Chapter 7 Biodiversity

7.1 Introduction

This chapter examines the ecology of the receiving environment within and surrounding the proposed Dursey Island Cable Car and Visitor Centre Development, Beara, west Co. Cork (hereafter 'the proposed development') and assesses its potential impacts on biodiversity. The methods employed to establish the ecological baseline within and around the proposed development are described, together with the process followed to determine the nature conservation importance of the ecological features present. The ways in which habitats, species and ecosystems are likely to be affected by the proposed development are explained and the magnitude of the likely effects are predicted while taking into account the conservation condition of the habitats and species under consideration. Mitigation and enhancement measures are also proposed, and any residual effects are assessed, taking into account the mitigation and enhancement measures proposed.

7.1.1 Biodiversity Conservation Legislation and Planning Policy

The European Communities (Birds and Natural Habitats) Regulations, 2011, as amended ('the Habitats Regulations'), transpose into Irish law Directive 2009/147/EC (the 'Birds Directive') and Council Directive 92/43/EEC (the 'Habitats Directive'), which list priority habitats and species of international (European Union) conservation importance which require protection. This protection is afforded in part through the designation of Natura 2000 sites - areas that represent significant populations of listed species within a European context. Areas designated for bird species are classed as Special Protection Areas (SPAs), while those designated for other protected species and/or habitats are classed as Special Areas of Conservation (SACs). Wild bird species in SPAs, and habitats and species in contained in SACs that are listed on Annexes I and II (respectively) of the Habitats Directive, are legally protected. Additionally, species listed on Annex IV of the Habitats Directive are strictly protected wherever they occur – whether inside or outside the Natura 2000 network. This protection is afforded to animal and plant species by Sections 51 and 52, respectively, of the Habitats Regulations. Annex I habitats outside of SACs are still considered of national and international importance and, under Section 27(4)(b) of the Habitats Regulations, public authorities have a duty to strive to avoid the pollution or deterioration of Annex I habitats and all habitats integral to the functioning of SPAs.

The Wildlife Act 2000, as amended ('the Wildlife Acts') is the principle legislative mechanism for the protection of wildlife in Ireland. A network of nationally protected Nature Reserves, which public bodies have a duty to protect, was established under the Wildlife Acts. Sites of national importance for nature conservation are afforded protection under planning policy and the Wildlife Acts. Natural Heritage Areas (NHAs) are sites that are designated under the Wildlife Acts for the protection of flora, fauna, habitats and geological features of interest. Proposed Natural Heritage Areas (pNHAs) are published sites identified as of similar conservation interest but have not been statutorily proposed or designated – but are nonetheless afforded some protection under planning policies and objectives. The Wildlife Acts also protect species of conservation value from injury, disturbance and damage to individual entities or to their breeding and resting places. All species listed in the Wildlife Acts must, therefore, constitute a material consideration in the planning process.

An additional, important piece of national legislation for the protection of wild flora, i.e. vascular plants, mosses, liverworts, lichens and stoneworts, is the Flora (Protection)

Order, 2015, which makes it illegal to cut, uproot or damage listed species in any way or to alter, damage or interfere in any way with their habitats.

Ireland's *National Biodiversity Action Plan 2017-2021* (Department of Culture Heritage and the Gaeltacht, 2011), in accordance with the Convention on Biological Diversity, is a framework for the conservation and protection of Ireland's biodiversity, with an overall objective to secure the conservation, including, where possible, the enhancement and sustainable use of biological diversity in Ireland and to contribute to collective efforts for conservation of biodiversity globally. Action 1.1.3 of the National Biodiversity Strategy states that "all Public Authorities and private sector bodies move towards no net loss of biodiversity through strategies, planning, mitigation measures, appropriate offsetting and/or investment in Blue-Green infrastructure". This is particularly relevant to developments. The plan is implemented through legislation and statutory instruments concerned with nature conservation. The *All-Ireland Pollinator Plan 2015-2021* (NBDC, 2015) seeks to halt the decline in pollinators through a range of objectives. This plan is supplemented by the guidance document *Councils: actions to help pollinators* (NBDC, 2016).

The *Cork County Development Plan 2014* (Cork County Council (CCC), 2014) sets out a number of objectives with the aim of conserving the integrity of 'green infrastructure' (including habitats), soils and surface/groundwater bodies of the county, although biological diversity is not directly referred to. The *County Cork Biodiversity Action Plan 2009 – 2014* (CCC, 2009; now expired) aimed to "conserve and enhance biodiversity, and to ensure that every person in the county has the opportunity to appreciate and understand its importance in our lives" (p. 5). It set out 6 key objectives, and 21 corresponding actions with respect to conservation of biological diversity. Under the Action Plan, "Inappropriate development in sensitive areas" was identified as a key threat to biodiversity.

7.1.2 Approach and Objectives

A 'habitat' is the environment in which an organism lives and is generally defined in terms of vegetation and physical structures. Habitats and species of ecological significance occurring or likely to occur within the defined **Zone of Influence** and **Study Area** of the proposed development were classified as **Key Ecological Receptors**.

In accordance with Transport Infrastructure Ireland (TII) *Guidelines for Assessment of Ecological Impacts of National Road Schemes* (2009), an impact assessment has been undertaken of Key Ecological Receptors within the Zone of Influence of the proposed development. According to these guidelines, the Zone of Influence is the "effect area" over which change resulting from the proposed development is likely to occur and the Key Ecological Receptors are defined as features of sufficient value as to be material in the decision-making process for which potential impacts are likely.

In the context of the proposed development, a Key Ecological Receptor is defined as any feature valued as follows:

- International Importance
- National Importance
- County Importance
- Local Importance (Higher Value)

Features of local importance (Lower Value) and features of no ecological value are not considered to be Key Ecological Receptors. The assessment presented in this

Chapter does not consider any other type of environmental effects other than those on biological diversity (of flora and fauna). This Chapter quantifies the potential effects on identified Key Ecological Receptors and prescribes mitigation measures required to avoid and reduce any significant negative effects identified.

Determining the ecological issues to be addressed in the assessment was informed by early engagement with relevant stakeholders. During this scoping process, selected consultees were allowed the opportunity to provide comments and observations on the proposed development. Further details of the consultation process, including a list of the statutory and non-statutory consultees, are presented in Section 7.2.5.

On completion of the scoping process, a desk study was undertaken to review all available published data describing ecological conditions within the greater area of the proposed development. The desk study cross-referenced this published data with publicly available maps and aerial orthophotography from Ordnance Survey Ireland (OSi), National Parks & Wildlife Service (NPWS) and Environmental Protection Agency (EPA) to identify Key Ecological Receptors. During this assessment, the statutory conservation agency, the NPWS, provided data on nature conservation designations, habitats and species of conservation interest. The baseline information obtained from the desk study constituted the first stage in defining the Zone of Influence of the proposed development.

In addition to this desk study, a number of ecological surveys were carried out in 2018 and 2019 in order to obtain primary data regarding the baseline environment with respect to biodiversity and to identify potential effects thereon. Section 7.2.6 presents details of these surveys.

Where potential significant negative effects were identified, detailed and specific mitigation measures have been proposed in accordance with the hierarchy of options suggested in European Commission report, '*Assessment of plans and projects significantly affecting Natura 2000 Sites: Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC'*. Accordingly, the avoidance of effects at their source is the prioritised approach. Where this is not possible, the following approaches are adopted, in order of decreasing preference: (i) reduction of effects at source, (ii) on-site abatement, and finally, (iii) abatement at receptor. These mitigation measures (as set out in Section 7.8 of this chapter) have been incorporated into the design of the proposed development.

The information provided in this chapter accurately and comprehensively describes the baseline ecological environment, provides an accurate prediction of the potential ecological impacts of the proposed development, prescribes specific mitigation as necessary and describes the likely residual ecological effects.

7.1.3 Terminology

The valuation of Key Ecological Receptors and the terminology used to determine ecological value is in accordance with aforementioned guidance (TII, 2009). The description of effects is in accordance with the EPA's Draft *Guidelines on the Information to be Contained in Environmental Impact Statements* (EPA, 2017).

7.2 Methodology

This section describes the methodologies that were followed in collecting information, in describing the baseline ecological conditions and in assessing the likely effects of the proposed development.

7.2.1 Guidelines on Environmental Impact Assessment

The process of identifying, quantifying and evaluating potential impacts of the proposed development on habitats, species and ecosystems was undertaken in accordance with the Chartered Institute of Ecology and Environmental Management (CIEEM) best practice guidance (CIEEM, 2018). In addition, reference to the following recognised guidance on the Environmental Impact Assessment of National Road Schemes provided for an appropriately defined scope and evaluation process:

- EPA (August 2017). Draft Guidelines on information to be contained in the Environmental Impact Assessment Report;
- EPA (September 2015). Draft Advice Notes for preparing Environmental Impact Statements;
- EPA (2002). Guidelines on the Information to be Contained in Environmental Impact Statements;
- EPA (2003). Advice Notes on Current Practice in the Preparation of Environmental Impact Statements;
- TII (2006a). Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes;
- TII (2006b). Guidelines for the Treatment of Bats during the Construction of National Road Schemes;
- TII (2006c). Guidelines for the Treatment of Badgers prior to the Construction of National Road Schemes;
- TII (2008a). Environmental Impact Assessment of National Road Schemes – A Practical Guide (Revision 1);
- TII (2008b). Guidelines for Ecological Survey Techniques for Protected Flora and Fauna during the Planning of National Road Schemes;
- TII (2008c). Guidelines for the Treatment of Otters Prior to the Construction of National Road Schemes;
- TII (2008d). Guidelines for the Crossing of Watercourses During the Construction of National Road Schemes;
- TII (2009). Guidelines for Assessment of Ecological Impacts of National Road Schemes;
- TII (2010). Guidelines on Management of Noxious Weeds and Non-native Invasive Plant Species on National Roads;

7.2.2 Establishing the Zone of Influence

The key variables determining whether Key Ecological Receptors will be subject to effects through development are:

- the physical distance of the proposed development to the Key Ecological Receptors;
- the sensitivities of the Key Ecological Receptors within the receiving natural environment; and
- the potential for in-combination effects.

The Zone of Influence, as presented in Plate 7.1, was defined as follows:

- The proposed development itself;
- The R572 approach road west of the Bealbarnish Gap and all of the proposed works (passing bays and visibility splays) along it;
- All established roads and walking routes west of the Firkeel Gap, including those on Dursey Island, Garinish Head, Crow Head and routes linking these; and,
- A 500 m buffer around all of the above.

The on-road and off-road walking trails on Dursey Island and in the vicinity of the cableway on the mainland (i.e. at Garinish Head and Crow Head) have been included since it is known that a proportion of visitors to the site will undertake walks in the vicinity (particularly on the island) and, as a result, increased visitor footfall at the site and on Dursey Island (as a result of the proposed development) has the potential to give rise to indirect negative effects on biodiversity in these areas.

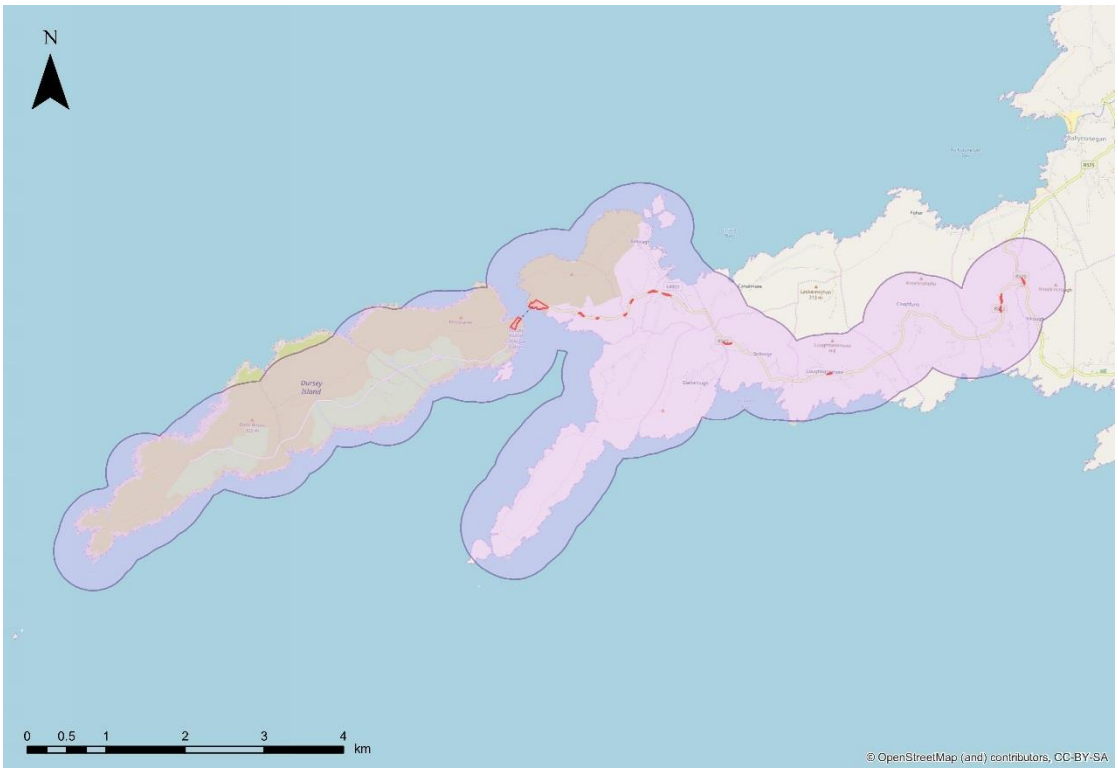

Plate 7.1 **Map depicting the proposed development (including proposed works along the R572) (red) and the Zone of Influence (magenta)**

7.2.3 Establishing the Study Area

The extent of the study area is defined by the ecological features likely to occur within an effects distance from the proposed development. This is informed by the findings of the desk study (presence/absence of protected habitats, flora or fauna within the Zone of Influence) and best practice methodology referenced above for assessing effects on those ecological features. The study area in this case is similar to the defined Zone of Influence in that the ecological features which are likely to be impacted by the development are potentially found within and around the site of the proposed development, within 250m of the walking routes on Dursey Island itself, and also along the R572 approach road between Bealbarnish Gap (R572 – R575 junction).

7.2.4 Desk Study

The desk study undertaken for this assessment included a thorough review of the available baseline data relating to biological diversity in the study area. The following resources were used:

- Colhoun & Cummins (2013). Birds of Conservation Concern in Ireland 2014-2019.
- Environmental Protection Agency (EPA) Unified GIS Application data related to Water Framework Directive Status of waterbodies and watercourses within the Zone of Influence
- National Parks & Wildlife Service (NPWS) Map Viewer
- NPWS documents related to NHAs, pNHAs and Natura 2000 sites within the Zone of Influence
- National Biodiversity Data Centre (NBDC) Map Viewer
- NBDC National Invasive Species Database
- Crushell, P., Foss, P. & Kirwan, B. (2015). Wild Atlantic Way Signature Discovery Points: Ecological Study of Visitor Movement Areas 2015. Report prepared for Fáilte Ireland.
- CAAS Ltd. (2016). Strategy for Environmental Surveying and Monitoring for the Wild Atlantic Way Operational Programme: Visitor Observation Study Results. Report prepared for Fáilte Ireland.
- CAAS Ltd. (2018). Environmental Surveying and Monitoring of the Wild Atlantic Way Operational Programme: 2017 Visitor Observation Study Results. Report prepared for Fáilte Ireland.
- Botanical Society of Britain and Ireland (BSBI) (2019). Distribution Database.

As with all desk studies, the data considered were only as good as the data supplied by the recorders and recording schemes. The recording schemes provide disclaimers in relation to the quality and quantity of the data they provide, and these were considered when examining outputs of the desk study.

7.2.5 Consultation

The statutory and non-statutory consultees listed in Table 7.1 were contacted during the desk study, sent a copy of the EIA Scoping Report, and invited to submit any observations in relation to the proposed scope of the EIAR.

The purpose of the consultations was to:

- Identify any relevant information that consultees held, including the presence of data on protected species or species of conservation concern;
- Identify any concerns that consultees may have about the proposed development with respect to biodiversity; and,
- Identify any issues that the consultees would like to see addressed in the biodiversity impact assessment.

The responses received from the organisations or individuals consulted in relation to biodiversity, are also listed in Table 7.1. In each case, only the responses relevant to this Chapter have been included, even in cases in which responses received addressed other topics of relevance to the EIA – those elements of the responses are discussed in the relevant Chapters of this EIAR.

In addition to responses received as a result of written consultations, meetings were held with (i) Dr. Philip Buckley of NPWS and (ii) Mr. Mike Trewby of Woodrow Environmental Consultants in order to inform the biodiversity impact assessment:

- On the 7th of May 2019, a conference call was held between representatives of the Project Team from ROD and Mr. Mike Trewby, ornithologist at Woodrow Environmental Consultants and national expert on the ecology of red-billed chough (*Pyrrhocorax pyrrhocorax*; hereafter 'chough'). It was the opinion of Mr. Trewby that, in order to conserve the resident chough population, a numerical carrying capacity should be established for Dursey Island based on Keribiou *et al*. (2009; see Appendix 7.3). It was also advised that, in order to facilitate future monitoring of the chough population, the key parameter to be measured during the breeding bird surveys was productivity (i.e. breeding success) of the population.
- On the 9th of May 2019, a meeting was held between Dr. Philip Buckley, NPWS Divisional Manager for the Southern Region, and representatives of the Project Team from ROD and CCC, including the CCC Biodiversity Officer. The need to obtain sufficient breeding season survey data for the resident population of chough was emphasised by Dr. Buckley. It was stated that data required for the population was (i) location of nest sites, (ii) key areas of habitat, and (iii) flush distances. It was advised that a minimum survey schedule should include 3 – 4 surveys per week during May and June 2019. It was also stated that data should be obtained regarding the movement of visitors on the island, particularly with a view to identifying what proportion of walkers (i) wander onto the western end of the island, and (ii) stay on established walking routes.

All issues raised by the consultees have been addressed insofar as possible herein.

Table 7.1 Consultation Responses

Consultee	Date Correspondence Received	Summary of Responses with Respect to Biodiversity
Inland Fisheries Ireland (IFI)	14th March 2019	There should be no interference with, bridging of, draining of, or culverting of any watercourse or its banks or bankside vegetation without prior approval of IFI. The EIAR should detail all construction methodology to be employed to facilitate a complete assessment of potential impacts on fisheries.
Irish Peatland Conservation Council (IPCC)	21st March 2019	It is hoped that the necessary surveys are carried out and that wetland habitats will not be negatively affected. IPCC want assurance that the hydrological system of the Glanmore Bog SAC (which overlaps with the Kenmare River SAC) is preserved or improved as a result of the proposed development. It is pointed out that the site may be affected by the import of foreign soils and species, peat slippage as a result of construction vehicles, noise pollution and nutrient pollution during the construction phase. IPCC want the proximity of the proposed development to the Pulleen Harbour NHA to be considered. They want the site to be protected, particularly with respect to its hydrological integrity. It is pointed out that, according to the Wetlands Survey Ireland Map, there are two wetlands in the vicinity of the proposed development which should be considered in the EIA, particularly with respect to the potential impact of haulage routes on the sites in question. It is requested that landscaping in the proposed development will not utilise peat-based compost or non-native species, which pose a risk to the surrounding habitats.
Irish Water	2nd April 2019	The EIA should consider whether the integrity of any protected or sensitive sites is affected by the abstraction of water or discharge of wastewater. Corresponding mitigation measures should be developed, as appropriate.
Fáilte Ireland	11th of April 2019	The ecological integrity of the Irish environment contributes to its appeal as a tourist destination. As such, it should be considered that negative effects on flora and fauna may indirectly result in negative effects on tourism.
Cork Environmental Forum	3rd of May 2019	Concern is expressed regarding the nature of EIA, which does not always monitor a full year of activity of sensitive species. It is pointed out that the study area is species rich.

7.2.6 Overview of Ecological Surveys

Specific ecological surveys were carried out with respect to the following:

- Habitats and vegetation
- Breeding birds
- Bats
- Betony (*Betonica officinalis*)
- Invasive alien plant species (IAPS)

In addition, multidisciplinary site walkover surveys were carried out by the Project Ecologist on a number of occasions during 2018 and 2019. These surveys aimed to identify any occurrence of rare and protected habitats and species in the study area, including those for which specific surveys were not ultimately deemed necessary, including badger and otter.

Paul Murphy of EirEco Environmental Consultants was contracted as the Project Ecologist for the proposed development. Mr. Murphy is a Chartered Environmentalist with over 25 years of experience carrying out ecological assessments. He holds an MSc degree in Environmental Science from Trinity College Dublin. Mr. Murphy completed the surveys of habitats/vegetation and betony. Surveys of breeding birds were carried out principally by Paul Murphy, with assistance from three ROD employees – Ms. Christina McKiernan, Mr. Tadhg Twomey and Mr. Jason Cahill – and sub-consultant ecologist, Mr. John Deasy.

Surveys of IAPS were carried out partly by Paul Murphy and partly by Kyran Colgan of Invasive Plant Solutions. Mr. Colgan has 5 years of experience in the identification and management of IAPS.

Dr. Tina Aughney of Bat Eco Services carried out the bat surveys. Dr. Aughney has over 13 years of experience conducting bat surveys. At the time that these surveys were conducted, Dr. Aughney held the relevant bat survey licences (C30/2017 to handle bats, 33/2017 to photograph/film bats, and DER/BAT 2017-09 to disturb a roost).

Sections 7.2.7 – 7.2.11 outline the methodologies applied during these surveys. Results of these surveys are presented in Section 7.4.

7.2.7 Survey of Habitats and Vegetation

In order to identify the habitat types and their extents within the study area, aerial imagery was initially employed, followed by a multi-disciplinary walkover survey and field-based ground-truthing of findings on the 6th and 7th September 2018 and the 22nd to 25th of May 2019. During the field surveys, detailed botanical assessments were conducted (i) in order to verify habitat classifications according to *A Guide to Habitats in Ireland* (Fossitt, 2000) and (ii) to determine each habitat's conformity to those listed under Annex I of the Habitats Directive. A species list was compiled for each habitat and abundances of particular species were estimated using the DAFOR scale. Hand-drawn habitat maps were produced on Ordnance Survey of Ireland (OSi) Discovery maps of the study area, and later digitised. The survey was carried out in accordance with the Heritage Council's *Best Practice Guidance for Habitat Survey and Mapping* (Smith et al., 2011) and *Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes* (NRA, 2008). Habitat maps are presented in Figures 7.2 – 7.12 of Volume 3 of this EIAR.

7.2.8 Surveys of Breeding Birds

Surveys of breeding birds were carried out between March and July 2019. Post-breeding surveys have commenced and will continue to be carried out on a monthly basis throughout the months of August – November 2019. While all breeding birds in the defined study area have been included in the surveys, an emphasis has been placed on Chough (*Pyrrhocorax pyrrhocorax*), which is a Qualifying Interest (QI) of the Beara Peninsula SPA.

Surveys were carried out according to the methodologies set out in McKeever *et al*. (2010) and Trewby *et al*. (2004). Transects were based on the existing network of paths on Dursey Island, as well as the established looped walks on Garinish Head and Crow Head (both on the mainland). Dedicated nest watches were also undertaken wherever potential nest sites were identified and at the locations of nest sites identified in previous surveys (Berrow *et al*., 1993; Scott, 2002; Gray *et al*., 2003). The schedule of surveys for Chough is outlined in Table 7.2, below.

Table 7.2 Breeding bird survey schedule, indicating activity phase of the focal species of the surveys, Chough

Date	Survey Type	Chough Activity Phase
March 2019	Spring	Early breeding season – mature adults nest making. Young Choughs take up to three years to reach breeding age and over this sub-adult stage they join a flock of non-breeding birds.
April 2019	Breeding	Breeding commences early to mid-April. Eggs are laid in the wool lined nest cup. The female is solely responsible for incubating the eggs and during this time the male forages alone returning to the nest periodically to feed the female and allowing her time to feed close to the nest.
May 2019	Breeding	Breeding season – adults foraging locally.
June - July 2019	Fledging / Dispersal	Nestlings start to fledge and form family group which remains within their breeding season home range.
August – November 2019	Post-breeding	Family groups have formed flocks and communal roosting begins.

Data recorded during the breeding bird surveys included the following:

- Maximum chough flock size;
- How individuals first detected (seen/heard, flying/on ground, distance from surveyor);
- Location (grid reference, place name, description);
- Behaviour (foraging/flying/preening/vigilant/loafing/breeding/heard only);
- Habitat/micro-habitat patch use;
- Land use on habitats in question (i.e. grazed/ungrazed/etc.; livestock type);
- Flush distance of chough, defined as "*the distance at which a foraging bird or flock will fly off when approached [i.e. disturbed] by a person or group of persons*" (Keribiou *et al*., 2019; p. 658);
- Chough nest site locations;
- Number of chough juveniles fledged per known nest;

- Weather (wind force, wind direction, visibility, occurrence of precipitation);
- General notes on other interesting observations, including:
  - Features of land use and habitats (e.g. poaching, strip-grazing, out-wintering of livestock, timing of agricultural activities (e.g. spring grazing, cutting of silage)); and
  - Behavioural aspects of individual birds (e.g. direction of flights).

