Institution: University of Aberdeen

Unit of Assessment: 5 - Biological Sciences

Title of case study: Population science shapes conservation policy for rare Red-billed Choughs in Scotland

1. Summary of the impact

European Union (EU) law stipulates that governments must conserve listed species of conservation concern, necessitating the legal designation of Special Protection Areas (SPA) and the design and implementation of appropriate land management and other targeted conservation policies. Such policies should be underpinned by robust scientific understanding of population ecology, but this is rarely achieved for populations of immediate conservation concern.

A University of Aberdeen study of Scotland's remaining red-billed chough bird population provided the scientific understanding and evidence required to designate a new SPA, introduce new components to the Scottish government's agri-environment policy and underpin emergency management intervention.

The research thereby impacted statutory land designation and agricultural policy, and hence the management and conservation of a figurehead natural population in Scotland.

2. Underpinning research

Effective conservation management requires clear understanding of ecological and demographic constraints on population growth. Such understanding is typically lacking for populations of immediate conservation concern. This knowledge gap severely limits the degree to which conservation policy can be evidence-based, limiting the efficacy of policy and resource allocation decisions.

The red-billed chough (*Pyrrhocorax pyrrhocorax*) is a rare crow that is listed on Annex 1 of the EU Wild Birds Directive and is a figurehead species for High Nature Value agriculture. Scottish Natural Heritage (SNH), as the designated Scottish government agency, is legally obliged to implement appropriate conservation policy, including designating SPAs, agri-environment schemes and targeted management interventions. However, SNH's ability to fulfil these obligations was limited by a lack of rigorous scientific understanding of chough population ecology.

Since 2001, Dr Jane Reid, a Senior Research Fellow at the University of Aberdeen, has compiled demographic data from Scotland's main remaining chough population on Islay [1-3]. She used these data to identify demographic and ecological constraints that limit population growth [1-6]. While at the University of Aberdeen since 2006, she identified key life-history stages and locations where conservation management should focus [4-6], and translated these research results into Scottish government conservation policy (see section 4).

Reid used sophisticated demographic analyses to show that population growth is constrained by low juvenile survival [3,6] and that juvenile and adult survival vary substantially among choughs fledged in different areas of Islay [4]. This research caused policy-makers to focus on juvenile survival, rather than on breeding adults as they had previously. It also highlighted areas of Islay that are key to population growth [4], thereby altering the spatial focus of conservation action. Thanks to Reid's analysis, one key area was subsequently designated an SPA. Reid's analyses also helped define areas that have now been incorporated into agri-environment policy (see below and section 4).

Reid and her collaborators secured a Knowledge Transfer grant from the Natural Environment Research Council (2006-2009, [7]) to identify ecological causes of demographic variation and translate this knowledge into agri-environment policy. The grant also involved Glasgow University,

SNH and the Royal Society for the Protection of Birds (RSPB), and Reid led the work. It supported a postdoctoral researcher to collect field data, plus data analyses and knowledge transfer among researchers, conservation managers, farmers and birdwatchers (section 4). This research identified ecological determinants of variation in juvenile survival [5], resulting in land management recommendations that were subsequently implemented through the Scotland Rural Development Programme (SRDP) agri-environment policy (section 4).

However, substantial time elapsed before SRDP policy could be implemented, due to the need to negotiate overarching EU policy. Meanwhile, chough juvenile survival decreased drastically, threatening population persistence and necessitating urgent action. Reid therefore ran further demographic analyses to identify the precise timing of mortality and hence the most effective times for targeted intervention [6]. Reid tabled this information to SNH and led discussions that initiated emergency supplementary feeding [8]. This programme is proving successful, and SNH have now funded three further years of feeding and analysis of future policy implications [9].

Initial data compilation and analysis was instigated during 2001-2005 while Reid was a postdoctoral researcher at Universities of Glasgow (2001, [10]), British Columbia (2001-2003) and Cambridge (2003-2005). However Reid undertook the main policy-relevant research, and ensured its translation into impact, while holding a Royal Society University Research Fellowship at the University of Aberdeen during 2006-2013 [11].

