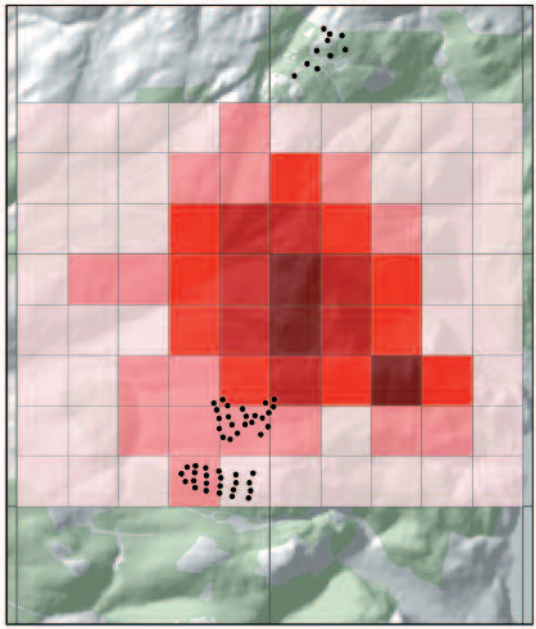


Figure 3 *Flight lines (left, n=811) of resident Golden Eagles (male and female). Grid (1 km^2) colour shows relative use by eagles (dark red=heavy use, light pink=light use).*







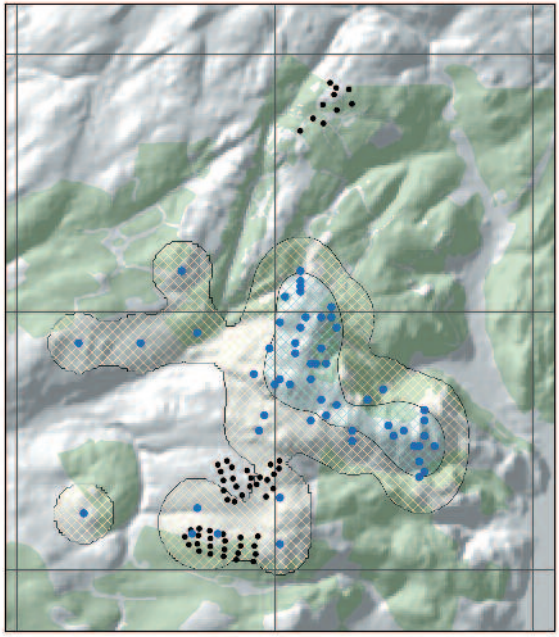
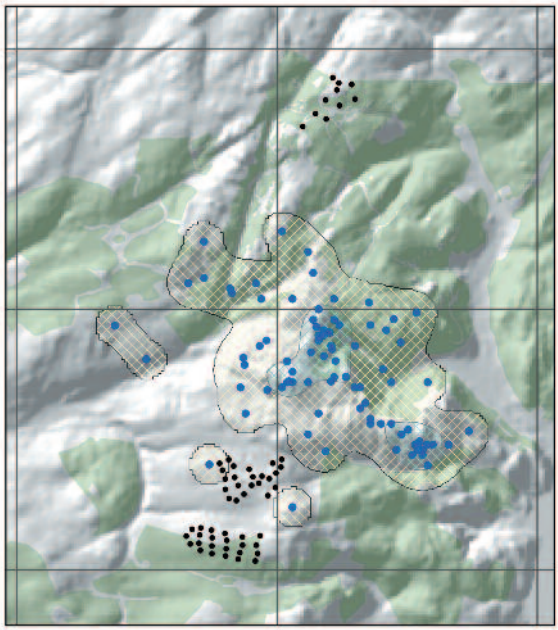


Figure 4 ***Kernel analysis of ranging of resident eagles (male and female) showing their ranging before (left, n=57) and after (right, n=83) windfarm construction.***



bands of <5m, 5-20m, 21-60m & >60m) and activity (hunting, transitional flights, species interaction, display, height gain and directional flights) were noted to the nearest second, as was the time when the bird either landed or flew from view. Factors that might influence eagle behaviour (eg human activity, presence of intruding eagles) were also noted. Even when more than one eagle was visible, all flights were followed, timed and plotted. No flights were excluded from the recording process and no assumptions were made about the route or activity of birds when they were intermittently lost from view.

Analyses of eagle ranging data

Two analytical approaches were taken, one based on generating a representative set of eagle locations and one that used a grid overlaid on eagle flight lines to calculate an index of use of km^2 areas by eagles. These were used to create maps that show location, extent and concentration of use by eagles. Data on eagle ranging and habitat were entered into a Geographical Information System (GIS, ArcView 3.3 and ArcGIS, ESRI, Redlands, CA, USA), where analyses and map making were undertaken using the Animal Movement (ver 2.0) extension (Hooge and Eichenlaub 1997).

Point analysis. We framed the area in which eagles were observed by mapping the maximum extent convex polygon, the vertices of which were the most outlying of observations of eagles. The maximum extent convex polygon probably overestimates the actual range, so we also used a randomised selection of points along mapped flight lines to generate a 'representative' set of eagle locations that could be analysed. Points along plotted flight lines were selected in a way that promoted randomness and independence, while enhancing sample size. To do this we randomly selected a single point along the flight lines for each 4 hour observation bout, then selected the sequence of points before and after that random point that were separated from that point and from each other by at least 45 minutes. Observations of radiotagged, territory holding eagles in western Scotland suggested that they can fly from one end of their range to the other in < 15 minutes (McGrady unpublished data), so the 45 minute limit we set is a conservative estimate of the time needed to achieve independence between points. These randomly selected eagle locations were then used to produce maps of area use for the resident male eagle, for the resident female eagle, and for the eagles as a pair. Two representations of eagle range use were employed that used randomised point data: the minimum convex polygon (MCP) (Mohr 1947) and an adaptive kernel analysis set at 95 and 50% levels (Worton 1989). The MCP maps extent of the random location's distribution and kernel analyses map likely use of areas by eagles based on the distribution of eagle locations over time. The 50% kernel predicts the centrally located area where eagles concentrate 50% of their time, and is used by us as a nominal "core area".

One to 6 observations of intruding eagles were made per year. These are not included in our analyses, but provide useful context for interpreting behaviour of the resident eagles.

Grid analysis. The study area was overlaid with a grid that corresponded to the Ordnance Survey one km grid. We then measured the total length of flight lines recorded from our direct observations that occurred in each square. Total length of flight lines per grid square was then mapped and used as a measure of eagle use.

We made comparisons of ranging before (prior to August 2000) and after (after January 2002) windfarm construction for the male, the female and the pair using the kernel analyses and the flight line information. By way of these comparisons we assessed the effect of the Beinn an Tuirc windfarm and the effects of the associated

tree felling and habitat management. Because data are from eagles within a single range, and likely to be the same individuals, robust statistical analyses could not be undertaken.

Results

A total of 776 observation hours were logged over 194 watches. Prior to construction 98 watches were made, during construction 17 watches, and after construction 79 watches. No eagles were seen during 60 of the watches.

Golden eagle occupancy and breeding

The home range was occupied throughout the study period, apparently by the same 2 adult eagles. The eagles used a different nest in each year until 2003 when that of 1998 was reused. The eagles laid 2 eggs each year except 2003, when a single egg was laid. A single juvenile was fledged in 1997. During the study period, productivity was 0.125 young per breeding attempt.

Golden eagle ranging

The maximum extent convex polygon in which eagles ranged covered 49.2 km^2; the MCP covered 32.9 km^2 (n= 154). Thirty two percent of the Beinn an Tuirc windfarm was overlaid by maximum extent convex polygon and 28 % was overlaid by the MCP. The 95% kernel of eagle ranging covered 20.5 km^2, and had 2 core areas (50% kernel) that were both outside the Beinn an Tuirc windfarm area and covered a combined area of 2.9 km^2 (Fig 2). The windfarm area was only overlapped by the 50-95% isopleth of kernel analyses of eagle ranging ie it was not included in the core area. Table 1 summarizes the areas of 95% and 50% kernels of eagle home ranging before and after construction and the amount of overlap between eagle ranging maps and the footprint of the Beinn an Tuirc windfarm. Eagle ranging kernels are illustrated in Figures 2-4.

Three randomised locations of eagles (2.56% of all locations) were over the windfarm footprint, two (1.7%) were over turbines, and all of these were prior to construction. Additionally, 3 locations were within 500 m of the windfarm and 2 of these were prior to construction.

Kernel areas for males were similar to those of females (Table 1). Also, for both sexes kernel areas were similar before and after windfarm construction, though the shape and spatial location of the ranges shifted, mostly east and north (Figures 5 and 6) after construction.

Table 1 ***Areas (km^2) within 50% and 95% kernels for eagles during the whole study period and before and after windfarm construction. Values in () are % of eagle range that overlap the windfarm.***

	N	50% area kernel	50-95% kernel	Total 95% kernel
Male 97-04	66	3.0 (0)	17.8 (4.4)	20.8 (3.8)
Male pre construction	27	6.1 (0)	19.3 (6.7)	25.4 (5.1)
Male post construction	37	2.3 (0)	15.0 (0.03)	17.3 (0.03)
Female 97-04	88	4.9 (0)	20.8 (3.7)	25.7 (3.0)
Female pre construction	30	4.7 (0)	20.6 (8.9)	25.3 (7.2)
Female post construction	46	3.8 (0)	19.7 (2.4)	23.5 (2.0)
All birds 97-04	154	3.2 (0)	20.9 (2.7)	24.1 (2.4)
All birds pre construction	57	5.2 (0)	20.7 (9.0)	25.9 (7.2)
All birds post construction	83	6.9 (0)	33.6 (0.5)	40.5 (0.4)

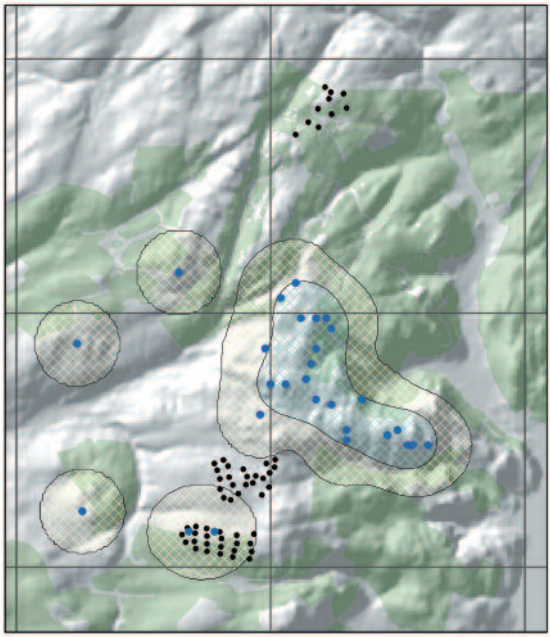


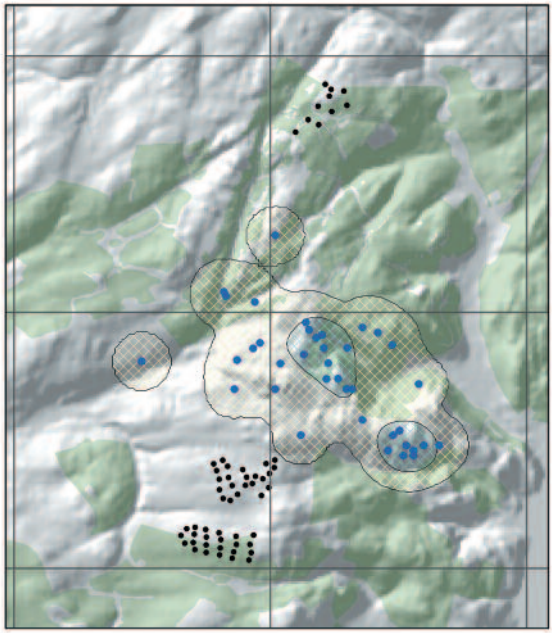
Figure 5 ***Kernel analysis of ranging of resident male eagle before (left, n=27) and after (right, n=37) windfarm construction.***

