

**Project plan for the re-introduction of red-billed chough
Pyrhocorax pyrrhocorax into
Jersey, Channel Islands**

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by



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1 INTRODUCTION

A re-introduction is one that attempts to “*establish a species in an area which was once part of its historical range, but from which it has been extirpated or become extinct.*”

- IUCN 1998

1.1 Background

The red-billed chough *Pyrrhocorax pyrrhocorax* is a member of the crow family typically found in mountain and coastal regions of Europe, North Africa and Asia. One sub-species, *P. pyrrhocorax pyrrhocorax* is found only in coastal Britain, Ireland and Brittany (France). It is a specialist invertebrate feeder favouring ants, crane fly larvae, and beetles, which it requires in great abundance. For this reason it prefers to forage amongst short-grazed pastures and strandlines where seaweed attracts insects (Reid *et al.* 2009). Coastal habitats also provide cliff faces for nesting although choughs will also use artificial sites such as abandoned quarries and mineshafts (Reid *et al.* 2009).

Globally the chough has quite an extensive range being found across Europe and Central Asia, which means that it is classed as Least Concern on the IUCN Red List (Birdlife International 2012). However, within Britain and Ireland the range has declined and become fragmented due to changes in agricultural practice and land use. Within their fragmented habitats they face further threats from predation, egg collection, and adverse weather. It is estimated that there are now less than 500 breeding pairs in the UK (Johnstone *et al.* 2007).

Within the Channel Islands the chough was considered a common resident until the turn of the twentieth century, but since 1929 there have been no reports (Dobson 1952). Breeding pairs could be found along the south and east coast of Guernsey, on Sark, and Alderney. On Jersey there were reports of choughs breeding on the cliffs at Fiquet Bay, La Moye (de Gruchy 1880), and Noirmont (de Gruchy 1912).

A re-introduction project has been proposed to re-establish the chough within its historical range in Jersey and aid the north-west European population. It is hoped that the chough will act as a flagship species for the restoration of coastal habitat and, thus, aid in the re-establishment of other threatened birds on the islands. These activities along with the re-introduction project are all part of the wider *BIRDS ON THE EDGE* programme created to restore Jersey's coastal biodiversity: this programme is a partnership between Durrell Wildlife Conservation Trust (Durrell), the States of Jersey Department of Environment (DOE), and the National Trust for Jersey (NTJ). Management of a captive population will be necessary in order to provide donor stock and habituate individuals prior to release. This document details the project plan for re-introducing choughs into Jersey and will focus on the pilot study aimed to lead the way for future releases.

1.2 Vision, Aim, and Objectives

The **vision** for the BIRDS ON THE EDGE programme is to see the biodiversity of Jersey's coastline restored to its former glory. The reintroduction of choughs onto Jersey is seen as one of the driving forces in achieving this vision.

The **aim** of this re-introduction project is to establish a viable, free-ranging population of red-billed choughs within their historical range on Jersey, Channel Islands.

The **objectives** are to (1) enhance the long term survival of the European red-billed chough population (2) restore the natural biodiversity of Jersey's farmland and coastal areas within the next 20 years (3) to promote public awareness of coastal restoration and farmland ecology through educational opportunities (4) to develop research opportunities to maximise understanding of captive-husbandry and breeding of choughs applicable to other social species and (5) to produce a

husbandry manual on the management techniques needed to guarantee successful re-introductions of choughs and related birds elsewhere.

1.3 Targets

There are several achievable targets that must be met within the first year of the release. It is not an exhaustive list and will no doubt increase as the project grows. Evaluation of the pilot release will determine the targets for 2013 onwards. The targets are to:

- Create two dedicated off-show breeding aviaries at Durrell for the 2012 breeding season and maintain a public display aviary for the non-breeding flock;
- Hatch and rear a minimum of six chicks per year for the next five years from birds held at Durrell and/or Paradise Park, Cornwall;
- Design and build a release aviary on the north coast to accommodate up to 10 choughs for the pilot release;
- Provide supplementary feed at the release site until optimum habitat conditions have been restored;
- Release six juvenile birds per year for the next five years. The release cohort size and demographics may increase or decrease for subsequent years depending on the success of the pilot;
- Achieve a survival rate to adulthood of at least 33% for released choughs¹;
- Achieve, by 2017, a wild population of at least 15 individuals with at least one established pair;
- Publicise the project in the national and regional press including Durrell, NTJ, and DOE publications;
- Develop public awareness and appreciation of choughs at Durrell and in the wild in Jersey as well as in the UK, Ireland and Brittany;
- Engage the local farming community in the project and promote awareness of how agricultural practices can benefit bird populations;
- Incorporate local schools in the project to raise awareness of the BIRDS ON THE EDGE programme and the importance of Jersey's and north-west Europe's coastal and farmland biodiversity;
- Produce, by 2020, re-introduction guidelines for choughs that can also be applied to other corvid species worldwide.

¹ Population/Survival targets measured according to number of released birds in the wild as of twelve months after the first release.

2. PRE-PROJECT ACTIVITIES

2.1 Justification assessment

The chough re-introduction project was created from a need to restore Jersey's coastal and farmland biodiversity. It is thought that the charismatic nature of the chough will appeal to the public and attract the attention of funding bodies. The chough will therefore act as the flagship species for the *BIRDS ON THE EDGE* programme. Its ecological and behavioural preferences post-release will assist in directing the coastal habitat restoration.

The *BIRDS ON THE EDGE* programme began work on habitat restoration in 2010 through sheep grazing and manual bracken removal on the north coast. Successful re-establishment of the chough within its historical range will require much more to be done. This regeneration will also be of benefit to other bird species that have declined or disappeared from Jersey in the last few decades. For example, the removal of bracken to provide foraging areas for the chough will, at some sites, open up areas for heath land plants to re-grow. In turn regeneration of this habitat will attract stonechat *Saxicola rubecula*, a species whose breeding population on Jersey has declined so much that it is now been awarded 'red list' status on the Conservation Status of Jersey's birds list (Young *et al.* 2011).

The chough has quite an extensive global range yet within Britain, Ireland and Brittany it has declined dramatically and become fragmented due to changes in agricultural practice and land use. Within their fragmented habitats they face further threats from predation, egg collection, and persecution. It is estimated that there are now less than 500 breeding pairs of chough in the UK (Johnstone *et al.* 2007). In the Channel Islands the previously resident species went extinct by 1930 (Dobson 1952).

Natural re-colonisation in Jersey is unlikely within the next 10-20 years without the intervention of a re-introduction project. The chough's prolonged absence from Jersey has meant that there are currently no local species action plans for the chough's recovery.

If the chough were to have a negative impact anywhere it might be on population sizes of other bird species through competition or perceived negative impacts on farmland crops. The latter would most likely arise if farmers thought the chough would become a pest like the carrion crow *Corvus corone* or magpie *Pica pica*. This would be an unfair assumption since choughs are highly specialised feeders and unlikely to reach high population densities due to the limited land availability on the island. Likewise, the carrying capacity on Jersey means that any future population size will be far less than that of other corvid species, so the competition threat by choughs is low. By increasing habitat suitability for choughs you also increase it for other insectivorous bird species and, therefore, are not limiting food availability. Admittedly these theories are yet to be tried and tested; however, any negative association will be far outweighed by the benefits that this re-introduction will have.

The project plan will follow the *IUCN Guidelines for Re-introductions* (IUCN 1998) and report back to the relevant authorities. The published data can then be used to develop a future species action plan for the chough and inform existing biodiversity plans managed by the States of Jersey. Evaluation of the project's methodologies and outcomes will help inform other re-introduction projects worldwide.

2.2 Feasibility assessment

Background

The red-billed chough *Pyrhocorax pyrrhocorax*, once widespread along the coastline of the British Isles, has declined dramatically in numbers since the turn of the twentieth century. The number of breeding pairs has reduced greatly to the extent that in some areas it is now considered locally extinct, e.g. Channel Islands, Isle of Wight, Scottish Borders.

The Birds of Conservation Concern list for Europe (Eaton *et al.* 2009) currently places the chough at the second highest level of concern, i.e. 'amber status'. Recent conservation measures have boosted populations in certain areas, yet their fragmented distribution means that the chough population in the British Isles is still worryingly low.

The Channel Islands is one of the areas where choughs are now considered locally extinct within the British Isles. The Red-billed Chough Re-introduction Project aims to re-establish a viable, free-ranging population of choughs in Jersey where they once bred. Achievement of this would enhance the long term survival of the European population and restore the natural biodiversity of Jersey's farmland and coastal areas in the process.

Biological, Environmental, and Technical considerations

Natural History

The current population size in the UK and the Isle of Man is just under 500 breeding pairs and less than 400 non-breeding birds (Johnstone *et al.* 2007). The majority of these birds are confined to Wales (53%) and the Isle of Man (30%) and the remainder can be found in south-west Scotland, Cornwall, and Northern Ireland (1 breeding pair only). **Figure 1** shows the current distribution of these populations and highlights their fragmented and often isolated distribution. The Isle of Man had 128 breeding pairs in 2002 and almost the same number of non-breeding individuals (Johnstone *et al.* 2007). Living on an island limits the availability of habitat therefore any threats carry a greater risk for these birds. The closest neighbouring populations are to be found on the island of Anglesey and the single breeding pair on Rathlin Island, Northern Ireland.



Figure 1: Distribution of red-billed chough populations in the UK and Isle of Man in 2002.

