COLLECTION AND ANALYSIS OF COASTAL PEREGRINE EGGS

Report No. F01AC317

For further information on this report please contact:

Phil Whitfield
Scottish Natural Heritage
2 Anderson Place
Edinburgh
Tel: 0131 447 4784

This report should be quoted as:

Jon Hardey (2002). COLLECTION AND ANALYSIS OF COASTAL PEREGRINE EGGS. *Scottish Natural Heritage Commissioned Report F01AC317* .

COMMISSIONED REPORT

Summary

COLLECTION AND ANALYSIS OF COASTAL PEREGRINE EGGS

Report No: F01AC317

Contractor : Jon Hardey

MAIN FINDINGS

- Breeding success of coastal eyries in Northeast Scotland is low. This is attributed to the effect of DDT.
- Analysis of addled eggs to identify pollutants was not possible. No accessed or observed eyries contained addled eggs.
- The main prey taken by coastal peregrines was feral pigeons. There were few seabirds.
- A comparison between selected inland eyries below 250m with no evidence of persecution and with coastal eyries showed that productivity was significantly higher in the inland eyries while there was no significant difference between the brood size of successful eyries.

For further information on this project contact :
Phil Whitfield, SNH, 2 Anderson Place, Edinburgh tel .no: 0131 447 4784
For further information on the SNH Research & Technical Support Programme contact ascg@snh.gov.uk

CONTENTS i

Tables

INTRODUCTION

The report of the UK Raptor Working Group (2000) recommended 'an investigation into the causes of the current decline in the numbers of peregrine falcons (*Falco peregrinus*) in the Scottish Highlands' (recommendation 9). A component of these declines is the poor status of many coastal populations. Several of these populations have poor reproductive success, including those peregrines breeding on the coast of Northeast Scotland (Crick & Ratcliffe 1995).

On the coast of Northeast Scotland between Buckie and Montrose, there are known to be twenty-one breeding sites for peregrine falcons. All are located on sea cliffs. Nine are found along the north coast bordering the Moray Firth between Buckie and Fraserburgh while the remaining twelve are along the east coast between Peterhead and Montrose. This coastal population died out in the late sixties due to contamination by chemical pollutants (Ratcliffe 1993). Peregrines started to recolonise the Northeast coast in the late nineteen eighties and now occupy the majority of their old breeding sites. While the population has increased, the breeding success of these peregrines has been low. Newton et al. (1989) showed that the low breeding success of coastal peregrines was associated with high levels of contamination of organic chemical compounds (organochlorides and PCBs) and heavy metals but the identity of the chemical responsible and its source was unclear.

The objective of the present study was to document the recent status of coastal peregrines in Northeast Scotland and to identify the possible causes of the continued poor reproductive success. The study analyses the site occupancy and productivity of these coastal peregrines over the last six years and compares it with inland eyries below 250m for which there is no evidence of persecution. Attempts were also made to collect a sample of addled eggs. It was hoped that analysis of these eggs would assess levels of chemical pollutants. Prey remains were noted to identify the likely source of any chemical pollutants.

METHODS

Location of coastal eyries.

Prior to the commencement of the current contract, visits had been made in February 2001 before access restrictions caused by the foot and mouth epidemic, to all known twenty-one of the known coastal peregrine sites between Buckie and Montrose. A site was recorded as occupied if birds were seen or if fresh kills were found in the area. Nineteen sites were occupied. All of these sites were revisited as the access restrictions were progressively lifted through May and June. Permission was obtained from local farmers before a site was visited. If possible, the eyrie was located by searching the cliff with binoculars or by observation of the adults. Observations were made from a secure point on the cliff top, which allowed a clear view of the site and was at a sufficient distance not to alarm the falcons. Each site was viewed for at least two hours. The eyrie could not be located at seven sites. Breeding attempts at three of these sites probably failed before access was possible. At the other four, the eyrie was not visible from the viewpoint at the cliff top. If an eyrie had probably failed before being located, searches were made of all nearby cliffs to ensure that the falcons had not moved. These searches included two hour watches of extensive areas of cliff. Any breeding falcons present should have had young at the time of the search and birds should have been observed during the watches and prey remains should have been located. No evidence of falcons breeding or of them moving to a new location was found during any

of these searches. Additional searches were made of all sea cliffs believed to be unoccupied, to confirm the lack of breeding peregrines. All visits were made under licence from SNH.