Legend

- Turbines
- Randomised eagle locations

Male eagle movement 1997-2004

- 50% Kernel
- 95% Kernel



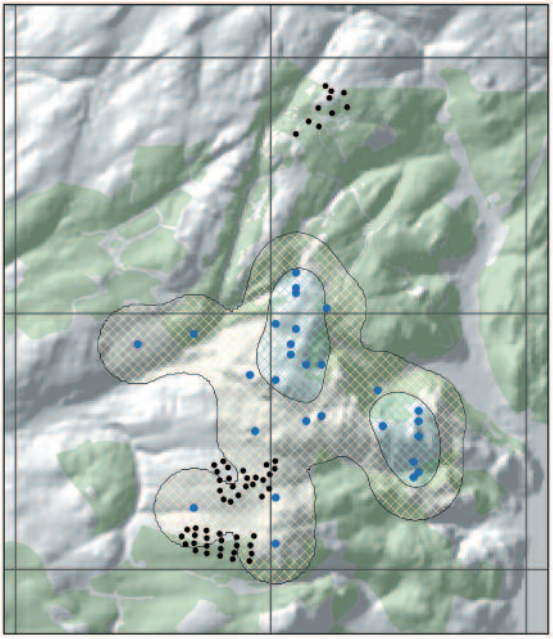


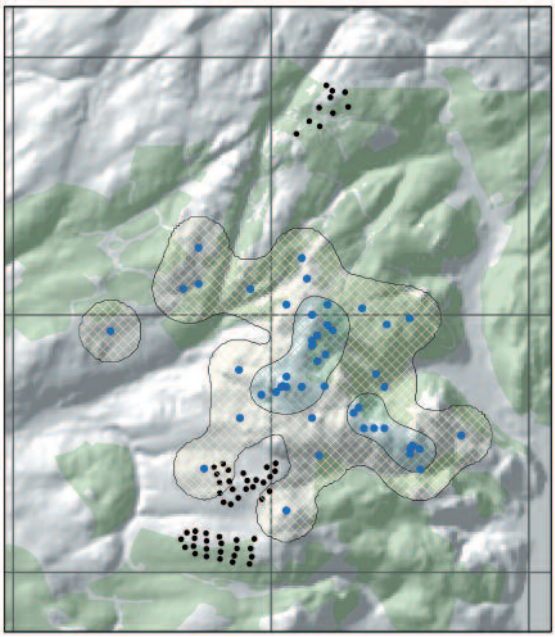
Figure 6 ***Kernel analysis of ranging of resident female eagles before (left, n=57) and after (right, n=83) windfarm construction.***

Legend

- Turbines
- Randomised eagle locations

Female eagle movement 1997-2004

- 50% Kernel
- 95% Kernel



A total of 811 flight paths were mapped. Only one eagle flight line was recorded at low to medium altitude (21-60 m) within the Beinn an Tuirc windfarm after construction and this passed between the 2 discrete clusters that comprise the windfarm. In that instance the nearby presence of an intruding eagle was almost certainly a contributing factor. No eagles have been seen within the turbine clusters. Two of 3 instances of eagles over flying the windfarm were when intruding eagles were in the area.

Seventy seven percent of randomised locations were over open landcover types. The percentages of locations over different landcovers suggest the following 'preference' by the eagles: heather moor>treefell>grass hill>forest. Eighty percent of pre construction randomised locations were over open landcover types; the value was 79% for the post construction period.

Regarding the area of forestry that was felled, 21.6% of random locations prior to felling (n=37), 3.1 % of random locations during felling (n=32), and 18.8% of random locations after felling (n=85) were within this area. Eagles flew 0.095 km over the forest area prior to felling per hour of observation and 0.285 km/hr of observation after felling, a three-fold increase in use. Figure 8 utilizes flight line data and shows relative use of different areas overall and proportion of use of each habitat polygon before and after tree felling. Over 70% of total eagle flight line length was over the central open area. Figure 8 illustrates that eagles shifted their ranging to the northeast after trees were felled.

Discussion

Impacts of windfarms on birds can include collisions (See Hunt *et al* 1999 and Hunt 2002) or loss of habitat (eg Leddy *et al* 1999). In this study, resident Golden Eagles appeared to avoid the windfarm within their home range except when responding to intruders south and west of the centre of the territory. Studies exist that show that birds (eg Osborn *et al* 1998) including raptors (Curry and Kerlinger 1998) will try to avoid moving turbines.

Physical accessibility does not seem to be what hinders eagle use of the windfarm. Turbines were separated by relatively large distances, larger than tree spacing in forested areas used by Golden Eagles (Tjernberg 1983), and the eagles we studied were seen hunting Willow Ptarmigan in open patches and rides within forestry smaller than those available within the windfarm (D Walker unpublished data). In combination with the fact that resident eagles continue to forage in areas comparatively close to the windfarm especially toward the centre of the range this suggests that eagles avoid the windfarm as a unit rather than individual turbines. While food densities are comparatively low within the windfarm footprint, current potential prey populations of Willow Ptarmigan, Common Snipe and sheep carrion (S Sheridan and D Walker, unpublished data) and previous use suggest that the eagles would still forage within the windfarm area if turbines were not in place. In particular, eagle foraging might be expected here at times of relatively high grouse availability, July-October, but this has not been recorded since construction. Also, the regular presence within the windfarm of corvids, upon which eagles prey, suggests that eagles may be excluded from the windfarm. Hooded Crows *Corvus corone cornix* are a comparatively common and easily taken prey species but appear to be safe from predation while within the farm. Rotor noise and movement or prey distribution, or any combination of these factors, may be influencing eagle movement. However, we had no impression that the windfarm was avoided less during periods when the turbines were not rotating (D Walker, unpublished data).

The kernel map of eagle ranging suggests that the windfarm may act as a barrier to some areas of the range for the eagles, however VP watches prior to construction did not suggest that the windfarm footprint was along any major transit route for the eagles.

The management plan for this windfarm included activities that potentially would reduce risk of collision by reducing prey availability within the windfarm. In addition, the enhancement of other areas for eagle prey was seen as providing new feeding opportunities for eagles. According to the grid based analysis eagles did appear to more frequently use an area where trees were felled to improve foraging potential. The random point analysis did not show this, though low sample size in the pre felling period could have caused this. Willow Ptarmigan numbers have increased here (S Sheridan unpublished data) since felling, and use of the area by eagles may increase further as prey numbers recover from being limited by blanket forest and their availability increases. This may further reduce the relative attractiveness of the land within and around the windfarm to eagles.

The relative use of different habitats by the eagles to some extent reflects their foraging potential. However, even within particular habitat types there can be variations in quality and prey carrying capacity. Still, so far the findings point to the Golden Eagles at Beinn an Turic being similar to eagles elsewhere and preferring open habitats to closed ones (McGrady 1997, McGrady *et al* 1997). In contrast, eagle use has increased in areas where managed tree felling occurred. The area where trees have been felled in mitigation of open ground lost to the windfarm notwithstanding, tree growth to canopy closure in other areas will restrict use by the eagles. McGrady *et al* (1997) show that eagles avoid areas of closed canopy forestry, probably because prey becomes less available.

Our impression from direct observations of eagles and cursory examination of pellets suggest that the eagles' most important food source is sheep carrion. It also appears that carrion availability varies spatially and temporally. Carrion hot spots are located in wet flushes on the eastern sloping open ground and the windfarm area, but there was no evidence of use of carrion within the windfarm area by eagles since construction. Most sheep carcasses are removed from the windfarm area when they are found, but some are not found and these have not been used by eagles (D Walker unpublished data). Carrion availability within the windfarm area has probably declined since construction. Rabbits, Willow Ptarmigan and Hooded Crows are the main live prey species we have recorded. This prey list is similar to that recorded for eagles elsewhere in western Scotland (Watson *et al* 1993).

Increased human activity can influence eagle behaviour (including breeding and foraging behaviours) and productivity (Watson 1997), and in general, eagles tend to avoid human activity. We have no data to suggest that increased visitor pressure has caused the eagles to change their ranging behaviour. Indeed, eagles did not go into the windfarm even when no people were there. However, we were unable to monitor eagle ranging at the site during construction when human activity was greatest because of access restrictions due to Foot and Mouth Disease. The windfarm is regularly visited by turbine technicians, shepherds and eagle project and other fieldworkers. None of these activities seem likely to cause reduced eagle use because they tend to be localised and relatively infrequent. It is possible that eagles are influenced more by human activity in artificial habitats (eg windfarms or newly felled forestry) than in natural habitats, but we know of no data to support this.

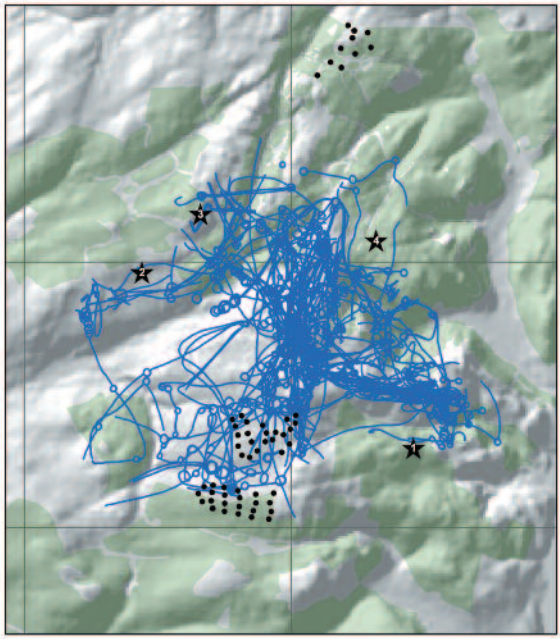


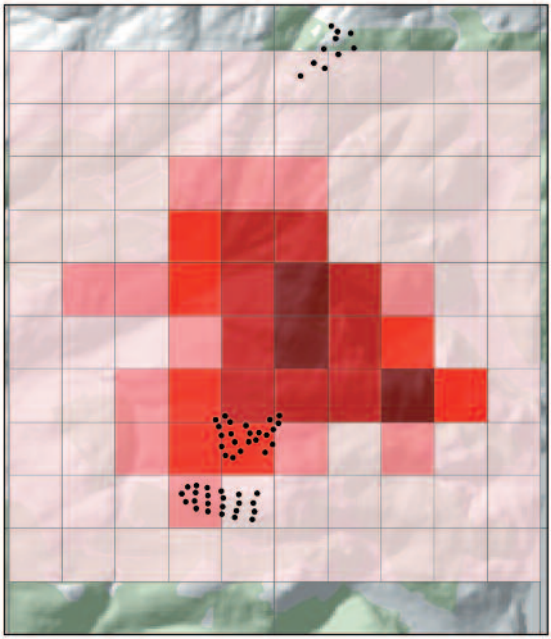
Figure 7a ***Flight paths (left), and grid of relative use of km squares (right) by Golden Eagles (male and female) before windfarm construction at Beinn an Tuirc.***

Legend

- Vantage points
- Turbines
- Flight lines
- Forestry

Metres of flight line per km square

- 0 - 5000
- 5001 - 10000
- 10001 - 20000
- 20001 - 40000
- > 40001



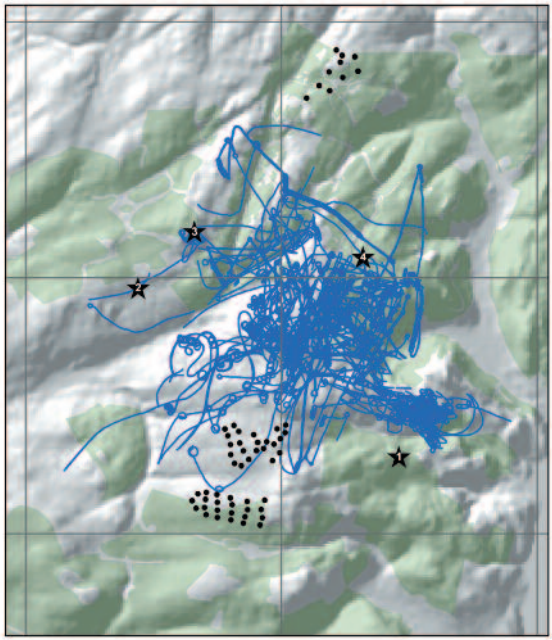


Figure 7b ***Flight paths (left), and grid of relative use of km squares (right) by Golden Eagles (male and female) after windfarm construction at Beinn an Tuirc.***