Choughs are also found in the Republic of Ireland, north-west France (Brittany), across southern Europe, North Africa, and part of Asia making them a species of 'least concern' on the IUCN Red list (IUCN 2012). Ireland is home to an estimated 835 breeding pairs, although only 338 are confirmed, and a non-breeding flock over 700 individuals (Gray *et al.* 2003). Brittany however only has 48 known breeding pairs and 22 non-breeding individuals (Johnstone *et al.* 2007).

In Europe there are approximately 12,265 – 17,350 breeding pairs (Hagemeijer and Blair 1997) the majority of which are found across Spain. As in the UK the distribution is fragmented and in France there are only a handful of localities restricted to Brittany including the offshore island of Ouessant (Kerbiou *et al.* 2006).

The population trend has declined markedly over the last hundred years or more (Bullock *et al.* 1983; Owen 1988). Pre 1800 the chough could be found across the south and west coasts of England from Sussex to Cumbria and across the Scottish Borders (Lamacraft and Muirhead 2007). It went extinct on the Isle of Wight in 1860 and in the Channel Islands sixty years later (Dobson 1952). In Wales there has been an overall increase in numbers due to direct conservation management (Cross and Stratford 2008; Thorpe and Johnstone 2003) and a natural re-colonisation in Anglesey in the 1960s. Yet in mid-Wales numbers have fallen (Green 2002). The regional fluctuations and fragmented habitat all lead to contraction within its range.

The decline in the chough population is mirrored by the increase in intensive agricultural practices and development of land for residential and commercial use. Intensive agriculture creates less profitable marginal land which tends to be abandoned by the farmer (Blanco *et al.* 1998b) and becomes overgrown with bracken (Kerbiou 1999; Meyer 2000). This type of habitat is totally unsuitable for invertebrate specialist like the chough as it cannot access its food source.

Choughs feed by probing the ground or animal dung for invertebrates namely crane fly larvae, ants (adults and larvae) and beetles (adults and larvae) (Bullock *et al.* 1983; Cowdy 1973; Warnes and Stroud 1988) and occasionally plant material when insect abundance is low (Kerbiou and Julliard 2007). They tend to graze on land where the sward height is less than 5cm such as coastal heath, cliff tops, grazed pastures, and footpaths. Feeding habitats can vary greatly, Scottish choughs will forage in the seaweed strandline, but generally share common features notably sheep and cattle grazing. **Figure 2** shows the coastal area near the Lizard Peninsula, Cornwall, where cattle grazing is used to improve the quality of foraging habitat for choughs.

Animal dung can be a valuable bi-product of habitat management as it supports population growth of crane fly and beetle larvae for the chough to feed off (Bignal *et al.* 1997). It should be noted however, that as the use of anti-parasitic drugs in cattle increases there is the potential to kill non-target dung invertebrates and reduce food availability to the choughs. Ivermectin for example has been shown to be lethal to dung breeding invertebrates in horse manure (Lumaret and Errouissi 2002).



Figure 2: Ruby Red cattle introduced to Cornwall for grassland management in chough foraging areas (left). Cowpats are probed by choughs for the insect larvae found inside them (right).

Whilst choughs have been known to disperse over a distance of 50km post-fledging (Wernham *et al.* 2002) they tend to forage within a 3km range (Kerbiou *et al.* 2006; Lamacraft and Muirhead 2007) and are sedentary in nature (Bignal *et al.* 1997). Fledging success is not dependent on size of foraging area in a territory, but the proximity of the nest-site to the foraging area (Kerbiou *et al.* 2006). In Brittany, breeding pairs tend to stay within 300-500m of the nest-site and the same is true in Wales (Trewby *et al.* 2007).

Nest-sites tend to be found in cliff face crevices and caves although they will also use abandoned quarries and buildings (Bullock *et al.* 1983) and artificial nest boxes specifically designed for choughs (Cross *et al.* 1993). Most pairs nest in low densities thereby having their own home ranges, but in Wales and the Isle of Man they cluster together due to food availability (Bignal *et al.* 2007). In Ireland, where densities are high, nest-sites are sometimes located less than 50m apart (Trewby *et al.* 2007). This makes them more vulnerable to stochastic events as well as agricultural changes.



Figure 3: Red-billed chough breeding sites in South Stack, Wales (left) and Lizard Point, Cornwall (right top and bottom).

The breeding season runs from April until late June (Bullock *et al.* 1983) and pairs tend to lay 3-5 eggs in a clutch. Eggs are incubated for 17-21 days by the female who will brood them for a further 10 days once hatched after which time both parents feed the chick (Laiolo *et al.* 1998). Chicks will fledge after 6-7 weeks although survival typically is low due to environmental factors (Reid *et al.* 2003) and predation from other birds such as raven, *Corvus corax* or peregrine *Falco peregrinus*.

Choughs in Spain have been found to carry haematozoa including a species of *Plasmodium*, but prevalence was less than 1% and not deemed a threat (Blanco *et al.* 1997b). They can also carry parasitic feather mites (e.g. *Gabucinia delibata*) although fledglings that have the parasite show improved feather condition. Choughs are prone to gapeworm, *Syngamus trachea* in the wild and in captivity (Meyer and Simpson 1988) and this could possibly pose a serious threat to small isolated populations. Further study on disease prevalence is needed.

In 2003 there was an attempt to re-introduce the chough back to Cornwall (Burgess *et al.* 2011). In 1800 there were over 150 breeding pairs in Cornwall, but by the end of the 1800s the population had crashed due to loss of habitat and persecution (Owens 1988). The last breeding attempt in Cornwall,

and the south-west of England, was recorded in 1947 although the odd individual would be spotted over the next few decades (Owens 1988). The red-billed chough is a sedentary species therefore, making long-distance dispersal and re-colonisation a slow process (Carter *et al.* 2003). Paradise Park in Hayle, Cornwall, took the initiative to re-introduce a small population back into the wild from their captive stock in 2003. The release cohort consisted of two males and four females between the ages of 4 years and 11 years, one of which was hand-reared. Within two months of release two birds went missing and a third disappeared four months later (Burgess *et al.* 2011). The other three died due to natural predation, accidental drowning, and human persecution. Whilst the release may appear to have been a failure it has allowed a great deal of knowledge and understanding to be gained from evaluating the methodologies employed.

At the same time as the re-introduction attempt, a natural re-colonisation occurred further south in Cornwall. In 2001 three choughs appeared at the Lizard Peninsula and their first breeding attempt was in 2003 (Carter *et al.* 2003). Since then there has been annual breeding activity supported by habitat management and a close monitoring scheme run by the RSPB to protect the birds from any human persecution. By 2011 there were six breeding pairs and fifteen chicks had successfully fledged (Johnstone *et al.* 2011).

Potential reasons for local extinction in Jersey

The chough has been absent from the Channel Islands for almost a century (Dobson 1952). There is limited scientific data regarding historic population size, genetic origin, or ecology preferences within the Channel Islands. What is known is from ornithological observation at the turn of the 20th century and inferences from British and French populations.

The last report of choughs in Jersey was a sighting of two birds at Noirmont in 1910 (de Gruchy 1912) although the breeding pairs were thought to have died out by 1900 (Marett 1941). There is a record of “a few choughs breeding in the cliffs at Fiquet Bay, La Moye” on the south-west of the island in 1880 and individuals were reported in that area for the following two years, but absent after that (de Gruchy 1882).

In Guernsey, the second largest of the Channel Islands, choughs were considered a common resident in the 1870s (Smith 1879). They were known to breed along the cliffs on the south and east parts of the island and spread over the cultivated parts in autumn and winter in “*considerable flocks*” (Smith 1879). The last report in Guernsey, and for the Channel Islands, was of a potential breeding pair at Torteval in 1929 (Dobson 1952).

The only detailed breeding information regards a clutch of eggs taken from Sark on April 30th 1906 that had been incubated for “*seven to ten days*” (Dobson 1952). The collector noted that “*the same pair laid again and hatched young*” but after that no other choughs were reported in Sark. Persecution by egg-collectors may be one reason the choughs disappeared as well as through hunting (Smith 1879): although this author writes that the birds wary nature meant it was “*not easy to get a shot at them....and as they are not good eating...no Guernsey man thinks of expending powder and shot on them.*”

There is mention of jackdaws *Corvus monedula* being potential competitors and cause for decline based on relative numbers (Smith 1876). Jackdaws were irregular winter visitors on Guernsey in the 18th century so it was thought the chough thrived without the competition. In Sark the relatively larger jackdaw population was thought to outcompete and ultimately drive away the choughs. However, even the jackdaws started to disappear thirty years later. In Jersey the first flock of jackdaws was recorded eight years after the disappearance of the chough, with breeding occurring in 1929 (de Gruchy) on the same cliffs as the choughs.

The most likely reason for the choughs disappearance from Jersey and the other Channel Islands is the change in agricultural practices. The decline in of the wool and knitting industry in the 19th century led to a reduction in grazed marginal land. The loss of associated practices such as bracken and gorse collecting for animal bedding and fuel meant unfarmed land went unmanaged and bracken spread out of control (see **figure 4**).



Figure 4: Bracken smothers much of the northern coastline of Jersey.

In the late 1870s the growing and export of the newly discovered potato variety, the Jersey Royal, became a highly profitable business. The Island's well drained and sunny slopes proved perfect for potato growing and many cliff tops were converted to potato production. By the beginning of the 20th Century almost 30% of the island's land had been converted potato production. Today, while land used for potato growing is much reduced it still impacts greatly on the wild bird populations. The use of pesticides on crops has reduced the amount of insects for the birds to feed off. In addition to that farmers typically cover their freshly seeded fields with plastic sheeting during the spring months to prevent pest damage. This in turns prevents birds from getting to the insects in the soil thus limiting their food supply during the onset of the breeding season.