Accessing eyries to collect addled eggs

When it was apparent that a breeding attempt had probably failed or that the young were at least two weeks old, eyries were accessed by abseiling. A team of two to three people was used. As there were no secure points on the cliff tops for attaching ropes, ropes were secured to belay bars which were driven into the soil behind the cliff. Two dynamic ropes were used. The descent was made on one with a stop descendeur. The second rope was run through a belay to secure the climber. Eyries were not accessed if their contents could be clearly observed and they were known not to contain addled eggs. The collection of addled eggs was licensed by SNH.

Analysis of occupation and productivity, 1996 - 2001

In previous years, the methods used to collect the data were similar to those described for this study. Less time was available, but this should not unduly effect the results. Emphasis was placed on obtaining information on occupancy of sites and on the number of young fledged. Searches of adjacent cliffs were made to locate peregrines where they were apparently absent. Two sites were excluded from this analysis, one site is possibly an alternate site for one another site currently occupied and the second has no breeding records since the 1930's.

A group of eight inland sites was chosen for comparison to the coastal sites.

Table 1. Inland peregrine breeding sites used for comparison with coastal sites.

Site	Main land use within 1 km.	Altitude (m)	Distance from coast (km)
007	Arable and livestock farming	90	24
010	Forestry and livestock farming	190	31
041	Forestry and livestock farming	200	25
043	Livestock farming	220	25
152	Forestry and livestock farming	120	21
173	urban	75	5
174	Arable and livestock farming	90	26
175	Arable and livestock farming	90	4

The inland sites were all below 250m altitude and were within 31 km. of the coast (Table 1). These sites were all in active or disused quarries. There was no evidence of

persecution at any of the inland or coastal sites during the study period. The main land uses within 1 km of the inland sites were similar to those of the coastal sites but there was less arable farming and more forestry. Data on peregrine falcons has been collected annually for all these sites by J.Hardey and by members of the Northeast of Scotland Raptor Study Group.

Collection and identification of prey remains
No attempt was made to abseil to prey remains on the cliffs. Remains were collected from eyries or from readily accessible plucking places. Prey remains on cliffs that were not readily accessible were identified with binoculars and the minimum number of items assessed.

This tends to give greater emphasis to larger items (Langvatn 1977). This bias was considered not to be important as the bulk of the prey recovered from eyries and accessible plucking places also consisted of larger items. Prey remains were recorded on each visit. Old plucks of feathers were recognisable as vegetation grew through them and were not recorded as they may have originated from before the current breeding season.

RESULTS

Location of coastal eyries
All nineteen sites were occupied in February. Eyries were located at twelve sites during visits in May and June. Details of occupancy and success are given in Appendix 1.

Collection of addled eggs
Addled eggs can only be collected when it is known that they are infertile. They cannot be collected early in the season unless the eyrie has failed.

No addled eggs could be collected. Eight descents were made to eyries (Table 1). The contents of three other eyries were observed from the cliff top and no eggs were present. It was expected that the failed eyries would have held some addled eggs and that eyries with smaller broods, especially when younger, would also have held some addled eggs. Addled eggs could have been expected from ten of the eleven nests described in Table 2, based on likely clutch sizes. The absence of addled eggs is probably due to a number of factors. These include –

i) Egg breakage due to pesticide contamination.
ii) Egg removal by herring gulls (*Larus argentus*) when the falcons stop incubating. Large numbers of these gulls nest near to the peregrine's eyries and they are known to predate eggs within seabird colonies.
iii) Eggs being crushed by growing chicks.

in 2001 as the foot and mouth epidemic precautions restricted access in the early part of the breeding season.

Table 2. Status of coastal eyries at time of attempted collection of addled eggs.

Site Code	Date	Status of eyrie
112	3 June	4 young, no eggs
117	3 June	Eyrie failed, no eggs
118	3 June	Eyrie failed, no eggs
123	14 June	Eyrie failed, no eggs
131	2 June	3 young (14 day), no eggs
133	2 June	2 young (21 days), no eggs
134	30 May	Eyrie failed, no eggs
135	14 June	Eyrie failed, no eggs
137	14 June	1 young (28 days), no eggs
138	30 May	2 large young (21 Days), no eggs
139	2 June	3 young (7 days), no eggs

Site occupancy and breeding success.

Site occupancy and breeding success is summarised for coastal eyries (Table 3) and for the sample of inland eyries (Table 4). Full details are given in appendix 1 for the coastal eyries and in appendix 2 for the selected inland eyries.