Legend

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- Turbines
- Flight lines
- Forestry

Metres of flight line per km square

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- 5001 - 10000
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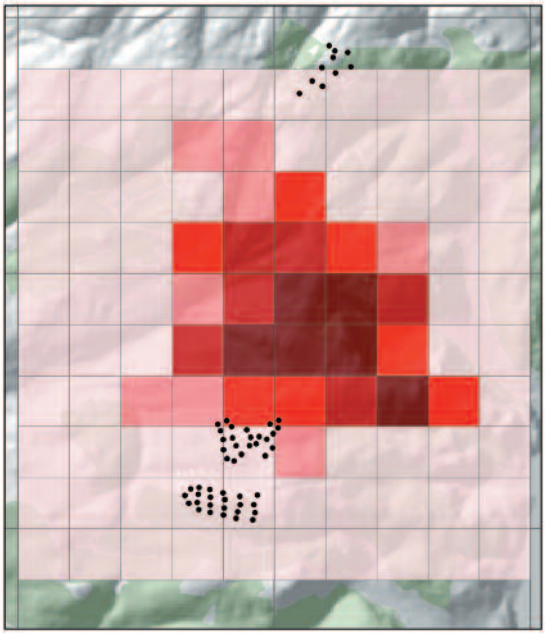
- > 40001



Intruding eagles were mostly recorded outside the breeding season over the main area of open ground and the tree felled area (D Walker unpublished data). When detected, the resident pair routinely intercepted intruding birds, even when they were towards the fringe of their range, with interactions usually consisting of the resident pursuing the intruder, sometimes with apparently aggressive approaches. In general locations away from the territory centre were associated with territorial defence behaviour, especially by the male (eg Figure 5, western edge of left map), and these added greatly to the size of the range that we mapped.

Different methods used to map animal movements have different advantages and shortcomings (Kenward 1987). We present different mapped representations of the same data to partially overcome this problem. Also, although these data are from a single pair, the number of observations (811 flight lines) is large, is spread over different seasons over 7 years, and this lessens the impact of the shortcomings of the range mapping methods.

Golden Eagle occupancy has not changed during the study period. Overall productivity of this range is 0.44 young per attempt (n=28, M Gregory, unpublished data), compared to an Argyll mean of 0.66 (1992, 96, 99-2004, Argyll Raptor Study Group, unpublished annual report 2004) and a Scottish mean of 0.52 (Watson 1997). Although productivity during the project was only 0.14 young per attempt, there is no evidence that links this low reproductive rate to windfarm construction or operation activities. Declines of this magnitude have been recorded in other ranges in Scotland where no windfarm, or indeed other change, has occurred, though we know of no published information that illustrates this. Rather, it seems that this home range has been relatively unproductive in recent years (only one chick since 1988), and this may be a result of the range viability already being challenged by the expansion of forest (Watson *et al* 1987) and the impoverishment of the flora and fauna that has occurred (Thompson *et al* 1995). We have verified the presence of the adult territorial eagles every 2 weeks, and no eagles, territorial or non territorial, are known to have been killed by colliding with the turbines. There is no indication that the resident eagles have become accustomed to the windfarm area and are more likely to use it as time passes. It remains likely that any fledglings reared at the site, intruders, or new 'naïve' replacement breeders are at greatest risk of collision.

Because tree clearance roughly coincided with the construction of the windfarm, it is difficult to say to what extent eagles responded to the clearance rather than the windfarm. However, the avoidance of the windfarm since construction suggests that the existence of relatively open areas within the windfarm is not sufficient motivation to attract eagles for foraging. Further, if the shift to the north east is a result of windfarm avoidance, then it suggests the eagles, at least at Beinn an Tuirc, 'prefer' recently felled forest areas to the windfarm.

Interestingly, though there was an overall shift to the northeast, there was no real shift in the location of the core areas. These remained in the open area that has never been under forestry to the northeast of the windfarm between blocks of forestry. This result is likely influenced by the location of the nest sites, but supports the idea that these areas are particularly important. If this relative inflexibility in location of the core area is a feature of eagles elsewhere identifying the core area and protecting it may be particularly important. Guidance by Watson *et al* (1987) and modelling of eagle ranging (McGrady *et al* 1997, McLeod *et al* 2003a, 2003b) have established nominal core areas for eagles, but these are criticised as being too simplistic, and are a point of contention between developers, conservation organizations and government agencies. More

data are needed to clarify the impact of windfarms on eagles, and it would be useful if data collected at windfarm sites elsewhere in Scotland were made available for collective analyses.

Acknowledgements
The authors would like to thank Mike Gregory and the Argyll Raptor Study Group for use of data on eagle productivity. Scottish Power funded data collection. Saya Sheridan provided information on habitat and prey within the windfarm management area. Steph Carey-Miller of Natural Research (Projects) provided GIS support. The Central Kintyre Management Group has provided a forum for interesting discussions on windfarms and their effects on eagles, and encouraged us to publish the results.

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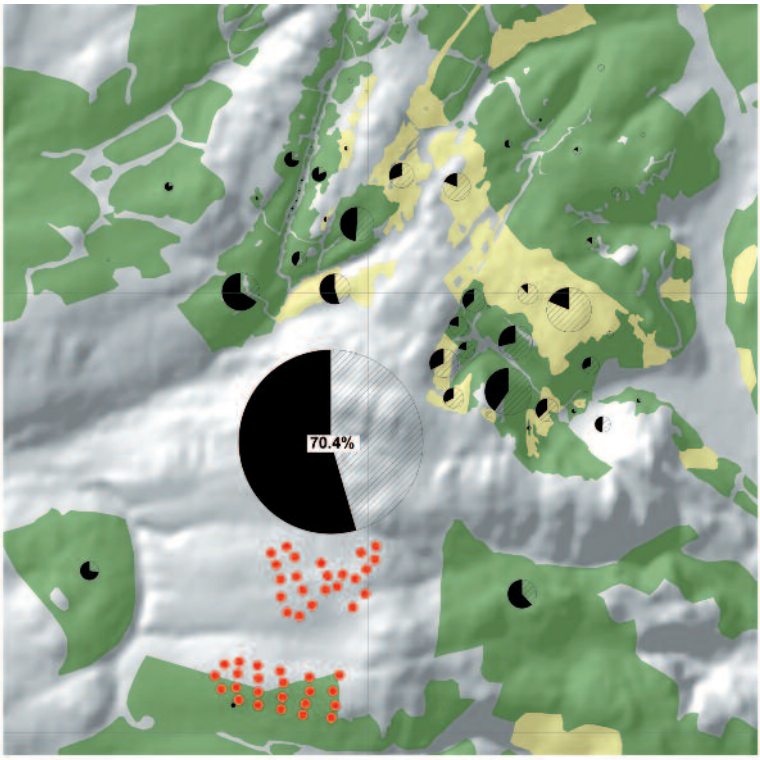

Figure 8 ***Use of habitat by Golden Eagles at Beinn an Tuirc. Size of pie chart shows relative use of habitat polygons for the whole study period, dark portion is percentage use before tree felling, and hatched portion is percentage use after tree felling.***

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The biology of a population of Willow Warblers in East Fife

J L S COBB

The breeding biology of a population of Willow Warblers in East Fife was investigated using colour ringing. Post fledging dispersal and return in following years is described. Nestlings fledge at 14 days old and are looked after by the parents for another 10 days. They then disperse locally for another 3 weeks before beginning a gradual migration south. The national ringing data is used to corroborate the findings in this study as well as to speculate on the further migration of this population. Nearly 200 nestlings have been found the following or later breeding seasons and the distribution of these returns is described.

Introduction

The population of Willow Warblers *Phylloscopus trochilus* in a wood in north east Fife has been studied from 1987 to 2004. The main aim of the study was to describe in detail the numbers, behaviour and the use of the habitat by this species throughout the breeding season in the entire wood. This data set would then allow the effectiveness of a Constant Effort Project carried out in about one fifth of the wood to be assessed (Cobb in preparation). A Constant Effort Project is a BTO scheme to use ringing to monitor populations.

Study area and methods

Kippo is an area of about 40 hectares of mixed woodland and moorland. There are significant gaps in the mixed wooded areas and hundreds of metres of wide rides in the conifers. Two artificial ponds have been created. Kippo Wood is entirely surrounded by arable land with little in the way of shrubs and trees for at least 1.5 km in all directions. Birds were also ringed in Redwells Wood 2 km south of Kippo and near Crail, 6 km SE.

At the population peak, there were about 85 Willow Warbler territories packed into this area. The Willow Warblers in the Kippo population are almost all of the brown and white morph with little yellow except under wing. In autumn a higher proportion of the passage birds have much yellow colouration.

In all 8,750 Willow Warblers have been handled during this period and all caught before the first week in August have been individually colour ringed. Observations and ringing were carried out daily for much of the duration of the study. About 80% of Willow Warbler territories over a 5 km radius were checked for singing males during May and 680 Willow Warblers were ringed at 2 sites – Redwell, 2 km south and Crail, 5 km south east - during the period 1994 to 2003. As many broods as possible were ringed after 1994, a total of 2,200 nestlings. Most nests were on the ground but a small number nested in Spruce trees, one 4m above the ground. Between 1994 and 1998 each brood carried a unique combination of colour rings but in 1999 - 2003 nestlings only received a single year colour but were individually colour ringed if subsequently retrapped after fledging.

Birds were sexed on wing length (Svennson 1984) and adults, if appropriate, by cloacal protuberance or brood patch and in some cases by behaviour or song with targeted individuals. There has been an undoubted male with a wing length of 64 mm and at least 10 females with a

wing of 67 mm. Birds with wings of 65 and 66 were left unsexed unless other evidence was available. There is a discrepancy of the sex ratio in juveniles with apparently up to 30% more females. It seems most likely that changes in wing length in a proportion of recently independent young account for this apparent imbalance in the number of females caught and suggests that care needs to be exercised in sexing juvenile Willow Warblers until post juvenile moult is virtually complete.

The national ringing recovery data up to 1996 was made available by the BTO and this was used in conjunction with the local study, in particular to try and assess onward movement of juvenile Willow Warblers during autumn migration.

Results

In all 727 nestlings were retrapped after fledging, some of them up to 4 times and 187 have been found on territory in subsequent years. Nestlings usually stay close to the nest for at least a week to 10 days after fledging normally at 14 days old. In rare cases, they may be moved by the parents into thick cover up to 200m from nests in exposed or vulnerable sites. They sit in thick cover and are usually fed by both parents. Some young leave the nest as early as 12 days old and can disperse on the ground where they are fed. At about 10 days after fledging the parents leave the young to fend for themselves and at this time they start post juvenile moult. Young birds begin a gradual dispersal away from the nest site (Figures 1 and 2). It may be that the direction of dispersal is partly dictated by the local topography but it appears largely random and in all directions. In Kippo, many of the catching sites are at the south end and this produces a strong bias in direction. Both nestlings and recently fledged young were also ringed at Redwells, 2 km south of Kippo. Some of these birds were found in Kippo during dispersal indicating that at least some birds do briefly move north. In mid Scotland this phase of local dispersal lasts for about 3 weeks when post juvenile moult is about half completed. They may during this time form flocks of various sizes and at times be mixed with other species - particularly tits (*Parus sp*) and Goldcrests (*Regulus proregulus*). Figure 3 plots the movements of juvenile males and females separately. The rates and pattern of dispersal are very similar for both sexes. There is also a tendency for birds from the same brood to keep together during this period (Figure 4). Two sets of 2 birds from the same broods were still together 3 weeks after fledging 6 km away. Analysis of the national ringing data showed that there are few records of young Willow Warblers moving more than 10 km to the north anywhere in the UK in July.