The prolonged absence of the chough has meant that there are no conservation measures or legislation for the protection and/or management of the species. There is, however, a Jersey coastal restoration initiative, *BIRDS ON THE EDGE*, that targets species of conservation concern. It was started in 2010 as a partnership between DOE, Durrell, and NTJ. Key areas of habitat were identified based on selection preferences of UK and French bird populations since Jersey shares a similar terrain to coastal Britain and north-west France.

Habitat availability in Jersey

Restoration work has already begun on the north coast with the manual removal of bracken, planting of hedgerows, and low-intensity sheep farming. Over the next five years, NTJ plan to reduce the coverage of bracken by 5ha increasing the area available for grazing to just over 23ha. In turn this could increase the potential foraging area for choughs.

Recent habitat assessments of the coast of Jersey have identified several potential sites for immediate focus of habitat management and potential first release areas for choughs (Sellares 2010; Sangan 2011). From these La Don Paton (14ha) was selected as the most suitable based on current

habitat availability, potential for expansion, minimal human disturbance, and suitability for a release aviary. The site also benefits from being owned by NTJ and thereby having a certain amount of protection over it.

Le Don Paton, a protected site managed by NTJ, is situated between Mourier Valley and the cliff tops of Sorel Point. This area is largely scrub with patches of gorse, bramble, bracken and broom. Hidden amongst the gorse is a mature heather community. Previously a heathland area, Le Don Paton was historically farmed. Today the majority of the land is either agricultural fields or covered in gorse and bracken along the cliffs.

On the Sorel (eastern) side of the site, pioneer heather is beginning to emerge in two areas and these are being helped to further establish. There is also open grassland on both the plateau and on the slopes which provide suitable feeding habitat for many birds and hopefully the chough.

At Mourier Valley progress has been made in improving the land using mechanical and chemical management which has helped start the restoration process. In 2008 NTJ introduced twenty Manx Loaghtan sheep at La Don Paton to remove the bracken especially on steep sloped areas inaccessible by machine.



Figure 5: Manx Loaghtan sheep introduced by the National Trust for Jersey to managed grassland at La Don Paton.

Whilst Le Don Paton has been selected as the best site for a release, it does not hold enough suitable habitats to successfully re-establish the chough in Jersey at this time. The same is true for the other potential release sites. In order to succeed the released birds will be supplementary fed until habitat area is deemed sufficient.

Other potential sites that once managed may become suitable for choughs include Portlet common (31ha), Noirmont (34.5ha) and Les Landes (102ha). Portlet and Noirmont both contain bracken, scrub heath, and species-rich grassland and we know from historic records that the chough used to live along the cliffs here. There are concerns with using these sites for an immediate release through the level of disturbance from tourists and recreational users. It may well be that choughs naturally choose to return to these sites with or without increased habitat restoration and, if so, there may be a need to create protected areas.

Les Landes is the largest site of scientific interest (SSI) on Jersey and already contains a large amount of short stubble vegetation maintained by a grazing rabbit population and exposure to strong winds. Whilst these conditions might make it favourable foraging ground for choughs it would be

impractical to house a release aviary at such an exposed site. There is also a high level of footfall from visitors to Grosnez castle, cliff paths and the adjacent racecourse.

Potential Sources of Birds

Since the chough is already vulnerable in the wild it would seem more advantageous to use the existing captive stock for the pilot release. Paradise Park, Cornwall, have over thirty years experience with the red-billed chough and have developed husbandry and captive breeding techniques (Burgess *et al.* 2012). Recent genetic studies confirmed that the captive population originated from North Wales (Wenzel *et al.* 2012) and is likely to be the same sub-species that would have been present in Jersey.

Evaluation of the release of captive choughs by Paradise Park into Cornwall (Burgess *et al.* 2011) recommended the use of juvenile birds to increase breeding opportunities. In addition, they should be more adaptable to the wild environment having spent less time in captivity than adults.

In 2010 Paradise Park housed twenty four individuals in captivity including four breeding pairs. At the start of that year two breeding pairs were sent to Durrell on loan from Paradise Park to embark on a captive breeding programme (see **figure 6**). For the 2012 breeding season Paradise Park set up six breeding pairs and Durrell set up two breeding pairs. A pilot release would only require a cohort of six juvenile birds which seems more than feasible. By using both institutions to provide donor stock there should be no negative impact on existing captive breeding programmes and no impact on wild stock.



Figure 6: Breeding pairs of choughs at Durrell Wildlife Conservation Trust, Jersey, on loan from Paradise Park, Cornwall

Transport and Release techniques

Re-introductions and translocations of bird species for conservation management have become increasingly popular as more and more pressure is placed on wild populations. However, their intrusive nature is often frowned upon and dismissed in favour of passive habitat management. For certain species that may work, but for others habitat management and re-introduction go hand in hand. Carter *et al.* (2008) reviewed the role re-introductions play in conserving birds using several case studies to highlight the pros and cons of the practice.

Past re-introductions of choughs or related corvids are limited to just a handful and none have fully succeeded in their aim. Methods for the Cornish release of choughs were deemed successful in that birds found roosting sites and responded to an audible cue for monitoring and assessing health. However, the failure to establish a viable population was attributed to the birds being too old and naive to natural threats, a single release and not several birds over a longer period and a lack of sufficient post-release monitoring (Burgess *et al.* 2011). A translocation attempt of the Mariana crow *Corvus kubaryi* from Rota to Guam failed in 2001 (Plentovich 2005) likely due to lack of sufficient invasive predator and habitat management. The Hawaiian crow *Corvus hawaiiensis* re-introduction project has suffered greatly from mismanagement despite a long running captive breeding programme now run by San Diego Zoo (Banko *et al.* 2009): one example being the predation of

released birds by the Hawaiian hawk *Buteo solitarius* which had its own conservation strategy boosting numbers.

Successful re-introduction projects have occurred on Mauritius with the pink pigeon *Columba mayeri* (Jones *et al.* 1992), echo parakeet *Psittacula eques echo* (Jones and Duffy 1993), and Mauritian kestrel *Falco punctatus* (Jones *et al.* 1994). All three projects utilised soft-release techniques which are recommended for use when re-introducing choughs, albeit with species specific ‘tweaks’ (Jones pers. comm.).

Socio-economic, political, and legal considerations

The success of the project will rely a great deal on public acceptance for the re-introduction of choughs back into Jersey. There are numerous stakeholders involved in this project namely the landowners in the immediate vicinity of the release site. Prior to the first release there will be a stakeholder’s meeting to explain the project, discuss concerns, and find ways that stakeholder’s can contribute to the project (date set for stakeholders meeting is 17th July 2012). There will also be opportunities post-release for stakeholders’ to comment and for the project manager to provide feedback.

There might be a need to involve other people in the future once we know where the released birds disperse to and if any unforeseen problems arise. **Table 1** details the stakeholders who will be invited to participate in the pilot release.

The States of Jersey government are partners in the re-introduction project and there is full support from the Department of the Environment. Durrell will manage the captive breeding programme with support of DOE and NTJ to manage habitat restoration. The Société Jersiaise (a non-governmental organisation) fully supports the project and will contribute to post-monitoring efforts through their Ornithology Section. The bird groups on the neighbouring islands have also been informed in case any released birds choose to disperse off shore. [REDACTED], registered bird-ringers on Jersey, have also been notified and will have access to any ringing data gathered.

Other groups that will be informed of the project as their input will be of value include the JSPCA, local vet practices (in case members of the public bring in injured birds) and local media.

The red-billed chough is not a CITES listed species; therefore, transportation of choughs from the UK to Jersey only requires veterinary certification. However, the release of choughs into the wild does require a licence to be granted from the States of Jersey under the Wildlife and Countryside Act 1981 (release of non-native species and those species listed under schedule 9). An application has been submitted by the project manager.

Table 1: Stakeholders invited to participate with the pilot release of choughs

STAKEHOLDER	REASON FOR INCLUSION	POTENTIAL IMPACTS
Jersey New Waterworks Company	Landowner	No perceived negative impacts Participation with conservation project good PR
Rosnez Quarry	Landowner	No perceived negative impacts Participation with conservation project good PR
St John Manor	Landowner	Home range of chough may require unfavourable land management interventions Land management interventions mutually beneficial and increased biodiversity.
La Barcelone Farm	Landowner	Home range of chough may require unfavourable land management interventions Land management interventions mutually beneficial and increased biodiversity.
Sorel Farm House	Landowner	Home range of chough may require unfavourable land management interventions Land management interventions mutually beneficial and increased biodiversity.
Jersey Light Car and Motorcycle Club	Land users	Dirt track area is a potential foraging site, choughs become a nuisance Participation with conservation project good PR
Caesarean Cycling Club	Land users	Release site restricts their land use Participation with conservation project good PR
Jersey Rough Shooters Association	Land users	Home range of choughs may encompass shooting range Participation with conservation project good PR
██████████/CS Conservation	Land user	Release protocols may interfere with sheep farming practices in immediate vicinity Habitat management for choughs mutually beneficial
██████████	Local ornithological expert	No perceive negative impacts Increased natural biodiversity for the island
St John's Falconry	Potential land user	Restriction of flying space for falconry practice Participation with conservation project good PR

Key Criteria Assessment and Conclusions

Using the following scoring method, key feasibility criteria (**table 2**) have been assessed for the re-introduction of choughs to Jersey:

0. No fulfilment, and based on current knowledge it is not possible to address the deficit in knowledge, skills, resources and/or support required;
1. No fulfilment, but it may be possible to address the deficit;
2. Partial fulfilment, but it may be possible to address the deficit;
3. Partial fulfilment, but it is possible to address the deficit;
4. Complete fulfilment, but based on assumptions;
5. Complete fulfilment.