3. References to the research

Primary publications

[1] Reid, JM, Bignal, EM, Bignal, S, McCracken, DI & Monaghan, P (2003). Age-specific reproductive performance in the red-billed chough (*Pyrrhocorax pyrrhocorax*): patterns and processes in a natural population. *Journal of Animal Ecology* 72, 765-776. *Awarded the journal's Elton Prize. Citations = 126.*
[2] Reid, JM, Bignal, EM, Bignal, S, McCracken, DI & Monaghan, P (2003). Environmental variability, life-history covariation and cohort effects in the red-billed chough (*Pyrrhocorax pyrrhocorax*). *Journal of Animal Ecology* 72, 36-46 *(journal cover). Citations = 84.*
[3] Reid, JM, Bignal, EM, Bignal, S, McCracken, DI & Monaghan, P (2004) Identifying the life-history determinants of population growth rate: a case study of red-billed choughs (*Pyrrhocorax pyrrhocorax*). *Journal of Animal Ecology* 73, 777-788. *Citations = 40. Highlighted the impact of juvenile survival on population growth.*
[4] Reid, JM, Bignal, EM, Bignal, S, McCracken, DI & Monaghan, P (2006). Spatial variation in demography and population growth rate: the importance of natal location. *Journal of Animal Ecology* 75, 1201-1211. *Citations = 30. Identified areas of the Scottish island of Islay that are key to population growth rate, prompting Special Protection Area designation.*
[5] Reid, JM, Bignal, E, Bignal, S, McCracken, DI, Bogdanova, MI & Monaghan, P (2008). Investigating patterns and processes of demographic variation: environmental correlates of pre-breeding survival in red-billed choughs (*Pyrrhocorrax pyrrhocorax*). *Journal of Animal Ecology* 77, 777-789. *Identified ecological correlates of juvenile survival, facilitating targeting of government agri-environment policy.*
[6] Reid, JM, Bignal, E, Bignal, S, Bogdanova, MI, Monaghan, P & McCracken, DI. (2011). Diagnosing the timing of demographic bottlenecks: sub-adult survival in red-billed choughs. *Journal of Applied Ecology* 48, 797-805. *Identified occurrence and timing of severe juvenile mortality, prompting emergency conservation intervention.*

Grants *(all grants except [10] were held while Reid was at the University of Aberdeen)*

[7] NERC Research Grant (Knowledge Transfer scheme, 2006-2009, £125,000): 'Turning population ecology into conservation strategy: development of agri-environment policy for red-billed choughs in Scotland', with Prof. P. Monaghan (University of Glasgow). KT partners: Scottish Natural Heritage and Royal Society for the Protection of Birds.
[8] Scottish Natural Heritage Research Grant (2011-2012, £18,306): 'Chough survival and food limitation', allowing monitoring and supplementary feeding, with Scottish Chough Study Group.
[9] Scottish Natural Heritage Research Grant (2012-2015, £98,204): 'Towards sustainable

conservation strategy for red-billed choughs in Scotland', allowing demographic monitoring, supplementary feeding experiment and review of the efficacy of current government conservation policy, with Scottish Chough Study Group.
[10] Scottish Natural Heritage and Royal Society for the Protection of Birds Research Grant (2001, £14,200): 'Demography and population dynamics of red-billed choughs', with Prof. P. Monaghan, University of Glasgow.
[11] Royal Society University Research Fellowship (2006-2013 - £764,000): 'Individual variation in a population context'. Supported the primary research in population ecology that was subsequently used to underpin conservation policy.

4. Details of the impact

Reid's research directly impacted upon government conservation and agricultural policy regarding the conservation of an important protected population of red-billed choughs in Scotland, and consequently impacted conservation policy-makers and practitioners and farmers.

Reid's analyses identified specific areas of the Scottish island of Islay that contribute substantially to chough population growth rate and hence to maintaining a viable population of this Annex 1 species [4]. Her analyses were used to designate a major SPA on Islay (Gruinart Flats, total area 3261 ha [a]) with chough as a 'qualifying interest'. Reid's work [6] has subsequently supported a statutory condition assessment of Scottish chough SPAs, causing some to be deemed in 'Unfavourable' condition relative to stipulated baselines [b]. This is now prompting further monitoring and action by governmental and non-governmental organisations.

Reid's research provided the rigorous understanding of demographic and ecological constraints on chough population growth rate that was required to write chough-specific management options into the Scottish agri-environment scheme (the Scotland Rural Development Programme, SRDP [4-6]). Farmers in specific areas of Islay that were highlighted by the research can now apply for agri-environment funding to undertake land management activities that benefit choughs [c]. These activities include bespoke grazing and cutting regimes, and providing or maintaining chough nest sites, in key locations identified by Reid's research. The first applications have now been approved and funded to a total value of >£250k. This agri-environment scheme has therefore changed agricultural practices on Islay, and injected substantial resources into the rural economy.

Reid's quantification of recent unprecedentedly high juvenile mortality prompted an SNH programme of emergency supplementary feeding, now funded for 4 years, and an associated policy review [8, 9]. This programme has added a new dimension to conservation policy, and is directly impacting the state of the protected population [d].