Between 45 and 50 days from hatching (31 to 36 days from fledging) local Willow Warblers begin a gradual movement southwards starting in the last week of July. Figure 5 plots the hatching dates for all Willow Warblers. The peak is about 6 June and these start to leave the area on average 45 days later - about 21 July. There are differences between years of up to 10 days in average hatching date and replacement broods up fledge up to 10 July (Figure 6). At Kippo 2 females deserted their broods and nested again leaving the initial rearing of the fledglings to the male alone. Only 3 other second broods have been found, these fledged in the last week of July.

Observation and ringing have revealed Willow Warblers moving in late afternoon across country on a broad front at a relatively low level rather than at heights associated with long distance migration. Each year in the last week of July and for at least the first half of August this movement is particularly obvious in open arable farm land in this part of Fife when birds arrive at isolated patches of vegetation. At nearby Fife Ness where daily observations were made

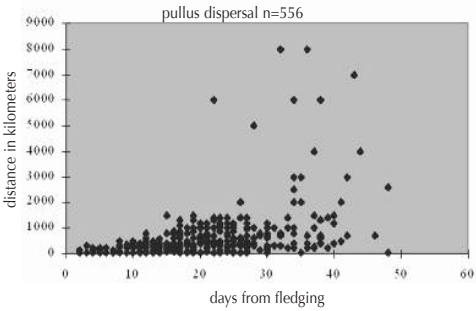


Figure 1 ***Distance of dispersing of fledglings from the nest. Up to 31 days (45 days from hatching) nearly all records are less than 1500m which means they were captured within Kippo wood. After about 35 days (49 from hatching) captures increase outside Kippo (more than 1.5 km) and the number of records in Kippo drops away.***

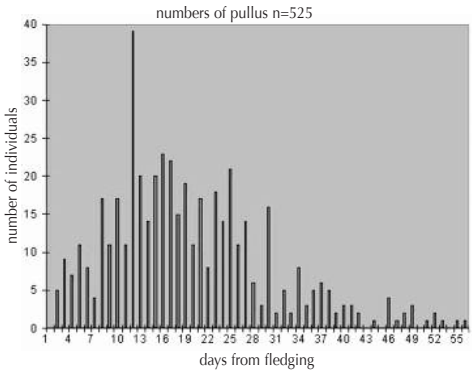
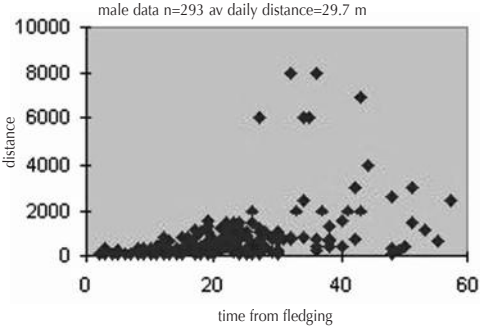


Figure 2 ***Captures of fledglings during dispersal. In the first 10 days after fledging nestlings remain fairly sedentary. At about 31 days after fledging (45 after hatching) the numbers again start to drop away as the birds leave Kippo to begin migration.***



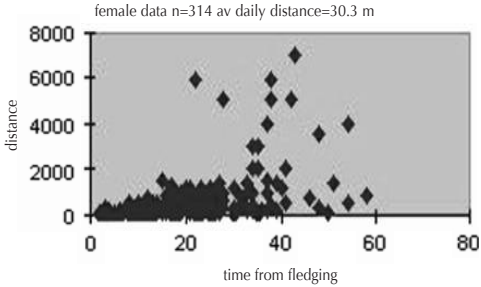


Figure 3 a-b ***Rates of dispersal compared between young male and young female Willow Warblers. Both the rate of dispersal in metres per day and the pattern of dispersal are very similar. Records over 1500m are outside Kippo.***

during August there was no evidence of 'coasting' and Willow Warblers are scarce. The Isle of May, 7 km off the coast, does record larger numbers of Willow Warblers than Fife Ness during August. These are also likely to be Scottish birds as they are not associated with weather conditions that produce drifted continental birds. The regular occurrence of these birds suggests a daily southwards short distance movement of Scottish Willow Warblers. Nearly all birds caught during these movements have been juveniles.

By the beginning of August most locally bred Willow Warblers have left Fife. By then most of the adults have completed a full moult and are also leaving (Figure 7). Very few adults known to have bred locally are caught during August.

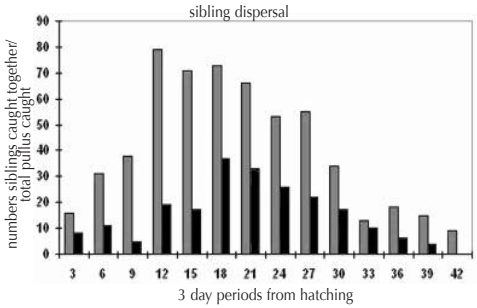


Figure 4 ***Significant numbers of siblings are caught together during the post fledging dispersal period. The proportion and pattern of siblings caught together mirrors the accompanying plot of all pullus caught.***

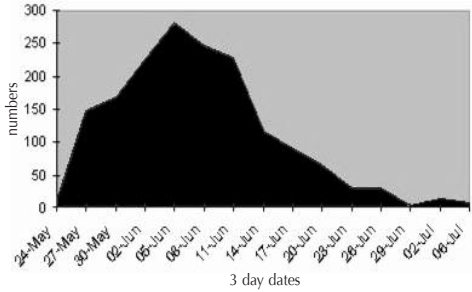


Figure 5 ***Average hatching dates over the years of the study. The peak date is 6 June and the earliest recorded is 25 May. Replacement broods occur throughout the rest of June and into the first week in July. Not shown are 5 second broods at the end of July.***

Willow Warblers in Kippo during August are likely to be largely from farther north; though national recoveries are few they confirm the more northerly origins of these birds. Birds move in the late afternoon and in some years form very large feeding flocks with other species during the morning. Large numbers of juveniles in these flocks were dye marked. However, these birds were never resighted nor were ringed birds caught on subsequent days. No birds trapped at Kippo in August or September showed any significant accumulation of fat.

Onward movement evaluated from the national data

This study has produced only 2 long distance recoveries of birds in autumn. The national data was used to investigate the early part of autumn migration. All juveniles and nestlings ringed in the UK up to 1996 recovered in the same year were used. There is good evidence from this study that juvenile Willow Warblers in Scotland do not migrate until about 45 days from hatching. The hatching date in the Kippo study averaged 6 June which gives a departure date of 21 July. This formula has been applied to all birds ringed north of a line from Cheshire to the Wash but south of the Highlands. For birds ringed south of this a departure date of 14 July has been used and for birds ringed in the Highlands of Scotland a date of 28 July. Nestlings were assumed to be 8 days old at ringing. Using these approximate departure dates instead of the date of ringing, rates of movement were found of 17 km/day for the southern birds, 20 km/day for south of Scotland - northern England birds and 27 km/day for Highland birds. Two nestlings from Kippo were controlled in the same autumn from the south coast; applying the formula for middle UK to these Fife birds gives a daily movement of 19.5 and 20 km a day - which fits very nicely!

Return in spring

There were 187 recoveries of birds ringed as nestlings in Kippo returning the following year (106 males and 81 females). A further 91 juveniles ringed in Kippo before the end of July, and thus likely to be local birds, were also found in subsequent years breeding in Kippo. In all 170 of the nestlings returned to Kippo itself and 17 to sites up to 9 km away. Over 6 years territories were examined over a radius of up to 9 km and 830 territorial males were located, of these 9

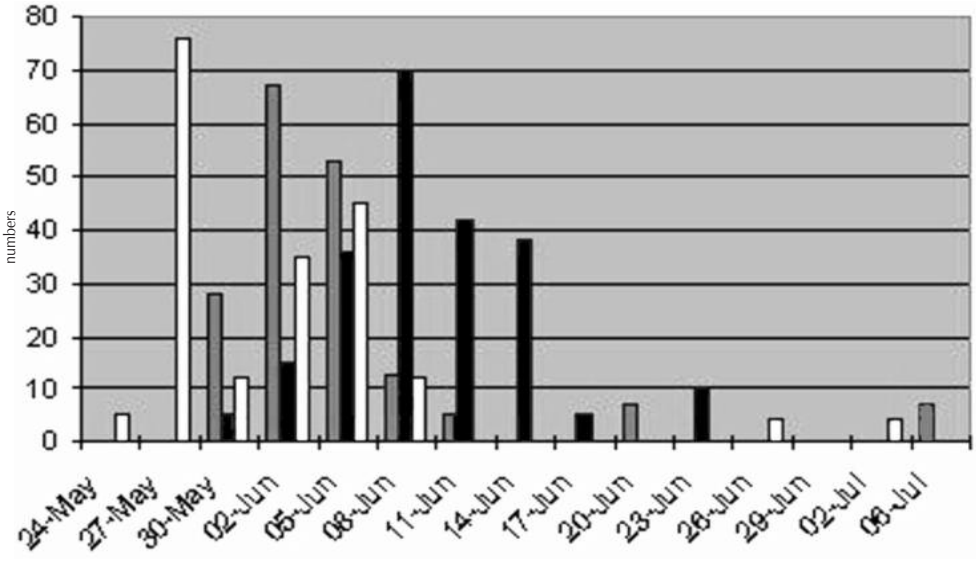


Figure 6 ***The hatching dates for 3 successive years to show variability. The peak in 1997 was exceptionally early at the end of May and 1996 was a year when the females arrived really late and the peak was not until the 9 June. 1995 was a more typical year. Presumably dispersal in any year is related to fledging date.***

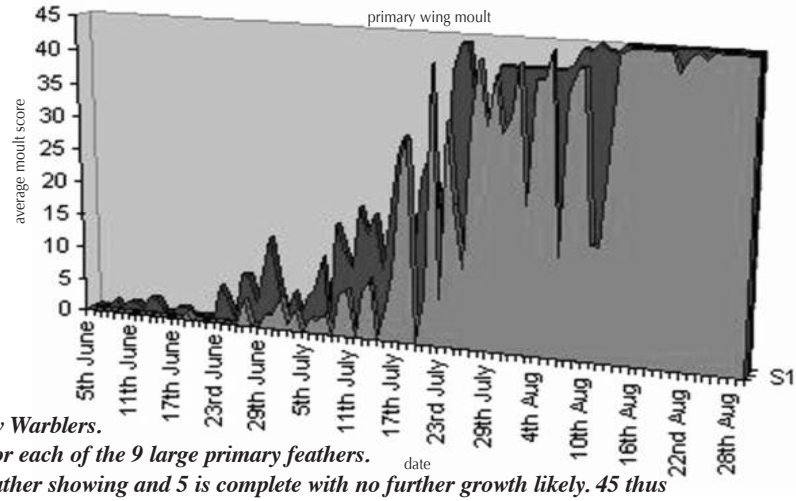


Figure 7
Moult in adult Willow Warblers. Moult is scored 1-5 for each of the 9 large primary feathers. 1 is in pin with no feather showing and 5 is complete with no further growth likely. 45 thus represents complete moult. Males start moult before females and most have virtually finished by the beginning of August when they leave. Female moult is later and many females replacing lost broods delay the moult as do the females that produce rare second broods.

were Kippo nestlings; 189 adult females were caught over the same area during the breeding season with active brood patches and 6 of these were nestlings from Kippo. A juvenile ringed in Kippo when recently fledged was recovered the following year as a breeding female 9 km away. A juvenile male in Redwells on 22 July was controlled the following July at Loch Leven, presumably breeding, and until 2004 was the only record of a bird that might be breeding well away from its natal site. However it is possible from the date first caught that this bird had dispersed relatively early from the Loch Leven area when caught.