For a project to be considered feasible, each criterion should ideally achieve a score of 4 or more. A project scoring 3 on some criteria but 4 or above on others may be considered feasible assuming the identified problems can be overcome (e.g. through further research or experimental trials). A project scoring 2 or below on any criterion should not be considered feasible without further evaluation.

Although this is a subjective scoring system the assessment would suggest that the reintroduction project is feasible. Only 4 of the 10 criteria score three or below with an overall score of 37 out of 50. However, it highlights the need to address habitat availability and develop a sound release

methodology. Both of which to some extent require the pilot study to commence before they can be addressed sufficiently.

Table 2: Key feasibility criteria assessment for the red-billed chough project.

Key feasibility criteria	Score	Explanation
BIOLOGICAL, ENVIRONMENTAL AND TECHNICAL CONSIDERATIONS		
1. Is there sufficient knowledge of the species' natural history?	4	A lot is known for choughs in the UK. Channel Island information is based on historic record or assumptions based on UK and Northern Europe populations.
2. If required, are captive breeding and rearing techniques for the species known?	4	Developed by Paradise Park. Hand rearing techniques still need work but certain assumptions made from related species.
3. Are transport and release techniques for the species known?	3	Transport techniques known. Release methods not developed for choughs but will be addressed by this project.
4. Is suitable habitat available in which to release the animals?	4	Sufficient habitat is available for the pilot study providing birds are supplementary fed. Deficit will be addressed
5. Have the previous causes of decline been eliminated or sufficiently reduced?	3	Reasons for decline in Jersey based on assumptions and care has been taken to address issues. But others will come to light once birds are released.
6. Is a suitable source of animals available?	4	Yes assuming captive breeding seasons are successful
SOCIO-ECONOMIC, POLITICAL AND LEGAL CONSIDERATIONS		
7. Does stakeholder support exist?	4	Yes although assessment underway to confirm assumptions that all landowners will be supportive.
8. Will the project conform to relevant laws and regulations?	5	Yes
RESOURCE CONSIDERATIONS		
9. Are sufficient financial resources available?	3	Continuous fundraising needed to support lifetime of project.
10. Are sufficient technical resources available?	3	Any deficit in resources will be addressed as the project progresses.

3. PLANNING AND PREPARATION STAGE

3.1. Organisational structure of the chough re-introduction project (CRP)

It is widely recognised that for any re-introduction project to be successful there is a need for a multidisciplinary approach. The nature of the *BIRDS ON THE EDGE* programme means that both government (DOE) and non-governmental bodies (Durrell, NTJ) are involved. **Figure 7** shows the organisational structure of the overall *BIRDS ON THE EDGE* programme and responsibilities of those involved. The CRP is a single component of that programme led by Durrell in partnership with the DOE and NTJ.

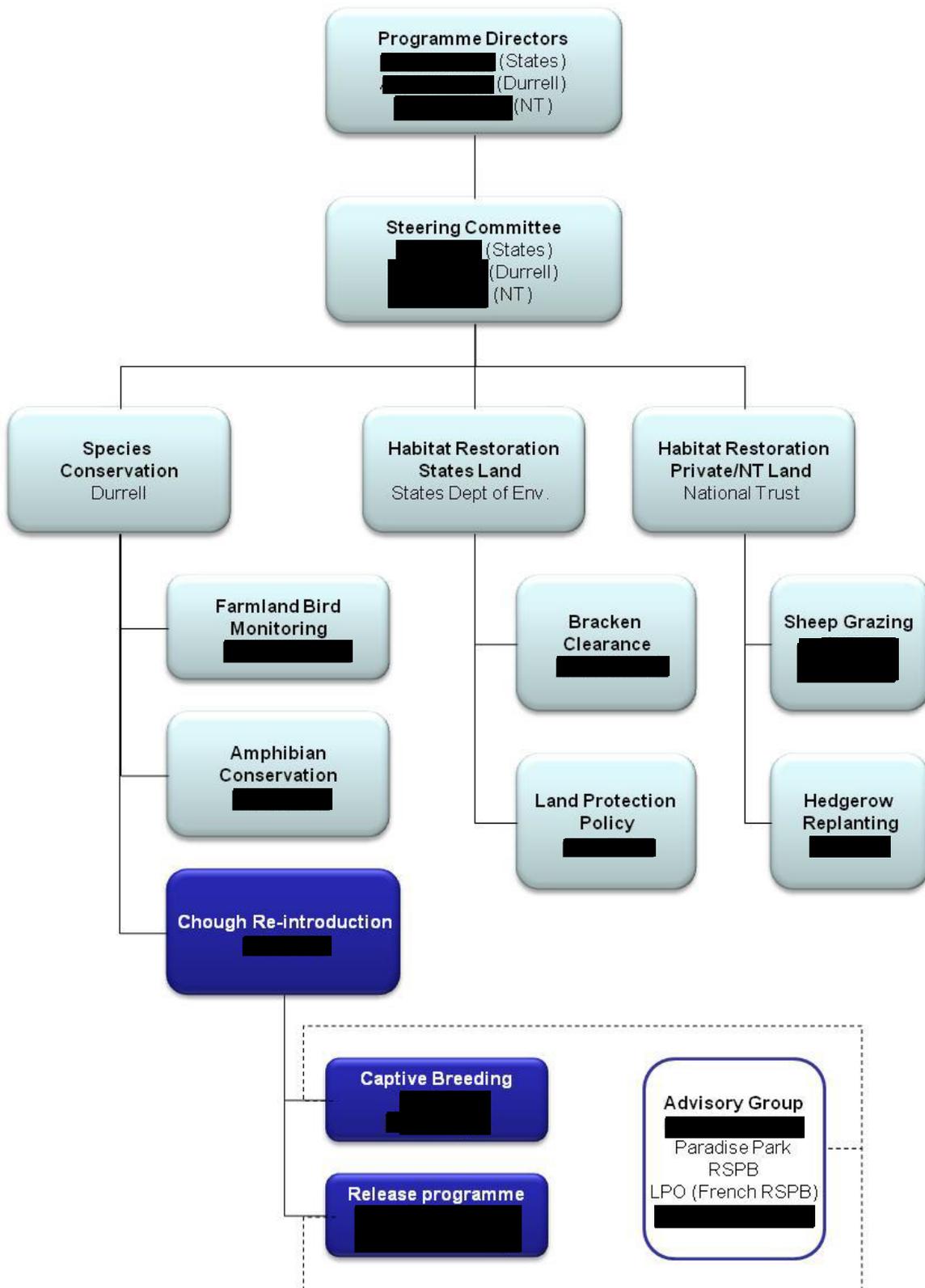


Figure 7: Organisational structure of the *Birds on the Edge* programme. States refers to the States of Jersey Department of Environment (DOE) and NT refers to the National Trust for Jersey (NTJ).

There is an advisory group, including Paradise Park who provided the donor stock for the re-introduction, and other sub-groups as detailed in **Table 3**. Every effort has been made to also include scientific experts and stakeholders in the development and continued evaluation of this project. **Section 3.10** provides more information regarding the stakeholders and their involvement.

Table 3: Roles and responsibilities within the Chough re-introduction project (CRP)

CRP Directors	
<p>██████████ (Durrell) ██████████ (DOE) ██████████ (NTJ)</p>	<p>Policy decisions on CRP work programme, budget, fundraising and public relations/media work.</p>
Strategic Planning Group	
<p>██████████ (Durrell) ██████████ (Durrell) ██████████ (Durrell) ██████████ (Durrell) ██████████ (Durrell) ██████████ (MWF/Durrell)</p>	<p>Strategic direction of the project – recommending decisions on the work programme, budget, fundraising and public relations/media work; reviewing and signing off sub-group work programmes</p>
Implementation Subgroup	
<p>██████████ (Durrell) ██████████/Bird Dept. (Durrell) ██████████ (Paradise Park) ██████████ (Durrell) <i>Field Assistant (Durrell)</i></p>	<p>Delivery of the project, in particular building and maintenance of facilities, bird rearing and release, ensuring adequate animal welfare standards; providing quarterly progress reports to the CRP SPG.</p>
Fundraising Subgroup	
<p>██████████ (Durrell) Member of the NTJ Member of the DOE ██████████ (Durrell)</p>	<p>Accurately cost the CRP, produce funding strategy and raise funds for the CRP; providing quarterly progress reports to the CRP SPG.</p>
PR Subgroup	
<p>██████████ (Durrell) ██████████ (Durrell) ███ (NTJ) ███ (DOE) ██████████ (Durrell)</p>	<p>Plan strategic communications to promote the CRP and the involvement of partners; develop effective relationships with other stakeholders; sign-off public communications material; providing quarterly progress reports to the CRP SPG.</p>
Monitoring Group	
<p>██████████ (Durrell) ██████████ (Durrell) ██████████ (University of Reading) ██████████ (Durrell) ██████████ (Durrell) <i>Field Assistant (Durrell)</i></p>	<p>To devise and oversee a monitoring programme for the released choughs that will provide data to measure success and ensure the highest survival rates possible. Data will also inform and advise future habitat management in Jersey.</p>

3.2 Identification of appropriate release sites

According to the *IUCN Guidelines for Re-introductions* (IUCN 1998) the release site should be within the historic range of the species providing appropriate habitat still exists. Records show that the chough was once common throughout the Channel Islands (Dobson 1952; Smith 1879). In Jersey the

chough had been recorded along the north-west and parts of the south-west coast, but there is no scientific data to support specific habitat preferences on Jersey.