7.2.9 Survey of Bats

Bat surveys were carried out throughout the day (including the entire night) on 29th – 30th September 2018. Surveys were carried out within the footprint of the proposed development, on both island and mainland sides. The day-time survey involved the examination of the site of the proposed development with a view to identifying potential bat roosts and foraging habitats. The night-time surveys involved the use of two bat detectors ((i) Wildlife Acoustics EchoMeter Touch 2 Pro and (ii) Pettersson D200 Heterodyne) by the surveyor at dusk on 29th September. Additionally, two units of Wildlife Acoustic SongMeter 2 BAT+ Platform were set-up to record bats calls from fixed locations between sunset and sunrise. Recordings made by the latter were analysed using various software, including SongScope.

The corresponding report was developed in accordance with the following reports and guidelines:

- McAney, K (2006). Irish Wildlife Manual No. 20: A conservation plan for Irish vesper bats. Report prepared for NPWS.
- Kelleher, C. & Marnell, F. (2006). Irish Wildlife Manual No. 25: Bat Mitigation Guidelines for Ireland. Report prepared for NPWS.
- Department of Arts, Heritage and the Gaeltacht (2017). *National Biodiversity Action Plan 2017 - 2021*
- Department of Arts, Heritage and the Gaeltacht (2013). The Status of EU Protected Habitats and Species in Ireland 2013

7.2.10 Survey of Betony

On 25th October 2018, a survey was conducted to identify and map the distribution and abundance of the Flora (Protection) Order (2015) species, betony (*Betonica officinalis*) at the mainland side of the site of the proposed development. This rare floral species was known to be present in the environs of the site of the proposed development (Botanical Society of Britain and Ireland, 2019). Locations where the species was identified were recorded on field maps, and corresponding grid coordinates were logged using a Satmap hand-held GPS device. Photographs were taken using a Fuji XP Digital camera. The survey was carried out in accordance with *Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes* (NRA, 2008).

7.2.11 Survey of Invasive Alien Plant Species

On the 16th October 2018, a survey was conducted (by Kyran Colgan) to provisionally identify and map all IAPS listed in Part 1 of the Third Schedule of the *European Communities (Birds and Natural Habitats) Regulations 2011* in the following areas:

- R572 approach road and road margins between Castletownbere and the site of the proposed development, and,
- The site of the proposed development (island and mainland).

It involved a walkover inspection of the site of the proposed development and a drive-through inspection of the R572. Areas outside the bounds of the survey area were also inspected, where these could be safely and easily accessed. Each time an IAPS was sighted, the following data were recorded:

- Species level identification;
- GPS position;
- Photographic image;
- Approximate area of plant/stand;
- General condition of plant(s);
- Broad habitat occupied;
- Proximity to waterbodies; and
- Other relevant site-specific factors.

A Satmap GPS device was used to log grid coordinates. Locations of IAPS were subsequently plotted onto aerial maps using Google Maps.

Since the provisional IAPS survey was carried out outside of the optimum survey period for identification of plants, a further IAPS survey was carried out following the same methodology (by Paul Murphy) in May 2019. It took in the following locations:

- The locations of proposed passing bays on the R572;
- The entire Zone of Influence; and
- The entirety of Dursey Island.

7.2.12 Ecological Evaluation and Impact Assessment Methodology

The ecological evaluation and impact assessment within this chapter follows the methodology that is set out in Chapter 3 of the '*Guidelines for Assessment of Ecological Impacts of National Roads Schemes*' (TII, 2009).

7.2.12.1 Evaluation of Ecological Resources

The criteria used for the ecological evaluation follows those set out in Section 3.3 of the TII Guidelines (2009). These guidelines set out the context for the determination of value on a geographic basis with a hierarchy assigned in relation to the importance of any particular receptor. The guidelines provide a basis for determination of whether any particular site is of importance on the following scale:

- International
- National
- County
- Local Importance (Higher Value)
- Local Importance (Lower Value)

This guidance clearly sets out the criteria by which each geographic level of importance can be assigned. For example, Locally Important (Lower Value) receptors contain habitats and species that are widespread and of low ecological significance and only of importance in the local area. Conversely, Internationally Important receptors are either designated for conservation as part of the Natura 2000 network (SAC or SPA) or provide the best examples of habitats or internationally important populations of protected fauna.

All habitats and species within the Zone of Influence and study area were assigned a level of significance on the above basis and Key Ecological Receptors were established and classified on this basis.

7.2.12.2 Impact Assessment Methodology

The impact assessment uses the EPA 2002 and 2003 guidelines, but also has regard to the 2015 and 2017 draft revised guidelines with respect to characterising the impact of the proposed development on the receiving environment. The parameters used to characterise impacts were:

- Magnitude – relates to the quantum of impact, for example the number of individuals affected by an activity;
- Extent – relates to the area over which the impact occurs;
- Duration – intended to refer to the length of time for which the impact is predicted to continue, until recovery or re-instatement;
- Reversibility – whether an impact is ecologically reversible, either spontaneously or through specific action; and,
- Timing – timing and/or frequency of impacts in relation to important seasonal and/or life-cycle constraints should be evaluated. Similarly, the frequency with which activities (and associated impacts) would take place can be an important determinant of the impact on receptors.

It is necessary to ensure that any assessment of impact takes account of construction and operational phases; direct, indirect and cumulative impacts; and, those that are temporary, reversible and irreversible. The most relevant criteria for assessment of effects include quality and significance and these criteria are defined in Table 7.3 and 7.4. Definitions of terms used when quantifying duration of effects are defined below (as per EPA, 2017):

- Temporary – up to 1 year
- Short-term – 1 to 7 years
- Medium-term – 7 to 15 years
- Long-term – 15 to 60 years
- Permanent – over 60 years

Table 7.3 Criteria for Assessing Impact Significance (EPA, 2017)

Impact Magnitude	Criteria
No change	No discernible change in the ecology of the affected feature
Imperceptible Impact	An impact capable of measurement but without noticeable consequences
Slight Impact	An impact which causes noticeable changes in the character of the environment without affecting its sensitivities
Moderate Impact	An impact that alters the character of the environment that is consistent with existing and emerging trends
Significant Impact	An impact which, by its character, its magnitude, duration or intensity alters a sensitive aspect of the environment
Profound Impact	An impact which obliterates sensitive characteristics

Table 7.4 Criteria for Assessing Impact Quality (EPA, 2017)

Impact Type	Criteria
Positive	A change which improves the quality of the environment e.g. increasing species diversity, improving reproductive capacity of an ecosystem or removing nuisances
Neutral	A change which does not affect the quality of the environment
Negative	A change which reduces the quality of the environment e.g. lessening species diversity or reducing the reproductive capacity of an ecosystem

Once the potential impacts are characterised, the significance of any such impacts on each of the Key Ecological Receptors is evaluated.

7.2.12.3 Assessing Significance of Effects

The significance of effects was determined following guidance set out in Section 7.2.20 of the TII guidelines (2009), whereby effects are assigned significance based on their characterisation, irrespective of the value of the receptor. Significance is determined by effects on conservation status or integrity, regardless of geographical level at which these would be relevant.

7.2.12.4 Mitigation

The proposed development has been designed to specifically avoid, reduce and minimise negative effects on all Key Ecological Receptors. Where potential significant negative effects on Key Ecological Receptors are predicted, mitigation has been prescribed to ameliorate these effects.

Proposed best practice design and mitigation measures are specifically set out in this Chapter and are realistic in terms of cost and practicality. Provided measures follow the prescribed methodologies and best practice guidelines where available. They have a high probability of success in terms of addressing the impacts on the identified Key Ecological Receptors.

The potential impacts of the proposed development were considered and assessed to ensure that all impacts on Key Ecological Receptors are adequately addressed.

7.2.12.5 Survey Limitations

Standard survey methods were followed and no particular difficulties were encountered during the completion of the surveys described above. However, any biases or limitations associated with these methods could potentially affect the results collected. While every effort was made to provide a full assessment and comprehensive description of the study area, ecological trends (e.g. population trends) may not be fully reflected due to the instantaneous/short-term nature of the field surveys. However, the data obtained from field surveys coupled with the background knowledge provided by the desk study provides a robust representation of the baseline for the habitats and species within the Zone of Influence.

7.3 Desk Study Results

7.3.1 General Description and Context

The proposed development will see the replacement of the existing Dursey Island Cable Car (located in the townland of Ballaghboy, Beara Peninsula, west Co. Cork), which traverses the Dursey Sound, connecting the mainland with the nearby island of Dursey. It is also proposed to construct a new interpretative exhibition space ('Visitor

Centre') and café. The existing car park, which accommodates approximately 70 spaces, will be replaced with an approx. 100-space car park. Additionally, it will be necessary to carry out improvement works on the principle approach road to the site, the R572, including construction of 10 no. suitably spaced passing bays and 1 no. visibility splay. For a detailed description of the proposed development, refer to Chapter 4 of this EIAR.

The site of the proposed development is situated in a sparsely populated, rural area on the coastline of west Co. Cork. The mainland side of the site is approx. 12km from the village of Allihies, 22km from Castletownbere (the nearest major town), and 145km from Cork City. Principle land uses in the area are agriculture, transportation and recreation/tourism. Farming in the area is largely pastoral, with both dry stock cattle and sheep farming represented. Anecdotal evidence indicates that periodic burning of heath and some degree of peat extraction occur on the island.

The environment in the study area is considered to be of exceptional natural beauty. The rugged, treeless landscape is dominated by undulating landforms, indented rocky coastline and open Atlantic seascapes. Thin peaty soils are punctuated by exposed purple and green sandstone and siltstone. Predominant terrestrial habitats are dry humid acid grassland (GS3) and dry siliceous heath (HH1).

Dursey Island itself has an area of approx. 6km² and is orientated in a north-westerly to south-easterly direction. A high elevation spine runs along the length of the island from its south-western to its north-eastern points. Farmland is concentrated on the sheltered south-eastern flank of the island, while the less accessible, windswept north-western flank and the hilltops are dominated by open heathland. Grazing pressure is particularly heavy on the island (as opposed to the mainland), where sward heights are consequentially short. A fence at the bounds of the CCC lands on the mainland excludes livestock, and sward heights are higher in the immediate vicinity of the cable car site as a result.

In 2015, Fáilte Ireland established an environmental monitoring programme for the fifteen Signature Discovery Points of the WAW, of which Dursey Island is one. Under the programme, data related to the pattern and intensity of visitor activities, and the ecological status of vegetation in the immediate vicinity of the site of the proposed development were recorded in 2015 (CAAS, 2015; Crushell *et al*., 2015), 2016 (Crushell *et al*., 2016) and 2017 (Boyle, 2017; CAAS, 2018a; 2018b). These data indicate that visitor footfall on vegetated areas immediately adjacent to the cable car site has resulted in trampling and some de-vegetation, soil compaction/erosion in certain localised heavily trafficked areas.

> *"Overall, the condition of the coastal paths was fair, with some evidence of erosion due to visitor numbers."*– CAAS, 2018b, p. 29
>
> *"The trampling effects [of visitors] were seen to have low impacts and were localised to within the immediate vicinity of the [cable car]"* – CAAS, 2018a, p.21

Dursey Island and the Beara Peninsula are popular destinations for recreational walkers. The current situation with respect to walking routes in the Zone of Influence is as follows:

- On Dursey Island, there is a public road running along the central high elevation spine of the island from east to west. There are a number of informal paths on private land, which generally run in parallel to the public road, from east to west. Roads and paths are largely situated inland and not near potential chough nesting sites (i.e. sea cliffs). With the exception of the western end of the island

(beyond Tilickafinna), walkways are fairly well defined. On the extreme western end of the island (a chough 'hotspot'), there is no defined trail, creating a risk of walkers spilling out across the open habitat. Yellow waymarker posts guide walkers to the hill of Maoil on the extreme western end of the island. A map of the island and its existing looped walk is provided on the mainland, but is not placed in a prominent position and is likely to be overlooked by many visitors.

- At Garinish Head, the Garinish Loop walk is well defined and the trail attracts considerable numbers of visitors, not all of whom are likely to undertake the full route, but rather use the existing cable car car park as a starting point. Between the site of the proposed development and Garinish Pier, the walk is on a well-defined walking trail, which is heavily eroded in a small number of localised areas. From Garinish Pier back to the Cable Car, the walk is on public roads.
- At Crow Head, the walkway is poorly defined, creating a risk of walkers spilling out over open habitat, though this walk appears to attract very few visitors.

Plate 7.2 presents a map of established paths/roads on the island.

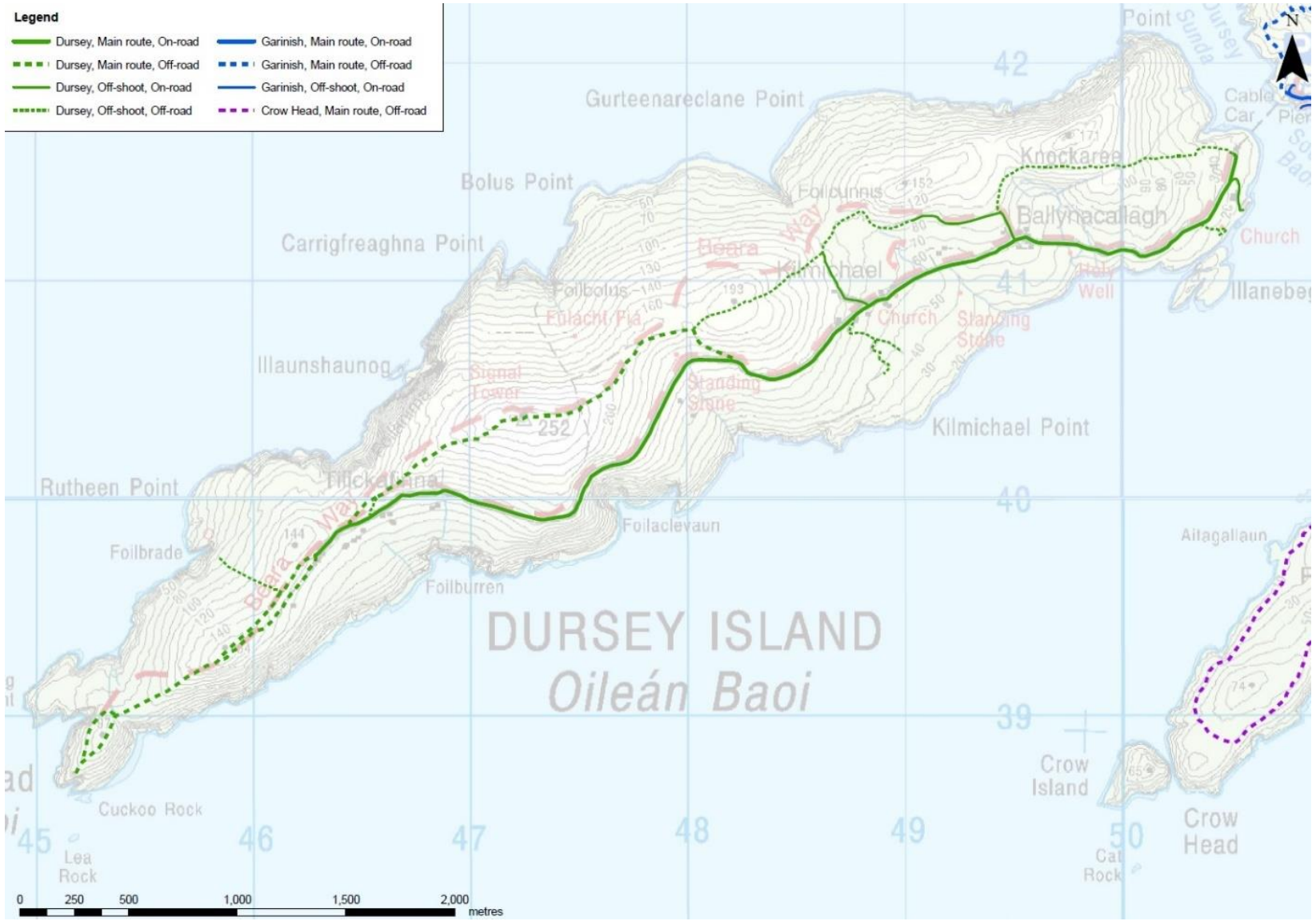

Plate 7.2 Map of Dursey Island showing key walking paths (dotted green line) and road (continuous green line)

7.3.2 Designated Sites

The NPWS web-based Map Viewer was consulted in order to identify legally designated sites within the Zone of Influence. Table 7.5 lists those sites. Thereafter follows a description of the sites in question, according to the NPWS site synopses (NPWS, 2009; 2015; 2016), conservation objectives (NPWS, 2013; 2018) and Natura 2000 Standard Data Forms (NPWS, 2017a; 2017b) for the respective sites, where available.

Table 7.5 Designated sites within the Zone of Influence

Site	Distance from Proposed Development
Designated under European Law	
Beara Peninsula SPA [004155]	Site of proposed development is within SPA
Kenmare River SAC [002158]	SAC extends to high water mark immediately adjacent to site of proposed development
Designated under National Law	
Dursey Island pNHA [000086]	Island-side of proposed development is within the pNHA
Garinish Point pNHA[001986]	Mainland-side of proposed development is within the pNHA
Firkeel Gap pNHA [001051]	R572 approach road (a part of the proposed development) traverses the pNHA

7.3.2.1 Beara Peninsula SPA

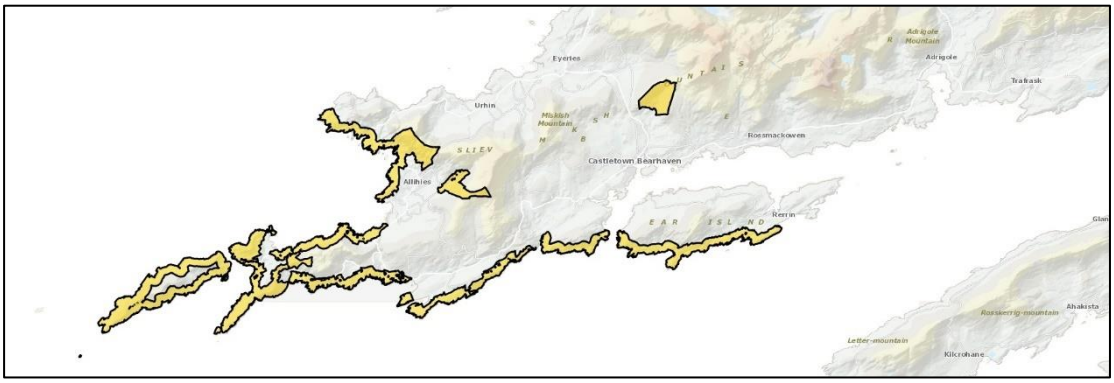

Plate 7.3 Location of Beara Peninsula SPA (yellow). Source: NPWS Map Viewer

The Beara Peninsula SPA (Plate 7.3) is a coastal site situated on the west coast of Co. Cork. It encompasses the high coast and sea cliff sections of the western end of the peninsula from Reenmore Point/Cod's Head in the north, around to the end of Dursey Island in the west, and as far east as Bere Island in the south.

The QIs of the SPA (Table 7.6) are red-billed chough (*Pyrrhocorax pyrrhocorax*, hereafter 'chough') and northern fulmar (*Fulmarus glacialis*, hereafter 'fulmar'). In addition to these QIs (discussed below), the site synopsis states that the SPA supports populations of other breeding seabirds including: shag (12 pairs), herring gull (20 pairs), lesser black-backed gull (4 pairs), razorbill (5 pairs) and black guillemot (87 individuals in 1999) – all seabird data from 2000. The site is also used by peregrine falcon (4 pairs in 2002). The conservation objective of the SPA is to maintain or restore the favourable conservation condition of the site QIs – fulmar and chough.

Table 7.6 Qualifying Interests of the Beara Peninsula SPA

Species Common Name	Scientific Name	NPWS Code
Fulmar	*Fulmarus glacialis*	[A009]
Chough	*Pyrrhocorax pyrrhocorax*	[A346]

Fulmar

Fulmar are protected under the Irish Wildlife Acts but the species is not considered to be of conservation concern in Ireland. Birds winter and feed at sea and nest and roost on sea cliffs and caves – and occasionally on level ground or in artificial structures in coastal areas (BirdWatch Ireland, 2019b). Fulmars forage principally on fish and crustaceans and are partly reliant on scavenged fish from commercial fishing vessels but also catch live prey themselves (Phillips *et al*., 1999). The species is not native to Ireland, and the first national breeding record is from Co. Mayo in 1911 (Ussher, 1911). Research suggests that Iceland and St. Kilda are the ancestral range of the species (Fisher, 1966; Burg *et al*., 2003). However, the abundance and range of the species has increased greatly in the boreal and sub-boreal North Atlantic over the last two centuries, although numbers in certain areas (including the Isle of Muck in north-east Ireland) have declined somewhat in recent years (Fisher, 1966; Mitchell *et al*., 2004). The dramatic expansion of the species' distribution is often attributed to concurrent growth in the commercial whaling and fishing industries (Fisher, 1952; Mitchell *et al*., 2004), although other factors, such as climate change, may also be at play (Thompson, 2006). The species is now found at sea and in coastal areas across the entirety of the Irish coastline (NBDC, 2019c) and is one of the most abundant seabirds in the Northern Hemisphere (Mitchell *et al*., 2004). At the turn of the century (1998 – 2002), Ireland had approximately 32,918 individual fulmars (Mitchell *et al.*, 2004). The Beara Peninsula SPA supports a nationally important breeding population (575 pairs, according to the NPWS site synopsis). A seabird survey of Dursey Island and Crow Head/Island was carried out in May 2016 and (to a lesser degree) May 2018 (Heardman, pers. comm., 2019). This survey identified a total of 487 individual fulmars on Dursey Island in 2016 (426 on the north coast of the island, 52 on the south coast, and 9 on the west coast). A flock of 12 individuals was also observed on Crow Head/Crow Island. Seven individuals were identified in the Dursey Sound area (the only area surveyed) in 2018.

Chough

Choughs are a corvid species primarily associated with coastal areas. They are amber-listed species under Birdwatch Ireland's *Bird of Conservation Concern in Ireland* (BWI BoCCI), afforded statutory protections under the Irish Wildlife Acts and the EU Birds Directive (Annex I). They generally nest on ledges in cliffs and in sea caves, but also occasionally in suitable artificial structures (i.e. derelict buildings) (Holyoak, 1972; Bignal *et al*., 1987; BirdWatch Ireland, 2019a) or on inland cliffs with suitable foraging habitat in their vicinity (Blanco *et al*., 1993; Gray *et al*., 2003). Research indicates that choughs distribute nesting site faithfulness, with some sites being used by successive generations (Kennedy *et al*, 1954). Choughs lay somewhere in the region of 2 – 6 eggs per clutch (Holyoak, 1972; Bullock *et al*., 1983; Bignal *et al*., 1987; Stillman *et al*., 1998), typically in late March – April (Holyoak, 1972; Keribiou & Julliard, 2007; BirdWatch Ireland, 2019a). The average number of young fledged in the south-west of Ireland is 3 (Trewby *et al*., 2006a) The fledging period is typically in June (Keribiou & Julliard, 2007; BirdWatch Ireland, 2019a), when somewhere in the region of 1 – 3 offspring are generally successfully fledged (Bullock *et al*., 1983; Bignal *et al*., 1987;

BirdWatch Ireland, 2019a). There is evidence to indicate that the availability of suitable forage is a key limiting factor on survival of juveniles (Keribiou & Julliard, 2007; Keribiou *et al*., 2009). Research indicates that chough populations may have high proportions of non-breeders (as much as 30%; Holyoak, 1972), since individuals do not generally begin breeding until their third year (Bignal *et al*., 1987; BirdWatch Ireland, 2019a). After the breeding season, choughs tend to join flocks at communal roost sites, while some pairs tend to remain in the vicinity of their nest site throughout the year (Bignal *et al*., 1997).

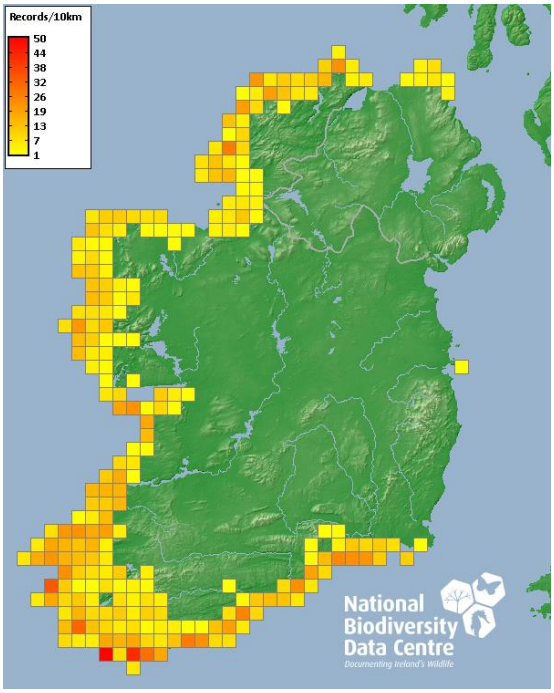

Plate 7.4 National distribution of chough. Source: NBDC, 2019

Choughs in Ireland are known to forage principally on grazed grassland with short sward heights, earthen banks, coastal machair and maritime turf, and to a lesser degree, also on heathland, dunes, cliffs, improved grassland and tidewrack (Holyoak, 1972; Bullock, 1980; Bullock *et al*., 1983; Berrow *et al*., 1993; Robertson *et al*., 1995; Trewby *et al*., 2006a; 2006b). Dung – particularly cattle dung – is also thought to provide an important supply of invertebrate prey during the autumn months (Trewby *et al*., 2006b). Anthills and invertebrates associated with carrion have also been observed to be used by Irish choughs (Trewby *et al*., 2006b). Birds use their curved bills to dig for food – almost exclusively insects and arachnids (including ants, beetles, spiders and soil-dwelling invertebrate larvae, particularly those of leatherjackets (*Tipulidae* spp.), wireworms (*Elateridae*) and beetles) (Holyoak, 1972; Bullock *et al*., 1983; Robertson *et al*., 1995; Keribiou & Julliard, 2007) with some plant material (particularly grains) also eaten during the winter months when insect availability is low (Keribiou & Julliard, 2007). Research has found evidence that the Alpine chough (*Pyrrhocorax graculus*) will forage opportunistically on food scraps left behind by humans (Holyoak, 1972) but there is no record in the academic literature of this behaviour in *P. pyrrhocorax*. On the contrary, research indicates that red-billed choughs are particular in their choice of food items (Keribiou & Julliard, 2007).