The national ringing data

In an analysis of the national ringing data it was assumed that any adult bird is on territory between 1 June and 15 July in any year, the 6 week period is deliberately conservative. It is true that many caught in May and the second half of July were also on breeding territories. Adults that have been ringed in this 6 week period and found in the same period in subsequent years show almost no evidence that they move sites in later years. Birds initially ringed in the nest or juveniles ringed before they start migration (birds ringed before 15 July south of a line from Cheshire to Wash, before 21 July for regions between this line and south of the Grampian Mountains and 28 July for further north) and found in the 6 week period in subsequent years, show virtually no evidence of a return to anywhere other than a few kilometres of their natal site in subsequent breeding seasons.

Return of Kippo nestlings

In all 68 of the nestlings that returned to Kippo the following year to breed had also been caught after fledging as free flying juveniles. It is therefore possible to compare the distance between the nest and the juvenile capture site and the nest and the adult territory. This shows that there is a statistically significant correlation between juvenile capture site and its adult territory; this is the subject of a separate paper (Cobb and Gil in preparation.) A plot of return sites within Kippo for both males and females shows adult territories are evenly distributed between 100m and the maximum possible within the wood of about 1,500m from the natal site, (Figure 8). There are 10 males and 8 females (out of 170 nestlings returning) that came back to hold territory within 200m or less of their birth site. There have been no recorded cases of parent sibling incest. With the exception of a single female in this study all adult females and adult males have always returned to their previous territory. The same pairs have been recorded breeding in successive years.

There are also a number of multiple returns of broods from the same nest. There have been 2 brother sister pairings; both successfully fledged young. Two sets of 3 brothers returned to exactly the same area; in one set the 3 arrived back to exactly the same song post over 3 successive days; they were all immediately displaced by up to 500m by the old male in the area they had adopted. A sister of this trio bred 200m away. The other trio of males adopted an area in the wood that was only just becoming suitable for Willow Warblers and successfully raised broods in adjacent territories that all fitted into an area of 200 square metres. These 3 males in adjoining territories was initially very confusing since they all carried the same colour ring combination. All 3 broods were exactly synchronized and in a newly colonized area of the wood. Four females from another brood returned and were spaced out over a linear distance of 1 km.

Discussion

There have been a number of previous studies of Willow Warblers in the UK. There was an early

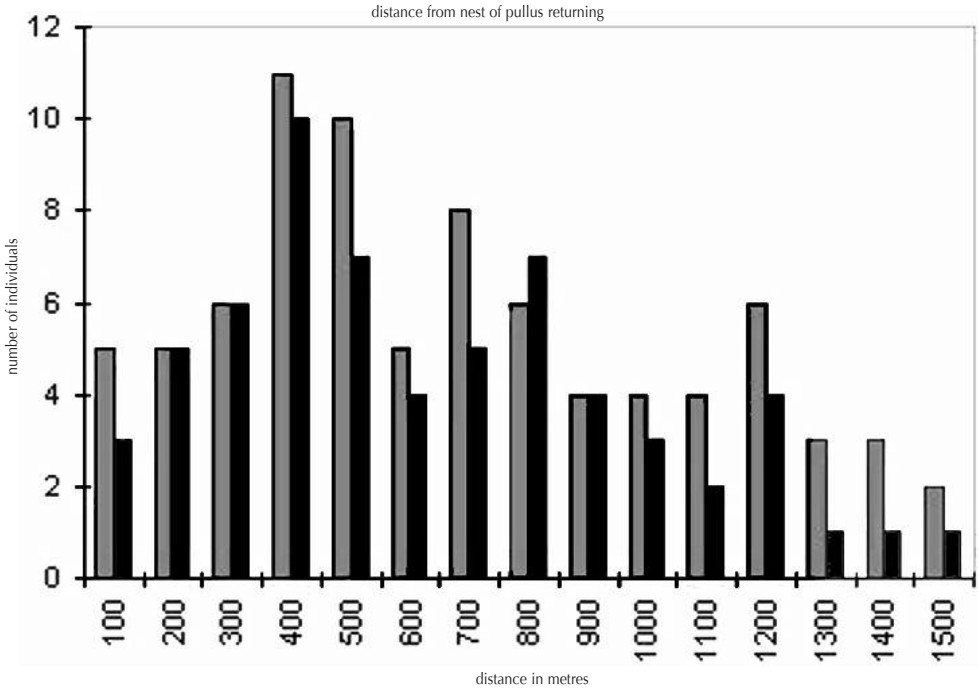


Figure 8 ***All nestlings returning to breed in subsequent seasons in Kippo up to 2001. The distance is metres between nest and adult territory. The maximum distance possible within Kippo is 1500m. Note the distribution of males and females is similar.***

study in Midlothian by Brock (1910) and later also in a similar area by da Prato (1982, 84) as well as a long term study by Lawn in Surrey (Lawn 1982, 1984, 1994 and 1998) and another by Norman in Cleveland (1981, 1983, 1990). Much of the basic biology described in these studies was also found in Fife, however they show the importance of basing current understanding of the biology of a particular species on a number of studies. There are significant differences in detail in these studies relating to habitat, geographical location and particularly to population levels. There is an estimate of 5% to 20% double broods based on BTO nest record cards (Cramp 1955) and the work of Brock (1910) in Lothian and May 1949 in southeast England. da Prato (1982) concluded that these studies may have misinterpreted the evidence and that double broods are rare; my own observations of just 5 over the whole study support this and it requires unequivoval evidence from marked females to prove double brooding. This will be discussed more fully in a later paper (Cobb in preparation). Once abandoned the young then gradually disperse. This may be in any direction but the national data (Cobb in preparation) suggests that it is never more than 10-15 km to the north. It has been suggested that post fledging dispersal is a time when the young scout out territories for the following year (see Berthold 1999). The data presented here suggests that at least initially

broods tend to do this dispersal together. This implies that they would return the following year to this same area with a risk of inbreeding between siblings. The fact that 2 such matings have been found may confirm this. However DNA fingerprinting studies (Gil 1998) in Kippo have shown substantial infidelity between some pairs and this may reduce the genetic significance of apparent incest. Norman showed in his studies of dispersal (1981) that females moved farther and faster then males and implied that this reduced the risk of inbreeding and that females were less inclined to return to the area of natal territories. This study has not shown such difference (Figure 8), but it also showed that, like the Cleveland and Midlothian populations, juveniles start their movement away from the natal site before the post fledging moult is complete. Lawn (1984) in the south of Britain found that this movement was not made until moult was completed. There is however at least a 10 day difference between mean fledging dates between the north of Britain and the south. Large flocks may form in August, feeding with other species, mainly tits but Goldcrests, Treecreepers *Certhia familiaris* and other warblers as well has been well documented, see da Prato (1981) and Simms (1985). Birds caught from these flocks are not resighted or recaptured and this conforms with the idea that there is a gradual daily movements south once they have achieved sufficient food for a short flight and an overnight roost. National ringing data shows reverse migration to be very rare in Willow Warblers so birds during August in Kippo are not likely to be birds from farther south. They are likely to be from farther north in the United Kingdom since there is almost no evidence for a normal migration route for Scandinavian Willow Warblers through Scotland.

The high return rate found at Kippo may be influenced by the fact that it is an island of suitable habitat surrounded by open ground. Studies in Norway have shown that in continuous large tracts of habitat returning birds may be less faithful to their immediate natal site (Cuadrado and Hasselquist 1994). However even in Kippo 2 factors suggest that a proportion of birds do not return to their immediate natal area. Every year a number of unringed male birds were found holding territory or breeding females found, as most Kippo nestlings are ringed these must be outsiders. Just 10% of ringed nestling birds have been recovered returning to Kippo. This figure is not compatible with a self sustaining population and implies a significant percentage must return to other sites. In 2004 a nestling from Kippo was trapped as an adult male in the breeding season north of Inverness. Such a movement is almost unprecedented within the UK ringing scheme for a Willow Warbler as most records show that birds return to within a few kilometres of their natal sites.

When using ringing data to study migration one cannot be certain that a bird leaves immediately it has been ringed or that it has just arrived where it is recovered. Within Kippo, however, non resident juveniles are very rarely retrapped the following day or subsequently. In case birds had learnt to avoid capture after being initially caught they were dye marked but none of these birds was ever resighted. This implies that migration in the northern UK is continual from the end of July to mid August and in this region at least seems to occur late every afternoon.

Over the last 6 years the weights and interclavicular regions of a small percentage of birds caught in the reedbeds at another site in Fife (Kilconquhar Loch) and at Loch Leven in Kinross (Alan Lauder, personal communication) have shown evidence of substantial fat accumulation in late August and early September. It is possible therefore that either a small sub population of Scottish birds fatten up and then

make (long - 1000 km plus) night time flights to the south or that these heavy birds are Scandinavian migrants. Much more data is required before any sort of conclusion can be drawn about these possibilities, or indeed others.

The occurrence of 2 different colour morphs in Scotland may be natural variation but the brown and white morph is more similar to some Scandinavian populations than that of the southern United Kingdom and this may be linked to migration strategies. Norman (1987) showed that normal weights allowed for nocturnal flights of a few hundred kilometres. Migration in Willow Warblers leaving the UK may consist initially of movements of a few tens of kilometres, particularly in Scotland, each afternoon, then possibly nocturnal flights of a hundred or so kilometres before they accumulate a fat loading to make very long flights into Africa (see Norman 1987). Migration north in spring seems to be rapid and nocturnal with new birds often on territory soon after dawn.

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SHORT NOTES

Bird numbers in an Aberdeenshire glen (1987-2004)

We described counts of birds in upper Feughside in 1987-99. (1999, *Scottish Birds* 20:81-93). This note summarises counts from 5 more years (Table 1) and tests previous conclusions with a longer run of data on bird numbers and local weather. The year 2004 was the final year of the study in its present form. As before, DJ did the fieldwork and AW analysed the data.

The winter of 1986-87, preceding the start of observations, was very cold, followed by low numbers of several species in the first year of study. Over 1987-99, 10 species increased significantly, 4 species declined significantly, and snow or frost accounted well for year to year proportionate change in numbers of 5 species.

For 1987-2004, correlations between the numbers of birds and the year show statistically significant increases with the year in 15 species and significant decreases in 5 species now including Eurasian Curlew (Table 2). Proportionate change in the numbers of Eurasian Oystercatcher, Winter Wren, European Robin, Stonechat and Mistle Thrush, as before, was negatively correlated with winter weather and the list now also includes Grey Wagtail, Goldcrest and Great Tit (Table 3).

Goosanders are now scarce, associated with regular cooperative shooting in autumn and winter on much of the Dee catchment. In 2003, numbers of lekking Blackcocks were similar to the previous mean, but were lower in 2004 (Table 1). Blackcocks now use 2 main lek sites instead of one, with only the original lek site on the study area, and one-2 additional cocks often display solitarily elsewhere. Numbers of Eurasian Oystercatchers and Northern Lapwings remain high, though Eurasian Oystercatchers rear few young, and perhaps at least one third of the adult Eurasian Oystercatchers may not attempt to breed or lose their eggs as soon as they are laid. Northern Lapwings have bred well and July flocks numbered over 70 in 2002 and 2003. In 2003 and 2004, Black-headed Gulls failed to breed, in 2003 associated with spring drought, and their nesting area was deserted in 2004. Mew Gulls stopped breeding on the study area in 1995, though they still nest on nearby hilltops.

Sand Martins dug nestholes (7 holes) in a roadside bank in the mid glen in the late 1990s and then moved to a quarry, reaching a maximum of about 40 pairs in 2000. Subsequently, the colony declined (Table 1) and no birds nested in 2004 though a few were seen nearby. Numbers of European Robins and Hedge Accentors increased in 2000-2003 above their former means but decreased in 2003-2004. Yellowhammers are now absent from Ballochan farm although land use there has stayed much the same, but Common Linnets have successfully colonized and European Goldfinches, formerly almost unknown, probably bred in 2004.