Reid pro-actively disseminated the research to conservation managers, policy-makers and practitioners, farmers and the wider public through ongoing activities designed to maximise impact:
(i) The NERC Knowledge Transfer research project culminated in the production of a major research and policy report [e]. This summarised the key policy-relevant results of the primary research, and included a set of policy recommendations that were agreed through a two-day round-table discussion that involved Reid, conservation managers and practitioners from SNH and Royal Society for the Protection of Birds (RSPB), farmers and scientists from Scotland's Rural College (SRC) and University of Glasgow [e]. These recommendations were used to inform agri-environment policy incorporated into the SRDP [c], and SNH's policy of funding emergency supplementary feeding [8,9].
(ii) The 'Scottish Chough Forum', which comprises Reid and representatives from SNH, RSPB, SRC, Scottish Chough Study Group and the University of Glasgow, meets twice per year to ensure ongoing effective exchange between science and policy [b].
(iii) As part of the NERC Knowledge Transfer project an international stakeholder conference was held in Ayr, Scotland in 2007. Approximately 90 delegates attended the two-day workshop, including scientists, policy makers and practitioners from England, Wales, Ireland, France, Spain, Italy, Portugal and Canary Islands as well as Scotland. This facilitated the transfer of new scientific understanding, and views of emerging threats, to policy makers across Europe. This meeting

sparked follow-up international meetings in Canary Islands (2011) and Portugal (2013).
(iv) Reid presented her research to public audiences of farmers and birdwatchers [f]: Scottish Ornithologists' Club (2011); Islay Farmers' Association (2008 [g]); Scottish Ringers' Conference (2007). Reid also gave major invited plenary lectures to the public at the British Trust for Ornithology Annual Conference (2011), and to policy makers and conservation scientists at the Norwegian Academy of Sciences conference on 'Sustainability Conservation' (Oslo, 2010).

Reid's work has directly impacted upon public policy and policy-makers; on resultant agricultural and conservation policy and hence on the environment; and on public understanding of and participation in conservation science. It has directly impacted on governmental conservation management by providing information and understanding on which key policy discussions were focussed and policy decisions were based [a-e]. In so doing, it has also benefitted the broader research and conservation community in Scotland by providing a successful and ongoing example of rigorous conservation science being translated into policy [b,h]. It has directly impacted on agri-environment and land management policy and on Islay's rural economy by leveraging substantial funding for chough-friendly farming [c]. Such schemes are critical to maintaining viable agriculture in Less Favoured Areas. Importantly, it has directly impacted on the agricultural environment that red-billed choughs inhabit, positively impacting population size and persistence. This further benefits Islay's economy because choughs are a major ecotourism attraction, thereby supporting visitor accommodation and hospitality outlets and transport infrastructure.

The impact claimed as defined by REF therefore includes: environmental policy decisions and planning decisions were influenced by research and management, and conservation of natural resources has changed.

5. Sources to corroborate the impact

[a] Scottish Natural Heritage (SNH) map showing the Gruinart Flats Special Protection Area (SPA) and Site of Special Scientific Interest (SSSI) on Islay, Scotland. This area was designated with red-billed chough as a qualifying interest using Reid's research.
[b] Testimonial from SNH Area Officer, Islay, Scotland.
[c] Links to the Scottish Government webpages that provide farmers with information regarding chough-specific land management options that are now available in the Scotland Rural Development Programme (based on information from Reid's work). Farmers in key areas of Islay (also identified by the research) can agree appropriate grazing plans and land management regimes with the Scottish Minister, and receive substantial funding for their implementation.
http://www.scotland.gov.uk/Topics/farmingrural/SRDP/RuralPriorities/Options/GrazedGrasslandforChou
http://www.scotland.gov.uk/Topics/farmingrural/SRDP/RuralPriorities/Options/GrasslandForCorncrakes
[d] A recent popular article, published in *British Wildlife* magazine, that highlights the impact of the emergency supplementary feeding policy that resulted from Reid's research [6].
[e] Major research and policy report that was produced by the Knowledge Transfer project [7], including conservation policy recommendations that were agreed with SNH policy officers and Royal Society for the Protection of Birds (RSPB) conservation managers.
Reid, J.M., Bogdanova, M. & Monaghan, P. (2009) *Population ecology and conservation of red-billed choughs in Scotland*. Research and policy report to SNH & RSPB, 112 pages.
A summary is publicly available at:
http://www.knowledgescotland.org/images_db/chough%20research%20report%20summary%20document.pdf The full document is available on request from Dr Jane Reid.
[f] Powerpoint files that supported these public and policy presentations are available on request.
[g] Video of the presentation that Reid gave to the Islay Farmers' Association is available on request. Land-managers who attended the live presentations requested that the video was made so that information could be further disseminated to farmers who were unable to attend in person.
[h] SNH has funded a CASE PhD studentship with University of Aberdeen (2012-2016) to continue and exemplify translation of rigorous science into conservation policy for Red-billed Choughs.