A survey of the species in Britain and Ireland carried out in 1982 (Bullock *et al*., 1983) found that distribution was influenced by the quality of coastal foraging habitat, with birds exhibiting a strong preference for heavily grazed grassland. The presence of grazing animals (such as sheep and rabbits) seem to be of critical importance for chough populations (McCanch, 2000). Indeed, sheeps' wool forms a key component of nests, and choughs have been observed to travel long distances to obtain the material (Holyoak, 1972).

According to Trewby and co-authors (2006b), "*Choughs occupy a relatively restricted niche in terms of both nesting and feeding habitat and species could be regarded as prone to localised extinction*" Bullock *et al*. (1983) reviewed 9 factors affecting the abundance and distribution of chough in the British Isles: land use change, human disturbance, human persecution, geographical isolation and inbreeding, disease, toxic chemicals, climate, predation, and interspecific competition with other corvids. They concluded that land use change (i.e. de-stocking of land) represented the greatest

threat to the conservation of the species. With respect to human disturbance, Bullock and colleagues (1983) state that,

> "*the species is extremely tolerant of human disturbance and continues to breed at several tourist spots. Prolonged disturbance, such as climbing in inland quarries in the vicinity of traditional nest sites, seems the only serious form of direct [human disturbance] threat*" (p.395).

Indeed, research indicates that choughs at tourist sites can become habituated to human disturbance in terms of physiological and behavioural responses (Jimenez *et al*., 2011) and surveys conducted for the purposes of an Appropriate Assessment at Bray Head, Valentia Island, Co. Kerry (Wild Eye & Ecology Ireland, 2018, p. 52) support this conclusion: "*Chough at Bray Head appear to show a high degree of tolerance to disturbance from human visitors to the site, with many instances of birds not flushing even at low distances of 15-20m, and many instances of Chough approaching humans to distances of less than 20m*". However, a more recent research paper (Keribiou *et al*., 2009; Appendix 7.3), found that human disturbance constitutes a significant threat to the short-term viability of chough populations in heavily trafficked areas. They found that, on the French island of Ouessant, the number of visitors at any one time was negatively correlated with the foraging probability of choughs, and that juvenile survival rates were lowest in months when visitor numbers were greatest. Human disturbance has been identified as a potential threat to the choughs of Dursey Island (CAAS, 2018b):

> *"The potential risks to local bird population of current levels of visitors using the site are mainly centred on the risk of increased disturbance to Choughs which use the maritime grasslands along the peninsula to feed"*

Ireland supports over 60% of the total north-western European chough population (Johnstone *et al*., 2007). The Beara Peninsula SPA supports an internationally important population of chough. The peninsulas of west Co. Cork and Co. Kerry are a stronghold of the species, with each County supporting roughly 30% of the national population (Gray *et al*., 2003). During the breeding seasons of 2002/03, Dursey Island had a total of 46 birds, with 10 pairs identified, of which 8 were confirmed to be breeding (Gray *et al*., 2003). Only two islands – Valencia and Achill – were found to have a greater absolute population size than Dursey (with 52 and 66 birds, respectively). Three islands had greater numbers of confirmed breeding pairs – Clare Island (10 confirmed breeders), Achill (11 confirmed breeders) and the collective Aran Islands (9 confirmed breeders).

Between the 1992 (Berrow *et al*., 1993) and 2002/03 surveys (Gray *et al*., 2003), the chough populations in Counties Cork, Kerry, Mayo, Sligo and Donegal remained relatively stable while those in Wexford, Waterford and Galway decreased, and those in Clare and Leitrim increased (Table 7.8). Overall, the national Chough population incurred a decline of approximately 8% between 1992 and 2002/03. It should be noted that different methodologies were employed during the 1992 and 2002/03 surveys, and this is likely to account for some of the differences in numbers recorded. According to Trewby *et al*. (2006b), actual trends for the intervening years may have been of "less severe decreases or even stability".

It was found that while the south-west Cork region and the Beara Peninsula had both incurred Chough population declines between 1992 and 2002/03 (of -33% and -25%, respectively), the Dursey Island population had more than doubled over the same period, from a total of 20 birds in 1992 (Berrow *et al*., 1993) to 46 birds in 2002/03 (Gray *et al*., 2003). Fifty-eight breeding pairs were recorded within the entire SPA in the 1992 survey and 54 in the 2002/03 survey (Trewby *et al*., 2006b). In the 1992

survey (Berrow *et al*., 1993), 2 confirmed breeding pairs, 3 probable breeding pairs and 5 possible breeding pairs (possible total of 10 breeding pairs) were recorded on Dursey Island. In the 2002/03 survey (Gray *et al*., 2003), 8 confirmed breeding pairs and 2 possible breeding pairs (possible total of 10 breeding pairs) were recorded on the island (Table 7.7). According to Trewby *et al*. (2006b), breeding pairs on the Beara Peninsula are likely to have been under-recorded in 2002 and overestimated in 1992. Thus, "*in term of its breeding population, the picture for the Beara Peninsula seems to have remained relatively stable over the last decade*" (Trewby *et al*., 2006b).

Table 7.7 Numbers of chough breeding pairs recorded on Dursey Island during the 1992 and 2002/03 all-Ireland chough surveys. Sources: *Berrow et al., 1993; **Gray et al., 2003

Year	No. Breeding Pairs			
	Confirmed	Probable	Possible	Possible Total
1992*	2	3	5	10
2002/03**	8	0	2	10

Because of the lack of 'honeypot' habitats (such as dune systems) in the area, flocking activity is considered to be less pronounced on the Beara Peninsula than elsewhere and choughs tend to disperse widely during the post-fledging and winter months with more cohesive flocks developing in the run-up to the breeding season (i.e. late winter). By contrast, large winter flocks were observed at the Derrynane dune system on the neighbouring Iveragh Peninsula (Co. Kerry). However, during the 2002/03 surveys, smaller, "ephemeral" communal roosts were identified at cliffs on the eastern end of the island, overlooking the Dursey Sound (12 birds observed) and at Allihies (30 birds observed). The potential sensitivity of communal roosts to human disturbance has been highlighted (Trewby *et al*., 2006b).

Table 7.8 Total numbers of Choughs recorded in flocks in counties of Ireland in 1992 and 2002/03. Sources: *Berrow et al., 1993; **Gray et al., 2003

County	Total Birds in Flocks		Percentage Change
	1992*	2002/03**	
Wexford	31	26	-16%
Waterford	191	161	-16%
Cork	856	765	-11%
Kerry	752	767	+2%
Clare	73	91	+24%
Galway	104	49	-53%
Mayo	196	177	-10%
Sligo	50	53	+6%
Leitrim	8	12	+50%
Donegal	366	326	-11%
Total	2633	2432	-8%

7.3.2.2 Kenmare River SAC

Kenmare River SAC (Plate 7.5) takes in over 43,000ha of the long, narrow, south-west facing Kenmare Bay between the Iveragh and Beara Peninsulas of Counties Kerry and Cork, and open ocean immediately outside the mouth of the bay, including the waters surrounding Dursey Island. The site contains a wide range of marine communities from exposed coast to ultra-sheltered areas. The site contains three marine habitats listed on Annex I to the Habitats Directive, namely reefs, large shallow bay and marine caves. There is also a very high number of rare and notable marine species present and some uncommon communities are represented. The QIs of the site are listed in Table 7.9.

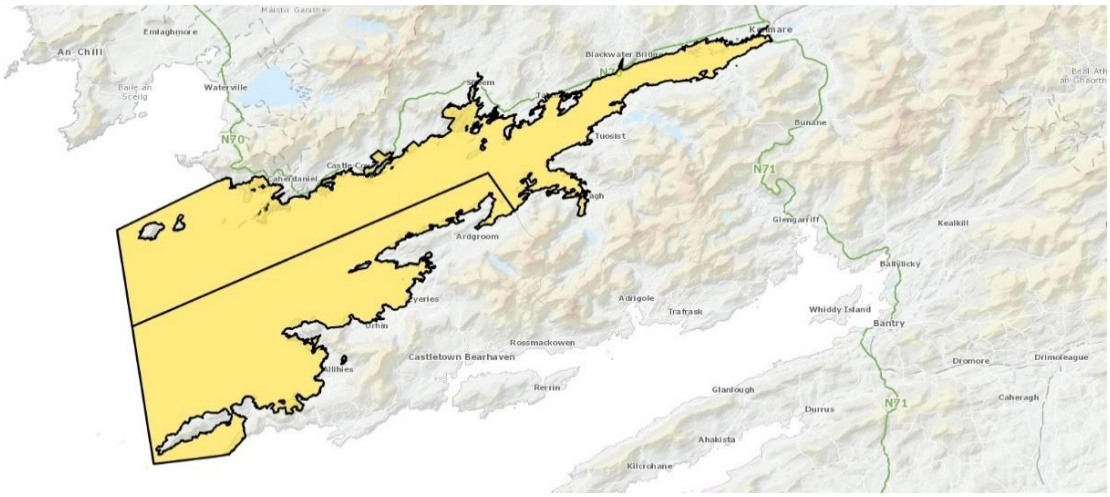

Plate 7.5 Location of Kenmare River SAC (yellow). Source: NPWS Map Viewer

Impacts arising from aquaculture, fishing, dumping of wastes and water pollution are the principal threats to the nature conservation interests of the Kenmare River. There are several resorts for water sports and a number of popular beaches within this large coastal site and impacts associated with such recreational activities may also pose a threat. Housing developments within the areas of dry heath present another possible threat to the integrity of the site.

Table 7.9 Qualifying Interests of the Kenmare River SAC

	Habitat/Species and Scientific Name (Where Applicable)	NPWS Code
Habitats	Large shallow inlets and bays	[1160]
	Reefs	[1170]
	Perennial vegetation of stony banks	[1220]
	Vegetated sea cliffs	[1230]
	Atlantic salt meadows	[1330]
	Mediterranean salt meadows	[1410]
	Marram dunes (white dunes)	[2120]
	Fixed dunes (grey dunes)*	[2130]
	Dry heath	[4030]
	Juniper scrub	[5130]
	Calaminarian grassland	[6130]
	Sea caves	[8330]

	Habitat/Species and Scientific Name (Where Applicable)	NPWS Code
Species	Narrow-mouthed whorl snail (*Vertigo angustior*)	[1014]
	Lesser horseshoe bat (*Rhinolophus hipposideros*)	[1303]
	Otter (*Lutra lutra*)	[1355]
	Harbour seal (*Phoca vitulina*)	[1365]

* = Priority QI

Of the QIs of the site, only 7 are found within or in the vicinity of the Zone of Influence (NPWS, 2016) and may potentially be affected by the proposed development. They are as follows:

- Large shallow inlets and bays [1160]
- Reefs [1170]
- Submerged or partially submerged sea caves [8330]
- Vegetated sea cliffs of the Atlantic and Baltic coasts [1230]
- Otter (*Lutra lutra*) [1355]
- European dry heaths [4030]
- Common harbour seal (*Phoca vitulina*) [1365]

Since there is no potential pathway for negative effects on the other QIs of the SAC, they may be ruled out of this assessment as potential KERs. A description of the 7 QIs which are found within/in the vicinity of the Zone of Influence, their relation to the proposed development and their conservation objectives (Table 7.10) are presented in the following sections.

Large shallow inlets and bays

This habitat is listed in Annex I of the Habitats Directive. It is composed of a host of sub-habitats ('community complexes'). The entire marine area in the vicinity of the proposed development, including the Dursey Sound, corresponds to 'Large shallow inlets and bays'. Within this area, the following communities are represented:

- *Laminaria*-dominated community complex;
- Subtidal reef with echinoderms and faunal turf community complex;
- Fine to medium sand with crustaceans and polychaetes community complex;
- Intertidal reef community complex; and
- Coarse sediment dominated by polychaetes community complex. (NPWS, 2016).

The overall conservation status of this habitat type was considered to be 'Bad' and declining in the most recent national assessment (NPWS, 2019b). Nutrient enrichment, dredging and IAS have been identified as key threats (NPWS, 2019b).

Reefs

This habitat is listed in Annex I of the Habitats Directive. Reefs are characterised as "widespread [intertidal and subtidal] marine features with stable hard substrate available for colonisation by plants and animals" (NPWS, 2013d). Much of the sea bed in the vicinity of the proposed development, including the Dursey Sound, which the proposed cable car crosses, corresponds to 'Reefs' (NPWS, 2016). The overall conservation status of the habitat type was considered to be 'Inadequate' and stable

in the most recent national assessment (NPWS, 2019b). Fishing activities have been identified as a key threat (NPWS, 2019b).

Submerged or Partially Submerged Sea Caves

This habitat is listed in Annex I of the Habitats Directive. Sea caves "vary from small indentations to large caverns of 50 – 100m in width" which may be wholly or partially submerged in the sea and typically occur on sandstone or limestone cliff faces (NPWS, 2013d.). The diversity and abundance of fauna in sea caves depends on, among other things, the degree of exposure (NPWS, 2013d). Less exposed sea caves typically support species of anemone, tunicate, bryozoan, sponge, sea cucumber and brittle star (NPWS, 2013d). There are at least eight 'Submerged or partially submerged sea caves' within or adjacent to the Zone of Influence, mostly on Crow Head and Dursey Island, the closest occurrence of this habitat type being circa 1km west of the proposed development. (NPWS, 2016). The overall conservation status of this habitat type was considered to be 'Favourable' and stable in the most recent national assessment, and no significant threats have been identified (NPWS, 2019b).

Vegetated Sea Cliffs of the Atlantic and Baltic Coasts

This habitat is listed in Annex I of the Habitats Directive. Sea cliffs may be characterised as "steep or vertical slope[s] located on the coast […] subject to maritime influence in the form of salt spray and exposure to coastal winds" (NPWS, 2013d). The cliffs on Dursey Island and in the immediate vicinity of the proposed development at Garinish Head and Crow Head correspond to 'Vegetated sea cliffs of the Atlantic and Baltic coasts' (NPWS, 2016). The cliffs in the study area are largely 'hard cliffs' of sandstone but some 'soft cliffs' are also represented at Garinish and Crow Head. Dominant plant species on hard cliffs include fescues (*Festuca rubra* and *F. ovina*), kidney vetch (*Anthyllis vulneraria*), thrift (*Armeria maritima*), common bent (*Agrostis capillaris*), bog pimpernel (*Anagallis tenella*), ling heather (*Calluna vulgaris*), bell heather (*Erica cinereal*) and wild thyme (*Thymus polytrichus*). In the splash zone, there is a well-developed lichen flora, dominated by species such as *Verrucaria maura* and *Ramalina* spp. (NPWS, 2013c). The overall conservation status of the habitat type was considered to be 'Inadequate' and stable in the most recent national assessment (NPWS, 2019b). Trampling by walkers, IAS, gravel extraction, and changes in sea level height and wave exposure due to climate change have been identified as key threats (NPWS, 2019b).

Otter

The Eurasian otter, *Lutra lutra*, is listed on Annexes II and IV of the Habitats Directive. In spite of dramatic declines elsewhere in Europe, the conservation status of the species in Ireland is 'Favourable' and improving (NPWS, 2019b). However, the species has been classified as 'Near Threatened' on the Irish Red List of terrestrial mammals (Marnell *et al*., 2009). The species is a generalist predator which exploits a variety of terrestrial and freshwater and marine aquatic habitats. Key threats include habitat destruction (particularly of riverine and riparian habitats), pollution and traffic strikes (NPWS, 2019b). However, it is considered that none of these is currently impacting significantly upon the conservation status of the species (NPWS, 2019b) Otters potentially commute through the Zone of Influence, along the shoreline, up to 250m offshore and up to 150m inland (NPWS, 2016).

European Dry Heaths

This habitat is listed in Annex I of the Habitats Directive. It may be characterised as "vegetation dominated by ericaceous dwarf shrubs […] usually occur[ing] on well-drained nutrient-poor and acidic mineral soils or shallow peats on sloping ground"

(NPWS, 2013d). Dominant species are ling heather (*Calluna vulgaris*), bell heather (*Erica cinereal*) and bilberry (*Vaccinium myrtillus*), and western gorse (*Ulex gallii*) may also be present in coastal heaths (NPWS, 2013d). The heath habitats in the immediate vicinity of the proposed development potentially correspond to 'European dry heaths' (NPWS, 2016). The overall conservation status of the habitat type was considered to be 'Bad' and stable in the most recent assessment (NPWS, 2019b). Afforestation, agricultural activities (overgrazing, burning, drainage and destocking) and wind farms have been identified as key threats (NPWS, 2019b).

Harbour Seal

The harbour seal (also 'common seal'), *Phoca vitulina*, is listed on Annexes II and V of the Habitats Directive. *P. vitulina* is a marine mammal of estuarine, coastal of offshore waters which utilises intertidal and coastal habitats breeding, moulting, resting and socialising. Individuals are vulnerable to disturbance while spending time in terrestrial habitats or in shallow waters near the shore. Breeding (including birth of pups) occurs at terrestrial haul-out sites. As such, these sites are critical for the conservation of the species. When hauling out to terrestrial habitats, the species favours sheltered sites and, as such, the coastline on Dursey and in the vicinity of the proposed development on the mainland is unlikely to be utilised. Seals are known to frequent the marine area within the likely Zone of Influence while foraging. However, there are no known terrestrial haul-out sites in the area. The nearest known haul-out site is circa 15km northeast, at Eyeries Island. The species predates fish, cephalopods and crustaceans. (NPWS, 2013b). The overall conservation status of the species is 'Favourable' and stable (NPWS, 2019b). Key threats include fishing activities, disturbance due to geophysical seismic studies and human disturbance at haul-out sites (NPWS, 2019b). However, it is considered that none of these threats is of a sufficient magnitude to adversely affect that conservation status of the species (NPWS, 2019b).

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Table 7.10 Conservation objectives of 6 relevant QIs of the Kenmare River SAC. Source: NPWS, 2013a

Qualifying Interest	Conservation Objective	Target
Large shallow inlets and bays	To maintain the favourable conservation condition of the QI in the SAC	The permanent habitat area is stable or increasing, subject to natural processes
		Maintain the extent of the *Zostera*- and Maërl-dominated communities and the *Pachycerianthus multiplicatus* community subject to natural processes.
		Conserve the high quality of the *Zostera*-dominated community, subject to natural processes
		Conserve the high quality of the *Pachycerianthus multiplicatus* community, subject to natural processes
		Conserve the high quality of the Maërl-dominated community, subject to natural processes
		Conserve the following communities in a natural condition: Intertidal mobile sand community complex; Muddy fine sands dominated by polychaetes and *Amphiura filiformis* community complex; Fine to medium sand with crustaceans and polychaetes community complex; Coarse sediment dominated by polychaetes community complex; Shingle; Intertidal reef community complex; Subtidal reef with echinoderms and faunal turf community complex and *Laminaria*-dominated community complex
Reefs	To maintain the favourable conservation condition of the QI in the SAC	The distribution of reefs remains stable, subject to natural processes
		The permanent habitat area is stable or increasing, subject to natural processes
		Conserve the following community types in a natural condition: Intertidal reef community complex; Subtidal reef with echinoderms and faunal turf community complex; and Laminaria-dominated community complex.
Submerged or partially submerged sea caves	To maintain the favourable conservation condition of the QI in the SAC	The distribution of sea caves is stable, subject to natural processes.
		Human activities should occur at levels that do not negatively affect the ecology of sea caves at this site
Vegetated sea cliffs of the Atlantic and Baltic coasts	To maintain the favourable conservation condition of the QI in the SAC	Habitat area stable, subject to natural processes, including erosion
		No decline of habitat distribution, subject to natural processes.
		No alteration to natural functioning of geomorphological and hydrological processes due to artificial structures.
		Maintain range of sea cliff habitat zonations including transitional zones, subject to natural processes including erosion and succession
		Maintain structural variation within vegetation sward.
		Maintain range of sub-communities with typical species listed in the Irish Sea Cliff Survey (Barron *et al*., 2011)
		Negative indicator species (including non-natives) to represent less than 5% cover

Qualifying Interest	Conservation Objective	Target
		Cover of bracken (*Pteridium aquilinum*) on grassland and/or heath less than 10%. Cover of woody species on grassland and/or heath less than 20%.
Otter, *Lutra lutra*	To maintain the favourable conservation condition of the QI in the SAC	No significant decline in distribution.
		No significant decline in extent of terrestrial habitat.
		No significant decline in extent of marine habitat.
		No significant decline in extent of freshwater (river) habitat.
		No significant decline in extent of freshwater (lake/lagoon) habitat.
		No significant decline in couching sites and holts.
		No significant decline in available fish biomass.
		No significant increase in barriers to connectivity.
European dry heaths	To maintain the favourable conservation condition of the QI in the SAC	Habitat area stable or increasing, subject to natural processes
		No decline of current habitat distribution, subject to natural processes
		No significant change in soil nutrient status, subject to natural processes. No increase or decrease in area of natural rock outcrop
		Cover of characteristic dwarf shrub indicator species, typically heather (*Calluna vulgaris*), bell heather (*Erica cinerea*) and Western gorse (*Ulex gallii*) at least 25%
		Cover of senescent heather (*Calluna vulgaris*), less than 50%
		Long shoots of bilberry (*Vaccinium myrtillus*) with signs of browsing collectively less than 33%
		Cover of scattered native trees and shrubs less than 20%
		At least 2 positive indicator species e.g. bell heather (*Erica cinerea*) and Western gorse (*Ulex gallii*), with combined cover of at least 60%
		At least 2 bryophyte or non-crustose lichen species present
		Cover of bracken (*Pteridium aquilinum*) less than 10%
		Cover of agricultural weed species (negative indicator species) less than 1%
		Cover of non-native species less than 1%
		No decline in distribution or population sizes of rare/scarce species, including protected species Kerry lily (*Simethis planifolia*) and betony (*Stachys officinalis*) and uncommon species juniper (*Juniperus communis*)

Qualifying Interest	Conservation Objective	Target
		Cover of disturbed bare peat less than 5%
		No signs of burning within sensitive areas
Harbour seal, *Phoca vitulina*	To maintain the favourable conservation condition of the QI in the SAC	Species range is not restricted by artificial barriers to site use.
		Conserve the breeding sites in a natural condition.
		Conserve the moult haulout sites in a natural condition.
		Conserve the resting haulout sites in a natural condition.
		Human activities should occur at levels that do not negatively affect the harbour seal population at the site.

7.3.2.3 Dursey Island pNHA

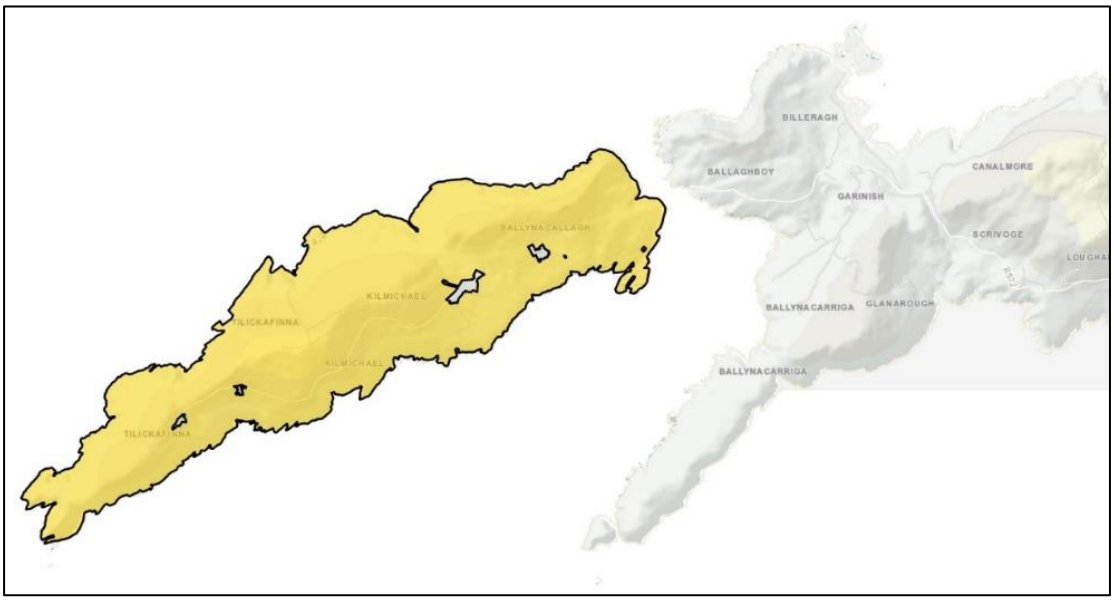

Plate 7.6 Location of Dursey Island pNHA (yellow). Source: NPWS Map Viewer

Dursey Island pNHA (Plate 7.6) comprises almost the entirety of Dursey Island, with the exception of a few small inland areas. Here, heath and and improved/semi-improved grassland are predominant habitat types. Table 7.11 lists the species identified in the site in the NPWS site synopsis and their status in terms of statutory protections. Of these, five are protected species – all of which are birds. Two of these are chough and fulmar, which have been discussed previously. The remaining three are European shag (*Phalacrocorax aristotelis*, 'shag' hereafter), European herring gull (*Larus argentatus*, 'herring gull' hereafter) and great black-backed gull (*Larus marinus*). A description of each follows.