An analysis of Breeding Bird Surveys in the UK has been published (MJ Raven, DG Noble & SR Baillie, (2004), BTO News 254, 10-13) covering 1994-2003. We compared this with Feughside data for the same period. The 2 sets of statistical analyses are not directly comparable because of far bigger sampling for the UK. With this proviso, 7 species (Pied Wagtail, Grey Wagtail, European Robin, Song Thrush, Common Blackbird, Chaffinch and Yellowhammer) showed significant changes in the same direction in Feughside and the UK, and only one different (Sand Martin).

Acknowledgements. We thank Mr A Dykes of Glen Dye Estate for the recent weather data, and DJ is grateful to the Demigryphon and Birse Community Trusts for grants towards his expenses.

Table 1 ***Annual total number of territories, based on number of singing passerines, lekking Blackcock, duck and wader pairs, and nest sites in 2 gull colonies to nearest 5.***

	Mean for 1987–99	2000	01	02	03	04
Mallard	5	3	1	0	1	0
Goosander	5	0	0	3	0	2
Black Grouse	23	16	12+	20	25	18
Eurasian Oystercatcher	11	10	20	11	19	14
Northern Lapwing	14	17	21	22	19	19
Eurasian Curlew	14	12	11	14	12	10
Common Sandpiper	1	2	3	2	2	1
Black-headed Gull	0	80	30	25	15	0
Mew Gull	17	0	0	0	0	0
Common Cuckoo	5	1	1	3	1	3
Sand Martin	0	40	20	20	10	0
Tree Pipit	2	0	0	4	1	0
Meadow Pipit	10*	27	28	32	32	23
Grey Wagtail	8	13	13	16	16	13
Pied Wagtail	8	16	13	15	15	13
White-throated Dipper	6	5	4	3	6	6
Winter Wren	64	99	25	53	71	71
Hedge Accentor	14	28	17	23	22	13
European Robin	43	71	60	53	76	31
Common Redstart	6	4	5	0	0	1
Whinchat	12	18	13	16	21	16
Stonechat	5	5	1	0	2(0)**	4
Common Blackbird	4	4	6	6	7	8
Song Thrush	16	20	22	20	25	19
Mistle Thrush	10	8	6	12	12	7
Willow Warbler	66	87	97	84	74	72
Goldcrest ^	4	10	7	5	11	8
Spotted Flycatcher	8	10	13	5	7	1
Long-tailed Tit	3	3	1	0	2	1
Coal Tit ^	9	17	27	18	25	16
Blue Tit	13	15	19	18	17	12
Great Tit	13	13	10	17	14	18
Eurasian Treecreeper	10	15	17	14	16	9
Chaffinch	73	92	92	96	94	91
European Greenfinch ^	2	3	2	3	2	3
Common Linnet	1	12	7	5	15	5
Yellowhammer	5	0	0	0	0	0

* counts in only 7 years, + birds counted at only one lek (see text), ** Two Stonechats singing early in 2003 disappeared when their breeding sites were burned, ^ See Jenkins & Watson 1999 Table 1, p.84; This paper gives scientific names omitted from this update to save space.

Table 2 ***Spearman rank correlations between year to year proportionate changes in the numbers of territorial birds counted and the year, over 1987 – 2004*** **(*- indicates decrease*).**

Species	Correlation	Significance
Mew Gull	- 0.88	***
Goosander	- 0.86	***
Yellowhammer	- 0.82	***
Common Cuckoo	- 0.78	***
Eurasian Curlew	- 0.52	*
Common Blackbird	0.42	ns
Song Thrush	0.43	ns
Grey Wagtail	0.43	ns
Hedge Accentor	0.53	*
Great Tit	0.54	*
European Robin	0.60	**
Whinchat	0.62	**
Sand Martin	0.64	**
Eurasian Treecreeper	0.67	**
Blue Tit	0.71	**
Goldcrest	0.72	**
Chaffinch	0.74	***
Common Linnet	0.76	***
Willow Warbler	0.76	***
Coal Tit	0.79	**
European Greenfinch	0.80	***
Meadow Pipit	0.82	**
Pied Wagtail	0.90	***

n = 18 except for Meadow Pipit where n = 12, * P<0.05, ** P<0.01, *** P<0.001

Table 3 ***Spearman rank correlation coefficients between proportionate year to year change in numbers and weather in the intervening winter, November to March inclusive.***

	Total cumulative (cm) snow depth per winter	Number of mornings with snow lying	Largest number of successive mornings with snow lying	Cumulative day degrees C below $0^{o}C$
Eurasian Oystercatcher				- 0.52*
Grey Wagtail	- 0.50*			
Winter Wren	- 0.60*	- 0.71**	- 0.72**	
European Robin	- 0.59*			
Stonechat	- 0.59*	- 0.70**	- 0.67*	
Mistle Thrush				- 0.52*
Goldcrest	- 0.60*		- 0.56*	
Great Tit		- 0.49*	- 0.52*	

n = 17 except for Goldcrest where n = 13 and Stonechat where n = 14, * P<0.05, ** P<0.01

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Unusually large roost of Common Sandpipers on the Solway

In 1961, David Bannerman wrote of Common Sandpipers *Actitis hypoleucos* (*The Birds of the British Isles* Vol 10 p 21), "As we in Scotland are so used to meeting with the bird singly or in pairs, the idea of it being found in flocks like other small waders had not occurred to me." Valerie Thom (*Birds in Scotland* 1986, p 202) described the species as "non gregarious in its habits at all seasons" and this would be confirmed by the experience of most birders.

It was, therefore, a surprise when we found a roost of 83 Common Sandpipers at the mouth of the Annan River on the Inner Solway on 25 July 2003. We had gone down to the shore at dusk and it happened to be high tide. Suddenly, from the shingle beach at the water's edge, sandpipers noisily took to the wing in conveniently small groups so that counting them in the gloaming was not difficult. We returned on 5 August 2003 and counted 28 at the same site, but it was earlier in the evening and the tide was lower – the birds were not in a flock, but scattered along the river bank and the beach. The local bird reports contain counts of up to 36 Common Sandpipers elsewhere on the Solway in July, particularly the River Nith, but the observers we have contacted report that their tallies were of scattered feeding birds, not roosts.

Roosting in flocks has been recorded on the wintering grounds in Congo (Bannerman, *op cit* p 20), but according to *The Birds of the Western Palearctic* Vol 3, pp 598-599, migration in flocks of more than 20 is exceptional. It may be that the habit of forming a flock while on passage in Scotland is simply under recorded. Not many birders go in search of roosting waders at dusk in July.

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Barrow's Goldeneye – a Hastings Rarity in Scotland

Ford-Lindsay (1913; *British Birds* 7: 21-22) records 2 male Barrow's Goldeneyes *Bucephala islandica* said to have been obtained at Scalloway, Shetland on 18 March 1913. Ford-Lindsay did not shoot these birds and the name of the person who did shoot them is not recorded. Ford-Lindsay wrote that they were sent from Scalloway to the taxidermist, George Bristow, of St Leonards-on-Sea, as Common Goldeneyes *B clangula*. Bristow allowed Ford-Lindsay to examine them; they were reidentified as Barrow's Goldeneyes. Photographs were forwarded to the editors of *British Birds* and the record was published. However, the editors of *British Birds* effectively rejected the record: 'We think that confirmatory records should be awaited before the species is fully admitted to the British List.'

The record is interesting because both Bristow and Ford-Lindsay were at the centre of the Hastings Rarities scandal. In 1962, as a result of an investigation led by the then editors of *British Birds*, several hundred records of rare birds,

including several British firsts, that were claimed from the Hastings area of East Sussex and nearby Kent between 1892 and 1930, were deleted from the record because of the high probability of fraud (Nelder, 1962; *British Birds* 55: 283-298. Nicholson and Ferguson-Lees, 1962; *British Birds* 55: 299-384). It appears that dead birds were being imported and then passed off as locally shot rarities. Many, probably upwards of 400 of these rarities, went through Bristow's hands and Ford-Lindsay examined and recorded nearly 100 of the specimens, especially during the critical 1910-1916 period when the Hastings Rarities were at their peak.

The disputed Hastings Rarities were nearly all said to have been seen and/or collected within 20 miles of Hastings itself but, apart from the location, the Scalloway Barrow's Goldeneyes are typical in every way of the general pattern: it was a spring record of an extreme rarity; more than one bird was involved; the identity of the supposed collector was withheld; they were supposedly sent to the taxidermist, Bristow, as a common bird; finally he 'reidentified' them and got confirmation from one of a small band of local authorities (Ford-Lindsay, in this case). This is a classic Hastings Rarity, albeit perhaps the only Scottish one, and should clearly be rejected.

What is less clear is why the record was rejected at the time, when so many other records from the same people were accepted uncritically for a further 3 years, until Witherby called time on them in 1916 (*British Birds* 55: 299-384). The 1915 edition of the BOU British list (BOU, 1915; *A List of British Birds*. British Ornithologists' Union. London) mentions the record in an Appendix, saying that the birds were probably imported from Iceland, but no reason for this supposition is given, nor whether the BOU List Committee thought this was a deliberate importation for purposes of fraud. Nevertheless, it is tempting to speculate that even by 1913, the Hastings team was attracting suspicion. For whatever reason, BOU and *British Birds* were unable to act against the established pattern of Sussex and Kent occurrences, but this unusual Scottish record was perhaps easier to reject.

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Female Merlin hunting in her nest area

In raptor species females that hunt near their nests depends on the availability of prey in the nest vicinity (Newton I 1979, *Population Ecology of Raptors,* Berkhamsted) but specific data on female Merlins *Falco columbarius* hunting in the immediate vicinity of the nest area is lacking. I have previously noticed that some female Merlins hunt within their nest area going back to 1973 but no systematic observations were made. An opportunity occurred in 2004 to study the hunting behaviour of a female for 100 hours from 22 June to 16 July at a nesting site in Galloway. All hunts were carried out within a radius of only 100-200m from the nest site which was in deep heather. The female always used a low flight attack from fence posts. In June and July broods of Meadow Pipits *Anthus pratensis* had fledged so there was a surfeit of available prey.

The young were about 14-15 days old on 22 June 2004 when I first saw the female hunting in the nest area. The female chased Meadow Pipits 7 times, finally capturing one by dropping into the heather and returning to the nest with it. On 28 June 2004 the male arrived with 6 food items in 3 hours for the young and the female cached 2 items. The next time the female was seen

hunting was on 30 June 2004, when she hunted in the nest area 9 times and caught a Meadow Pipit which she fed to her young. On 8 other occasions she caught moths or butterflies (*Lepidoptera/Papilionina)* which she consumed herself. On 4 July 2004 the 2 young were 26-27 days old; they had fledged and were scattered in the heather. The female hunted over the nest area capturing a Meadow Pipit which she fed to the young and continued to hunt insects. On 6 July 2004 the female fed on cached prey. On 10 July 2004 the male and female hunted outwith the nest area and both delivered one prey item each for the young. After the female brought in prey, she hunted insects and ate them herself. On 13 July 2004 both female and male were still hunting away from the nest area and on 15 July only the male delivered 3 prey items for the young in 2 hours. On 16 July 2004 the young had moved about 1 km from their natal area.

Female Merlins do not make important contributions to food gathering (Palmer 1988, *Handbook of North American Birds*, vol 5, London) and in most studies the male supplies food for the young and for the female. The advantage of the female Merlin hunting in the vicinity of the nest area was not readily apparent in these observations, as the male appeared to be a good food provider. During these observations the female only caught 3 prey items in the nest area and ate cached prey that the male had provided and moths and butterflies that she had caught. Perhaps when day flying insects are available they may supplement the female's diet (cf Watson 1979, *Bird Study* 26:253-258; Dickson 1983, *Scottish Birds* 12:194).