Some of the areas where choughs were last seen are now urbanised. For instance, La Moye Prison and La Moye Golf Club now sit on the land behind Fliquet Bay, a known breeding site in the 19th Century (de Gruchy 1880). Jersey Airport, built in 1934, now covers around 40ha of old farmland on the west coast; a potentially large proportion of historic foraging sites.

There are still plenty of areas that have not been extensively developed and could potentially become ideal foraging grounds and breeding sites once habitat management is underway. Using data from Phase 1 habitat surveys of Jersey (Sellares 2010; Sangan 2011) and applying knowledge of habitat preferences in UK populations (Bignal *et al.* 1996; Kerbiriou *et al.* 2006; Mucklow and Croft 2008) the area in and around Le Don Paton on the north-west coast has been selected for the pilot release. The photo in **figure 8** shows the habitat surrounding the proposed pilot release site and **figure 9** shows an aerial view of Le Don Paton).

Le Don Paton is a coastal area of approximately 14ha running from Sorel point (east) to Mourier Valley (west). The area, originally heathland, was farmed from the 1950s to 1990s. Today the majority of the land is either agricultural fields or covered in gorse and bracken along the cliffs.

NTJ currently use the headland at Sorel to manage their Manx Loaghtan sheep introduced to graze in amongst the bracken as part of the coastal habitat regeneration project. As the sheep graze they trample young bracken and expose the rhizomes to frost damage effectively destroying the fern so it has less chance of growing again. This management means that there is already a good proportion of seemingly suitable habitat for choughs in the vicinity of the proposed release site. Any released bird will be further supported by supplementary feeding.



Figure 8: Habitat adjacent to the proposed pilot release site for re-introducing choughs back into Jersey. Field site for soft release aviary (top) and neighbouring cliff tops at Sorel (bottom).

The location of the chosen release site also benefits from being close to the cliff edge and therefore potential nesting sites. Fledging success is not dependent on size of suitable foraging habitat in a territory, but the proximity of the nest-site to the foraging area (Kerbiriou *et al.* 2006). Habitat restoration work at Le Don Paton site has so far focused within 300-400m of the cliffs. This is the typical distance breeding choughs will travel in search of food. The expansion of habitat restoration along the cliff tops will serve to increase the number of suitable breeding territories.

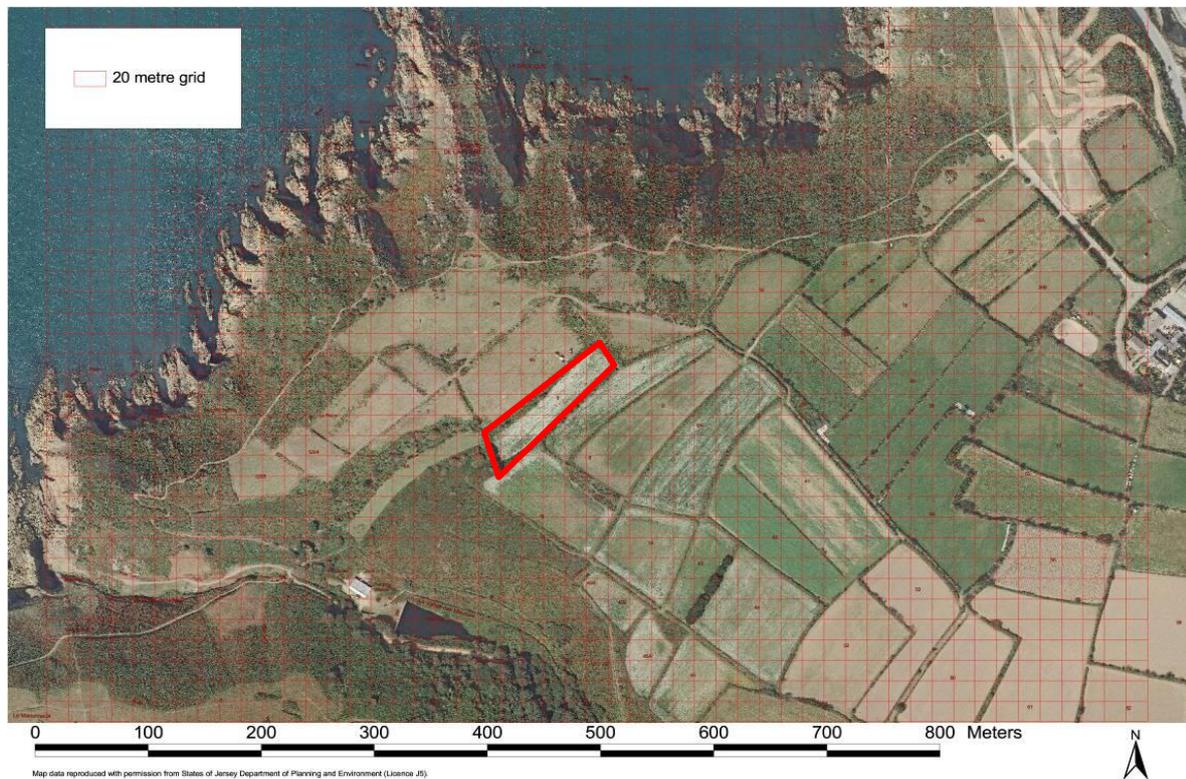


Figure 9: Aerial photograph of proposed pilot release site (field outlined in red) at Le Don Paton, Jersey.

Close monitoring of all released choughs will provide invaluable data on present-day habitat preferences in Jersey. Future habitat management can then be implemented in targeted areas thereby increasing habitat availability and sustaining the wild population.

For basic logistics, Sorel has easy vehicle access for transporting birds to the release aviary and daily staff visits. It is also relatively undisturbed in terms of housing and commercial development. Most of the surrounding land, if not owned by the States of Jersey, is privately-owned and used by owners or tenants for farming or grazing of horse. NTJ owns the field where the proposed release aviary will be built and several of the neighbouring fields providing a level of protection for the birds as well as enhancing ability to manage the habitat in a way that encourages the birds to thrive. There is a public footpath running along the coast which is accessed by walkers and cyclists. Through appropriate media and educational links it is hoped that the public will be respectful of the project.

3.3 Disease risk assessment

Diseases that should be taken into account include **(1)** those present in existing wild chough populations and **(2)** diseases observed in *post mortem* examinations at the Durrell Wildlife Park in passerines in the collection or in wild birds found dead within the park limits.

The presence of the diseases to be evaluated should be assessed geographically:

- In the two different sources of the birds to be released: Durrell (Jersey) and Paradise park (Cornwall, United Kingdom);
- Possibility of infection during the transport of the birds from the sources to the release place;
- Presence of the disease in the environment where the specimens are to be released.

In order to establish the number of diseases to monitor and identify as possible hazards in the introduction of the species in Jersey, a literature search was performed for disease, parasite and infection, and then expanded to include all Corvidae since the initial article yield was extremely low.

Using the above criteria the following diseases will be accounted for. Those specific to red-billed choughs are followed by a brief description of effects and bibliography citation.

Viral

- Avian paramyxovirus (including Newcastle disease)
- West Nile virus
- Highly pathogenic avian influenza virus
- Avian poxvirus

Bacterial

- Avian tuberculosis
- *Salmonella* sp.
- *Pasteurella multocida*
- *Campylobacter jejuni*, *C. lari*, *C. coli*
- Mycoplasma
- *Clostridium* sp
- *Yersinia pseudotuberculosis*

Fungal

- *Aspergillus* sp.

Parasites

- ***Syngamus trachea***: possible impact in population through impaired immune responses, relation with other species less susceptible Magpies, starlings (Meyer and Simpson 1988)
- Coccidia including *Atoxoplasma*
- Knemidocoptes sp.
- **Haematozoa**: *Babesia* and *Plasmodium*, report in Spanish population as carrier for *Plasmodium* and *Babesia*, without any obvious deleterious health effect (Blanco *et al.*

1997b).

- **Feather mites:** *Gabucinia delibata*, reported not to have detrimental effects of clough health, possibly a commensal, not present in fledgings, presence in remiges and primaries/secondaries (Blanco *et al.* 1997a)

3.4 Health management and biosecurity plan

3.4.1 Disease surveillance

The birds located at Durrell undergo a bi-annual faecal parasitological screening by the Veterinary Department as well as daily visual checks by the birds' keepers.

The screening plan before the transport of the birds from Durrell to the soft release aviaries will include a faecal parasitology of pooled faeces for three days in three consecutive weeks.

Faeces will be collected by keepers in a plastic 20ml faecal pot and taken to the Durrell Veterinary Laboratory after the three-day sampling period. The sample will be maintained in the refrigerator until the faecal parasitological exam can be performed.

Faeces will be examined by two methods:

- (1) Direct Preparation: a small amount of faeces will be mixed into hypertonic sodium chloride solution and a cover slip placed on top. The slide will be screened using x100 and x400 magnification.
- (2) Flotation: faeces mixed with saturated zinc sulphate solution, passed through a sieve (to remove large detritus) into a test tube, the tube is then topped up using additional zinc sulphate to produce a convex meniscus, a cover slip is placed on top and left for 20 minutes. After which it is placed on a slide and to be examined under the microscope.

If any parasites present cannot be identified at this stage, the sample will be sent to the Parasite Unit at the Natural History Museum in London.

Faecal bacteriology will be performed by plating the faeces onto Sheep's blood agar and three selective media (MacConkey without salt, XLD, and Campylobacter blood free selective agar). It will then be incubated for 24-48 hours at 37°C and up to 72 hours at 42°C for the Campylobacter. Identification of the bacteria will be performed through the API® system.