Table 7.11 Species identified in the Dursey Island pNHA Site Synopsis and their statutory statuses. Source: NPWS, 2009

Common Name	Scientific Name	Statutory Status
Plants		
Pearlwort	*Sagina subulata*	Not protected
Autumn gorse	*Ulex gallii*	Not protected
Bell heather	*Erica cinerea*	Not protected
Ling heather	*Calluna vulgaris*	Not protected
Cross-leaved heath	*Erica tetralix*	Not protected
Common bent	*Agrostis capillaris*	Not protected
Heath-grass	*Danthonia decumbens*	Not protected
Carnation sedge	*Carex panicea*	Not protected
Pill sedge	*Carex pilulifera*	Not protected
Green-ribbed sedge	*Carex binervis*	Not protected
Tormentil	*Potentilla erecta*	Not protected
Crowberry	*Empetrum nigrum*	Not protected

Common Name	Scientific Name	Statutory Status
Liverworts	*Scapania* spp.	*Scapania nimbosa* and *Scapania ornithopodioides* protected (FPO). No records of either in the study area in NBDC databases.
Liverworts	*Frullania* spp.	Not protected
Sphagnum mosses	*Sphagnum* spp.	Not protected
Deergrass	*Scirpus cespitosus*	Not protected
Sharp-flowered rush	*Juncus acutiflorus*	Not protected
Star sedge	*Carex echinata*	Not protected
Mat grass	*Nardus stricta*	Not protected
Bog pimpernel	*Anagallis tenella*	Not protected
Lesser spearwort	*Ranunculus flammula*	Not protected
Marsh pennywort	*Hydrocotyle vulgaris*	Not protected
Chamomile	*Chamaemelum nobile*	Not protected
Blinks	*Montia fontana*	Not protected
Brookweed	*Samolus valerandi*	Not protected
Round-leaved crowfoot	*Ranunculus omiophyllus*	Not protected
Yellow centaury	*Cicendia filiformis*	Not protected
Chaffweed	*Anagallis minima*	Not protected
Common knapweed	*Centaurea nigra*	Not protected
Cat's ear	*Hypochoeris radicata*	Not protected
Greater bird's-foot trefoil	*Lotus uliginosus*	Not protected
Eyebright	*Euphrasia* spp	Not protected
Buck's-horn plantain	*Plantago coronopus*	Not protected
Plantain spp.	*Plantago maritimus*	Not protected
Procumbent pearlwort	*Sagina procumbens*	Not protected
Allseed	*Radiola linoides*	Not protected
Birds		
Northern fulmar	*Fulmarus glacialis*	Protected (WA)
European shag	*Phalacrocorax aristotelis*	Protected (WA, BD I; BoCCI Amber)
European herring gull	*Larus argentatus*	Protected (WA, BD II; BoCCI Red)
Great black-backed gull	*Larus marinus*	Protected (BD II; BoCCI Amber)
Red-billed chough	*Pyrrhocorax pyrrhocorax*	Protected (WA, BD I)

Shag

The shag is a BWI BoCCI amber-listed species of bird, which is afforded statutory protections under the Wildlife Acts and the Birds Directive (Annex I). Shags nest in colonies on sea cliffs and forage on small fish (particularly sandeel, *Ammodytes* spp.) by diving at sea (Harris & Wanless, 1991; Mitchell *et al*., 2004; BirdWatch Ireland, 2019c). According to Mitchell *et al*. (2004), the population in the UK and Ireland has

declined by 25% since 1985 – 1988. Declines may be as a result of concurrent sandeel declines and 'wrecks' (prolonged periods of gale force wind), both of which are likely to be indirect effects of climate change (Harris & Wanless, 1996; Heubeck *et al*., 2015; Frederiksen *et al*., 2008). In the period 1988 – 2002, Ireland had approximately 3,426 pairs of shag. According to the Site Synopsis for the Dursey Island pNHA, the island has recently supported approximately 10 breeding pairs of the species (NPWS, 2009). Surveys carried out by the NPWS in May 2016 (Heardman, pers. comm., 2019), identified 18 individual shags on Dursey Island (1 on the north coast of the island, 15 on the south coast, and 2 on the west coast). Two individuals were observed on Crow Island (off the tip of Crow Head). One shag was identified in the Dursey Sound area (the only area surveyed) in 2018 (Heardman, pers. comm., 2019).

Herring Gull

The herring gull is a BWI BoCCI red-listed species, which is afforded statutory protections under the Wildlife Acts and the Birds Directive (Annex II). Herring gulls typically nest on islands, on cliff-tops, slopes or flatter ground, but are also known to nest on the rooves of inland buildings (Birdwatch Ireland, 2017). They are generalists, foraging in the intertidal zone, in parks/playing fields and on farmland, taking eggs and young from nests of other seabirds, and scavenging on food discarded by humans and waste from the fishing industry (BirdWatch Ireland, 2017). A dramatic decline of 90% in the 15 years prior to 2004 is attributed to an outbreak of avian botulism and reduced (Mitchell *et al*., 2004). It would appear that the Irish population has been recovering in recent years (BirdWatch Ireland, 2017). According to the Site Synopsis, the Dursey Island pNHA has recently supported approximately 50 breeding pairs of the species (NPWS, 2009). Surveys carried out by the NPWS in May 2016 (Heardman, pers. comm., 2019), identified a total of 36 individual herring gulls on Dursey Island (18 on the north coast of the island and an additional 18 on the south coast). Additionally, a flock of 27 individuals was recorded on Crow Island. The Irish Wetland Bird Survey (2009/10 – 2015/16; Lewis *et al*., 2019) did not identify the Study Area as a key site in Ireland for the species.

Great Black-backed Gull

The great black-backed gull is a BWI BoCCI amber-listed species, which is afforded statutory protections under the Wildlife Acts and the Birds Directive (Annex II). Between 1985 and 1988, the species suffered a 28% decline in Ireland (Mitchell *et al*., 2004). Like herring gulls, this species favours offshore islands for nesting and for its food supply relies somewhat on waste from the fishing industry, whose availability has decreased in recent years (Buckley, 1990; Mitchell *et al*., 2004). According to the Site Synopsis, the Dursey Island pNHA has recently supported approximately 6 breeding pairs of the species (NPWS, 2009). Surveys carried out by the NPWS in May 2016 (Heardman, pers. comm., 2019), identified a total of 5 great black-backed gulls on Dursey Island (1 on the north coast of the island and 4 on the south coast). Additionally, a flock of 24 individuals was recorded on Crow Island. The Irish Wetland Bird Survey (2009/10 – 2015/16; Lewis *et al*., 2019) did not identify the Study Area as a key site in Ireland for the species.

7.3.2.4 Garinish Point pNHA

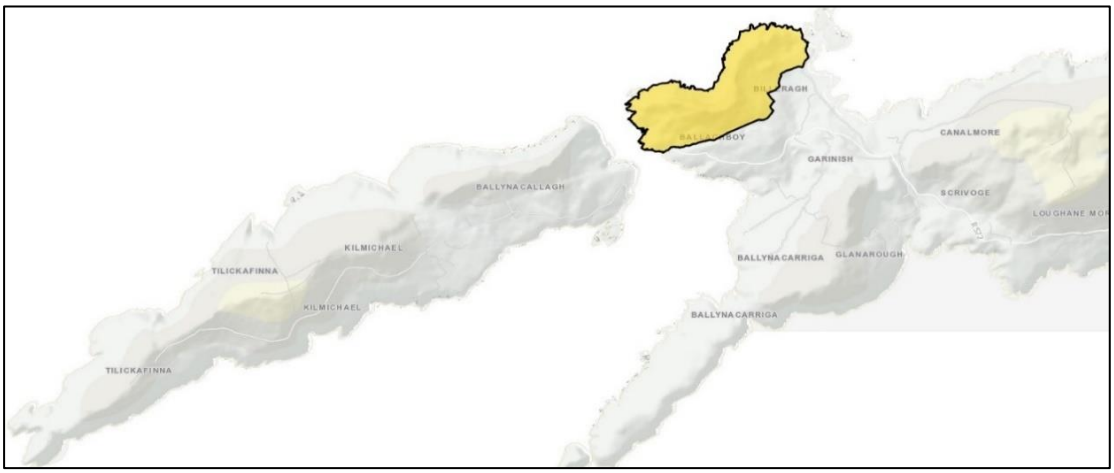

Plate 7.7 Location of Garinish Point pNHA (yellow). Source: NPWS Map Viewer

Garinish Point pNHA (Plate 7.7 above) is situated at the western extremity of the Beara Peninsula. It consists of a low hill (150 m) with fields of permanent pasture to the south and east. For the most part, the vegetation of the site is heath and grassland although there is local development of peat and a strong influence of sea spray and of springs on the north-western side. Grassland forms the other major component of this site and it is found in old fields around Bealaboe and White Strand. Where little reclamation has been done and the ground is still flushed by spring water during wet weather, an interesting community develops which is characterised by Betony (*Betonica officinalis*). The whole area is used by Red-billed Chough (*Pyrrhocorax pyrrhocorax*) for feeding. The main feature of interest in this site the survival of old rough grassland communities and varied heathland. (SEI, n.d.).

7.3.2.5 Firkeel Gap pNHA

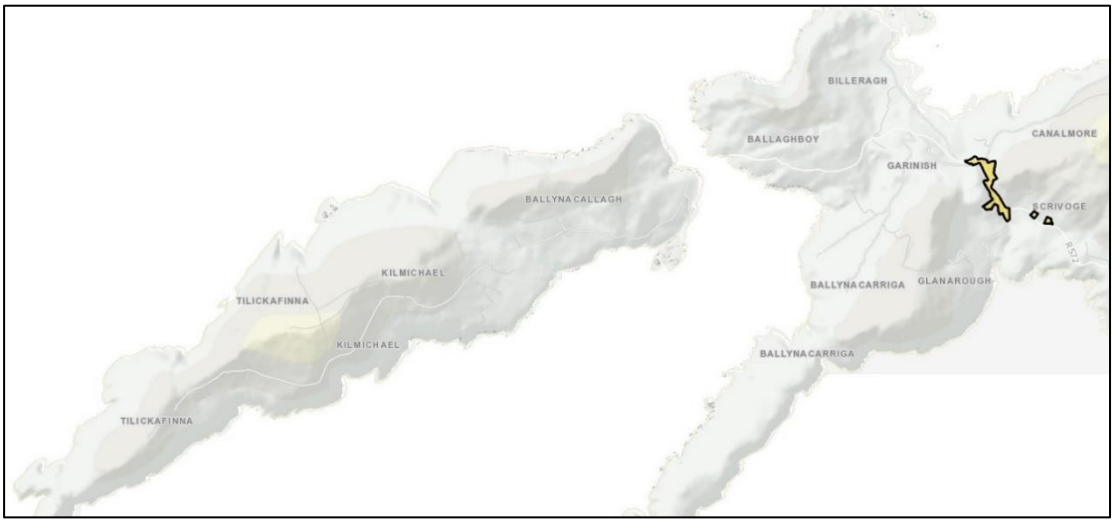

Plate 7.8 Location of Firkeel Gap pNHA (yellow). Source: NPWS Map Viewer

Firkeel Gap pNHA (Plate 7.8 above) is a small, dry valley that runs in a northwest-southeast direction through the end of the Beara Peninsula. There is little drift or soil on the slopes and the slatey sandstone shows as outcrops and in stabilised screes in many places. The sides of the valley are covered by heath vegetation which includes bushes of Eared Willow (*Salix aurita*) or Bramble (*Rubus fruticosus* agg.) around cliffs and other rocks. The main feature of interest, Betony, occurs frequently in this vegetation and near rocks in the purer heath that covers the eastern side. (SEI, n.d.).

7.3.3 Rare and Protected Species

Table 7.12 lists the rare and protected species of flora and fauna recorded in or within 5km offshore of the Zone of Influence, in addition to those discussed in the previous section in the context of designated sites. Since, with the exception of bullfinch (*Pyrrhula pyrrhula*), all wild birds in Ireland are protected under the Wildlife Acts, and since there are records of over 160 different species of birds in the Zone of Influence in the NBDC database, only those avian species which are listed on Annex I of the Birds Directive and/or are Amber- or Red-listed Birds of Conservation Concern in Ireland (BoCCI) have been considered here. The data in this table have been obtained principally from the NBDC record databases for the 2km squares that intersect the Zone of Influence, but also from:

- The Irish Whale and Dolphin Group (IWDG) databases (2019);
- A survey completed on behalf of Fáilte Ireland (CAAS, 2018b)

Table 7.12 Endangered and Protected Species within and up to 5km Offshore of the Zone of Influence (*IWDG, 2019; NBDC, 2019; **CAAS, 2018b). Note: Species discussed in the previous section in the context of designated sites have been excluded.

Common Name	Scientific Name	Statutory Status	Notes on Ecology and Conservation
Marine Mammals			
Bottlenose dolphin	*Tursiops truncatus*	WA; HD II, IV;	Breeds, forages and socializes in marine habitats. Key conservation threats are disturbance due to marine geophysical seismic studies and fishing activities (NPWS, 2019b). Overall conservation status in Ireland 'Favourable' and stable (NPWS, 2019b).
Harbour porpoise	*Phocoena phocoena*	WA; HD II, IV; Ospar; IUCN VU	
Common dolphin	*Delphinus delphis*	WA; HD IV	
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	WA; HD IV	
Striped dolphin	*Stenella coeruleoalba*	WA; HD IV	
Grey seal	*Halichoerus grypus*	WA; HD II, V	Forages in marine habitats. Breeds, rests and socializes at terrestrial haul-out sites. Refer to description of *P. vitulina*, above. Key conservation threats are disturbance due to marine geophysical seismic studies and fishing activities (NPWS, 2019b). Unlikely that there are haul-out sites in Zone of Influence, due to exposed nature of site. Overall conservation status in Ireland 'Favourable' and improving (NPWS, 2019b).
Minke whale	*Balaenoptera acutorostrata*	WA; HD IV	Breeds, forages and socializes in marine habitats. Key conservation threats are disturbance due to marine geophysical seismic studies and fishing activities (NPWS, 2019b). Overall conservation status in Ireland 'Favourable' and stable (NPWS, 2019b).
Risso's dolphin	*Grampus griseus*	WA; HD IV	Breeds, forages and socializes in marine habitats. Key conservation threats are marine geophysical seismic studies, fishing activities and use of sonar at sea (NPWS, 2019b). Overall conservation status in Ireland 'Favourable' and stable (NPWS, 2019b).
Humpback whale*	*Megaptera novaeangliae*	WA; HD IV	Breeds, forages and socializes in marine habitats. Key conservation threats in Irish waters are thought to be disturbance due to marine geophysical seismic studies and fishing activities (NPWS, 2019b). Overall conservation status in Ireland 'Unknown' due to insufficient data (NPWS, 2019b).

Common Name	Scientific Name	Statutory Status	Notes on Ecology and Conservation
Terrestrial Mammals			
Eurasian badger	*Meles meles*	WA	Large terrestrial mammal. Generalist omnivore which feeds on a variety of food items, including earthworms, insects, amphibians, small mammals and berries (NRA, n.d.; Cleary *et al*., 2009). Tends to inhabit lowland farmland, woodland and scrubland (NRA, n.d.). Live in social groups of 2 – 6 adults plus young, and inhabit subterranean 'setts' (NRA, n.d.). Irish Red List status is 'Least Concern' (Marnell *et al*., 2009). May be present in the Study Area but most likely absent from Dursey Island.
Eurasian pygmy shrew	*Sorex minutus*	WA	Small mammal with a broad Irish distribution, found in a variety of habitats with rich ground cover, including woodland, peatland, hedgerows and grassland (Vincent Wildlife Trust, 2019; Grainger & Fairley, 1978). Forages on small invertebrates, including beetles and spiders (Vincent Wildlife Trust, 2019). Nests under logs, rocks and dense vegetation and also in burrows of other animals (Vincent Wildlife Trust, 2019). Irish Red List status is 'Least Concern' (Marnell *et al*., 2009). Study Area contains suitable breeding and foraging habitat.
Irish hare	*Lepus timidus* subspp. *hibernicus*	WA; HD V	Widely distributed endemic lagomorph which utilizes a variety of coastal and inland habitats. Largely nocturnal except when breeding – typically during spring and summer (Irish Wildlife Trust, n.d). Irish Red List status is 'Least Concern' (Marnell *et al*., 2009) and Irish Habitats Directive conservation status is 'Favourable' and stable (NPWS, 2019b). Key conservation threats include agricultural intensification and direct persecution (Marnell *et al*., 2009; NPWS, 2019b). There is one recorded occurrence in the Study Area (at Garinish Point on the mainland) from the 2006/07 Hare Survey of Ireland (Reid *et al*., 2007).
Irish stoat	*Mustela erminea hibernica*	WA	Near endemic sub-species. Primarily carnivorous, feeding on small mammals and birds. Distribution is widespread and a variety of habitat types are utilised, open habitats are generally avoided. Direct persecution by landowners is a threat in some localities. Irish Red List status is 'Least Concern' and there is no evidence of decline. (Marnell *et al*., 2009). There is one recorded occurrence in the Study Area (south-east of Garinish Point, in the townland of Canalmore).
Reptiles			
Leatherback turtle	*Dermochelys coriacea*	HD IV; Ospar; IUCN VU	Breeds in tropics (Doyle, 2007). Forages in marine habitats, particularly in temperate waters, on jellyfish and pelagic tunicates (Doyle, 2007). Key conservation threats in Irish waters include entanglement in fishing nets and plastic pollution (Doyle, 2007). Overall Habitats Directive conservation status in Ireland is 'Unknown' due to insufficient data (NPWS, 2019b). Irish Red List status is 'Least Concern'; although threatened elsewhere, the Irish migrant population is considered to be stable or increasing (King *et al*., 2011).

Common Name	Scientific Name	Statutory Status	Notes on Ecology and Conservation
Common lizard	*Zootoca vivipara*	WA	Hibernates from late October – March; active during the rest of the year. Typically inhabits coastal and heathland habitats. Requires open patches for basking and vegetation cover from predators. Widespread in Ireland with no evidence of a population decline. Irish Red List status is 'Least Concern'. Habitat loss/fragmentation and predation are potential conservation threats. (King *et al*., 2011). Study Area offers plenty of suitable breeding and foraging habitats.
Birds			
Ground-nesting Passerines			
Northern wheatear	*Oenanthe oenanthe*	WA; BoCCI Amber	Summer migrant. Breeds in rocky upland heath and bog and at coastal locations, nesting in drystone walls, rocks, scree and rabbit burrows and on vegetated sea cliffs. Ground-nesting. Forages in grassland tightly grazed by sheep or rabbits and on coastal machair. Subject to drastic declines in recent years. (Nairn & O'Halloran, 2012). Zone of Influence contains optimal breeding and foraging habitat.
Eurasian skylark	*Alauda arvensis*	WA; BoCCI Amber	Typical breeding species of open raised and blanket bog, where it is one of the two dominant avian species (along with meadow pipit) during the summer months. Also dominant breeding bird species of sand dunes and coastal machair. Ground-nesting. Leaves breeding sites for adjacent farmland (arable, set-aside, stubble and grassland) in winter in search of food. (Nairn & O'Halloran, 2012).
Yellowhammer	*Emberiza citrinella*	WA; BoCCI Red	Farmland seed-eating passerine that has experienced significant population declines in Ireland. Forages in agricultural land (arable, cereal, bare earth, stubble). Changing agricultural practice on tillage land (particularly the cessation of cereal cultivation) is the key conservation threat to this species. (Nairn & O'Halloran, 2012). Very little suitable foraging habitat in Zone of Influence but species may breed here in small numbers.
Linnet	*Carduelis cannabina*	WA; BoCCI Amber	Resident seed-eating, flock-forming finch. Characteristic of open, scrubby habitats with elevated vantage points, including bracken, raised bog, fen carr and pre-thicket conifer plantation (Nairn & O'Halloran, 2012). Also utilizes agricultural land such as cereals and stubble (Nairn & O'Halloran, 2012). May also forage on seeds of salt marsh plants in winter flocks (Nairn & O'Halloran, 2012). Breeds on or close to the ground in a variety of scrubby habitats, including coastal areas with gorse and hedgerows (BWI, 2019n; Nairn & O'Halloran, 2012). May potentially breed in the Zone of Influence in small numbers.

Common Name	Scientific Name	Statutory Status	Notes on Ecology and Conservation
Twite	*Carduelis flavirostris*	WA; BoCCI Red	Seed-eating passerine and partial migrant. Irish breeding population of 54 – 110 pairs, with strongholds in Counties Mayo and Donegal (McLoughlin & Cotton, 2008). Nests in upland heath and bracken (Nairn & O'Halloran, 2012). Winters in coastal wetlands (salt marshes and estuaries) and wet grassland (Nairn & O'Halloran, 2012). Agricultural intensification is key conservation threat (Nairn & O'Halloran, 2012). Grassland habitats in Zone of Influence may be used for winter foraging.
Meadow pipit**	*Anthus pratensis*	WA; BoCCI Red; IUCN NT	Resident ground-nesting grassland species. Nests on upland raised bogs, cutaway peatlands, fens, dunes, machair and wet grassland. Favours raised bog and fen, where it is the dominant avian species during the summer months. Like skylark, forms flocks in winter and leaves peatland in search of food on more lowland farmland (tillage, set-aside). (Nairn & O'Halloran, 2012).
Stonechat**	*Saxicola torquatus*	WA; BoCCI Amber	Species nests on or close to the ground, favouring scrubby areas with gorse and/or bracken (Magee, 1965). Insectivorous passerines of agricultural grassland (Magee, 1965; Cummins & O'Halloran, 2002; Revaz *et al*., 2008) which favour warmer coastal areas during the winter months (Nairn & O'Halloran, 2012). The Irish stonechat population is partially migratory, with some birds travelling to the south in winter (Callion, 2002, as read in Cummins & O'Halloran, 2003). The population trend for the species in Ireland is of medium-term increase (+7.66% between 1998 and 2008 (Crowe *et al*., 2010)) and short-term decline (>25% (Colhoun & Cummins, 2013)). Afforestation and maturation (canopy closure) of forest, and human disturbance have been identified as potential conservation threats (Magee, 1965). The mosaic of semi-improved grassland and heathland which dominates the Study Area is well suited to the breeding and foraging requirements of the species.
Western yellow wagtail / Blue-headed wagtail	*Motacilla flava flava*	WA; BoCCI Amber	Very scarce passage migrant, which may breed in Ireland on very rare occasion (BirdWatch Cork, n.d). One occurrence has been recorded in the Study Area (townland of Kilmichael, Dursey Island) from 2000. European IUCN Red List status of *M. flava* is 'Least Concern' but no status is available for the subspecies.
Bluethroat	*Luscinia svecica*	WA; BD I	Rare vagrant. Has been recorded twice on Dursey Island (townland of Kilmichael; 2003 and 2004, respectively). European IUCN Red List status is 'Least Concern'.
Greater short-toed lark	*Calandrella brachydactyla*	WA; BD I	Rare vagrant. Has been repeatedly recorded on Dursey Island (townland of Kilmichael; 1979, 1983, 1986, 1988, 1989, 1993, 1997, 2000, 2004). European IUCN Red List status is 'Least Concern'.