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Twin embryos in the egg of a Northern Goshawk

In 2002, I found evidence that a Northern Goshawk *Accipiter gentilis* laid one egg with twin embryos in a nest in southern Scotland. This pair formed part of a larger, long term study of this species in southern Scotland and northern England. The first visit was on 5 March 2002, when the nesting area was found to be occupied and fresh nesting material had been added to an old goshawk nest. On 22 April, the nest tree was climbed and the female was found to have been incubating 4 eggs. On 24 May, there were 2 recently hatched chicks and 2 eggs in the nest. On 11 June, the nest contained 5 chicks; 3 females and 2 males. One of the males was very small and on the last visit, on 24 June, it was found to be missing. The remaining 4 chicks were well feathered and later fledged successfully. Thus, the only explanation for the difference in clutch and brood sizes is that one egg must have had twin embryos. This nesting area has been used for about 10 years and is one of the most productive sites in the whole study area, regularly producing 4 or 5 chicks annually.

Twin embryos are rarely reported in wild birds' eggs. I am aware of only 2 published accounts; from a Peregrine Falcon *Falco peregrinus* in Greenland (Pattee *et al* 1984. Twin embryos in a Peregrine Falcon egg, *Condor* 86: 352-353) and from a Northern Goshawk in Britain (Petty & Anderson 1989. Egg measurements from a Northern Goshawk *Accipiter gentilis gentilis* including one abnormally large egg with twin embryos, *Journal of Raptor Research* 23:113-115). The latter report was from the same study area as the 2002 record above.

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Little Egret attacked by a Eurasian Sparrowhawk

In the autumn and winter of 2004-05, 2 Little Egrets *Egretta garzetta* were present at Luce Bay, Galloway from August 2004 to February 2005. On 11 September 2004 at 1400 hrs I watched a Little Egret feeding in a tidal creek. At the same time a female Eurasian Sparrowhawk *Accipiter nisus* was hunting the saltmarsh. On reaching the creek the Sparrowhawk swooped directly on the Egret narrowly missing its head. The Egret flew up, circled and landed in another creek. It looked like an opportunistic attack by the Sparrowhawk considering its weight of 280+grams against the Little Egret's weight of 400+grams, although hen Sparrowhawks regularly take birds more than twice their weight in Britain (Newton 1973, Studies of Sparrowhawks, *British Birds* 66:271-278). On 18 October 2004 a Common Buzzard *Buteo buteo* soared directly above the 2 Little Egrets at their high tide roost on an islet but did not attack them. On 9 January 2005 a Common Raven *Corvus corax* landed beside one of the Egrets at a high tide roost. The Raven pecked the Egret's flank with its bill enough to disturb the Egret which flew low across the bay. Despite weekly visits to the area no more attacks were seen.

No mention was made in *BWP* that Little Egrets may experience attacks by raptors while Musgrove (2002, The non breeding status of the Little Egret in Britain, *British Birds* 95:62-80) considered that "there is no reason to suspect that Little Egrets may suffer significant predation in autumn and winter in Britain".

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Ospreys killing a Grey Heron

On 6 July 2004 I was watching a female Osprey, *Pandion haliaetus*, on its nest with 2 chicks above a loch in West Perthshire. At 8.50 pm she took off, and flew directly across the loch, where she was joined in flight above the loch by another Osprey, presumably her mate, and then a third large bird, which appeared ponderous in flight and less mobile than the Ospreys. The Ospreys were swooping and climbing without entering the water. Suddenly the third bird hit the water. I trained my fieldscope on the floating bird, which proved to be a Grey Heron, *Ardea cinerea*. The Ospreys continued to dive at its head, until it keeled over, and lay on the surface, wings flapping. Increasingly feeble wingbeats by the heron failed to raise it, and after a few minutes there was no further movement, only its grey back being visible, floating without a sign of life. It seems that the Ospreys had made a lethal strike, perhaps fearing the presence of a larger bird in their territory. *BWP* vol 2 p272 describes Ospreys defending their territory by flying at intruders and records an instance where another Osprey was killed. I have not found any reference to a heron being killed by Ospreys.

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Observations on a Red-backed Shrike nest in Shetland

Early June 2004 saw a notable influx of Red-backed Shrikes *Lanius collurio* into Shetland. Several were heard singing or appeared to be paired. On 15 June, Martyn Jamieson and Robin Sutton, who were leading a tour to Shetland, informed us that they had seen a pair of Red-backed Shrikes carrying nest material. The pair

was quickly located and, when the male caught some prey, the female immediately began begging by wing shivering and squealing. She was then fed by the male. A little later the female flew off out of sight into a nearby field. She soon returned, carrying a large ball of wool, and disappeared into a nearby clump of bushes. When the male did the same thing a few minutes later, it was clear that they were attempting to breed. The necessary licences were obtained from SNH and a watch was kept on the nest which was, fortunately, easily viewed from distance.

The pair bred in the garden of an uninhabited house. The garden, with an area of about 0.1 ha, is becoming overgrown with the rose *Rosa rugosa*, a few *Fuchsias* and Sycamores *Acer pseudo-platanus*. An occupied house was no more than 50 m away but otherwise the site was surrounded by largely unimproved pasture.

The nest was found after the juveniles had fledged. It was in the middle of the largest patch of rose, about 20 cm below the top of the bush and just over one metre above the ground. It was a rather untidy structure and quite large, almost as big as that of a Common Blackbird *Turdus merula*. It was lined with dry grass; the wool was incorporated into the general structure and not used for lining.

It is assumed that incubation began on 20 June, as the female was very rarely seen after this date. The male was seen on most days, usually within 50 m of the garden, but he occasionally wandered further afield. The area of the feeding territory was estimated as no more than 12 ha. If the male caught any small prey items they were usually eaten immediately, but larger items were taken to the nest and fed to the female. Initially, the male was very cautious and would perch near the nest before dropping into the bushes, but by the second week he would fly straight in. There were never more than 2 visits to the nest during a watch, which lasted up to 90 minutes. The female was seen 3 times during incubation. On 2 occasions she came off the nest after being fed by the male, but she was back at the nest within a minute. On 6 July, both adults were alarm calling and very agitated; a visit to the garden flushed a Eurasian Sparrowhawk *Accipter nisus* which had been sat in a tree next to the nest! Otherwise, the adults kept very quiet and were never heard alarm calling on any other occasion during incubation. Even after the eggs hatched, the adults could be very elusive.

If the female began incubation on 20 June then the eggs should have hatched on about 4 July. A few days after this date, the male began visiting the nest much more often, on one occasion visiting 8 times in 15 minutes, although the female was never seen during this period, not surprisingly, as she should brood the chicks for about 6 days after hatching (*BWP*). On 19 July, the male was taking food into a site a few metres from the nest, suggesting that fledglings had moved into nearby bushes. On 23 July, a short tailed juvenile was seen flying between the bushes and at least 3 juveniles were seen on 25 July.

These dates suggest an estimated incubation time of 14-16 days and an estimated fledging period of 15-19 days. *BWP* gives figures of 14 (12-16) days for incubation and 14-15 (11-20) days for fledging.

The young remained in the garden until 11 August, almost 3 weeks after they first left the nest. Four juveniles fledged, but one died after about 2 weeks and the corpse has been sent to the National Museums of Scotland. The juveniles could be very elusive and, although the adults would alarm call when a visit was made to the garden, they would stop after a short while.

Both adults fed the juveniles after they left the nest, but towards the end of their stay only the female hunted while the male patrolled around the garden or sat with the juveniles on one of their favourite branches. Towards the end of the stay he was often singing as he sat with the juveniles. On 8 August, both adults fed the juveniles, but this was also the last day the female was seen. Just one juvenile remained in the garden on 12 August; the

others were seen with the male patrolling fences about 800 m away. On 13 August, all 3 juveniles were with the male at an area of trees about 500 m from the nest. This was the last time the family was seen together but one juvenile remained in this area until 29 August.

Prey in Shetland is rather limited and most items caught were too small to identify. The commonest were bumblebees, almost all of these being queens of the local Shetland Bumblebee *Bombus muscorum agricolae*, but a few were White-tailed Bumblebees *Bombus lucorum*. Other prey items included bluebottles *Calliphora*, especially later as they became commoner, ground beetles *Carabus*, large hoverflies of the genera *Syrphus* and *Eristalis*, and an Angle Shades *Phlogophora meticulosa* caterpillar. There was no suggestion that a larder was ever built up but, given the weather and food supply, it is quite surprising that the pair managed to fledge as many as 3 juveniles.

There have been 13 confirmed breeding records in Scotland, all since 1977 (A Thorpe pers comm), with no breeding anywhere in Britain since 1999 (Ogilvie and the Rare Birds Breeding Panel 2004 *Brit. Birds* 492-536). There is only one other confirmed breeding record for Shetland involving a female and one fledged juvenile at Pool of Virkie in south Mainland from July until mid August 1990, but Henry Saxby recorded a female feeding 3 newly fledged young at Burrafirth on Unst on the extraordinarily early date of 9 June 1870; either the date or the identification must be in error (Pennington *et al* 2004. *The Birds of Shetland* Helm, London).

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Ruff breeding in Shetland in 2003

On 20 June 2003, Pete Ellis was on the Mainland of Shetland observing an area of pools and marshland as part of a breeding wader survey. A wader flew in from the south and began to run about on an area of short, wet turf. It was a female Ruff *Philomachus pugna*x, a rather dark individual with many blackish crescents on its upperparts, breast and flanks. The bird was running around very quickly and feeding rapidly. This behaviour suggested that it could have come off a nest and was trying to feed as quickly as possible. He watched the bird for about half an hour, after which it flew back south about 50 metres, landed in an area of cotton grass *Eriophorum angustifolium*, crept into a tussock and disappeared. The observer approached the area and when he was about a metre from the site, the female fluttered from the tussock and flew off. There were 4 eggs, slightly larger and more rounded than a Redshank's *Tringa totanus*, olive green with numerous dark brown blotches. He quickly left the area and observed at a distance, from a car. The Ruff returned to its nest within 10 minutes.

The incubation period of Ruff is given as 20-23 days (Cramp, S and Simmons, K E L 1983. *The Birds of the Western Palearctic*, Vol 3. Oxford) so, having obtained the appropriate licence from Scottish Natural Heritage, PME visited the nest again on 12 July 2003. Unfortunately the nest had failed, as it contained only one egg, with a second punctured egg lying outside; there was no sign of the Reeve.

On 22 July 2003, over 60km from the first site, Dave Okill and his son Antony were in a remote area of Mainland Shetland monitoring the breeding success of Red-throated Divers *Gavia stellata*. As they walked past a loch, JDO noticed a wader drop in behind a clump of cotton grass. Adjacent to the loch was an area of low mounds covered in short heather and grass, with the

damp hollows between the mounds, either of short grass or thick beds of cotton grass.

They walked over to the area and a female Ruff took off from behind the cotton grass and flew away. When it was about 100m away, the bird turned and flew straight back towards the observers. It passed very closely in front of them and called very softly. JDO could not recall hearing a Ruff call before. The bird landed at the rear of one of the small mounds, ran up the mound and watched from over the top, occasionally bobbing its head. As they backed away, the Reeve flew around them softly calling again before landing at the rear of another mound and again running to the top to watch them. This behaviour strongly suggested that the Reeve had chicks.

They backed away further and the bird ran down the mound and started to feed in a damp hollow. Scanning the area, JDO saw a small downy wader chick with very long legs run across an open area and into a large dense area of cotton grass. They soon saw a second chick wander across the side of one of the mounds. AO found it, crouched a few centimetres down a Rabbit burrow. The chick was at least 5 days old and very active. It was like a pale Redshank chick but with very long, olive grey legs. The under parts were plain, very pale buff. The crown was buff with darker (almost black) stripes. It was plain buff around the eye with a darker streak on the lores. The pattern on the back and wings was buff with darker markings, these dark marks were finely specked with buff. Its measurements were: wing = 25mm, bill = 17mm, tarsus = 34mm and weight = 29g.

There could have been other chicks out of view. The Reeve did not appear to be concerned at their presence, in contrast to the reaction of many other species of waders when they have chicks.