Table 3. Occupancy and productivity of coastal breeding peregrines in Northeast Scotland, 1996 - 2001

Year	Sites checked	Sites occupied (% of sites checked)	Number of sites fledging young (% of occupied sites)	Minimum number of young fledged	Mean number fledged young / occupied site	Mean number fledged young / successful site
1996	19	14 (74)	8 (57)	18	1.29	2.25
1997	19	14 (74)	4 (29)	8	0.29	2.00
1998	19	16 (84)	5 (31)	10	0.63	2.00
1999	19	17 (89)	8 (47)	15	0.88	1.88
2000	19	16 (84)	2 (13)	3	0.19	1.50
2001	19	17 (89)	9 (47)	21	1.11	2.33

At coastal sites, occupancy is high and has increased over the study period as the population has increased from 14 to 17 occupied sites. Productivity (mean number fledged young per occupied site) is low. The particularly low productivity of 0.19 fledged young/occupied site in 2000 was probably due to a severe storm in late April. Many eyries were known to have failed at that time. Productivity was high in 2001 with eyries that had failed for a number of previous years being successful (Appendix 1).

Site occupancy has been high at the selected inland sites and has also increased as the population increased. The lower productivity in 1998 was caused by two new sites being colonised by single birds. The mean number of fledged young per occupied site is

significantly higher than at coastal sites (t=5.501, p=0.01). The mean number of young fledging at successful sites does not differ significantly (t=2.203, ns)

Table 4. Occupancy and productivity of selected inland breeding peregrines in Northeast Scotland, 1996 - 2001

Year	Sites checked	Sites occupied (% of sites checked)	Number of sites fledging young (% of occupied sites)	Minimum number of young fledged	Mean number fledged young / occupied site	Mean number fledged young / successful site
1996	8	6 (75)	5 (83)	11	1.83	2.20
1997	8	6 (75)	5 (83)	10	1.67	2.00
1998	8	8 (100)	5 (63)	11	1.38	2.20
1999	8	8 (100)	5 (63)	15	1.88	2.50
2000	8	8 (100)	6 (75)	16	2.00	2.67
2001	8	8 (100)	8 (100)	23	2.88	2.88

Analysis of prey remains

Prey remains were recorded from 21 of the occupied coastal sites (Table 5).

Small prey will be under recorded as most of the remains were identified with binoculars from the cliff top. Such a bias towards larger prey items has been observed in other large falcons (Langvatn 1977) as well as peregrine (Hardey 1981). The bias towards larger prey observed from the cliff top should not influence the results substantially as a large number of feral pigeons (C*olumba livia*) were also recorded from accessible plucking posts and eyries. Similarly large numbers of pigeons were recorded in previous years (J Hardey pers ob). The lack of seabirds was not unexpected. Only a few are recorded annually (J.Hardey pers ob). Apart from kittiwake (*Rissa tridactyla*), puffin (*Fratercla artica*) and fulmar (*Fulmarus glacialis*) have been recorded in recent years. Starlings (*Sturnus vulgaris*) and blackbirds (*Turdus merula*) are recorded annually. A wider variety of other prey items have been found in other years. These occurred in small numbers and were recorded from the small number of sites with accessible plucking places.

Ratcliffe (1993) shows a more varied diet for coastal peregrines breeding in areas with few seabirds, with feral pigeons accounting for 24% of the diet by number. Even accounting for some of the biases in the recording methods of the present study, feral pigeons appear to be of greater importance to coastal peregrines in Northeast Scotland than indicated by Ratcliffe's (1993) analysis.

DISCUSSION

Breeding Success and Organochlorides

Peregrines breeding on the Northeast coast had a successful breeding season, rearing a record number of young. This was due to young being reared at several sites which had been unsuccessful for a number of years (Appendix 1). The pattern of several years of breeding success followed by several years of breeding failure is common in these coastal peregrines. It is possibly due to the falcons gradually accumulating pollutants, with the chemicals gradually having a greater effect on breeding success. Increasing levels of DDE have been shown to reduce reproductive success (Newton et al 1989) in peregrines by reducing eggshell thickness and increase egg breakage. Newton and Bogan (1978) showed that in sparrowhawks (*Accipter niscus*) DDE concentration was linked to hatching failure and egg addling. A combination of these effects would explain the reduction in productivity of coastal peregrines. DDE is a metabolite of DDT, a commonly used agricultural pesticide in the north east of Scotland until the mid 1980's (pers ob). DDE can persist in the soil for many years as it has a calculated half life between 12 and 57 years (Buck et al. 1983, Cooke and Stringer 1982). It is possible that significant residues may persist in coastal farmland and provide a source of contamination to the peregrines through their main prey, the pigeon (Table 5). It is unlikely that seabirds are a significant source of pollutants given the low number recorded as prey. Other recent studies in UK inland areas suggest that DDE levels are probably now sufficiently low to not cause any marked effects on breeding success (Mearns & Newton 1988, Horne & Fielding in press). The results from the present study would suggest that either peregrines in Northeast Scotland rely to a greater degree on prey from arable land or that capita levels of DDE are higher in their arable land prey. Both factors may be involved, but further research is required to establish their influence.