Common Name	Scientific Name	Statutory Status	Notes on Ecology and Conservation
Ortolan bunting	*Emberiza hortulana*	WA; BD I	Occasional passage migrant which does not breed in Ireland. Repeatedly recorded on Dursey Island (townland of Kilmichael; 1979, 1992, 1996, 1998, 2001, 2003, 2005, 2006, 2008, 2011, 2013). European IUCN Red List status is 'Least Concern'.
Red-backed shrike	*Lanius collurio*	WA; BD I	Scarce passage migrant in Ireland, which has been repeatedly recorded on Dursey Island (townland of Kilmichael; recorded in 1989, 1995, 1998, 2001, 2002, 2003, 2006, 2009 and 2013) and at one location in the Study Area on the mainland (townland of Scrivogue; recorded in 1985, 1988, 2006 and 2012). European IUCN Red List status is 'Least Concern'.
Tawny pipit	*Anthus campestris*	WA; BD I	Rare vagrant in Ireland, recorded three times on Dursey Island (in 1978, 2003 and 2011, respectively) (BirdWatch Cork, n.d.). European IUCN Red List status is 'Least Concern'.
Raptors			
Peregrine falcon	*Falco peregrinus*	WA; BD I	Raptor which preys on birds, including pigeons, thrushes, waders, wildfowl, gulls and other seabirds (BWI, 2019e). Breeds on coastal and inland cliffs and high-rise inner-city buildings (BWI, 2019e). Tend to winter at coastal estuaries (Nairn & O'Halloran, 2012). Numbers recovering following declines due to DDT in 1970s (Nairn & O'Halloran, 2012). The Study Area contains suitable breeding and foraging habitat for the species, which is known to breed in the Beara Peninsula SPA (NPWS, 2015).
Merlin	*Falco columbarius*	WA; BD I; BoCCI Amber	Nests on the ground on upland heathland and blanket bog or in trees in woodland (BWI, 2019d). Raptor which preys on small birds such as meadow pipits and skylarks (Lusby, 2016). Little data available on population conservation status but breeding habitat range has declined approx. 50% over preceding 40 years (Lusby, 2016). Afforestation and agricultural intensification believed to be key conservation threats (Lusby, 2016). Unlikely to breed in the Zone of Influence (due to preference for upland habitat) but may occasionally forage in the area during winter months.
Hen harrier	*Circus cyaneus*	WA; BD I; BoCCI Amber; IUCN NT	Ground-nesting in upland heathland, scrubland and pre-thicket forest plantation (BWI, 2016). Raptor which preys on small birds such as meadow pipits and skylarks and small mammals such as bank voles and mice (BWI, 2016). Subject to severe and ongoing population declines (approx. 33.5% overall) (Lusby, 2017). South-west is stronghold, with approx. 60% of population (BWI, 2016). Key conservation threats are loss of breeding and foraging habitat due to commercial afforestation, forest maturation (canopy closure), agricultural intensification and burning of heathland, and illegal persecution (BWI, 2016; Lusby, 2017). Unlikely to breed in the Zone of Influence (due to preference for upland habitat) but may occasionally forage in the area during winter months.

Common Name	Scientific Name	Statutory Status	Notes on Ecology and Conservation
Short-eared owl	*Asio flammeus*	WA; BD I; BOCCI Amber	Species largely a winter visitor of coastal habitats, where it forages on rodents (including pymgy shrews) and birds (principally the wader species dunlin, snipe and redshank) in dunes, rough grassland and machair, occasionally alongside hen harriers (Glue, 1976; Cullen & Smiddy, 2012; Nairn & O'Halloran, 2012; BWI, 2019h). A rare upland breeder in Ireland with similar nesting requirements to hen harriers (Nairn & O'Halloran, 2012). Species unlikely to use any site in the Study Area for nesting but may forage in the area and in nearby dune systems during the winter months (Smiddy, pers. comm., 2019).
Common kestrel	*Falco tinnunculus*	WA; BoCCI Amber	Forages over a variety of habitats including farmland, dunes, coastal machair, shingle beaches, raised bog, fen, reedbeds and public parks. Depredates small birds including seabirds and hirundines and small mammals, including the introduced bank vole. Nests in a variety of locations, including buildings, quarries, cliffs (including sea cliffs), former corvid nests and cavities in trees. The Study Area includes suitable habitats and it is considered possible that the species nests in the Zone of Influence.
Northern goshawk	*Accipiter gentilis*	WA; BoCCI Amber	Very rare vagrant species. Closely associated with woodland habitats. (Nairn & O'Halloran, 2012). Only record of species in the Study Area is from 1990 (NBDC, 2019f). Unlikely to occur with any regularity.
Sparrowhawk	*Accipiter nisus*	WA; BD I; BoCCI Amber	Common raptor, typically of woodland. The species has been recorded throughout the study area. It is unlikely that it breeds on Dursey Island, which is likely to be too exposed – and there are no records of such on the island. However, it may breed in small numbers on the mainland, although it is likely that the Study Area is mainly used for foraging during the winter months.
Montagu's harrier	*Circus pygargus*	WA; BD I	Very rare spring migrant. Two records on Dursey Island (townland of Kilmichael; 2000 and 2006). European IUCN Red List status is 'Least Concern'.

Common Name	Scientific Name	Statutory Status	Notes on Ecology and Conservation
Waders and Waterfowl			
European golden plover	*Pluvialis apricaria*	WA; BD I, II (SII), III (SIII); BoCCI Red	Summer and winter visitor from different ranges. Summer migrants breeds in upland blanket bogs in north-west of Ireland (BWI, 2019g); very unlikely to breed in the Study Area. Forage (often in association with lapwing and black-headed gulls) on soil and surface-dwelling invertebrates (particularly tipulids), berries, seeds and grasses (Pearce-Higgins & Yalden, 2003; BWI, 2019g). Utilise a variety of coastal and inland terrestrial habitats during the winter including floodplains, farmland, lakeshores and coastal mudflats (Nairn & O'Halloran, 2012; BWI, 2019g; Lewis *et al*., 2019). Long-term population decline in Ireland (-43.4% over 22 years prior to 2016) reasons for which not well understood (Lewis *et al*., 2019). Premature egg-laying as a result of warmer springs (an effect of climate change), habitat loss as a result of upland peat extraction, and wind farms have been identified as potential conservation threats (Pearce-Higgins *et al*., 2008; Pearce-Higgins *et al*., 2005; Nairn & O'Halloran, 2012). Zone of Influence not among sites supporting nationally important populations (Lewis *et al*., 2019) and it is very unlikely that the species breeds here, but may occasionally visit while migrating.
Eurasian teal	*Anas crecca*	WA; BD II (SI), III (SII); BoCCI Amber	Dabbling duck which nests in vegetation, typically away from the coast, around oligotrophic lakes but sometimes also in unimproved wet grassland and other lowland wetlands, including fens (Nairn & O'Halloran, 2012). Utilises a variety of coastal and freshwater wetland habitats for winter foraging, particularly floodplains, turloughs, estuaries and coastal lagoons in the winter (Lewis *et al*., 2019; Nairn & O'Halloran, 2012). Forage principally on the seeds of aquatic plants (Nairn & O'Halloran, 2012). Irish population has increased in the long-term (approx. +4.1% in 22 years prior to 2016) but decreased in the short-term (approx. -6% in 5 years prior to 2019) (Lewis *et al*., 2019). Irish population is partially migratory; breeding population has suffered most significant decline (Nairn & O'Halloran, 2012). Study Area not among sites supporting nationally or internationally important populations (Lewis *et al*., 2019). Highly unlikely to breed in the Zone of Influence but may occasionally forage here during the winter months.
Jack snipe	*Lymnocryptes minimus*	WA; BD II (SI), III (SIII); BoCCI Amber	Winter visitor and passage migrant; does not breed in Ireland (Lewis *et al*., 2019). No reliable data on Irish wintering population (Lewis *et al*., 2019) but much scarcer than common snipe. Not recorded at or in the vicinity of the Study Area in the Irish Wetland Bird Survey (2011/12 – 2015/16) (Lewis *et al*., 2019) and highly unlikely to breed in the Zone of Influence but may occasionally forage here during the winter months.

Common Name	Scientific Name	Statutory Status	Notes on Ecology and Conservation
Common snipe	*Gallinago gallinago*	WA; BD II (SI), III (SIII); BoCCI Amber	Partial migrant; breeding population supplemented by migrants in winter months (Nairn & O'Halloran, 2012). Forages and nests (on the ground) in a variety of wet and damp habitats with soft ground, including wet grassland, blanket and raised bog, floodplains, tilled agricultural land, coastal machair and fens (Nairn & O'Halloran, 2012). The softness of the soil is a key habitat requirement of the species, which probes for prey with an elongated bill (Nairn & O'Halloran, 2012). Breeding population subject to a decline of somewhere in the region of 30 – 68% (Nairn & O'Halloran, 2012). Zone of Influence not among most important Irish sites for the species (Lewis *et al*., 2019). May potentially nest in the area in small numbers and may occasionally forage in Study Area during the winter months.
Eurasian woodcock	*Scolopax rusticola*	WA; BD II (SI), III (SIII); BoCCI Red	Partial migrant. Ground-nesting in woodland. In winter, forages in a broader variety of habitats, including woodland, scrub and heathland. (BWI, 2019o). Highly unlikely to nest in the Zone of Influence but may occaisonally forage in heathland in the area/vicinity during winter months.
Northern lapwing	*Vanellus vanellus*	WA; BD II (SII); BoCCI Red; IUCN VU	Resident breeding wader. Ground-nesting in a wide range of habitats, including coastal machair, cereal fields, cutover bogs, and upland rough grassland but favours cattle-grazed grassland with short swards, hummocks, exposed soil and freshwater nearby (Nairn & O'Halloran, 2012). Forages in winter on invertebrates and plant matter on a variety of habitats (typically closer to the coast, where it is warmer), including flooplains, wetlands, wet grasslands, turloughs and playing fields. Trend in Irish population is of long-term decline (-67.6% over 22 years prior to 2016). Predation of eggs and offspring and habitat loss are key conservation threats (Nairn & O'Halloran, 2012). Study Area not among sites supporting nationally or internationally important population (Lewis *et al*., 2019). May occasionally forage in the Zone of Influence during winter months.
Eurasian oystercatcher	*Haematopus ostralegus*	WA; BoCCI Amber; IUCN VU	Breeding wader. Forages in a variety of habitats including intertidal mudflats, rocky coastlines, exposed sandy beaches, playing fields and wet grassland (Nairn & O'Halloran, 2012). Typically nests on stony shores of offshore islands (Nairn & O'Halloran, 2012). Trend in Irish wintering numbers is of long-term increase and short-term decline (Lewis *et al*., 2019). Study Area not known to support a nationally important population (Lewis *et al*., 2019).

Common Name	Scientific Name	Statutory Status	Notes on Ecology and Conservation
Redshank	*Tringa totanus*	WA; BoCCI Red	Partial migrant; *T. totanus robusta* is a winter visitor and does not breed in Ireland, while *T. totanus totanus* breeds in the UK and Ireland (Lewis *et al*., 2019). Both populations are in short-term decline (-13.7% over 12 years prior to 2016) (Lewis *et al*., 2019). Forages on worms in estuaries and on mudflats (BWI, 2019j). Breeds mainly in wet grasslands of Midlands, nesting on the ground in tussocks (BWI, 2019j). Study Area not among sites supporting nationally or internationally important populations (Lewis *et al*., 2019) and offers little to no optimal habitat.
Little ringed plover	*Charadrius dubius*	WA; BoCCI Amber	Occasional passage migrant in spring and autumn, possible breeding in the County. Only one record of the species in the Study Area (townland of Kilmichael, Dursey Island; May 2000).
Eurasian dotterel	*Charadrius morinellus*	WA; BD I	Rare passage migrant in spring and autumn. Has been repeatedly recorded on Dursey Island during autumn/winter months (townland of Kilmichael; 1987, 1992, 1997, 2001, 2008, 2010). European IUCN Red List status is 'Least Concern'.
Great snipe	*Gallinago media*	WA; BD I	Rare vagrant. Only one record of the species in the Study Area (townland of Kilmichael; October 1983). European IUCN Red List status is 'Least Concern'.
Stone-curlew / Euarasian thick-knee	*Burhinus oedicnemus*	WA; BD I	Rare passage migrant, mostly in spring. Only one record of the species in the Study Area (townland of Kilmichael; April 1999). European IUCN Red List status is 'Least Concern'.
Gulls			
Mediterranean gull	*Larus melanocephalus*	WA; BD I; BOCCI Amber	Non-indigenous continental species which has been breeding in Ireland since 1995 and now firmly established (Lewis *et al*., 2019). Study Area not among sites which have supported species in five or more seasons between 2009/10 and 2015/16 (Lewis *et al*., 2019) but may support breeding/foraging individuals.
Lesser black-backed gull	*Larus fuscus*	WA; BoCCI Amber; Ospar	Greater Irish population comprised of wintering and breeding populations (Lewis *et al*., 2019). A third of Irish breeding population breeds inland around lakes (Nairn & O'Halloran, 2012). Nests colonially on cliffs or buildings (Nairn & O'Halloran, 2012). Forage at sea, on beaches and mudflats, and in urban parks (Nairn & O'Halloran, 2012). Study Area not among sites which supported populations in five or more seasons between 2009/10 and 2015/16 (Lewis *et al*., 2019) but may offer suitable breeding/foraging habitat.

Common Name	Scientific Name	Statutory Status	Notes on Ecology and Conservation
Common/mew gull	*Larus canus*	WA; BoCCI Amber	Irish population of species are partial migrants (Lewis *et al*., 2019). Roughly half of breeding population breeds inland by lakes, while others nest at coastal sites, including boulder beaches and sea cliffs (BWI, 2019l; Nairn & O'Halloran, 2012). Forages on terrestrial invertebrates and fish in a variety of habitats including playing fields, urban parks, landfill sites. and shingle and sandy beaches (Nairn & O'Halloran, 2012). Potential conservation threats include avian botulism and predation by mink (Nairn & O'Halloran, 2012). Study Area not among sites which supported populations in five or more seasons between 2009/10 and 2015/16 (Lewis *et al*., 2019), but habitats in the study area may be utilized for foraging.
Black-headed gull	*Larus ridibundus*	WA; BoCCI Red	Ireland's most numerous and widespread wintering gull species. Primarily an inland gull which tends to nest on islands of lakes (Nairn & O'Halloran, 2012). Forages on a wide variety of habitats including playing fields and public parks, lagoons, shingle and sandy beaches, reedy bogs, rivers and turloughs (Nairn & O'Halloran, 2012). Greater Irish population comprised of wintering and breeding populations (Lewis *et al*., 2019). Study Area not among sites which supported populations in five or more seasons between 2009/10 and 2015/16 (Lewis *et al*., 2019) and offers little optimal foraging habitat.
Other Seabirds			
Great northern diver	*Gavia immer*	WA; BD I; BoCCI Amber; IUCN VU	Winter visitor with widespread coastal distribution during winter months; Does not breed in Ireland (BWI, 2019f; Lewis *et al*., 2019). Forages up to 10km offshore (BWI, 2019f). Study Area not among sites supporting nationally or internationally important populations (Lewis *et al*., 2019).
Common guillemot	*Uria aalge*	WA; BoCCI Amber; Ospar; IUCN NT	Nest on sea cliffs (Nairn & O'Halloran, 2012). Forage on fish by diving offshore in shelf waters (Nairn & O'Halloran, 2012). May potentially nest in the Zone of Influence in small numbers.
Northern gannet	*Morus bassanus*	WA; BoCCI Amber	Resident breeding species. There are approx. six Northern Gannet colonies in Ireland, one of which is at the Bull Rock, a small uninhabited island approx. 2.5km west of the western tip of Dursey Island. Birds nest on sea cliffs and rocky slopes. Forage on fish at sea (in shelf waters over a very wide range) by plunging and diving up to 20m. (Nairn & O'Halloran, 2012). May potentially nest in Study Area.
Black guillemot	*Cepphus grylle*	WA; BoCCI Amber	Nest in sea caves, under boulders and in crevices in quaysides, stone walls, piers and lighthouses at coastal locations (Nairn & O'Halloran, 2012). Forage on fish at sea by diving in inshore area (Nairn & O'Halloran, 2012). May potentially nest in the Zone of Influence in small numbers.

Common Name	Scientific Name	Statutory Status	Notes on Ecology and Conservation
Great cormorant	*Phalacrocorax carbo*	WA; BoCCI Amber	Widespread, utilizing a range of coastal and inland wetland habitats (Lewis *et al*., 2019). Wintering numbers in decline in Ireland (-27.7% in 12 years prior to 2016; -5% in 5 years prior to 2016) (Lewis *et al*., 2019). Study Area not known to support nationally important population (Lewis *et al*., 2019). Has been identified as cohort of seabird colony on the Bull and Cow Rocks, with approx. 40 pairs present (NPWS, 2014). May also nest in the Zone of Influence.
Razorbill	*Alca torda*	WA; BoCCI Amber; IUCN NT	Nest on sea cliffs. Forage by surface diving at sea on shelf waters. Migrate southward during winter. (Nairn & O'Halloran, 2012). Has been identified as a cohort (88 pairs) of the seabird colony on the Bull and Cow Rocks (westward of Dursey Island) (NPWS, 2014). May potentially nest on cliffs in Zone of Influence.
Manx shearwater	*Puffinus puffinus*	WA; BoCCI Amber	Summer visitor. Nests in burrows on vegetated slopes of uninhabited offshore islands. Forages by diving over very wide range at sea and quite far offshore. Predation by introduced mammals such as American mink is a potential conservation threat. (Nairn & O'Halloran, 2012). Unlikely to nest in the Zone of Influence.
Kittiwake	*Rissa tridactyla*	WA; BoCCI Amber; Ospar; IUCN VU	Nest on sea cliffs. Forage on zooplankton at sea and, to a lesser degree, on discards from fishing vessels. (Nairn & O'Halloran, 2012). Has been identified as a cohort of the seabird colony on the nearby Bull and Cow Rocks – with approx. 350 pairs recorded (NPWS, 2014). Could potentially nest in small numbers in the Zone of Influence.
Balearic shearwater	*Puffinus mauretanicus*	WA; BoCCI Red; Ospar; IUCN CR	Scarce passage migrant during July – November (BWI, 2019i). Does not breed in Ireland. Forages at sea (BWI, 2019i).
Sooty shearwater**	*Ardenna grisea*	WA; BoCCI Red; IUCN NT	Seasonal migrant in August – September. Does not breed in Ireland. Forages on fish at sea by diving. (Nairn & O'Halloran, 2012).
Fea's / Cape Verde petrel	*Pterodroma feae*	WA; BD I	Rare vagrant. Only one record from the Study Area (townland of Kilmichael on Dursey Island, September 2013). Global IUCN Red List status is 'Near Threatened'.
Hirundines and Swifts			
Barn swallow	*Hirundo rustica*	WA; BoCCI Amber	Summer migrant which breeds in Ireland. Nests in and around farm buildings, old buildings and certain other artificial structures. Forage and roost in large flocks. Roosting sites include artificial structures such as bridges and reedbeds. Foraging habitats are varied and include reedbeds and improved agricultural land. (Nairn & O'Halloran, 2012). May potentially nest/forage in the Study Area.

Common Name	Scientific Name	Statutory Status	Notes on Ecology and Conservation
House martin	*Delichon urbicum*	WA; BoCCI Amber	Summer migrant which breeds in Ireland. Nest principally under eaves of houses and to a lesser degree in caves and under cliff overhangs. Forage on insects over farmland and along cliffs. (Nairn & O'Halloran, 2012). May potentially breed and forage in the Study Area.
Common swift	*Apus apus*	WA; BoCCI Amber	Summer migrant. Entirely reliant on artificial structures, particularly older buildings, for nesting in Ireland and typically found in urban areas (Nairn & O'Halloran, 2012). Forage solely on aerial insects (Nairn & O'Halloran, 2012). Subject to declines of approx. 40% since 2008 (BWI, n.d.). Key conservation threats are loss of nest sites due to refurbishment and demolition of buildings, climate change and declines in insect abundance (BWI, n.d.). May nest in buildings in the Study Area.
Sand martin	*Riparia riparia*	WA; BoCCI Amber	Flock-forming insectivorous hirundine. Summer visitor from March – September (BWI, 2019k). Requires bare sandy banks for nesting, e.g. of soft sea cliffs, sandy riverbanks or quarries. May forage and roost in reedbeds. Also known to forage in public parks. (Nairn & O'Halloran, 2012). May potentially nest in soft cliffs in vicinity of Study Area.
Other Birds			
Common starling	*Sturnus vulgaris*	WA; BoCCI Amber	Widespread generalist which forages in a variety of habitats including gardens, parks, playing fields, landfill sites, cutaway bogs, reedbeds, improved grassland and arable farmland. Nest in buildings and other artificial structures. Form large communal roosts in reedbeds, trees and artificial structures, such as bridges. (Nairn & O'Halloran, 2012). Study area contains suitable breeding and foraging habitats.
House sparrow	*Passer domesticus*	WA; BoCCI Amber	Resident seed-eating, flock-forming passerine. Especially prevalent in urban environment (particularly gardens) and on farmland. Nests in buildings. May nest in buildings in the Study Area.
Greenfinch	*Carduelis chloris*	WA; BoCCI Amber	Widespread resident seed-eating species. Habitats utilized include raised bog and fen, farmland, urban parks and gardens, and salt marshes. Nests in hedgerows.
Mistle thrush	*Turdus viscivorus*	WA; BD II; BoCCI Amber	Resident species, which breeds throughout Ireland. Feeds largely on berries and also invertebrates. Nests in hedgerows and trees. Has been recorded throughout the Study Area, including on Dursey Island.
European robin	*Erithacus rubecula*	WA; BoCCI Amber	Characteristic, widespread garden bird, which utilises a variety of habitats for foraging and breeding. Nests in well concealed spots in trees, hedgerows, ivy, cavities in walls and other artificial structures. Has been recorded throughout the Study Area, including on Dursey Island.

Common Name	Scientific Name	Statutory Status	Notes on Ecology and Conservation
Goldcrest	*Regulus regulus*	WA; BoCCI Amber	Resident, insectivorous species. Woodland specialist which is also found in urban parks and gardens (Nairn & O'Halloran, 2012). Nest in trees. Has been recorded throughout the Study Area, including on Dursey Island. Area does not feature optimal foraging or breeding habitat but species may nest in area (particularly mainland) in small numbers.
Grey wagtail	*Motacilla cinerea*	WA; BoCCI Red	Characteristic insectivore of riparian and riverine habitats. Breeds principally along streams and rivers. Often winters at coastal locations, where tidewrack provides an abundance of insect prey. Species has been repeatedly recorded at a number of locations within the Study Area, particularly on the mainland. Species is likely to use area principally for foraging during winter months but may breed in small numbers on the mainland.
Barred warbler	*Sylvia nisoria*	WA; BD I	Rare vagrant. Has been repeatedly recorded in the Study Area – both on Dursey Island and on the mainland. The European IUCN Red List status of the species is 'Least Concern'.
Common crane	*Grus grus*	WA; BD I	Former resident species; now a rare vagrant. There is only one record of the species from the Study Area (townland of Kilmichael, Dursey Island, December 1978). The Global IUCN Red List status of the species is 'Least Concern' (European status unknown).
Dartford warbler	*Sylvia undata*	WA; BD I	Rare vagrant. There is only one record of the species from the Study Area (townland of Kilmichael, Dursey Island, May 1999). The European IUCN Red List status of the species is 'Near Threatened'.
Red-breasted flycatcher	*Ficedula parva*	WA; BD I	Occasional autumn vagrant. There is only one record of the species from the Study Area (townland of Scrivogue on the mainland, November 2012). The European IUCN Red List status of the species is 'Least Concern'.
Fish			
Basking shark	*Cetorhinus maximus*	Ospar; IECS EN; IUCN EN	Large lamnoid shark which filter-feeds on plankton. Most commonly sighted feeding in surface waters off the coast of Counties Donegal, Mayo, Cork and Kerry. Long-lived species with low productivity whose Irish population is believed to have stabilised at a low density following historic exploitation. Irish Red List status is 'Endangered'. Potential conservation threats include entanglement in fishing nets and collision with marine vessels. (Clarke *et al*., 2016).

Common Name	Scientific Name	Statutory Status	Notes on Ecology and Conservation
Invertebrates			
Kerry slug	*Geomalacus maculosus*	WA; HD II, IV	Indigenous to south-western peninsulas of Counties Cork and Kerry. Utilises a range of habitats underlain by Devonian Old Red Sandstone, including deciduous woodland, blanket bog, heath, wet grassland, conifer plantations and areas of clearfell (McDonnell & Gormally, 2011). Forages on lichens, liverworts and mosses (McDonnell & Gormally, 2011). No major conservation threats identified at present (NPWS, 2019b), but burning of heathland, invasive species (particularly *Rhododendron ponticum*) and afforestation of heathland may pose future threats (Donnell & Gormally, 2011). Overall conservation status in Ireland is 'Favourable' and improving (NPWS, 2019b).
Wall brown	*Lasiommata megera*	IECS EN	Subject to a population decline of >50% over the last ~15 years. Habitats utilized include dry, calcareous grassland, coastal dunes, machair, vegetated sea cliffs, limestone pavement and cutover bog. (Regan *et al*., 2010).
Grayling	*Hipparchia semele*	IECS NT	Habitats utilized include limestone pavement, unimproved calcareous and acid grasslands, dunes and dry heath. Widespread in coastal locations. (Regan *et al*., 2010).
Moss carder-bee	*Bombus (Thoracombus) muscorum*	IECS NT; IUCN VU	Habitats utilized include dunes, meadows and damp areas with moss. Declining across Europe and showing signs of decline in Ireland. (Fitzpatrick *et al*., 2006).
Small heath	*Coenonympha pamphilus*	IECS NT	Habitats utilized include unimproved dry/humid grassland, grey dunes and machair. Feeds on fine-leaved grasses. (Regan *et al*., 2010).
Yellow shell	*Camptogramma bilineata*	IECS NT	Widespread macro-moth of coastal and unimproved grassland, lost from many inland sites as a result of agricultural intensification (Allen *et al*., 2016). Larvae feed on a number of herbaceous perennials (Allen *et al*., 2016). There is only one record of the species from the Study Area (townland of Scrivogue on the mainland, July 2012).
Plants			
Betony	*Betonica officinalis*	FPO; IECS NT	Flowering perennial of open woodland, hedgerows and grassland. Key conservation threat is habitat loss as a result of agricultural intensification. (Curtis & McGough, 1988).
Sea frillwort	*Fossombronia maritima*	IECS NT	Near threatened coastal liverwort with very limited distribution (NBDC, 2019d; Lockhart *et al*., 2012).
Sea pea	*Lathyrus japonicus*	FPO	Perennial plant of sand and shingle beaches (Minchin & Minchin, 1996) with limited coastal distribution. There is only one record of the species occurring in the Study Area (townland of Cloughfune on the mainland, 1991) which is a significant distance from any proposed works.