Faecal parasitology and bacteriology from birds coming from Paradise Park will be performed prior to shipment to Jersey.

A blood sample will be collected when the birds are captured to be transported to the pre-release aviary. Ideally bloods should be taken before this point to account for analysis time. However, in order to avoid repetitive catch-ups and reduce stress associated with the handling of the birds it will be done upon crating. A full physical examination of each bird will also be performed by a veterinarian at this point.

Blood samples will be collected under manual restraint from the ulnar, medial metatarsal or jugular veins; and a total of 2.5ml of blood will be collected. Two blood smears will be conducted by filling two micro-haematocrit tubes and the rest distributed in two heparin an1 plain tubes. Ethylenediaminetetraacetic acid (EDTA) tubes will be avoided as these have been reported to cause haemolysis in corvids.

Blood smears will be stained with and haematoxylin and eosin type stain and will be screened for the presence of haemoparasites. Haematocrit tubes will be spun and a smear will be done with the buffy coat to assess the presence of Atoxoplasma.

Blood smear, plasma and whole blood will be sent to Greendale Labs, UK, for haematology and biochemistry examination.

A serum sample will be saved and stored at -70°C at the Durrell Veterinary Department in case that it is required in the future for further analysis.

3.4.2 Possible environmental problems associated with treatments in captivity

The choughs held at Durrell have been treated previously with toltrazuril (Baycox 2.5%, Bayer) due to the presence of coccidia. Although the product should have been eliminated from the body by the time of the release, it is possible that this previous treatment may have caused some resistances in the coccidia harboured by the choughs. Therefore, it is possible that there may be coccidia released into the environment resistant to this specific medication.

Regular treatments with antiparasitic drugs such as Fenbendazole, Flubendazole and Ivermectin have been performed at Durrell for nematode treatments. Choughs to be released may be carriers of parasites that may have developed resistances to these drugs, the same as to bacteria, although none of these treatments has been specifically applied to the choughs at Durrell.

3.4.3 Health maintenance in the release aviary

New birds will be held in the release aviary for a minimum of 30 days to allow acclimatisation to the outdoor conditions and initiate and/or continue target training for supplementary feeding. There is no legal requirement to have the UK birds in quarantine upon entering Jersey. However, as a matter of best practice, and in consultation with the States of Jersey Veterinarian, quarantine-like standards will be enforced throughout the initial holding period. Faecal screening will occur on a weekly basis to assess wild disease transmission and to aid in selection of healthy individuals for release.

Whilst in the aviary the following practices will help maintain general health:

- Hygiene standards will be adhered to (see **section 3.4.6**) to reduce the chance of infection and rodent infestation;
- Adequate food and fresh water will need supplying daily;
- Shelters will be provided to protect the birds from adverse weather;
- Rocks, positioned at various heights in the aviary will provide suitable surfaces for the birds to wear down claws and bills preventing them from becoming overgrown;
- A large flight-space will allow the birds to build up their flight muscles prior to release,;
- Daily monitoring for signs of stress will be implemented to reduce e.g. bullying – by providing extra food sources and shelter spread throughout the aviary, individuals will be separated if severe.

3.4.4 Health maintenance of released birds

The birds will undergo a soft release whereby they build up the duration of their release period on a daily basis. For example: Day 1 released for 20 minutes then called back into captivity; Day 2 for 30 minutes; etc. This allows staff to keep close observation on an individual bird's condition during the initial release.

For the pilot release, all birds will be monitored daily for at least the first three months after release. This will be maintained through a combination of field observations and radio-tracking. Evaluation of

these techniques post release will determine what methods and duration of monitoring will be used in the following years.

See **Section 3.8** for the interventions policy.

3.4.5 Post mortem analysis

If a bird was to suffer a fatality pre- or post-release its body will be submitted for *post mortem* analysis as soon as possible. The *post mortem* will be conducted at Durrell.

The specimen should be refrigerated (4-8°C) as soon as possible in order to slow down the autolysis of the tissues. Specimen should be double bagged and a *post mortem* form should be attached with the following information: **ID, date, location, any previous signs of disease, approximate age and breeding status**. The following protocol will be followed for the *post mortem* exam:

- Gross *post mortem* examination undertaken to determine cause of death;
- Morphometric measurements including weight and any other measurements required will be taken;
- Impression smears of liver, lung and spleen will taken, stained and examined in-house;
- Faecal parasitology and bacteriology analysed, even if there is no evidence of lesions associated;
- Bacteriology of any relevant lesions assessed;
- Tissues will be stored in formaldehyde 10% including: liver, lung, spleen, brain, kidneys, proventriculus, ventriculus, duodenum and pancreas, small intestine, large intestine, brain, Fabricius bursa and thymus (when present in young specimens)
- The carcass will be frozen at -20°C: as above and skin and muscle, intestinal content and ventriculus content retained;
- Histopathology Laboratory will be sent: brain, liver, spleen, lung, kidney, proventriculus, ventriculus, duodenum, pancreas, small intestine and large intestine.

Radio-tracked individuals will be fitted with mortality sensors if transmitter size permits. These allow the tracker to distinguish if a bird out of visual range is dead or just stationary. This means a bird can be retrieved quicker to prevent the body condition becoming too autolysed for useful *post mortem* examination.

3.4.6 Biosecurity

The biosecurity protocols set out in **Table 4** will be upheld whilst the birds are held in captivity at the release site. There are several public footpaths in the immediate vicinity of the release site whose access rights must be upheld. There will be signage around the site and media activities to encourage people to be respectful of the site will be undertaken including Island-wide coverage in press, radio and television. Public activity will be monitored by the field staff and any concerns reported to NTJ (landowners) and States of Jersey (DOE).

Table 4: Biosecurity protocols at the release site

Site security
<ul style="list-style-type: none"> • Access to release aviary will be limited to named field staff
<ul style="list-style-type: none"> • All staff to receive biosecurity training
<ul style="list-style-type: none"> • Entry and exit doors to be locked at all times and release hatches to have locks fitted
<ul style="list-style-type: none"> • Safety porch will act as 'biosecurity portal' for disinfection entering and exiting aviary
<ul style="list-style-type: none"> • Authorised visitors must be accompanied by field staff, be logged accordingly in logbook and adhere to personal hygiene protocols
<ul style="list-style-type: none"> • Site logbook to be maintained, in which persons accessing the aviary will be logged
<ul style="list-style-type: none"> • Dedicated equipment at site e.g. grass cutting equipment, food, water bowls, cleaning brushes gloves, wellington boots
Staff hygiene
<ul style="list-style-type: none"> • Field staff must have limited physical contact with wild or captive birds for the duration of the quarantine period
<ul style="list-style-type: none"> • Any staff working with other animals at the Wildlife Park previously should change clothing before entering the aviary. This should also apply if the person is going to be in contact with other animals later
<ul style="list-style-type: none"> • Disposable gloves to be worn and personnel to change into facility-based footwear when entering the aviary
Routine health monitoring
<ul style="list-style-type: none"> • Logbook to be maintained
<ul style="list-style-type: none"> • Daily visual health check and behavioural observations
<ul style="list-style-type: none"> • Any bird showing signs of illness will be reported to Durrell's veterinarian
<ul style="list-style-type: none"> • Medical treatment will be carried out <i>in situ</i> when feasible
Feeding Equipment
<ul style="list-style-type: none"> • Dedicated food and water bowls and cleaning brushes to be used at all times
<ul style="list-style-type: none"> • Feeding equipment to be cleaned in 1:250 F10 disinfectant soak, then air-dried for use the following day. F10 is biodegradable, with a zero hazard rating according to EU standards which should indicate a minimum environmental impact through product use and spillage outside
<ul style="list-style-type: none"> • Fresh food to be prepared off site at Durrell and taken to the aviary daily
<ul style="list-style-type: none"> • Fresh food and water to be provided every morning and old food removed
Waste disposal
<ul style="list-style-type: none"> • Waste food, used gloves etc. to be disposed of in clinical-waste bags, double bagged and cable tied and removed from site each day
Pest/Predation Control
<ul style="list-style-type: none"> • Integrated pest management will be in place to limit damage to aviary structure and protect the welfare of the birds
<ul style="list-style-type: none"> • Methods used will be legal, humane, and safe to non-target species

3.5 Captive breeding management plan

Donor stock for the re-introduction project will be sourced through captive breeding in the UK (Paradise Park) and in Jersey (Durrell). All choughs currently held at Durrell originate from Paradise Park. The cohort size for the pilot study will be six juveniles (<2yr). These will be individuals hatched in 2012 and any 'shortfall' made up by the juveniles currently held at Durrell (hatched 2011). Future releases will be dependent on the outcomes of the pilot study. If successful further birds (cohort size approx. 6) will be released each year until 2016. This would mean an annual breeding target of approximately six to ten birds.

Captive breeding and husbandry guidelines for choughs have been published by Paradise Park and will be adhered to throughout this project (Burgess *et al.* 2012). Paradise Park will be given access to all data and information gathered during this project regarding captive management of choughs so they can update the guidelines.

3.6 Habitat management plan

Whilst there has already been a substantial area of habitat restored at Le Don Paton, more land will be needed in order to support a viable chough population. Supplementary feeding methods will support the population in the short term. On Islay, in the Inner Hebrides, a study has shown that supplementary feeding mealworms to wild choughs increases the survival rate of first year juveniles and increases survival over harsh winter periods when natural insects are difficult to obtain (Bignal and Bignal 2011). By providing mealworms on a daily basis to the released birds in Jersey we can increase their chances of survival over winter.

Once we know what type of habitat the choughs will choose in Jersey and how far they travel to find it we will know where to focus our conservation efforts.