At no time was a male bird seen at either site. It is indicated that males often abandon the nesting areas whilst the female is sitting and it is suggested that mating may even take place on the northerly migration in the spring (Cramp S & Simmons K E L 1983. *The Birds of the Western Palearctic*, Vol 3. Oxford).

These are the first records of Ruff breeding in Shetland (Pennington M G, Osborn K, Harvey P V, Riddington R, Okill J D, Ellis P M, & Heubeck M 2004. *The Birds of Shetland*. Helm, London). The Ruff is a common passage migrant through Shetland in the autumn, but is scarce in spring, so these breeding records were completely unexpected.

Previous records of Ruff breeding or apparently breeding in Scotland include an agitated female seen in the inner Hebrides on 17 July 1977, a nest with 4 eggs found in Sutherland in 1980 (although no male was seen, the eggs did hatch) and breeding was also suspected in the outer Hebrides in the early 1980s (Thom, V M 1986. *Birds in Scotland*. T & A D Poyser).

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Yellow-billed Diver in Chelmsford Museum - the earliest record for Scotland and fourth for Britain

In preparation for our new book on the *Birds of Essex*, Simon Wood, Russell Neave, Graham Ekins and I arranged a visit to Chelmsford Museum with Dr Tony Walentowicz, Keeper of Natural Sciences, in July 2000. I was particularly interested to see the divers there, having seen a

sketch of the bill of one of the labelled Great Northern Divers *Gavia immer* drawn in 1961 by the late Stan Hudgell (1935–2002). Stan had always thought the bird to be a Yellow-billed *G. adamsii* and, on investigation, we confirmed the identification. The specimen (now in storage, catalogue number E13541) came from the collection of G. P. Hope, whose notes stated the specimen was taken at Aberdeen on 17 December 1891.

Although mounted and cased individually, the specimen had no label. The collection details were, however, listed in the Museum's catalogue. Newspaper taken from the base of the display proved to be from *The Times* of 5 February 1892, just a few weeks after the bird had been shot. Together with other circumstantial evidence, this convinced TW that the bird was the listed Aberdeen specimen. Two Great Northern Divers at one time in the Chelmsford collections had been collected in 1881 (11 years before the newspaper) and 1920 (28 years after the newspaper), and were thus eliminated. Fraud was ruled out as the specimen had been identified as a Great Northern Diver since the outset.

Details were forwarded to the Scottish Birds Records Committee. As well as confirming the identification, the Committee also considered the bird's authenticity, documentation and the possibility of fraud. The record was accepted in September 2003.

I would encourage all authors of county avifaunas to visit and maintain good relations with their local natural history museums. Other Chelmsford Museum highlights include an immature male Baltimore Oriole *Icterus galbula* caught alive on Unst, Shetland, on 26 September 1890, long considered an escape, and only recently accepted as the first for Britain by the British Ornithologists' Union's Records Committee (British Ornithologists' Union. 2003. British Ornithologists' Union Records Committee: 29th Report October 2002. *Ibis* 145: 178-183.).

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The British Birds Rarities Committee's remit generally does not extend to pre 1950 records and both they and BOURC who have ultimate responsibility for pre 1950 rarities, amongst their other duties confirmed SBRC should adjudicate the record.

We were supplied with a series of photographs of the specimen and, on first circulation, identification was agreed by SBRC as an adult Yellow-billed Diver, moulting from summer into winter plumage. However, as the bird was no longer directly labelled, we were unwilling at that stage to accept the record. It was clear that more information would be required to enable the Committee to make a judgement about the bird's origin. Bob McGowan (SBRC Museum Consultant) and Dr Alan Knox (University of Aberdeen) looked into the case with Dr Walentowicz, and reported back to the Committee.

Their investigation confirmed:

- There was no indication of fraud as the bird had, until very recently, been labelled as a Great Northern Diver.
- The specimen was part of a significant and reputable collection of birds assembled by George Palmer Hope (Christy R M. 1890. *The Birds of Essex*. Durrant, Chelmsford.). Hope prepared and cased many or most of his own birds. Although Hope purchased specimens, he appears to have set the diver up himself, as the taxidermy and groundwork of the mount are consistent with Hope's style.
- Hope collected birds mainly in Essex and Suffolk, but he also obtained a number of specimens from Scotland.
- Other diver specimens in the Hope collection, or listed in the Museum's documentation, were satisfactorily accounted for.

- The date of the newspaper in the base of the mount is particularly supportive.
- Although Great Northern Divers were not common off Aberdeen in 1891, and naturalists often published details of the occurrence of individual birds, there is no record of one having been reported at that time. This is not of great concern, as there were many shooters in the area in the late 1800s, and few recorded anything that they killed.
- Whilst the locality for the diver is given as 'Aberdeen', the locality for some of Hope's other Scottish specimens is a little imprecise. It is probable that 'Aberdeen' refers to the county of Aberdeen, rather than the city.

On the basis of this information, SBRC recirculated the record and it was accepted unanimously. The first Scottish record of Yellow-billed Diver was hitherto regarded as one picked up dead at the head of Whiteness Voe, Shetland on 21 January 1946 (Baxter E V and Rintoul L J 1953. *The Birds of Scotland*. Oliver & Boyd, Edinburgh). The Aberdeen specimen was killed over half a century before this and thus becomes the first Scottish (and fourth British) record (Burn D M and Mather J R. 1974 The White-billed Diver in Britain. *British Birds* 67: 257-296.).

We are grateful to Alan Knox and Tony Walentowicz for their assistance with this record.

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Hybridisation between a Whooper and Mute Swan in Shetland

Swans did not breed regularly in Shetland until towards the end of the last century (Pennington MG, Osborn K, Harvey PV, Riddington R, Okill JD, Ellis PM & Heubeck M 2004. *The Birds of Shetland*. Helm, London). In 1992, a pair of Mute Swans *Cygnus olor* nested on Tingwall Loch and since this pairing Mute Swans have bred at a number of sites on Mainland or nearby islands. Up to 7 pairs have bred in some years.

Whooper Swans *Cygnus cygnus* began nesting in 1994 and up to 3 pairs have bred in any year since, again in different areas of Mainland. In 2003, a pair of Whoopers nested on a hill loch in the east Mainland and had a brood of 4 well grown chicks when the site was last checked. In 2004, this site was first checked on 29 April when a pair of Mute Swans and Greylag Geese *Anser anser* were present. The next check was on 24 May when a female Mute Swan was found sitting on a nest whilst a male Whooper was nearby standing guard. On 12 June the 2 adult swans were closely accompanied by 2 small chicks no older than a week. It was not possible to approach the chicks but they were very pale in colour and significantly lighter than Mute Swan chicks. The site was next checked on 18 June after a period of cold, windy and wet weather and although the 2 adults were still present there was no sign of the chicks.

Hybridisation in wildfowl is fairly common in captivity and not uncommon in the wild. However the ranges of Mute and Whooper Swans do not overlap in many places and mixed pairings between these 2 species are relatively uncommon (Cramp S & Simmons KEL 1977. *The Birds of the Western Palearctic*. Vol 1. Oxford). In some areas feral or injured Whooper Swans have paired with Mutes when the former injured birds have been unable to migrate back to their normal breeding areas. Both of the Shetland birds were able to fly and there is no suggestion that either was injured.

M Brazil (2003. *The Whooper Swan*. Poyser, London) notes a number of mixed pairings in scattered sites through Europe and cites a pairing between a male Whooper and a female Mute

Male Whooper Swan paired with female Mute Swan, 2004, East Mainland, Shetland.

Larry Dalziel

Swan on Loch Corrib, County Galway, Ireland in 1972 which produced hybrid chicks; 20 years later, a mixed pair in France also produced chicks.

Swans have not been introduced into Shetland and it is believed that the small breeding populations are of wild birds. This is the first time that these species have hybridised in Shetland. In the Western Isles there has been a single hybrid pair recorded, again the cob was the Whooper, the pen the Mute Swan and although a nest was built they did not produce chicks (C Spray pers comm). A captive Whooper cob paired with a Mute Swan pen in the English Midlands and produced 9 chicks over a period of 4 years, the chicks have subsequently escaped or been released and are now in the wild (B Coleman pers comm). It should be noted that in all these instances the male has been the Whooper and the female the Mute.

It is likely that this is the first time that hybrid swans have been hatched in the wild in Scotland.

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Merlin hunting in a wood in winter

In winter the distribution of hunting Merlins *Falco columbarius* in Britain is mainly confined to open habitats such as farmland, moorland and the coast, generally avoiding forests and woods (Cramp & Simmons 1980, *The Birds of the Western Palearctic*, vol 2, Oxford; Dickson 1988, Habitat preferences and prey of Merlins in winter. *British Birds* 81:269-274).

On 5 January 1985 at 1410 hrs I saw a female or juvenile Merlin actively pursuing a Chaffinch *Fringilla coelebs* above pasture on low ground in Galloway. The birds made their way into a conifer plantation adjoining a deciduous wood and on entering the wood, the Merlin continued to chase the Chaffinch amongst the tree branches like a Eurasian Sparrowhawk *Accipiter nisus*. The falcon got near enough to clutch at its prey 26 times without success. The Chaffinch managed to escape by flying deeper into the wood and the Merlin eventually landed on the

top of a beech *Fagus sylvatica*. The Merlin flew away out of sight across pasture at 1415 hrs.

It is uncommon for Merlins to follow prey into large woods in winter but they are known to penetrate willow scrub *Salix* near their roosts and on one occasion a Merlin emerged clutching a small bird in its talons (Dickson 1970, Bird predators at passerine roosts. *British Birds* 63:85-86). In Germany a male Merlin was seen chasing and following a Yellowhammer *Embireza citrinella* into a wood and a passing female Merlin then chased it through the trees (Brauning & Lichtner 1970, Gemeinsame Jagd zweier Merline. *Vogelwelt* 91:32). In Montana, USA a Merlin followed Bohemian Waxwings *Bombycilla garrulus* to some conifers and then chased the Waxwings through the trees like a Sharpshinned Hawk *Accipiter stiatus* (Servheen 1985, Notes on wintering Merlins in Western Montana. *Raptor Research* 19:97-99).

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OBITUARIES

Roger Frank Durman (1944–2003)

With his wife Penny, Roger came to Edinburgh in 1971 moving north from London to work as a chartered surveyor with the firm of Montagu Evans. He specialised in the field of retail planning and, as a partner in Montagu Evans, built a huge reputation as an expert witness particularly in relation to planning enquiries; he took part in over 100. Not only was he very highly regarded in professional circles he was also an excellent field ornithologist. As a ringer he was initially very involved with Bardsey Bird Observatory. He had a wide range of anecdotes from Bardsey usually involving ringing during "attractions" at the lighthouse. Following his involvement with Bardsey, Roger chaired the Bird Observatories Council from 1970–1974 and edited the Poyser book entitled *Bird Observatories in Britain and Ireland* published in 1976.

During the 1970s Roger carried out a number of studies in the Pentland Hills particularly focusing on Ring Ouzels, work that was subsequently carried forward by other Lothian ringers. Roger had a great affection for the East Lothian coast and he and Penny spent many years at Peffermill not only in studying the resident breeding birds but also the migrants which arrived on the coast during spring and autumn. I am sure he would have liked to have spent longer at Peffermill but work pressures usually impinged on spare time at weekends.

Roger and Penny eventually moved to Drylawhill, East Linton. Barn Swallows nested in the outbuildings and he and Penny took delight in following the fortunes of different broods over the years. The last significant travel which Roger was able to undertake was to visit Spain with Penny to view a site where one of their Swallows had been controlled on its migration south from Scotland.

Roger was a very modest and self effacing individual whose skills and talents were not instantly on show. His moderate manner did not, however, conceal his underlying authority and professionalism whether in the context of work or the natural world. The large turnout at his memorial service in East Linton, testified to the high regard he was held in by so many. And it was entirely typical that the funeral notice asked for colourful ties to be worn!

Not only his family, his partners and his many friends but also the professional and ornithological world of Scotland give thanks for a remarkable man, who will live long in our memories.

Ian Darling

Advice to contributors

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