Acronyms used: HD = EU Habitats Directive (Roman numerals indicate Annex(es)); WA = Wildlife Acts; Ospar = Ospar Convention; BD = EU Birds Directive (Roman numerals indicate Annex(es)/Section(s), S = Section); BoCCI = BirdWatch Ireland - Birds of Conservation Concern in Ireland (Amber = Amber-listed, Red = Red-listed); IECS = Irish Conservation Status (NT = Near threatened, EN = Endangered; Fitzpatrick *et al*., 2006; Marnell *et al*., 2009; Regan *et al*., 2010; NPWS, 2013d; Clarke *et al*., 2016; Wyse Jackson *et al*., 2016); IUCN = European Conservation Status (or Global in cases in which European status unavailable; VU = Vulnerable, NT = Near threatened, EN = Endangered, CR = Critically endangered)

7.3.4 Invasive Alien Species

Table 7.13 lists the Invasive Alien Species (IAS) recorded in the NBDC databases in 2km squares that are wholly or partially within the Zone of Influence.

Table 7.13 Invasive Species Recorded in 2km Squares within the Zone of Influence (NBDC, 2019)

Common Name	Scientific Name	NBDC Invasiveness Risk Rating
Japanese knotweed	*Fallopia japonica*	High Impact
Brown rat	*Rattus norvegicus*	High Impact
European rabbit	*Oryctolagus cuniculus*	Medium Impact

7.3.5 Surface Water Ecological Status

The study areas (excluding Dursey Island) is within the Dunmanus – Bantry – Kenmare Hydrometric Area (No. 21) and the Fanahy Water Framework Directive (WFD) Sub-catchment (ID. 21-9). The Zone of Influence contains two Water Framework Directive Sub-basins – Ballydonegan_010 and Hill Loughanemore_010. According to the EPA Map Viewer (2019), there are at least 13 surface water bodies (all streams) wholly or partially in the Zone of Influence. It is possible that a number of these watercourses are drainage ditches associated with agricultural land. There are no lakes in the Zone of Influence. Since Dursey Island is not included in the Hydrometric Area, detailed data are not available for surface water on the land mass. However, the EPA Map Viewer indicates that there are at least two streams on Dursey Island, and it is known that there are springs on the island. There are no surface water ecological status (i.e. Q Value) data available for waterbodies in the Zone of Influence. The coastal waters of the South Western Atlantic Seaboard are considered to be 'Unpolluted' (EPA, 2019), although no specific coastal water quality data are available for the study area. For in-depth assessment of potential hydrological effects of the proposed development, refer to Chapters 9 and 10 of this EIAR – Hydrogeology and Hydrology, respectively.

7.4 Field Survey Results

7.4.1 Habitats

For details of survey methodology, see Section 7.2.7. This section lists the habitats recorded during the habitat surveys carried out on the 6th and 7th September 2018 and 22nd and 25th of May 2019 (as per Fossitt, 2000), and describes the general character of the habitats in the study area. Table 7.14 lists the habitats recorded on the mainland and island sides of the site of the proposed development. Habitat maps are presented in Figures 7.2 – 7.12 of Volume 3 of this EIAR.

Table 7.14 Habitats recorded at the site of the proposed development (mainland and island sides)

Habitat Type	Fossitt Code (Fossitt, 2000)
Improved agricultural grassland	GA1
Dry meadows and grassed verges	GS2
Dry-humid acid grassland	GS1
Dry siliceous heath	HH1
Exposed siliceous rock	ER1

Habitat Type	Fossitt Code (Fossitt, 2000)
Drainage ditches	FW4
Rocky sea cliffs	CS1
Sea stacks and islets	CS2
Exposed rocky shores	LR1
Mosaic of dry-humid acid grassland and dry siliceous heath	GS1-HH1
Buildings and artificial surfaces	BL3

General Character of Habitats at Site of Proposed Development

Dry-humid acid grassland (GS1) and dry siliceous heath (HH1), or a mosaic of the two, are the dominant habitat types in the study area, on both island and mainland. Sward heights are low, particularly on Dursey Island. The coastline is rocky and highly indented. At the mainland, the land rises abruptly from the exposed rocky coast to more gently sloping ground around the car park and along the approach road, R572. To the east of the road, the land continues to rise with numerous rock outcrops forming an undulating profile and giving rise to a considerable mixture of gradients and depths of soil which is reflected in the vegetation. On the island, the cableway pylon is located at the top of a low broken cliff, and thereafter to the terminal building the land rises gently with a similar variation in rock outcrop and soil depth.

The mainland site is comprised of a mosaic of habitats associated with its rural, coastal location and the existing infrastructure at the site. There is a considerable element of buildings and artificial surfaces (BL3) associated with the access road which terminates in a car park at the cableway line station and the pylon footprint. In addition, there is a small pier (CC1) located to the southeast of the cable car with a steep access track leading from the road. A chain-link fence has been recently erected around the boundary of the CCC land parcel on which the cableway is situated, and a low earth berm has been built along the seaward side of the carpark which has resulted in some disturbance and recolonising bare ground (ED3). These areas support a mixture of species associated with dry meadows and grassy verges (GS2) including cock's-foot (*Dactylis glomerata*), thistle (*Cisium* sp.), nettle (*Urtica diocia*) and yarrow (*Achillea milefolium*).

To the south-east and at the boundary of the Council lands, a small drainage ditch (FW4) flows into the sea in a steep sided cut which is heavily vegetated with a mixture of briar (*Rubus fruticosus* aggr.), bracken (*Pteridium aquilinum*), lady fern (*Athyrium felix-femina*) and royal fern (*Osmunda regalis*), along with the non-native species montbretia (*Crocosmia x crocosmiflora*) and New Zealand flax (*Phormium tenax*).

The majority of the lands to the east of the access road, within the Council lands, are a mixture of dry-humid acid grassland (GS3) with dry siliceous heath (HH1), with scattered exposed siliceous rock (ER1) outcrops. This community extends beyond the fence-line and northwards towards Garinish Point, and also extends to the west of the road/car park to the top of a low cliff finding the coast. The vegetation within the fenced enclosure is mainly ungrazed and is resultantly much more luxurious than that outside the enclosure, which is heavily grazed by sheep.

The dominant species in the dry-humid acid grassland are fescues (*Festuca rubra* and *Festuca ovina*), bents (*Agrostis* spp.), sweet vernal (*Anthoxanthum odoratum*), Yorkshire fog (*Holcus mollis*), yarrow (*Achillea millefolium*), mouse-ear (*Cerastium tomentosum*), hawkweed (*Hieracium pilosella*), tormentil (*Potentilla erecta*), birdsfoot

trefoil (*Lotus corniculatus*), selfheal (*Prunella vulgaris*), clovers (*Trifolium* spp.), and sheep sorrel (*Rumex acetosella*).

The heath elements are dominated by western gorse (*Ulex gallii*), bell heather (*Erica cinerea*), ling heather (*Calluna vulgaris*), green-ribbed sedge (*Carex binervis*), along with many of the species associated with the dry humid acid grassland. Purple moor-grass (*Molina caerulea*) occurs occasionally mainly associated with damper areas where drainage lines occur, along with small amounts of Sphagnum mosses (*Sphagnum* spp.) and the non-native willowherb (*Epilobium brunnescens*).

The coastline in the vicinity of the site is comprised of low cliffs with a wave-cut platform in the intertidal zone. The habitat conforms to Fossitt's description of exposed rocky shores (LR1), dominated by barnacles (*Semibalanus* and *Chthalmus* spp.) and mussels (*Mytilus edulis*), while the subtidal element is dominated by kelps (*Laminaria* spp.) and red seaweeds.

The vegetation on the island is also comprised primarily of a mosaic of dry siliceous heath and dry-humid acid grassland habitats. The vegetation here, however, is heavily grazed and, consequentially, quite stunted. The species composition of these habitats is similar to that of the mainland, though no evidence of betony was found. There is some grassland along a drainage line to the north of the line station which is intermediate with wet grassland and includes jointed rush (*Juncus articulatus*), black bog rush (*Schoenus nigircans*), blue sedge (*Carex flacca*), spear wort (*Ranunculus flammula*), lousewort (*Pedicularis sylvatica*) and lesser skullcap (*Scutellaria minor*).

The low cliffs along the coast, especially at Foilnamuck (the small bay immediately north of the line station) supports a typical coastal cliff community including thrift (*Armeria maritima*), buck's-horn plantain (*Plantago coronopus*), samphire (*Crithmum maritimum*), sea beet (*Beta vulgaris*), orache (*Atriplex patula*) and sea spurrey (*Spergularia rubicola*). Vegetation is confined primarily to the cliff top and large crevices.

7.4.1.1 Significance of Habitats at Site of Proposed Development

The heathland on both the mainland and island sites conforms in places to the description of European dry heath [4030], a QI of the Kenmare River SAC. However, the boundary of the SAC only extends to the high-water mark at this location. The loss of this habitat at the site will therefore not constitute an impact on the SAC. Dry siliceous heath and dry-humid acid grassland are foraging habitats for Chough, which is a QI of the Beara Peninsula SPA, while rocky sea cliffs are roosting/nesting habitat for same, as well as a number of other rare and/or protected avian species that have been recorded in the Study Area (Table 7.9).

7.4.2 Fauna

7.4.2.1 Bats

For details of survey methodology, see Section 7.2.9. Table 7.15 provides an overview of the bat surveys conducted.

Table 7.15 Bat survey details

Survey	Date	Time	Temp.	Conditions
Daytime Bat Suitability Assessment	29/09/18	-	3°C	Overcast, dry, breezy
Dusk Bat Activity Survey	29/09/18	19:00 – 21:00		Sunset: 19:20

Survey	Date	Time	Temp.	Conditions
Night-time Bat Activity Survey	29 – 30/09/18	19:00 – 07:00		

The bat suitability assessment (a walkover of the site during the daytime) found that there were no trees located in the vicinity of the proposed development. The open, treeless, coastal nature of the landscape in the study area is not optimal bat foraging habitat. While there are a number of buildings and artificial structures on the site, no bat roosts were identified within any of these structures. However, it was concluded that these structures could be used as night-time or satellite roosts at times of inclement weather conditions.

The dusk bat activity survey recorded common pipistrelles (*Pipistrellus pipistrellus*) feeding along the coastline in the vicinity of the site at 20:03hrs and 20:37hrs. Otherwise, no other bat activity was recorded during the dusk survey.

The bat passes recorded by the static recording devices employed for the night-time bat activity survey are listed in Table 7.16. Two species were recorded – common pipistrelle and soprano pipistrelle (*Pipistrellus pygmaeus*). A much higher level of bat activity was recorded on the mainland than on Dursey Island. The activity recorded is indicative of bats commuting to the study area to forage. While many passes were recorded of common pipistrelle on the mainland, these results are likely to reflect a small number of individuals travelling back and forth in the vicinity of the recording device. Considering the foraging behaviour of the common pipistrelle, it is likely that a small number of individuals were foraging around the lighting of the cableway line station building. On sonograms, just two individuals were detected at a time. No roosting sites were identified and it was considered that the probability of bats roosting in buildings associated with the existing Dursey Island Cable Car site is low.

Both the common and soprano pipistrelle are of 'least [conservation] concern' in Ireland, Europe and globally and are considered to be Ireland's commonest bat species. However, as with all bat species, both are legally protected under Annex IV of the Habitats Directive. Both have Irish populations that are stable and increasing. The distribution of both covers much of Ireland. Their habitat preferences are similar, with both favouring broadleaf woodland, riparian woodland and low density urban areas. (Roche *et al*., 2014).

Table 7.16 Bat passes recorded by static recording devices during night-time bat activity survey

Location of Static Recording Device	Time	Bat Passes Recorded
Dursey Island (roof of line station)	21:00	4 passes of common pipistrelle (2 individuals)
	22:00	4 passes of common pipistrelle
Mainland (adjacent to line station)	20:00	1 pass of common pipistrelle
	21:00	4 passes of common pipistrelle
	22:00	184 passes of common pipistrelle 19 passes of soprano pipistrelle
	23:00	168 passes of common pipistrelle
	00:00	25 passes of common pipistrelle

Location of Static Recording Device	Time	Bat Passes Recorded
	01:00	1 pass of common pipistrelle
	06:00	1 pass of common pipistrelle

7.4.2.2 Breeding Birds

For details of survey methodology, see Section 7.2.8. Numerical data related to breeding season surveys are presented in Appendix 7.4. Key findings thus far are as follows:

Chough – Abundance

The largest flock of choughs recorded during the surveys was 32. This flock was comprised of adults and juveniles and was observed on the western end of Dursey Island in early July. This number is greater than that of the 1992 survey (20; Berrow *et al.,* 1993) and less than that of the 2002/03 survey (46; Gray *et al.,* 2003). Plate 7.9 illustrates the population trend over time.

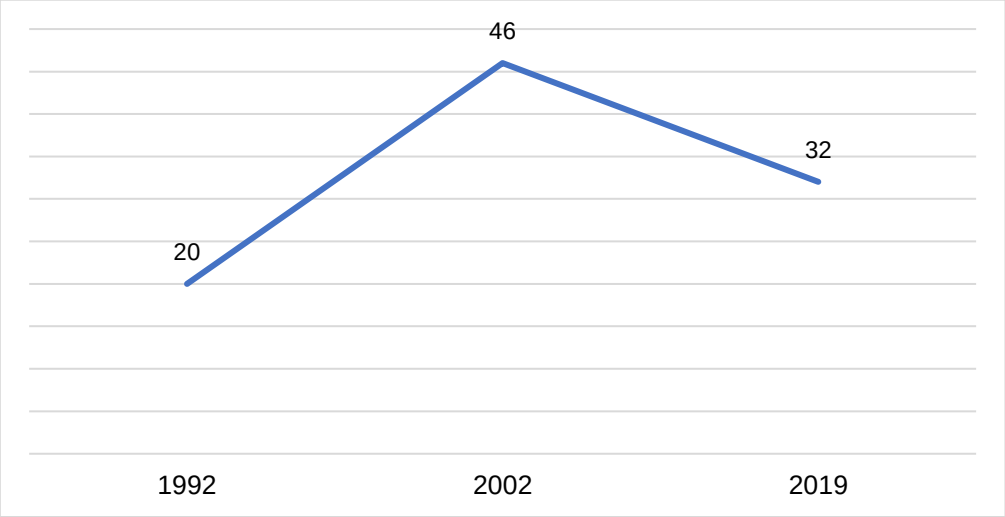

Plate 7.9 Total number of chough recorded on Dursey Island, 1992 – 2019 (Source: Berrow et al., 1993; Gray *et al*., 2003; ROD surveys, 2019)

Chough – Breeding

Since chough are known to exhibit site fidelity when nesting, certain passages of text in this Section specifying the locations of potential/confirmed chough nest sites have been redacted in order to protect the sites and population in question. Six confirmed breeding pairs and their respective nest sites were identified (Table 7.17). [Redacted]. Five out of the six nests were located on Dursey Island. None of these were in the vicinity of the site of the proposed development, although a potential nest site at [redacted] was prospected by a pair who did not go on to breed (potentially a pair of non-breeders simulating breeding). No nest sites were identified on Garinish Head, although chough were observed to forage here in small numbers. A single confirmed nest site was recorded at [redacted]. Most nest sites recorded are too remote to be at risk of human disturbance. However, the three known nest sites at the western end of the island are potentially vulnerable in this respect.

Table 7.17 Details of chough nest sites with confirmed breeding in the Study Area

No.	Location	No. Juveniles Fledged	Date First Recorded
1	Dursey Island [redacted]	2	17/05/2019
2	Dursey Island [redacted]	2	03/06/2019
3	Dursey Island [redacted]	4	05/06/2019
4	Dursey Island [redacted]	3	03/06/2019
5	Dursey Island [redacted]	4	13/06/2019
6	Crow Head [redacted]	2	24/05/2019

All six known breeding pairs successfully fledged 2 – 4 young (mean = 3). A total of 17 juveniles were fledged in the Study Area.

Chough – Foraging and Disturbance

On Dursey Island, foraging during the breeding season has been concentrated on areas of unenclosed acid and maritime grassland, with occasional forays into heathland. Virtually all the unenclosed parts of the island are grazed by sheep and, in combination with the shallow soils and maritime influence, much of the habitat on the island (a mosaic of heath and acid grassland) provides suitable foraging habitat for chough. The enclosed fields, some of which are cattle grazed or cropped for silage, are also likely to provide foraging habitat during the winter period. It is considered that, with the exception of artificial structures, roads/paths and bracken (of which there is a negligible area), almost the entire area of the island (5.98km²) is suitable habitat for chough at one time of the year or another. That being said, the western end of the island (which takes in the hills of *Maoil, Maoil Mhór and Maoil Bheag*) has an open short grassland sward, and supported the greatest density of nesting pairs (three nests recorded consistently across all studies) and the highest levels of foraging activity. This may be regarded as a key area for foraging and flocking for the population (Plate 7.10). While no nesting was observed on Garinish Head, foraging was observed here, particularly on acid grassland-heath mosaic on the steep ground to the north of the established walking trail. Foraging activity on Crow Head has been recorded mostly along the northern fringes of the land mass, where there is a strip of grassland. Much of the headland is covered with heath, and it appears that grazing of the area has reduced significantly in recent times, which has likely reduced its suitability for foraging chough. Choughs were observed to fly between the island and mainland on a number of occasions.

The average flush distance observed in the Study Area was 31.6m (N = 49 observations; min. = 10m; max. = 150m; median = 30m). Choughs were observed to call more frequently when within 50m of walkers. Applying a 50m buffer (30m flush distance + 20m as a precautionary buffer) to the established paths and road on Dursey Island (Plate 7.12), it has been estimated that approx. 1.33km² of potential chough foraging habitat (22% of total area) could be subject to human disturbance at peak times (assuming walkers are well distributed across the island's network of roads and paths) (Plate 7.11). This is substantially lower than the equivalent area on Ouessant Island; Keribiou *et al*. (2009) calculated that, during peak times, 97% of chough foraging habitat on Ouessant could be affected by human disturbance.

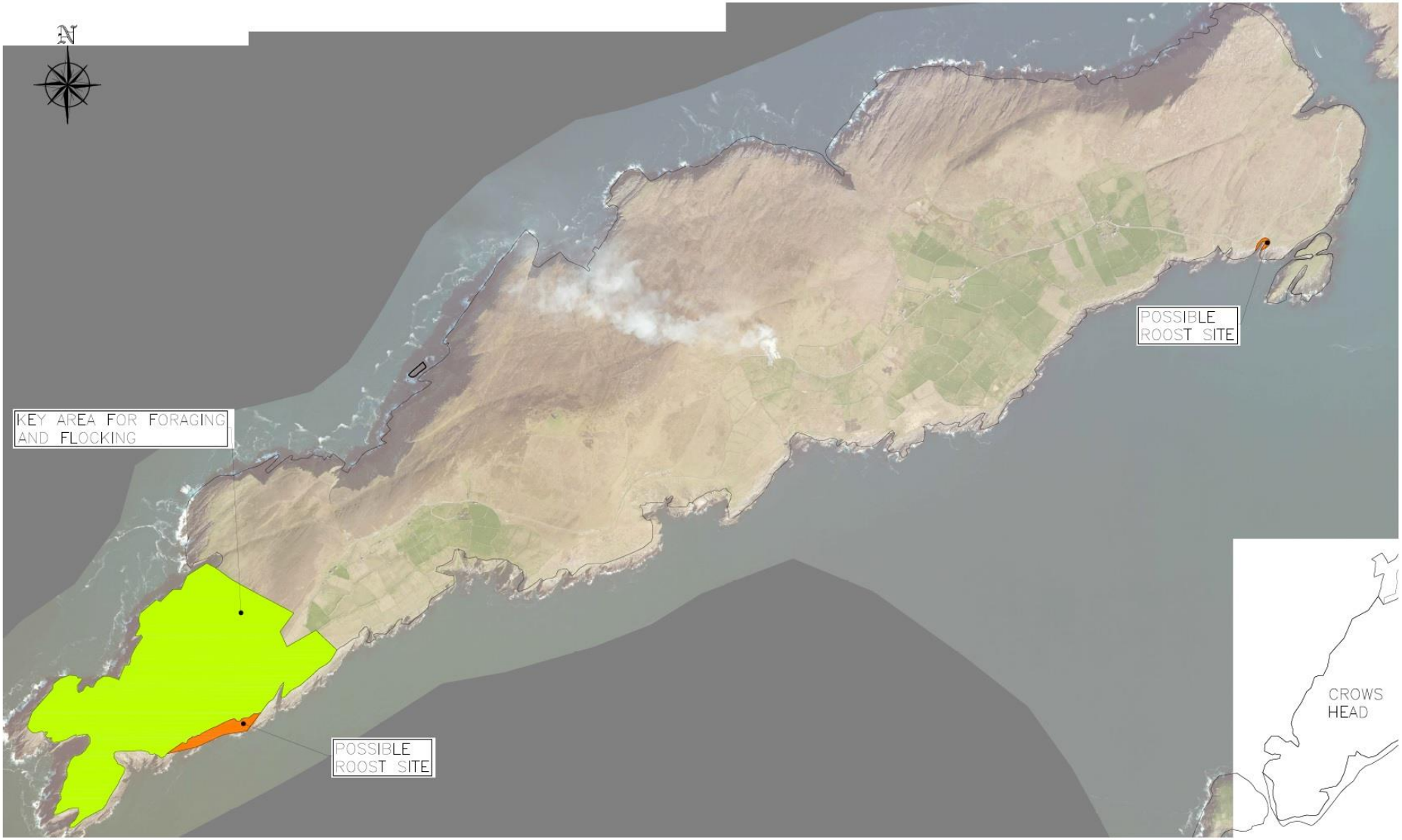

Plate 7.10 Map depicting locations of key areas of chough habitat on Dursey Island [locations of nest sites removed]

Plate 7.11 Map illustrating area of chough foraging habitat on Dursey Island likely to be affected by human disturbance during peak times

During the daytime, when there is plenty of visitor activity at the site, chough have been observed feeding in the grassland adjacent to the existing station on the mainland, within approx. 15m of the car park. On the western end of Dursey Island, there are no defined pathways for walkers and visitors tend to 'spill out' across the open habitat, potentially disturbing foraging and nesting birds. Birds have been observed foraging in the vicinity of roads and paths elsewhere on the island and while there is a risk of disturbance at these locations also, the visitors typically remain on the road or path limiting the disturbance to a linear strip. Contrary to the case of Keribiou et al. (2009), while human disturbance of foraging choughs was observed, this disturbance did not appear to lead to any mortality of juveniles in the Study Area – all known pairs successfully fledged two or more offspring. This is potentially since the scenario with respect to chough conservation on Ouessant Island is substantially different to that on Dursey. On Ouessant, there is an extensive network of roads and paths criss-crossing the land mass, there are cliff-side walking trails running along the entirety of the coastline (Plate 7.14), and chough foraging habitat is largely restricted to the coastline (Keribiou *et al*., 2009). By comparison, the road and walking trails on Dursey Island are largely restricted to the central high elevation spine of the land mass, and the vast majority of the terrestrial area constitutes suitable chough foraging habitat. Furthermore, the choughs of Dursey Island (unlike those of Ouessant) are not geographically isolated to the island, which is just 200m from the Beara Peninsula (Plate 7.15). Indeed, choughs were often seeing flying between island and mainland during surveys. The Ouessant choughs, on the other hand, rely on habitats on the island for the entirety of their lifecycle. In short, the environmental context on Dursey Island may be considered to be more favourable in terms of chough conservation than that of Ouessant Island, France.

Chough – Flock-forming and Roosting

From late June to early July, choughs were increasingly observed to gather in one or more flocks to forage at the western end of the island – especially around the hills *Maoil* and *Maoil Mhór*. Around this time, surveyors were less likely to observe chough activity elsewhere on the island. This underlines the status of the western end of the island as a chough 'hotspot'.

The Site Synopsis for the Beara Peninsula SPA (NPWS, 2015) lists two regularly used roosting sites for chough at (i) Dursey Sound (maximum of 17 roosting birds) and (ii) Allihies copper mines (maximum of 37 roosting birds). The precise location of the roost within Dursey Sound is not recorded, but Foilnamuck, the inlet on Dursey Island c. 120m north-west of the island side of the site of the proposed development, is thought to be the site which is referred to. Surveys were conducted of this area and no evidence of it being used for roosting was found. *Cuas na gColúr* (an inlet on the south-eastern side of the island) and the cliffs of *Brann Righe* (on the south-western side of the island) were identified as potential communal roost sites (Plate 7.10). Largely, however, birds were observed to roost at dusk in family groups near their respective nest sites. Since communal roosting occurs towards the end of the summer, ongoing post-fledging bird surveys (August – November 2019) should serve to confirm the location of roost sites in the Study Area.