Possible future management methods may include:

- Continued control of gorse and bracken through mechanical clearance;
- Reduction in the impact of rabbits on new heather shoots by fencing areas;
- Establishing a self-managing habitat through continued sheep grazing;
- Possible acquisition of adjacent fields to be put into cereal or weedy crops;
- Possible use of pigs to hit areas of dense bracken.

Long term survival of the choughs will be secured once a suitable habitat management plan can be developed that takes into account seasonal variations in diet and habitat and nest-site proximity to optimal foraging area on Jersey. Breeding pairs of chough tend to forage within 300m of their nest-site although it can be up to 1km (Kerbiriou *et al.* 2006; Whitehead *et al.* 2005). Distance differs between pairs and localities but is likely linked to optimal habitat availability. A study on the population in Brittany suggested that nesting success would increase at a rate of one further hatching for every additional 10km² of foraging habitat within 300m of the nest-site (Kerbiriou *et al.* 2006).

3.7 Release strategy

All birds selected for release will undergo an acclimatisation period of at least 30 days in the release aviary. Birds imported from the UK will undergo a 'quarantine' period carried out at the release aviary. This will also act as their acclimatisation period.

A soft release will then follow whereby the birds will be given time-restricted access outside and called back into the aviary by the field staff using insect feeds as a reward. The time period will increase on a daily basis dependent on the birds' behaviour and weather conditions. If there is fog, heavy rain or high winds the birds will not be released that day.

The pilot release will be timed for the end of the breeding season when choughs in the wild would naturally flock together. Evaluation of this strategy will help determine whether there is an optimal season or month to release in order to increase the chances of success.

The release group size for the pilot study will be six individuals of mixed sex. None of the birds will be sexually mature and there are no wild choughs in Jersey, therefore there is less concern over specific demographics.

Selection of birds for release will depend upon certain criteria related to physical and behavioural condition (see **Section 4.4**). Birds will be driven to the release site in standard pet carriers and every effort will be made to minimise stress levels whilst in transit.

There will be a release aviary built at the chosen release site and maintained for the duration of the release phase of the project (approximately five years). This will be located within the site so that the birds have a clear view of the coastline and the view is not blocked by hazards such as power lines or telephone masts that may prove dangerous when birds are released. There will be sheep-proof fencing surrounding the aviary to prevent damage from roaming stock and, as best as possible the building will be rodent-proof.

Once a bird has been selected and moved into the release aviary it does not automatically mean they will be released into the wild. They will still have to be of good physical condition and display the appropriate behaviours before being released. Through continuous monitoring of the birds the field staff will be able to determine if these criteria are fulfilled.

3.8 Interventions policy

There are several interventions that can be planned for if the release outcomes are to succeed and/or become unfavourable.

- Supplementary feeding

Birds will be supplementary fed insects on a daily basis at least over the winter period to provide a sustainable food source whilst a) wild insect abundance is naturally low and b) the habitat quality is not at an optimum. Supplementary feeding is likely to continue for the first year. Assessment will be based on the released birds' behaviour, physical condition, and wild prey availability. Each time a new cohort of birds is released they will be provided with supplementary feed.

- Provisions for adverse weather

During the initial release phase birds will only be let out if weather conditions are favourable to the bird's success i.e. not in fog, high winds or heavy rain. Sea mists are common on the north coast and may hamper the progress of the project. The release aviary will act as a roosting site for the birds' to safely shelter from adverse weather if natural roosts cannot be found.

- Predator protection

There are no foxes on Jersey, but there are dogs, cats, and feral ferrets. The release aviary will be built to a standard that is rat and large mammal proof, so the birds have a safe roosting site to go to once released. There is already an established rule that dogs must be kept on leads at the release site due to the Manx loaghtan sheep. Field staff will be onsite to monitor any day time activity and report to Durrell and NTJ if there are any problems. A public awareness programme will advise dog walkers about how they can avoid causing the birds stress.

Birds of prey and, potentially, other corvid species that are likely to pose a threat will be monitored at the release site. It is hoped that by using young birds in the release they will learn quickly to avoid such predators instead of older birds that have been in captivity for too long and would definitely need predator-avoidance training. If the pilot study reveals that this was to be the main failing of the project then avoidance training and/or relocation of release site would be considered.

- Veterinary care

The Durrell Veterinary Department will be responsible for the birds' veterinary care in captivity and post release (see **Section 3.4**). The vets will consult with the States of Jersey Chief Veterinary Officer over the development of any protocols. If a bird becomes sick or injured, it will be treated in the release aviary initially to avoid any undue stress. If the injury/illness is more severe it will be removed from the release site and taken into captivity at Durrell, but only as a last resort. Any decision regarding euthanasia of a bird will be the responsibility of the Durrell Veterinary Department after consultation with [REDACTED] (Head of Bird Department, Durrell).

- Nest-site provision

As the first birds to be released will not be sexually mature until 2-4 years into the project, nest-site availability will not be of immediate concern. However, the project needs to take this into account for the long-term success of the chough population. A survey of potential nest-site availability will be conducted after the pilot study once we know the locations that the released birds choose to settle in. If the survey finds that numbers of natural nest-sites are low and/or face high competition from other species then artificial nest boxes may be provided (Cross and Stratford 2008).

There are many other situations that may arise throughout the course of the project that may influence the success or failure of the project. Since choughs have not been present on Jersey for the last one hundred years these will only become apparent upon release of the new birds. Continuous assessment of the protocols and outcomes and close monitoring of the released birds will allow for adaptability and success.

3.9 Post-release monitoring strategy

Post-release monitoring of the initial cohort will be crucial in the development and success of subsequent releases. There will be continuous monitoring of the released birds at least until a self-sustaining population is achieved. For the pilot study this will take the form of behavioural observations of habitat use, diet, threats and competition, disease/health status. The choughs will be fitted with VHF radio-transmitters to track daily movements for the life time of the transmitter battery or until the transmitter falls off. See **Section 5** for further details.

3.10 Community and stakeholder engagement strategy

The success of the project will rely on public acceptance for the re-introduction of choughs back into Jersey. Prior to the first release there will be a stakeholders meeting to explain the project, discuss concerns, and find ways that stakeholders can contribute to the project. There will also be opportunities post-release for stakeholders to comment and for the project manager to provide feedback.

General public awareness will be raised through the use of websites, e.g. *BIRDS ON THE EDGE*, social networking, local radio and press coverage, school projects etc. A low profile will be adopted for the pilot release to avoid unnecessary disturbance at the release site that may jeopardise the birds' chances of success. Once the initial release cohort becomes established then promotional work can intensify with the potential for an appreciation society to be created much like 'Operation Chough' in Cornwall and the Great Bustard Group in Wiltshire. This will not only raise awareness, but provide a source of ongoing funds for the project.

A more detailed community and stakeholder engagement strategy will be completed in September 2012.

3.11 Budgeting and fundraising

A budget plan has been developed for the 2011-2012 financial year. This includes costs of renovating buildings for dedicated off-show breeding facilities, the release aviary, and monitoring equipment as well as ongoing staff costs. Some costs are one-off such as the nest box cameras and will last the duration of the project. Other costs such as radio-tracking equipment and UK import costs will change year to year depending on the demand and methods used. Therefore, this budget plan requires an annual, and possibly, quarterly review.

Fundraising will be managed by Durrell with the support of NTJ and the States of Jersey. In 2010 ██████████, a local trust company, donated ██████████ to the development of the chough display aviary at Durrell as well as providing volunteers for manual bracken removal on the north coast. In June 2012 NTJ held a weekend of 'sunset concerts' by local bands. Money raised from this will go towards the development of the release aviary. Various other fundraising activities involving the three project partners will be carried out during 2012 and 2013 to support the pilot study and future releases. Certain fundraising goals will only come to light once the birds have been released and their requirements understood. A quarterly progress review will help highlight these needs and goals.

4. PRE-RELEASE AND RELEASE STAGE

4.1 Licences and other legal requirements

The red-billed chough is not a CITES listed species. The transportation of choughs from the UK to Jersey only requires veterinary certification. However, the release of choughs into Jersey does require a licence be granted from the States of Jersey under the Wildlife and Countryside Act 1981 for the release of non-native species and those species listed under Schedule 9. An application has been submitted by the project manager.

4.2 Sourcing birds for release

Donor stock for the re-introduction project will be sourced through captive breeding in the UK (Paradise Park) and Jersey (Durrell). Durrell currently has two breeding pairs on loan from Paradise Park. For the 2012 breeding season Paradise Park established six breeding pairs. The average clutch size for choughs in captivity is three, but it can be up to five. For the pilot study there should be an adequate number of breeding pairs to produce enough chicks for the release. If not, then potential birds for release will be found from chicks reared the previous year.

4.3 Preparing birds for release

Choughs reared for release in captivity will require specific management and behavioural training to increase their chances of survival in the wild. **Table 5** shows the key areas of management and training that will be adopted for the pilot study. Many of these needs were brought to light through the evaluation of the first and only previous re-introduction of choughs into the UK by Paradise Park (Burgess *et al.* 2011).

There are, however, other questions about training needs that will only become apparent through post-release monitoring of the Jersey population. Do the birds need to be given predator avoidance training or is that behaviour innately learnt? If hand-reared birds are used will staff need to wear rearing costumes to avoid imprinting?

