

GOLDEN EAGLE DNA PROJECT UPDATE
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Mouth swabbing a Scottish golden eagle nestling
Photo © Logan Steele

PROJECT OVERVIEW

The UK has the fourth largest golden eagle (*Aquila chrysaetos*) population in Europe (Cramp & Simmons 1980; Watson 1997), with approximately 430 pairs occupying territories, of which almost all are in Scotland (Eaton *et al.* 2007). Demographic monitoring of the UK golden eagle population, primarily involving productivity and distribution of occupied and vacant territories, has been achieved by censuses every 10 years (Dennis *et al.* 1984; Green 1996; Eaton *et al.* 2007) and by more spatially limited but more temporally expansive annual surveys of approx. 200 occupied territories undertaken by the Scottish Raptor Study Groups (SRSG). Whilst these surveys have an important role for understanding the demographics of the UK golden eagle population, they are limited because individual golden eagles cannot be confidently recognised and information on annual turnover in the breeding population is lacking.

Recent modelling has suggested that the Scottish population does not have an overall favourable conservation status and may be close to decline, despite the apparent stability inferred by simple temporal comparisons of numbers of occupied territories, with persecution the principal national threat (Watson & Whitfield 2002; Whitfield *et al.* 2004a; 2004b, 2006; 2007) However, adult survival estimates are currently only possible using imperfect methods from classic population dynamics theory and observations of age structure of the population (Whitfield *et al.* 2004b). To overcome this research gap, we are using non-invasive genetic sampling to monitor the presence of individual eagles over time. With the support of the SRSGs and others, we are collecting moulted adult feathers and mouth-swabbing nestlings for DNA sources that will allow us to identify individual golden eagles to address the following research objectives:

- Test the feasibility of using genetic markers to monitor turnover in UK golden eagles.
- Quantify site fidelity of breeding adults and hence quantify the contributions of breeding dispersal and fatality to turnover, which, in turn, will allow adult survival to be estimated.
- Contrast genetically derived measures of adult survival against those derived using indirect measures from population age structure, and re-model national and regional population dynamics.
- Examine the effects of persecution on turnover and adult survival.

2006 SAMPLE COLLECTION & ANALYSIS

Sample collection for this project began in 2006 and we received 846 feathers and 30 mouth swabs from 125 sites across the golden eagle's UK range. Each sample was assigned a unique identifying code so we could retain site confidentiality, and this also helped to prevent any unintentional bias during genotype analyses and comparisons. A total of 212 individual golden eagles were genotyped and sexed and their DNA profiles were added to our national DNA database. See Table 1 for a regional breakdown of 2006 sample coverage.

Table 1. Regional breakdown of 2006 GE samples (feathers & mouth swabs)

| <i>Region</i> | <i>Number of Sites (includes nests & roosts)</i> |
|---------------------|--|
| Argyll | 17 |
| Central | 1 |
| Cumbria | 1 |
| Dumfries & Galloway | 2 |
| Highland | 36 |
| Lothian & Borders | 3 |
| North East | 5 |
| Tayside | 10 |
| Uists | 21 |
| Western Isles | 29 |
| <i>TOTAL</i> | 125 |

Our confidence in the power of the genetic markers being used for this study is supported by our ability to detect several samples whose profiles did not fit within the expected molecular range of Scottish golden eagles. These samples were subsequently sequenced and were determined to be of WTSE origin (from shared GE/WTSE roost sites). This is a particularly useful determination for our study as it is not always possible to distinguish between GE/WTSE feathers by sight, especially the smaller body feathers whose identification characteristics are not always diagnostic.

2007 SAMPLE COLLECTION

A total of 1,132 feathers from 126 sites and 31 mouth swabs from 29 sites (total site coverage was 130 sites) were collected during 2007 (see Table 2 for a regional breakdown of sample collection). Of these 130 sites, 67 were 'repeat sites' (i.e. samples were also collected in 2006), and 63 sites were 'new sites' (i.e. samples collected in 2007 only). Combining the unique sites that were covered in 2006 and 2007, **total site coverage for this project is now 188 unique sites sampled**. Coverage in both years has been particularly comprehensive in the Uists and Western Isles.

All the 2007 samples are currently at the lab and we expect to be completing analyses by Easter 2008.

Following some difficulties with DNA quality/quantity from the 2006 'dry' GE mouth swabs, in 2007 we trialled two different mouth swab types ('dry' and 'wet') on golden eagles, white-tailed sea eagles and goshawk. Cross-species preliminary results indicate that the 'wet' mouth swabs are more suitable for our research purposes and thus we will be switching to 'wet' swabs from 2008. The buffer used in the 'wet' swab tubes helps to stabilise the DNA from the point of collection until it reaches the lab, thus reducing the impact of DNA deterioration and hence improving the quality/quantity of DNA available for analysis. There was an issue with the lids on some of the wet swab tubes and we are working with the lab to improve this feature prior to 2008 swab collections.

Table 2. Regional breakdown of 2007 GE samples (feathers & mouth swabs)

| <i>Region</i> | <i>Repeat Site</i> | <i>New Site</i> | <i>TOTAL</i> |
|---------------------|--------------------|-----------------|--------------|
| Argyll | 9 | 9 | 18 |
| Central | 1 | 3 | 4 |
| Dumfries & Galloway | 2 | 1 | 3 |
| Highland | 5 | 24 | 29 |
| Ireland | 0 | 1 | 1 |
| Lothian & Borders | 1 | 0 | 1 |
| North East | 3 | 4 | 7 |
| Tayside | 3 | 6 | 9 |
| Uists | 16 | 4 | 20 |
| Western Isles | 27 | 12 | 39 |
| <i>TOTAL</i> | 67 | 63 | 130 |

DNA COLLECTORS

The success of this project relies on the hard work and contributions of many voluntary fieldworkers from the Scottish Raptor Study Groups, and others. Without this support the project would be untenable. To date, 62 collectors have contributed samples to this project and we would like to thank them all for their support during 2006/2007:

(*denotes multi-year contributions):

Dave Anderson*, Stuart Benn, Jamie Boyle*, Jon Brain*, Roger Broad, Keith Brockie, Duncan Cameron, Martin Carty, Anna Crawford*, Colin Croke, Martin Davison, Roy Dennis, Dave Devonport, Dave Dick, Ron Downing, Desmond Dugan, Keith Duncan*, Pete Ellis, Brian Etheridge, Arthur French*, Kenny Graham*, Ronnie Graham, Justin Grant*, Steve Hardy, Paul Haworth*, Derek Hayward*, Roger Hayward*, Tim Healy, Malcolm Henderson*, Hugh Insley, David Jardine*, Alan Lauder, Tony Lightley*, Liz Macdonald*, Ian Macpherson*, Peter Madden, Doug Mainland, Mick Marquis, Wendy Mattingley*, Mike McGrady*, Enda McLoughlin, Ian Miller*, Sean Morris, Dominic Morrogh-Bernard*, Mike Nicoll*, Lorcan O'Toole*, Dave Pierce*, Skitts Rae*, Stuart Rae, Robin Reid*, Chris Rollie*, Andrew Sandeman, Andy Schofield, David Sexton, Frank Stark*, Logan Steele*, Patrick Stirling-Aird*, Andy Summers, Des Thompson, David Walker*, Ewan Weston*, Phil Whitfield.

We were invited to give two project presentations in 2007 (Highland Raptor Study Group meeting and Scottish Ringers Conference). As a result, an additional nine people have received DNA collection kits and we hope they will feel encouraged to contribute in 2008. We thank David Jardine and Skitts Rae respectively for providing these opportunities to reach more collectors.

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