Other Breeding Birds

Dursey Island is on a major migratory flyway for birds and receives many unusual as well as more common species over the main migration periods in autumn and spring. Some of these birds are recorded in flight only, while others stop over briefly before resuming their migration.

Fulmar were observed nesting at various locations on steep and isolated cliffs on the north, west and southern sides of Dursey Island, as well as on the southern side of Crow Head and the northern side of Garinish Head. These birds are not considered to be vulnerable to disturbance by virtue of the isolated locations of their nests and their confinement to foraging at sea.

No evidence of breeding peregrine falcons (*Falco peregrinus*) was found during the surveys. However, individual peregrine(s) were observed flushing choughs and being mobbed by choughs in the Study Area on a number of occasions and it is likely that at least one individual is foraging in the area/vicinity.

Choughs were observed to interact regularly with other corvids, particularly ravens (*Corvus corax*), which were frequently mobbed by adult choughs. Antagonistic interactions with hooded crows (*Corvus cornix*) and magpies (*Pica pica*) were also observed.

Table 7.18 presents a list of avian species observed breeding in the Study Area during the breeding bird surveys. Additionally, it is considered (in light of observations made during the surveys) that the species of birds listed in Table 7.19 may possibly breed in the Zone of Influence in small numbers (although no evidence of such was observed).

Table 7.18 Species of birds confirmed breeding in the Zone of Influence during 2019 breeding bird surveys

Common name	Scientific Name
Rock pigeon	*Columba livia*
Pheasant	*Phasianus colchicus*
Eurasian oystercatcher	*Haematopus ostralegus*
Barn swallow	*Hirundo rustica*
Northern wheatear	*Oenanthe oenanthe*
Eurasian skylark	*Alauda arvensis*
Common starling	*Sturnus vulgaris*
Great cormorant	*Phalacrocorax carbo*
House sparrow	*Passer domesticus*
Meadow pipit	*Anthus pratensis*
Rock pipit	*Anthus petrosus*
Stonechat	*Saxicola torquatus*
Pied wagtail	*Motacilla alba*
Fulmar	*Fulmarus glacialis*
Herring gull	*Larus argentatus*
Greater black-backed gull	*Larus marinus*
Shag	*Phalacrocorax aristotelis*
Magpie	*Pica pica*
Robin	*Erithacus rubecula*
Dunnock	*Prunella modularis*
Wren	*Troglodytes troglodytes*
Hooded crow	*Corvus tristis*

Table 7.19 Species of birds considered to possibly breed in the Zone of Influence

Common name	Scientific Name
Peregrine falcon*	*Falco peregrinus*
Wood pigeon	*Columba palumbus*
Common snipe	*Gallinago gallinago*
Black guillemot	*Cepphus grille*
House martin	*Delichon urbicum*
Linnet	*Carduelis cannabina*
Common kestrel	*Falco tinnunculus*
Razorbill	*Alca torda*
Yellowhammer	*Emberiza citronella*
Kittiwake	*Rissa tridactyla*
Raven**	*Corvus corax*
*One solitary female was observed on Garinish Head in October 2018. In view of the lack of sightings during all surveys undertaken during the breeding season, it is considered unlikely that any peregrines nested in the Study Area during the 2019 season. **Species appears to have nested on Dursey Island and on Garinish Head, although no nest sites were confirmed.	

Other Notes

Evidence of illegal dumping of household waste was observed on the southern cliffs of Crow Head. Surveyors observed that the majority of walkers stayed on existing, established paths.

7.4.3 Flora

7.4.3.1 Betony

For details of survey methodology see Section 7.2.10. During the survey carried out on the 25th of October 2018, a total of five clusters of betony were recorded in the vicinity of the mainland side of the site of the proposed development (Table 7.20). These were mainly situated at the north-eastern boundary of the mainland side of the site, near to a fence. No evidence of the plant was found on grassland surrounding the site on the mainland, probably as a result of intensive grazing in the area.

In order to prevent negative effects on the protected species, these clusters of betony were translocated in February 2019. Sods of 30×50cm containing plants were excavated using a spade and transferred in boxes to suitable reception sites outside of the footprint of the proposed development under the supervision of Paul Murphy, who was licenced by NPWS for the translocation of the species (FL01/2019). The depth of sods (approx. 20×30cm) was sufficient to contain the root systems of the betony clusters. The reception site was cleared of topsoil in preparation for the translocation. Any gaps were filled with local topsoil. The translocation site was fenced to exclude animals/people from interfering with it. Inspections of the status of the translocated plants will continue until October 2019, to ensure the establishment of the plants at their new location.

Table 7.20 Records of betony from mainland side of site of proposed development

Grid Reference	No. Plants	Location
V50821 41882	1	In grassland, close to north-eastern boundary fence
V50837 41869	3	In grassland, close to north-eastern boundary fence
V50838 41867	1	In grassland, close to north-eastern boundary fence
V50847 41869	3	In grassland, close to north-eastern boundary fence
V50836 41858	4	In grassland, in middle of site

7.4.4 Visitors to Dursey Island – Numbers and Activities

A survey of visitors to Dursey Island was carried out during June and July of 2019. Survey sheets were distributed to visitors upon returning to the mainland after their trip to Dursey by the cableway operator. Key findings are as follows:

- 537 surveys were completed.
- Of these, 68% of respondents stated that they left the established path/road at some point on the island.
- 68% of respondents (365 persons) marked their route on the island on the map provided. Of these:
    - Approximately 50% of respondents walked in and around the eastern half of the island only, in the Ballynacallagh and Kilmichael areas;
    - A further 23% walked as far as the signal tower and/or Tillickafinna area, but not onto the extreme western end of the island; and
    - Approximately 26% of respondents reported walking to the extreme western end of the island. This group typically spent the longest amount of time on the island (≥3 hours).
    - Of the 95 respondents who reported walking to the western end of the island, 42% stated that they left the established path at this point. In other words, of the 537 persons who participated in the visitor survey, 40 (or 7%) reported wandering onto open habitat in this chough 'hotspot'.
    - Plate 7.12 presents a 'heat map' of visitor movements on the island.
- The average group size visiting the island is 3, and the median is 2.
- The average time spent on the island is 3 and a half hours, and the median is 2 and a half hours.
- Comments written by certain respondents on their survey forms indicate that:
    - Visitors are being allowed to bring dogs and bicycles onto the island.
    - A small proportion of visitors are camping overnight on the island.
    - Key complaints of visitors to the island are
        (i) The lack of information regarding walking routes and duration of walks on the island;
        (ii) The duration of queuing times on island and mainland; and
        (iii) The lack of shelter/facilities on the island.
- Visitors to the site also visit a number of other sites in the area during their trip, principally the Beara Way, Garinish Loop and the town of Allihies (Table 7.21).

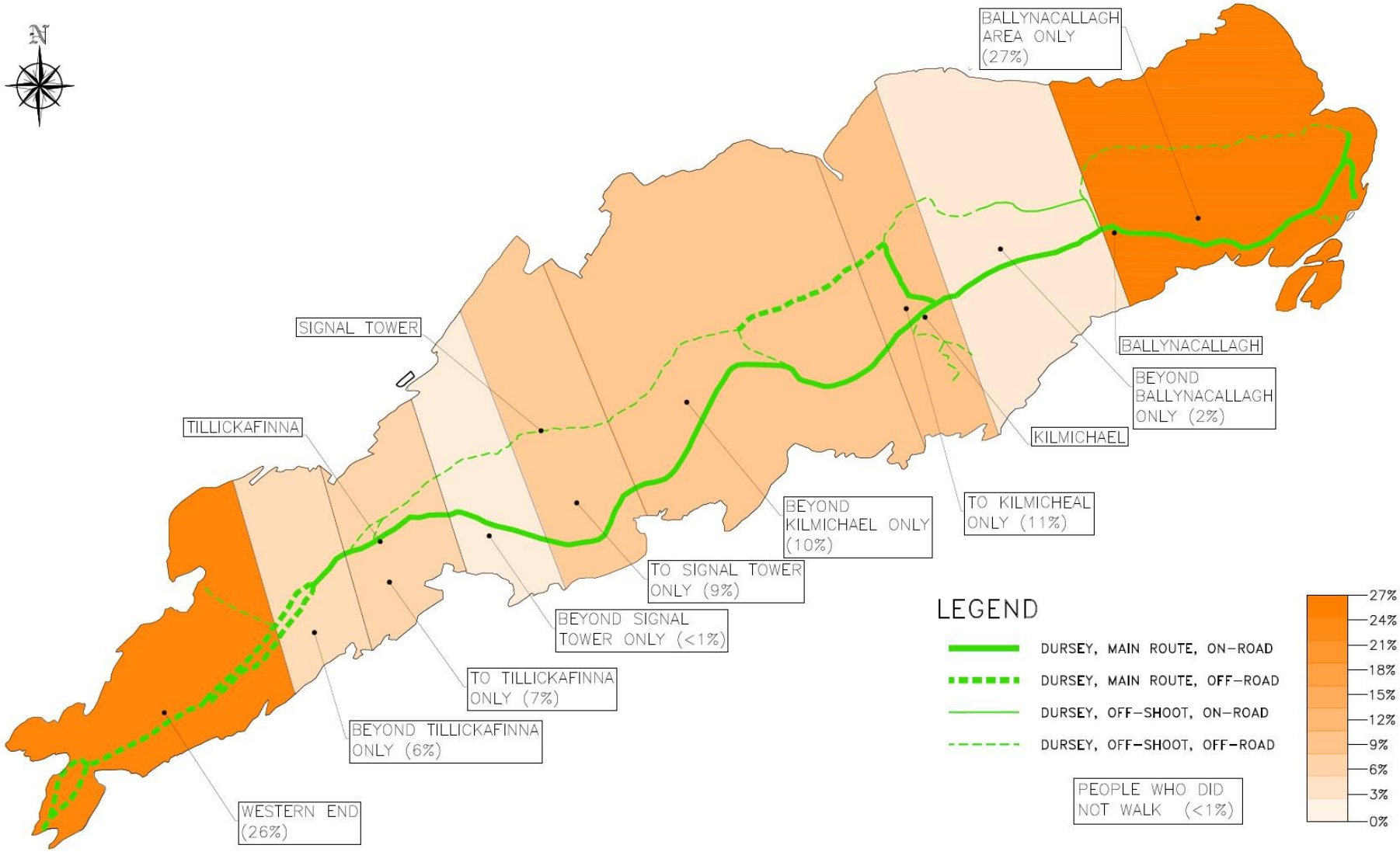

Plate 7.12 'Heat map' illustrating end point of walking routes taken by visitors to Dursey Island during June and July 2019.

Table 7.21 Other sites visited by visitors to the Dursey Island Cable Car on the same trip/excursion

Place	Number of Respondents
Beara Way	158
Garinish Loop	65
Allihies	38
Castletownbere	16
Eyeries	15
Crow Head	15
Garinish Island	15
Bere Island	13
Glengarriff	11
Kenmare	10
Allihies Copper Mines	9
Ring of Kerry	8
Kerry	7
Dzogchen Beara	7
Mizen Head	7
Beara Region	7
Healy Pass	6
Whiddy Island	6
Sheep's Head Peninsula	5
Bantry	5
Wild Atlantic Way	4
Ballydonegan Beach	4
Dingle	3
Hungry Hill	2
Adrigole	2
Ardgroom	2
Dereen Gardens	2
Lough Hyne	1
Skellig Michael	1
Skibbereen	1
Ballylickey	1
Coorycommane Loop	1
Killarney National Park	1
Dingle Peninsula	1
Loop Head	1

Place	Number of Respondents
Cape Clear	1
Baltimore	1
Schull	1
White Strand	1
E8 European Long Distance Walking Trail	1
Rodeen	1
Derrynane	1
Waterville	1
Barleycove	1
Crookhaven	1

7.4.5 Invasive Alien Plant Species

Table 7.23 presents the compiled results of the IAPS surveys carried out in the study area in October 2018 and May 2019. A total of five IAPS were identified in the study area, all of which are included in the Third Schedule of the *European Communities (Birds and Natural Habitats) Regulations 2011*. Subsequent field surveys carried out by Paul Murphy in July 2019 identified a further occurrence of *Fallopia japonica* in a private garden on Dursey Island (Table 7.18). Table 7.22 presents the IFI-NBDC NAPRA (**N**on-native Species **Ap**plication Based **R**isk **A**nalysis) and NBDC Invasiveness Risk Ratings for each of the species identified.

Table 7.22 NBDC Risk Ratings for IAPS identified in the study area.

Species	IFI-NBDC NAPRA Overall Risk Rating	NBDC Invasiveness Risk Rating
Rhododendron ponticum	Major - Massive	Risk of High Impact
Japanese knotweed, *Fallopia japonica*	Not assessed	Risk of High Impact
Giant rhubarb, *Gunnera tinctoria*	Major	Risk of High Impact
Three-cornered leek, *Allium triquetrum*	Moderate	Risk of Medium Impact
Hottentot-fig, *Carpobrotus edulis*	Major	Risk of High Impact

7.4.5.1 Hottentot-fig

Hottentot-fig has a very limited distribution in Ireland and it was tentatively believed that the IAPS had been eradicated from the country until recently (W. Earle, pers. comm., 2019). This confirmed record on Dursey Island reveals that this is not the case. However, it is possible that this occurrence is one of a very small number of occurrences in Ireland. Additionally, it is the first record of the species on the west coast of Ireland. As such, it is imperative that every effort is made to eradicate this localised occurrence, in agreement with the private landowner. This record provides an opportunity to contribute to the national eradication of a High Impact IAPS before colonisation reaches a stage when eradication is much more challenging or no longer feasible.

Hottentot-fig can be effectively removed off site via physical removal, and chemical means can be employed for control in cases in which physical removal is not practical (e.g. on inaccessible sea cliffs). In this case, since the occurrence in question is quite

localised and is situated in a fully accessible location (on a stone wall in a private garden at Kilmichael; Plate 7.13), it is considered that physical removal would be practical and effective and should be undertaken in agreement with the landowner in question. The situation of the occurrence on a public roadside creates the risk of dispersal by tourists who may pick the attractive flowers or foliage or inadvertently transport plant fragments or seeds on boots/clothing. Seabirds may also disperse the species to sensitive habitats (especially Vegetated Sea Cliffs [1230]) when gathering nesting materials. Therefore, every effort should be made to treat the occurrence at the earliest possible convenience. Early, appropriate treatment of this species will avoid medium to long-term ecological impacts and financial costs.

Plate 7.13 Occurrence of hottentot fig (*C. edulis*) on Dursey Island (marked in white)

Table 7.23 Compiled findings of IAPS surveys carried out in study area in October 2018 and May 2019

Species	Location	Coordinates	Details	Survey
Rhododendron ponticum	R572	466915;545345	Large stand	10/2018
	R572	466915;545345 – 465995;544699	Series small stands/individual plants	10/2018
	R572	465995;544699 – 465959;544645	Large linear stand	10/2018
	R572	465750;544498 – 465704;544492	Large linear stand	10/2018
	R572	465504;544489 – 465456;544456	Long linear stand	10/2018
	R572	465206;544374 – 464694;544480	Series of stands/individual plants	10/2018
	R572	464109;544294	Mature stand	10/2018
	R572	453442;544048	Mature stand	10/2018
	R572	461261;541846	Mature stand	10/2018
Japanese knotweed, *Fallopia japonica*	R572	463057;543661	Mature stand	10/2018
	R572	463044;543566	Several related stands	10/2018
	R572	461345;541912 – 461269;541856	Series of stands	10/2018
	R572	461221;541790	Single stand at stream	10/2018
	R572	460075;541314 – 460011;541269	Series of stands	10/2018
	R572	459586;541266 – 459551;541267	Large stand and linear stand at stream	10/2018
	R572. Outside passing bay site no. 4	454471;541018	Large stand. Subject to treatment; still extant.	06/2019
	R572	452796;541814	Single stand	10/2018

Species	Location	Coordinates	Details	Survey
	R572-L4901 junction	451700;541861	Extensive stand	06/2019
	Garinish Loop	452120;542644	Small stand	06/2019
	Garinish Loop	452077;542054	Moderate stand. Subject to treatment; still extant.	06/2019
	R572	451924;541841	Small amount of stems.	06/2019
	Dursey Island	449459;541927	Stands at front and back of house. Being cut by landowner on an ongoing basis.	07/2019
Giant rhubarb, *Gunnera tinctoria*	R572. Within passing bay site no. 5	453141;541445	Single young plant	06/2019
	R572. Within passing bay site no. 11	451300;541798	Two stands – one large, other smaller – in vicinity	06/2019
Three-cornered leek, *Allium triquetrum*	R572	451924;541841	Abundant in garden.	06/2019
	Dursey Island	448999;541065	Stems recently dumped on grass verge along road	06/2019
Hottentot-fig, *Carpobrotus edulis*	Dursey Island	448999;541065	Single plant in garden, cascading onto roadside	06/2019

7.4.6 Ecological Corridors

Article 10 of the Habitats Directive recognises the importance of ecological networks as corridors and stepping stones for wildlife, including for migration, dispersal and genetic exchange of species of flora and fauna. The Directive requires that ecological connectivity and areas of ecological value outside the Natura 2000 network of designated ecological sites are maintained and it recognises the need for the management of these areas through land use planning and development policies.

Ecological corridors are important in connecting areas of local biodiversity with each other and with nearby designated sites to prevent isolated islands of habitat from being created. Ecological corridors include linear features such as treelines, hedgerows, disused railway lines, rivers, streams, canals and ditches as stepping stones for wildlife moving within their range. They are particularly important for mammals, especially bats, and small birds.

Streams, rivers and drainage ditches, as well as hedgerows on roadsides and field margins are examples of potential ecological corridors in the Zone of Influence. However, the landscape in question is very open and, relatively speaking, exiguous of such features.

7.5 Key Ecological Receptors

This section of the report provides details of the Key Ecological Receptors (KERs). The following section (7.6) identifies KERs from the long list of protected habitats and protected/invasive species identified in the Zone of Influence during the desk study and/or field-based surveys.

7.5.1 Selection of Key Ecological Receptors

The following Table (7.24) presents a compiled list of all protected habitats and protected/invasive species identified in the Zone of Influence during the desk study and/or field-based surveys. On the basis of a description of the habitat/species in question and its relation to the proposed development, it has been determined whether the habitat/species in question is to be considered a Key Ecological Receptor (KER) for the purposes of this biodiversity impact assessment.

Table 7.24 List of protected habitats/species identified in the Zone of Influence during desk study and/or field-based surveys and reasons for classifying each as a KER (or not).

Species/Habitat	Description	KER? (Y/N)
Eurasian otter, *Lutra lutra*	Otters potentially commute through the Zone of Influence, along the shoreline, up to 250m offshore, and up to 150m inland. However, given the nature of the habitats present, there are few opportunities for the establishment of holts, particularly within 500m of the proposed development and no such sites have been identified (although a regularly used sprainting site was recorded by the Project Ecologist 150m north of the site of the proposed development on Garinish Head). Furthermore, the presence of otters in urban environments demonstrates that they habituate to human presence and, as such, any otters present in the Zone of Influence are unlikely to be subject to significant disturbance impacts as a result of the proposed development. No likely negative effects anticipated.	N
Eurasian badger, *Meles meles*	While the species has been recorded in the Zone of Influence, no evidence of setts was identified during field surveys and that suitability of the Study Area in terms of foraging habitat is poor. No likely negative effects anticipated.	N
Eurasian pygmy shrew, *Sorex minutus*	While the species has been recorded in the Zone of Influence, no evidence of *S. minutus* was found during field surveys. Since the area of habitat lost as a construction of the proposed development is quite small and the species has a broad distribution, it is considered that no significant negative effects are not likely.	N
Irish hare, *Lepus timidus hibernica*	There is only one record of the species in the Zone of Influence (at Garinish Point, Garinish Head, on the mainland), and no evidence of the species breeding or otherwise was observed during field surveys. This is a widespread species and it is not considered that the construction or operation of the proposed development will result in negative effects on a population of the species.	N
Irish stoat, *Mustela erminea hibernica*	There is only one record of the species in the Zone of Influence (at Canalmore, on the mainland, which is not in the immediate proximity of any proposed works), and no evidence of the species breeding or otherwise was observed during field surveys. This is a widespread species, which is secretive in its nature, and it is not considered that the construction or operation of the proposed development will result in negative effects on a population of the species.	N
Bats	Soprano pipistrelle (*Pipistrellus pygmaeus*) and common pipistrelle (*Pipistrellus pipistrellus*) have been recorded foraging in the Zone of Influence. While the bat survey concluded that the probability of bats roosting in the buildings associated with the existing cable car site was low, roosting at the site of the proposed development cannot be ruled out. Since bats are sensitive to lighting, the lighting design of the proposed development could negatively affect roosting and foraging bats. As such, it is considered that there is a small likelihood of significant negative effects accruing to bat species.	Y
Marine Mammals	No in-stream/marine works are proposed as part of the proposed development. Additionally, there are no known terrestrial haul-out sites for seals in the Zone of Influence, and the exposed nature of the area is not well suited to establishment of such sites. Thus, activities of marine mammals are restricted to the marine environment in the vicinity of the Zone of Influence. Since there is a very high dilution factor and there are rapid currents in the Dursey Sound,	N

Species/Habitat	Description	KER? (Y/N)
	severe pollution events of a scale which might result in significant negative effects accruing to marine mammals or their habitats are considered to be highly unlikely.	
Basking shark, *Cetorhinus maximus*	Activities of these species in Ireland are restricted to the marine environment, and no in-stream/marine works are proposed as part of the proposed development. Since there is a very high dilution factor and there are rapid currents in the Dursey Sound, severe pollution events of a scale which might result in significant negative effects accruing to these species or their habitats are considered to be highly unlikely.	N
Leatherback turtle, *Dermochelys coriacea*		
Common lizard, *Zootoca vivipara*	There are several records of the species in the Zone of Influence, although no lizards were identified during the field surveys. Lizards are known to utilise walking paths and adjacent habitat elsewhere in Ireland (e.g. at the Ballycotton Cliffs, Co. Cork). However, the species is not susceptible to human disturbance and there are no other likely pathways for significant negative effects on the species.	N
Fulmar, *Fulmarus glacialis*	The site supports a nationally important breeding population of the species. However, since the species nests at inaccessible locations on sea cliffs, and forages entirely at sea, it is considered that there is no likely pathways which would allow significant negative effects to accrue to the population.	N
Red-billed chough, *Pyrrhocorax pyrrhocorax*	The site supports an internationally important breeding population of the species, which forages in terrestrial habitats in the Zone of Influence. The area of potential foraging habitat lost as a result of the construction of the proposed development is considered to be not significant. It is proposed to execute the noisiest elements of the works during the winter months (i.e. outside of the breeding season, when birds are most susceptible to disturbance). Extant primary literature indicates that species is vulnerable to human disturbance while foraging and, as such, it is considered that potential negative effects may occur as a result of the proposed development.	Y
European shag, *Phalacrocorax aristotelis*	While the site supports a resident breeding population of European shag, the species nest at inaccessible locations on sea cliffs and forages entirely at sea. As such, it is considered that there is no likely pathway which would allow significant negative effects to accrue to the population.	N
European herring gull, *Larus argentatus*	The site supports a resident breeding population of the species. Herring gulls tend to nest on sea cliffs but may also nest at more accessible locations (e.g. on sloping ground near sea cliffs). The occurrence of substantial numbers of nesting herring gulls in urban areas would indicate that the species can become well habituated to human disturbance and it is not considered that the species will be negatively affected in this respect. Herring gulls typically forage at sea but may also take eggs of other seabirds and exploit food scraps left by humans. As such, substantial growth in the resident population (as a result of increased availability of food scraps as an indirect result of the proposed development) may potentially result in greater predation of eggs of more sensitive populations of seabird, such as chough. For this reason,	Y

Species/Habitat	Description	KER? (Y/N)
	potential significant negative effects (not on this species but potentially as a result of the foraging ecology of this species) as a result of the proposed development cannot be ruled out at this stage.	
Great black-backed gull, *Larus marinus*	The site supports a resident breeding population of the species. Similar ecology to *L. argentatus* Similarly, it is considered that potential growth of this population as a result of the proposed development could potentially give rise to indirect significant negative effects on more sensitive seabird populations.	Y
Ground-nesting Passerines	A number of species of ground-nesting passerine have been recorded in the Zone of Influence, some of which (Northern wheatear, Eurasian skylark, meadow pipit and stonechat) have been observed breeding in the area during field surveys. Others (yellowhammer and linnet) possibly breed in the Zone of Influence in small numbers, although no evidence was found during field surveys. Others (twite, grasshopper warbler) are not thought to breed in the Zone of Influence but may occasionally forage there. Others (bluethroat, blue-headed wagtail, great short-toed lark, Ortolan bunting, red-backed shrike and tawny pipit) are rare vagrants or passage migrants which are not expected to breed in the Study Area and are only expected to occur very briefly. Loss of habitats used by these species as a result of the proposed development will be minimal and any associated effects will be imperceptible. However, since these species all nest on or near to the ground, increased visitor numbers as a result of the proposed development may result in significant negative effects related to disturbance/destruction of nests.	Y
Montagu's harrier, *Circus pygargus*	Very rare migrant, unlikely to breed in the Study Area or be negatively affected by the proposed development	N
Other Raptors	While certain raptors which have been recorded in the Zone of Influence are likely to use the site for occasional foraging only (e.g. sparrowhawk, merlin, hen harrier and short-eared owl) and are unlikely to be affected by the proposed development, others may also breed in or near the Zone of Influence (e.g. kestrel and peregrine, the latter of which is known to breed in the Beara Peninsula SPA). While significant negative effects are unlikely, they cannot be ruled out.	Y
Common snipe, *Gallinago gallinago*	It is possible that the species breeds in the Zone of Influence in small numbers. Since this is a ground-nesting species, increased visitor numbers as a result of the proposed development may result in significant negative effects related to disturbance/destruction of nests.	Y
Eurasian oystercatcher, *Haematopus ostralegus*	Species has been observed breeding in the Zone of Influence (on a cliff-top at Tillickafinna). Since this is a ground-nesting species, increased visitor numbers as a result of the proposed development may result in significant negative effects related to disturbance/destruction of nests.	Y
Other Waders and Waterfowl	While there are records of a number of breeding and migrant wader birds and waterfowl in the Zone of Influence, the exposed nature of the area is poorly suited to such species, which generally favour wet/intertidal habitats with shallow, slow-moving water (e.g. estuaries, coastal mudflats, shingle/sandy beaches) and floodplains. Such species are highly unlikely to breed in the Zone of Influence, and are more likely to be occasional visitors or rare migrants/vagrants (e.g.	N