Table 5: Management and training needs to prepare birds for release

Captive rearing techniques
Use of off-show breeding aviaries so chicks are reared in relatively isolated conditions and do not become too tame around people
Provision of suitable substrate in aviary e.g. soil, barkchip, etc. so chicks learn to forage for food at an early age
Provision of wild insects e.g. ants and ant larvae, in addition to captive diet so birds learn from an early age what to forage for when released
If a chick has to be hand-reared it will be socialised with other chicks as soon as possible after fledging
Audio playback of parental vocalisations will be used when hand-rearing chicks
Release aviary management
Outdoor netted aviary design allowing the birds to acclimatise to the weather conditions whilst remaining in a sheltered and secure roost.
Long outdoor flight area allowing the birds to develop stronger flight muscles before release
Provision of suitable natural foraging sites within the aviary
Birds to be trained to a whistle command to feed at recognisable target sites in and out of the release aviary

4.3.1 Target training protocol for supplementary feeding

The **aim** of target training the birds is to allow field staff to manage the soft release effectively without negatively affecting the birds' natural behaviours.

The **objectives** of target training the birds are to (1) call back the birds into the aviary overnight and/or during adverse weather conditions in the initial release phase and to (2) recognise supplementary feeding sites so the birds should never go without food.

The **primary reinforcer**, or motivation, for the choughs will be mealworms. This may change once the birds are in the wild if they favour another food source more than mealworms. A neutral stimulus that is instantaneous is needed to bridge the time gap between the behaviour and the primary reinforcer. The **bridge** for the choughs will be a sports whistle. The sound made by a whistle is distinctive, whether in captivity or in the wild, and by using the same model of whistle it will be constant between staff members.

- Initial training will be carried out by nominated Durrell staff, including the field manager, until the birds have confidently learnt the required behaviour;
- To avoid the training becoming a routine that they respond to rather than the conditional reinforcement, it will be conducted at random times throughout the day. With a minimum of three sessions per day;
- Primary reinforcer (mealworms) will be placed on a plywood target board (30 x 40cm). Initially this will be on the raised food-stand at the back of the aviary near the keeper door. Once the birds are conditioned to the target it can be repositioned around the aviary;
- Only 4-5 mealworms per bird to be used during each session;
- Initially the staff member should enter the aviary, place the mealworms on the target and blow the whistle, then leave the aviary. Once the birds become confident, staff can try staying in

the aviary at a distance the birds feel 'safe'. Then gradually reduce that distance over the training period;

- There should be no need to reduce the amount of main diet given unless the birds start to become overweight. However, their food should be removed overnight so their motivation is greater for the morning session and setting the birds up for success.
- Staff should always remember to set the birds up to succeed and never finish a training session on a negative;
- A bird will only be released into the wild once it has repetitively demonstrated the desired behaviour with a high level of competence.

4.4 Selection of birds for release

Not all of the birds reared in captivity will be suitable for release. Selection criteria will involve genetic screening, health screening including physical condition and whether the bird responds to the behavioural training.

For the pilot study only birds from the Atlantic coast subspecies *P. p. pyrrhacorax* (British Isles and Brittany) will be selected for release. See **Section 3.4.1** with regards to health selection criteria.

4.5 Transport and holding conditions

All birds will be transported in pet carriers to the release site by vehicle. Any bird imported from the UK will be transported in carrying crates conforming to International Air Transport Association (IATA) regulations (<http://www.iata.org/ps/publications/Pages/live-animals.aspx>). Distances from the airport (imported birds) to the release site and from Durrell to the site are less than 10km. Travel time within Jersey will be very short and should not therefore cause the birds prolonged stress.

Once at the release site the birds will be housed in the release aviary for a minimum of 30 days to acclimatise to the environment and undergo pre-release screening. They will also continue (or start in the case of imported birds) their behavioural training during this period.

4.6 Individual marking

All birds will have a uniquely coded, permanent metal leg-ring and a colour metal leg-ring to permit identification in the field. These markings will be recorded in ARKS (zoo based animal records keeping system) and provided to Jersey's licensed bird ringing manager. Ringing will be carried out before arrival at the release site to avoid undue stress in their new environment.

Released birds will be fitted with VHF radio transmitters for post-release monitoring of the pilot release. Trials will be carried out in captivity to see if the attachment design causes any animal welfare issues and/or negatively impacts the bird's success when released into the wild. If successful then all the birds will be fitted with transmitters. See **Section 5.2** for further details on post-release monitoring.

4.7 Release

The soft release will proceed as set out in **Section 3.7**. During the holding period in the release aviary there is a risk of injury and /or stress and a potential risk of disease exposure. Daily monitoring of the birds will hopefully reduce the risk or increase the chance of detection so swift action can be taken.

The release into the wild will be a gradual process and closely monitored so events such as adverse weather or disturbance do not endanger the welfare of the birds. Constant evaluation of an individual's condition and whether or not they are feeding sufficiently will determine whether the bird is

released on a permanent basis. Any individual that is deemed unfit and unlikely to improve in the long-term will be removed from the programme and returned to Durrell's captive stock.

Post-release monitoring will allow field staff to determine whether further habitat management is needed in the immediate vicinity of the release site. Supplementary feeding will continue until the habitat quality is suitable. Where the birds disperse to, what foraging area they occupy, and on what habitat type will determine where future habitat management needs to be implemented and/or improved.

5. POST-RELEASE STAGE

5.1 Interventions

The interventions policy is outlined in **Section 3.8**. The primary intervention from Day 1 of the release will be supplementary feeding to ensure survival in the wild until the habitat has been restored to a suitable quality. Duration and quantity of feeding will be determined through post-release monitoring.

5.2 Post-release monitoring

A post-release monitoring strategy for the pilot release is set out below. This is a working document and is likely to change once release outcomes have been evaluated. IUCN guidelines will be followed closely and the responsibility for monitoring will lie with the project manager.

- **Record keeping**

All data regarding an individual's life history, medical history, and ringing information will be recorded in ARKS. Any behaviour, medical issues, handling procedures etc carried out in the release aviary will be documented daily and inputted into ARKS. Observational data post release will also be documented in ARKS and made available to the project partners.

All birds will have a uniquely coded, permanent metal leg-ring and a colour plastic leg-ring to permit identification in the field. Local birding groups, including licensed bird-ringers within the Channel Islands will be kept updated with ringing data. Any sightings made will be reported to the project manager to aid in monitoring of dispersal and habitat use.

- **Radio-tracking**

The use of VHF radio transmitters will permit continuous monitoring of the birds for the life time of the transmitter battery or until the transmitter falls off. Transmitters should weigh no more than 4% of the animal's body weight (Kenward 2001). This size of transmitter typically has a battery life of four months. Attachment methods will be trialled in captivity, but for the pilot release tail mounted transmitters will be used as these have been tried and tested with other birds (Kenward 2001) and with choughs (Burgess *et al.* 2011; Laiolo *et al.* 2001). Optimal attachment methods will be researched and developed for future releases. The bird will have moulted before the release date so there is less chance of the transmitters detaching from the birds. Both designs run risks to the animal's welfare (Irvine *et al.* 2007) which will be taken into consideration when selecting best method.

Data on location (GPS point), behaviour, weather conditions, basic habitat type, and disturbance levels (e.g. human presence) will be recorded. Arcview Spatial Analyst will be used to gain greater detail of habitat use, soil type, dispersal distances etc. Transmitters will be fitted with mortality sensors so any fatalities can be detected relatively quickly for *post mortem* analysis. [REDACTED], Senior Research Fellow at the University of Reading will act as consultant to the project manager over the final radio-tracking protocol. [REDACTED] has

several years experience with endangered species management programmes and post-release monitoring methods.

- **Other fieldwork**

- 1) Observations of physical condition, foraging behaviour, roost site selection, predator and competitor abundance and interactions and social interaction within the cohort will be recorded regularly on a daily basis;
- 2) Regular surveys of soil invertebrate availability and abundance will be carried out during the pilot study. This data, combined with pre-release information, can then be used to influence decisions on the degree of supplementary feeding, where and what type of habitat management is needed and what impact the choughs have on the natural environment;
- 3) A bird monitoring transect at Sorel, as part of the Island-wide farmland bird surveys, has been established. Data pre- and post-release will aid in monitoring the choughs long term survival and as well as their avian predators and competitors.

- **Laboratory analysis**

Opportunistic faecal sampling will be carried out to monitor bacteriology levels and diet. Faecals will only be taken from known individuals. Faecal analysis can identify invertebrate and plant matter consumed. It is a very basic low-cost procedure than can prove very insightful although opportunistic nature might yield limited results;

Post mortem analysis will look at not only cause of death, but at physical condition. Bacteriology, reproductive status, and stomach content analysis providing the body is in an acceptable state of decay will be recorded.

5.3 Annual project reports and publications

All post-release monitoring data will be made available to project partners and routinely reviewed. Monthly reports will be published internally and annual project reports made available to stakeholders and funding bodies.

A case-study report of the pilot release will be submitted to the IUCN for publication in their *Global Re-introduction Perspectives* series along with a final report at the end of the project. There will also be publication of non-academic papers for stakeholders, schools and the general public.

5.4 Success assessment

On-going assessment of the re-introduction will allow progress to be tracked throughout the duration of the project. Assessment will be based on the achievement of the objectives and targets set out in **Section 1.2** and **Section 1.3** and tracked for all aspects including budgeting and communications.

General indicators of success will be:

1. Individuals feed and roost within the immediate area of the release site displaying natural behaviours;
2. Formation of breeding pairs and the first breeding attempt;
3. Successful breeding attempt by released pair(s).

Ultimately, a population viability assessment (PVA) of the re-introduced choughs at the end of the project will define the overall success. The project's aim is to establish a self-sustaining population of choughs and parameters for the PVA can only be known post-release.

Whether the project fails or succeeds, the information gathered from this re-introduction will benefit other similar projects around the world and broaden our knowledge of conservation management.

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