The other important organochloride pollutant shown to effect peregrines is HOED (Newton et al 1989) which is the active ingredient of the insecticide dieldrin and a metabolite of another insecticide aldrin. These chemicals were more likely to have a toxic effect on adult peregrines rather than reducing breeding success. The use of both these chemicals had declined by the late 1960's. Their half life is calculated at 4 to 7 years (Anon.1964, Edwards 1966). It is unlikely that pollution by HOED is affecting these peregrines as residues were shown to have declined to biologically insignificant levels by the mid 1980's (Newton et al 1989, Ratcliffe 1993).

Breeding Success and other pollutants.

Levels of PCB's and mercury were shown to be higher in coastal peregrines than inland peregrines (Newton et al 1978). Evidence was obtained that mercury reduced brood sizes but the effect of mercury was difficult to separate from the effect of DDT. There was no evidence that PCB's had any effect on breeding success.

Analysis of eggs.

The analysis of addled eggs would have provided evidence for the pollutants found in coastal peregrines. The lack of eggs in eyries prevented this evidence being collected but valuable experience has been gained on the problems that must be surmounted to collect a sample of eggs for analysis.

Table 5. Prey remains identified at coastal eyries in Northeast Scotland, 2001

Site	Prey remains collected from Eyries or Plucking perches	Prey remains on cliffs identified by binoculars
111		9 pigeon
112	1 pigeon, 1 starling	5 pigeon
114		3 pigeon
115		11 pigeon
116		4 pigeon
118		3 pigeon
121		8 pigeon
123		3 pigeon
124		2 pigeon
117	2 pigeon, 1 starling, 1 blackbird	
131	2 pigeon, blackbird	10 pigeon, jackdaw
133	1 pigeon, 1 starling	7 pigeon
134		5 pigeon
135		1 pigeon
137		6 pigeon
138	8 pigeon, 1 blackbird	3 pigeon
139		12 pigeon, 1 kittiwake
TOTAL	14 pigeon, 2 starling, 3 blackbird	92 pigeon, 1 kittiwake, 1 jackdaw

Comparison between coastal and inland eyries

Inland eyries had a significantly higher productivity (Table 4) than coastal eyries (Table 3). The difference between brood size at fledging in successful nests was not significant. The greater success of the inland sites was due to the greater proportion of eyries fledging young. From 63 to 100% of nests inland fledged young compared to 13 to 57% on the coast. The greater success of the inland eyries is probably linked to lower exposure to pollutants. Agriculture is less intensive in these inland areas and there is more forestry (pers ob). Agricultural prey is probably less important in the diet. Although further analysis is required before definite conclusions can be reached, the indications are that despite marked improvements in the status of the peregrine in many parts of the UK (Crick & Ratcliffe 1995, Horne & Fielding in press) in some areas peregrines may still be suffering from problems that were widespread forty years ago (Ratcliffe 1993).

REFERENCES

Anon. 1974. *Report to the Research Council on Toxic Chemicals.* London: Agricultural Research Council, Her Majesty's Stationary Office.

Buck, N.A., Estesen, B.J., and Ware, G.W. 1983 DDT moratorium in Arizona: residues in soil and alfafa after 12 years. *Bulletin of Environmental Contamination and Toxicology.* **31**, 66-72

Cooke, B.K. and Stinger, A., 1982 Distribution and breakdown of DDT in orchard soils *Pesticide Science* **13**, 545-557

Crick,H.Q.P. and Ratcliffe,D.A. 1995 The peregrine *Falco peregrinus* breeding population of the United Kingdom in 1991. *Bird Study* **42**, 1-19

DETR and JNCC 2001 *UK Raptor working Group Report.* London: Her Majesty's Stationary Office

Hardey, J.J.C., 1981 Prey taken by peregrines in the Grampian region, 1974-1980 *Grampian Ringing Group Report* **3**, 30-35

Horne,G. and Fielding,A.H. in press The recovery of the peregrine falcon (*Falco peregrinus*) in Cumbria 1966-1999 *Bird Study*

Langvatn, R., 1977 Characteristics and relative occurrence of remnants of prey found at nesting places of gyrfalcon (*Falco rusticolus) Ornis Scandinavia* **8**, 113-125

Mearns,R. and Newton,I. 1988 Factors affecting breeding success of peregrines in south Scotland *Journal of Animal Ecology* **57,** 903-916

Newton, I. and Bogan, J. 1978 The role of different organo-chlorides compounds in the breeding of the British sparrowhawk *Journal of Applied Ecology* **15**, 105-116

Newton,I., Bogan, J.A. and Haas, M.B. 1989 Organochlorides and mercury in the eggsof British peregrines (*Falco peregrinus*). *Ibis* **131**, 355-376

Ratcliffe, D.A. 1993 *The Peregrine Falcon* 2nd ed. London: t. & A.D. Poyser

Appendix 1. Breeding Success of coastal Peregrines in Northeast Scotland, 1996 - 2001

SITE	YEAR					
	1996	**1997**	**1998**	**1999**	**2000**	**2001**
111	Single adult	Single adult	Not occupied	Not occupied	Not occupied	Fledged 2
112	Pair failed	Pair failed	Pair failed	Pair failed	Single adult	Pair hatched 4 fledged 3
113	Pair failed	Pair failed	Pair failed	Pair failed	Pair failed	Pair failed
114	Single adult	Fledged 1	Fledged 3	Pair failed	Pair failed	Pair failed
115	Pair failed	Pair failed	Fledged 2	Fledged 1+	Pair failed	Fledged 2
116	Fledged 1	Pair failed	Pair failed	Pair failed	Pair failed	Fledged 3
117	Fledged 2	Pair failed	Fledged 2	Pair failed	Pair failed	Pair failed
118	Fledged 2	Fledged 1	Pair failed	Pair failed	Pair failed	Pair failed
119	Not occupied	Not occupied	Not occupied	Pair failed	Not occupied	Pair failed
121	Fledged 3	Fledged 3	Pair failed	Pair failed	Fledged 2	Pair failed
123	Fledged 3	Pair failed	Pair failed	Fledged 3	Pair failed	Pair failed
124	Not occupied	Not occupied	Not occupied	Not occupied	Pair failed	Pair failed
131	Not occupied	Not occupied	Pair failed	Pair failed	Pair robbed 3 eggs	Fledged 3
133	Fledged 2	Fledged 3	Pair failed	Fledged 3	Pair failed	Fledged 2
134	Pair failed	Pair failed	Pair failed	Fledged 1+	Pair failed	Pair failed
135	Fledged 1+	Pair failed	Pair failed	Fledged 2	Single adult	Pair failed
137	Not occupied	Not occupied	Pair failed	Fledged 1	Fledged 1	Fledged 1
138	Fledged 4	Pair failed	Fledged 2	Fledged 3	Not occupied	Fledged 2
139	Not occupied	Not occupied	Fledged 1+	Fledged 1+	Pair failed	Fledged 3

Data from J. Hardey and Northeast of Scotland Raptor Study Group.

Appendix 2. Breeding Success of peregrines breeding at inland sites below 250m with no persecution, 1996 - 2001.

SITE	YEAR					
	1996	**1997**	**1998**	**1999**	**2000**	**2001**
007	Fledged 2	Fledged 2	Fledged 3	Fledged 3	Fledged 1+	Fledged 3
010	Pair failed	Fledged 1	Fledged 2	Pair failed	Fledged 3	Fledged 3
041	Fledged 2	Fledged 2	Fledged 3	Pair failed	Fledged 4	Fledged 4
043	Fledged 2	Fledged 3	Fledged 1	Fledged 2	Fledged 2	Fledged 3
152	Fledged 3	Pair failed	Pair failed	Fledged 2	Hatched 2 failed	Fledged 1
173	Fledged 2	Fledged 2	Fledged 2	Fledged 2	Fledged 3	Fledged 4
174	Not occupied	Not occupied	Single adult	Fledged 3	Fledged 3	Fledged 4
175	Not occupied	Not occupied	Single adult	Hatched 3 failed	Pair failed	Fledged 1

Data from J. Hardey and North east of Scotland Raptor Study Group.