Species/Habitat	Description	KER? (Y/N)
	little ringed plover, Eurasian dotterel, great snipe, stone-curlew). The situation of the Zone of Influence on a flight path may account for a number of records of species which are largely unsuited to the habitats in the area.	
Other Gulls	While there are records of these species in the Zone of Influence, none were observed breeding in the area during the breeding bird survey. Furthermore, these species can be largely expected to breed on isolated sea cliffs and can exploit a variety of habitats for foraging. No likely significant negative effects anticipated.	N
Other Seabirds	These species nest at isolated locations on sea cliffs or offshore islands and forage at sea. Some are migrants who do not breed in Ireland (e.g. great northern diver, Fea's petrel and the three species of shearwater). Others nest on the nearby Bull and Cow Rocks (e.g. gannet, great cormorant). While it is considered possible that black guillemots and razorbills could nest in the Zone of Influence, none were observed doing so during the breeding bird surveys. As such, it is considered that there are no likely pathways for significant negative effects to accrue to populations of these seabird species.	N
Hirundines	Barn swallow (*Hirundo rustica*) observed breeding in the Zone of Influence but not using any buildings that will be demolished as part of the proposed development. House martin (*Delichon urbicum*) not observed breeding but it is considered possible that the species also breeds in the Zone of Influence. Both species nest in buildings and forage while flying. Any loss of habitat associated with the proposed development will be minimal and insignificant. No evidence of sand martin (*Riparia riparia*) breeding in Zone of Influence. It is not considered likely that any significant negative effects will accrue to any species of hirundine.	N
Common swift, *Apus apus*	No evidence was found of the species nesting in the Zone of Influence (or in the buildings which will be demolished during the construction of the proposed development) during the breeding bird survey. It is considered unlikely that the proposed development will give rise to any significant negative effects on the species.	N
Rock pigeon, *Columba livia*	This species has been observed breeding in the Zone of Influence. It nests on and forages in the vicinity of sea cliffs. It is a widespread species which, in urban environments, exhibits a high degree of tolerance for human presence/disturbance. It is not considered that the proposed development will give rise to any significant negative effects on the species.	N
Common wood pigeon, *Columba palumbus*	It is considered possible that the species breeds in the Zone of Influence, although no evidence of breeding has been observed. This is a widespread species which, in urban environments, exhibits a high degree of tolerance for human presence/disturbance. It is not considered that the proposed development will give rise to any significant negative effects on the species.	N
Common pheasant, *Phasianus colchicus*	This species has been observed breeding in the Zone of Influence. It is a widespread non-native species. It is not considered that the proposed development will give rise to any significant negative effects on the species.	N

Species/Habitat	Description	KER? (Y/N)
Common starling, *Sturnus vulgaris*	This species has been observed breeding in the Zone of Influence (but not in structures that will be demolished during the construction of the proposed development). It is a widespread, generalist species which is capable of exploiting a variety of habitats and will take food scraps left by humans. It is not considered that the population in question will be subject to any significant negative effects as a result of the proposed development.	N
House sparrow, *Passer domesticus*	This species has been observed breeding in the Zone of Influence (but not in structures that will be demolished during the construction of the proposed development). It is a widespread, seed-eating species which is capable of exploiting a variety of habitats. It is not considered that the population in question will be subject to any significant negative effects as a result of the proposed development.	N
Greenfinch, *Carduelis chloris*	Species is widespread and Study Area does not constitute an important site for it. Area of potential habitat expected to be lost is very small and insignificant. Hedgerow removal shall be carried out outside of the breeding season. Species are abundant in urban areas and highly habituated to human disturbance. It is not considered that the species will be significantly negatively affected as a result of the proposed development.	N
Mistle thrush, *Turdus viscivorus*		
Robin, *Erithacus rubecula*		
Goldcrest, *Regulus regulus*	Species is widespread and Study Area does not constitute an important site for it. Study Area does not contain optimal foraging/nesting habitat (i.e. broadleaf or coniferous woodland). Area of potential habitat expected to be lost is very small and insignificant. Hedgerow removal shall be carried out outside of the breeding season. It is not considered that the species will be significantly negatively affected as a result of the proposed development.	N
Grey wagtail, *Motacilla cinereal*	Unlikely to breed in the Study Area, which offers little in terms of riparian and riverine habitats. However, it is possible that the small stream/ditch to the south of the mainland side of the site of the proposed development is used. Study Area likely to be used for foraging outside of the breeding season. It is not anticipated that the proposed development will result in significant negative effects on any habitat likely to be used by the species.	N
Barred warbler, *Sylvia risorii*	Rare vagrant which does not breed in the Study Area. It is considered highly unlikely that the species will be significantly adversely affected by the proposed development.	N
Dartford warbler, *Sylvia undata*		
Red-breasted flycatcher, *Ficedula parva*		

Species/Habitat	Description	KER? (Y/N)
Common crane, *Grus grus*	Very rare vagrant which does not breed in Ireland anymore and which has not been sighted in the Study Area in approx. 40 years. It may be stated with a fair degree of certainty that the species will not be significantly adversely affected by the proposed development.	N
Invertebrates	Area of habitat/vegetation loss as a result of the proposed development will be minimal. As such, it is unlikely that these invertebrate species will be significantly negatively affected by the proposed development.	N
Betony, *Betonica officinalis*	The Zone of Influence is a refuge for this rare plant species. Clusters of the plant which may have been destroyed as a result of construction of the proposed development have been translocated and no other plants have been identified in the area. However, it is possible that the plant does or will occur in other sensitive areas in the Zone of Influence and may be damaged or destroyed as a result of the construction or operation of the proposed development.	Y
Sea frillwort, *Fossombronia maritima*	There is only location in the Zone of Influence where the species has been recorded (NBDC, 2019). It is at Garinish Head (approx. coordinates: 51.618250, -10.137099). Since no development will occur in this area, and since the Garinish Loop walk does not pass in the immediate vicinity of the location, it not considered likely that the proposed development will give rise to any significant negative effects on the occurrence of the species.	N
Sea pea, *Lathyrus japonicus*	Species has only been recorded at only one location within the Study Area, which is a substantial distance from any proposed works, and was not sited in the site of the proposed development during ecological field surveys. Areas of optimal habitat will not be affected, and it is considered highly unlikely that the species will be negatively affected as a result of the proposed development.	N
Invasive Alien Species	There are a number of IAPS with potentially very high negative ecological impacts in the Zone of Influence, including on Dursey Island, which, as an island, is especially vulnerable to the negative effects of IAS. The potential introduction and distribution of IAS cannot be ruled out. As such, there are potential significant negative effects associated with these species. The presence of hottentot-fig is noteworthy, since this species is at a very early stage of invasion in Ireland, and, as such, there is an opportunity to contribute to the eradication/prevent the broader establishment of this relatively novel IAPS.	Y
Large shallow inlets and bays [1160]	The entire marine area in the vicinity of the cableway, including the Dursey Sound, corresponds to this habitat classification. As such, potential negative effects as a result of the proposed development cannot be ruled out.	Y
Reefs [1170]	Much of the seabed in the vicinity of the proposed development, including the Dursey Sound, which the proposed cableway would traverse, corresponds to this habitat classification. Owing to the proximity of the proposed development to this habitat type and the sensitivity of the latter to water quality impacts, which may arise during construction, there is considered to be a risk of significant negative effects on this habitat type arising from the proposed development.	Y
Vegetated sea cliffs of the	The cliffs in the immediate vicinity of the cableway correspond to this habitat classification. Owing to the proximity of the proposed development to this habitat type and the potential for increased erosion due to walkers and the risk of import	Y

Species/Habitat	Description	KER? (Y/N)
Atlantic and Baltic coasts [1230]	of IAS to the area, there is considered to be a risk of significant negative effects on this habitat type arising from the proposed development.	
European dry heaths [4030]	The heath habitats in the immediate vicinity of the site of the proposed development potentially correspond to this habitat type. As such, there is a potential for negative effects on the habitat as a result of the proposed development.	Y
Submerged or partially submerged sea caves [8330]	There are at least eight such sea caves within or adjacent to the Zone of Influence, mostly on Crow Head (north-west of the mainland side of the site) and Dursey Island. The nearest known occurrence of this habitat type is c. 1 km west of the existing cableway. As such, it is unlikely to be significantly negatively affected by the proposed development.	N

7.6 'Do Nothing' Scenario

Were the proposed development not to proceed, the existing Dursey Island Cable Car would continue to operate as it does at present in the short to medium-term. The number of visitors to Dursey Island would continue to be limited by the capacity of the existing infrastructure to somewhere in the region of 22,000 visitors annually. Thus, the level of direct human effects on biodiversity on Dursey would not be likely to increase substantially in the 'do nothing' scenario.

However, it is unlikely that the existing cableway infrastructure (which is already substantially corroded and non-compliant with European Union safety standards) could be maintained in safe working order in the medium to long-term. Closure of the Dursey Island Cable Car for safety reasons would significantly impair access to the island, since seafaring conditions in the Dursey Sound are not permissive of the establishment of a dedicated ferry service. Depopulation has been identified as an existing threat to the island (RPS & West Cork Islands Interagency, 2010) and a small amount of land abandonment is already in evidence. Any development (or lack thereof) which negatively affects access to the island for residents and/or farmers is likely to contribute to further land abandonment, which in turn would result in a decrease in the available area of suitable chough foraging habitat. Thus, failure to upgrade the cableway infrastructure might conceivably result in indirect negative effects on the resident chough population.

The mainland side of the site, meanwhile, would continue to be subject to unmanaged visitor footfall – and potentially a greater volume of unmanaged visitor footfall, considering the anticipated growth trend in the Irish tourist sector in the short to medium term. If appropriate mitigation measures were not put in place in the coming years, soil compaction, erosion and de-vegetation (already in evidence (Crushell *et al*., 2015; CAAS Ltd., 2016; 2018)) would continue as a result of visitors wandering from paved areas onto open grassland and heathland in the environs of the mainland side of the site. IAS along the R572 approach road (*Rhododendron* and Japanese knotweed) would most probably spread laterally along the road in both directions (due to traffic). IAS on Dursey Island (particularly Japanese knotweed) would potentially increase in cover on the island.

7.7 Description of Likely Effects (Unmitigated)

7.7.1 Effects on Natura 2000 Sites

The Zone of Influence overlaps with two Natura 2000 sites – the Beara Peninsula SPA and the Kenmare River SAC. As likely significant effects on these sites could not be excluded at the screening stage, an Appropriate Assessment (AA) was deemed necessary and a Natura Impact Statement (NIS) has been prepared for the proposed development. This NIS presents all of the predicted effects on these sites and their Qualifying Interests and also provides a detailed analysis and evaluation of these effects in the context of the relevant Conservation Objectives. The NIS also prescribes mitigation measures to address any negative effects identified. As such, there is some overlap between this EIAR Chapter and the NIS for the proposed development. However, both the EIAR and NIS for the proposed development are standalone documents which do not rely on each other.

7.7.2 General Impacts on Key Ecological Receptors

General impacts on biodiversity that are typical of development are described in this section. Negative effects on specific KERs are discussed thereafter in Table 7.25.

7.7.2.1 Habitat Loss

The construction of the proposed development will lead to the permanent loss of small areas of grassland and heathland, neither of which has been deemed to constitute Annex I habitat. On the mainland, the extension of the footprint of the cable car site will result in the loss of some small areas of dry-humid acid grassland, dry siliceous heath and dry meadows and grassed verges. The total area of habitat loss has been estimated at 0.8ha (7,936m²). There is an abundance of these habitat types in the Zone of Influence and the broader study area. As such, it is not considered that this small loss of habitats will constitute a significant negative effect on biodiversity in the Study Area.

The proposed development will not result in habitat fragmentation.

7.7.2.2 Disturbance due to Construction Phase Noise and Vibration

Some disturbance may occur during construction and operation as a result of noise, lighting and vibration. Noise and vibration generated by activities carried out during the construction of the proposed development (including earthworks and the use of marine vessels to transport materials to-and-from Dursey Island) may result in some moderate, temporary disturbance of wildlife in the vicinity. However, since the most disruptive elements of the proposed works will be carried out outside of the breeding season, when populations of wildlife tend to be less susceptible to disturbance, it is not considered that the generation of noise/vibration associated with the proposed works will result in significant negative effects on any resident/regularly occurring species.

7.7.2.3 Human Disturbance

Disturbance of fauna may occur during operation as a result of the presence of humans. Disturbance of species of fauna in their natural habitats may result in reduced time spent foraging and/or elevated levels of stress – both of which might directly or indirectly threaten the viability of the population in question. Since the proposed development will increase the number of visitors on Dursey Island and (potentially) also on walking routes in the vicinity of the proposed development on the mainland, human disturbance of certain species of fauna may also occur at levels that have significant negative effects. Additionally, research has shown that the walking of dogs in natural recreation areas has negative effects on biodiversity (a 35% reduction in avian species diversity and a 41% reduction in abundance (Banks & Bryant, 2007)).

7.7.2.4 Reduction in Water Quality

Construction and operational activities within and adjacent to surface waters can negatively impact on water quality in a variety of ways. Key pathways for negative ecological effects are discussed below. Specific pathways for negative effects on KERs identified above are discussed in Table 7.23, below.

Surface water run-off from construction areas has the potential to contain high levels of suspended sediments and other pollutants. Such run-off, if not attenuated and treated prior to discharge, has the potential to cause significant ecological impacts. Large amounts of fine sediment deposition can smother benthic habitats, leading to changes in biological composition.

During construction, concrete, grout or other pollutants may spill directly into the local environment or be washed into the water in construction site run-off. These materials are highly alkaline and, consequently, can drastically alter the pH of the receiving water body. This can lead to profound ecological impacts and can affect the condition of habitats by causing damage to pH-sensitive species.

Vehicles, marine vessels, plant and equipment which will be used during construction rely on hydrocarbons such as diesel, petrol and lubricating oils. Leaks from poorly maintained vehicles, plant, equipment or storage tanks provide for a risk of input of hydrocarbons into the environment. In the absence of appropriate mitigation, hydrocarbons from the construction site may spill directly into sea or be washed into the adjacent drainage ditch/stream in construction site run-off – and thereby, ultimately enter the sea also. This has the potential to cause negative ecological impacts on coastal and marine habitats present. Hydrocarbons can have direct toxic effects, including reducing the ability of organisms to absorb water and nutrients. Hydrocarbons can also alter the nutrient balance and microbiota in soil and water, which can benefit some species while detrimentally affecting others. Such changes have the potential to alter the ecological community structures and ecological integrity of habitats.

Inadequate treatment of wastewater from on-site toilets and washing facilities also provides for potential water quality impacts which could lead to ecological effects. Faecal contamination can alter the nutrient balance in soils and water, causing significant changes in microbial communities and reductions in oxygen levels. This can have significant effects on the biological composition of receiving habitats.

7.7.2.5 Direct Mortality

The operation of the proposed development, specifically the use of glass facades and windows, has the potential to lead to bird mortality through collision. However, since the scale of the buildings and associated glass facades in question is relatively small, and the buildings are low-rise, it is not considered that this aspect of the proposed development will present a significant negative effect for any of the identified KERs.

Direct mortality is also possible as a result of demolition works, particularly where nesting birds and roosting bats are concerned. However, no birds have been identified nesting in any structures proposed to be demolished. The presence of occasional bat roosts, however, cannot be ruled out. Potential impacts on bats are discussed in Table 7.23, below.

Increased traffic as a result of the proposed development will also increase likelihood of vehicular collisions with wildlife. It is not considered, however, that this presents a significant negative effect for any of the KERs identified.

The new cableway may potentially pose an increased collision risk for resident species of birds, particularly as a result of the increased number of cable cars (two cars as opposed to one, at present), the increased maximum speed of the cable cars (maximum speed = 6 m/s as opposed to approx. 0.9 m/s at present), and the presence of two (as opposed to just one) ropeway. These potential risks have been considered and it has been concluded that the proposed cableway does not present a significantly greater risk to birds. This is because (i) the cable cars will be clearly visible to birds (i.e. they will not be entirely composed of reflective glass, for instance, which is known to pose a collision risk (Klem, 2009)), (ii) the cable cars will still travel at a relatively slow speed (max. operating speed of 6 m/s or 21.6 km/hr), which birds are expected to be able to avoid, and (iii) the two ropeways will be in the same horizontal plane and, as such, will not pose a greater collision risk than the single ropeway does at present. With respect to the existing cableway, there is only one known occurrence of a bird strike – an incident involving a gannet. Besides this incident, according to the regional NPWS Conservation Ranger and one of the cable car operators, there have been no known bird strikes. While it is not possible to be certain that additional such strikes have not occurred – since if a bird were to collide with the cableway outside of the normal operating hours, it would likely fall into the sea – it is considered that the

occurrence of such strikes at present is very rare. It should also be noted that, although the max. operating speed of the proposed cableway is 6 m/s, in order to maintain the experiential qualities of the cable car journey, the outbound cable car will continue to operate at the existing speed (excluding when there are only residents in the cable car, or in case of emergency). Additionally, the key avian species of conservation concern in the area – red-billed chough – is a highly intelligent corvid species which is very unlikely to fly into the cableway. Furthermore, the Study Area is not known to support important populations of heavy-bodied avian species which are especially sensitive to collision with ski-lifts/overhead lines, such as species of the Order Galliformes (e.g. grouse, ptarmigan) (Miquet, 1990; Bevanger & Brøseth, 2004; Watson & Moss, 2004; Buffet & Dumont-Dayot, 2013). Nor is it on a flyway for geese or swans which are also prone to collision with overhead lines.

7.7.3 Impacts on Key Ecological Receptors

Impacts on the Key Ecological Receptor as defined in the preceding sections are described in Table 7.25.

Table 7.25 Impact characterisation for Key Ecological Receptors based on EPA (2017) and TII (2009)

KER	Construction	Operation	Significance if Unmitigated
Bats	There is a low likelihood that demolition of structures during the construction of the proposed development could result in the destruction of occasional bat roosts. Furthermore, if demolition were to occur during the summer months, when bats are using the area for foraging, there would be a greater probability of direct mortality of roosting bats during works.	Lighting at the proposed development may have detrimental effect on bat species, particularly if UV lighting is used and/or if lighting is situated near to potential roost sites.	Moderate, negative
Red-billed chough, *Pyrrhocorax pyrrhocorax*	Disturbance due to proposed construction works unlikely since disruptive aspects of works will be confined to off-season months (i.e. outside of chough breeding season) no confirmed nesting or roosting sites were identified in the immediate vicinity of the site of the proposed development during breeding bird surveys. Significant negative effects, therefore, unlikely at this stage.	If visitor numbers to Dursey Island during the operation of the proposed development were uncontrolled, it is considered that harmful levels of human disturbance of chough could occur. The western end of Dursey Island (a chough 'hotspot') and the potential roost sites at *Cuas na gColúr* and *Brann Righe* (Plate 7.9) are especially sensitive to human disturbance. Visitors' dogs and cyclists also pose a potential source of disturbance and it is likely that the number of dogs/bicycles being taken to the island would increase. Furthermore, if visitor movements on the island were unmanaged, greater numbers of visitors could wander over open habitat, causing degradation and destruction of potential foraging habitat.	Significant, negative
European herring gull	Significant negative effects unlikely.	Food scraps (litter) left outdoors by visitors to the proposed development could attract species of gulls and/or facilitate growth in resident gull populations. Since certain gull species are known to predate other seabirds and their eggs/offspring, litter could indirectly lead to significant negative effects on sensitive seabird populations at the site (including chough, for example).	Slight, negative

KER	Construction	Operation	Significance if Unmitigated
Great black-backed gull	Significant negative effects unlikely.	Food scraps (litter) left outdoors by visitors to the proposed development could attract species of gulls and/or facilitate growth in resident gull populations. Since certain gull species are known to predate other seabirds and their eggs/offspring, litter could indirectly lead to significant negative effects on sensitive seabird populations at the site (including chough, for example).	Slight, negative
Ground-nesting Passerines	Significant negative effects unlikely.	If visitor numbers to Dursey Island and the movement of visitors during the operation of the proposed development were unmanaged, it is considered that harmful levels of human disturbance of ground-nesting birds and/or destruction of nests could occur.	Moderate, negative
Raptors	Significant negative effects unlikely.	If potential significant negative effects on prey items (e.g. ground-nesting passerines) were unmitigated, population declines in these species could result in indirect negative effects on species of raptors foraging in the Zone of Influence.	Slight, negative
Common snipe,	Significant negative effects unlikely.	If visitor numbers to Dursey Island and the movement of visitors during the operation of the proposed development were unmanaged, it is considered that harmful levels of human disturbance of ground-nesting birds and/or destruction of nests could occur.	Slight, negative
Eurasian oystercatcher,	Significant negative effects unlikely.	If visitor numbers to Dursey Island and the movement of visitors during the operation of the proposed development were unmanaged, it is considered that harmful levels of human disturbance of ground-nesting birds and/or destruction of nests could occur.	Slight, negative
Betony, *Betonica officinalis*	It is conceivable that plants/clusters of plants of betony not already identified and translocated could be destroyed during construction works.	It is conceivable that plants/clusters of plants of betony not already identified and translocated could be destroyed during the operation of the proposed development, particularly as a result of increased visitor footfall in open grassland.	Moderate, negative

KER	Construction	Operation	Significance if Unmitigated
Invasive Alien Species	IAS, particularly IAPS, could be introduced and/or distributed by the movement of marine vessels/plant/equipment used during construction works and/or by the importing of construction materials into the site. It is not considered that there is an increased risk of dispersal of hottentot-fig at this stage.	IAS, particularly IAPS, could be introduced and/or distributed by the movement of traffic/visitors/equipment (e.g. fishing and watersports gear). Dursey Island is especially vulnerable to the introduction of IAPS. There will be an increased risk of dispersal of hottentot-fig as a result of increased visitor footfall in the immediate vicinity of the occurrence.	Significant, negative
Large shallow inlets and bays [1160]	Potential run-off of pollutants (including cement-based products, hydrocarbons, and untreated wastewater) and sediment loading to sea could occur during construction works, potentially negatively affecting the ecological integrity of the habitat. Marine IAS (such as leathery sea-squirt (*Styela clava*), carpet sea-squirt (*Didemnum vexillum*), slipper limpet (*Crepidula fornicata*) and Japanese wireweed (*Sargassum muticum*)) could be introduced and/or dispersed by the movement of marine vessels/plant/equipment in the marine environment during construction works. Colonisation of the habitat by marine IAS would likely negatively alter community structures.	During the operation of the proposed development, run-off of pollutants (e.g. hydrocarbons, salt), sediment loading, and discharge of improperly treated wastewater or spillage of untreated/partially treated wastewater into habitat (unlikely to occur but possible) could negatively affect the ecological integrity of the habitat.	Moderate, negative
Reefs [1170]	Potential run-off of pollutants (including cement-based products, hydrocarbons, and untreated wastewater) and sediment loading to sea could occur during construction works, potentially negatively affecting the ecological integrity of the habitat. Marine IAS (such as leathery sea-squirt (*Styela clava*), carpet sea-squirt (*Didemnum vexillum*), slipper limpet (*Crepidula fornicata*) and Japanese wireweed (*Sargassum muticum*)) could be introduced and/or dispersed by the movement of marine vessels/plant/equipment in the marine environment during construction works. Colonisation of the habitat by marine IAS would likely negatively alter community structures.	During the operation of the proposed development, run-off of pollutants (e.g. hydrocarbons, salt), sediment loading, and discharge of improperly treated wastewater or spillage of untreated/partially treated wastewater into habitat (unlikely to occur but possible) could negatively affect the ecological integrity of the habitat.	Moderate, negative

KER	Construction	Operation	Significance if Unmitigated
Vegetated sea cliffs of the Atlantic and Baltic coasts [1230]	There is a potential risk of introduction/dispersal of IAPS due to the movement of marine vessels/plant/equipment used during construction works and/or by the importing of construction materials into the site. Introduction/dispersal of IAPS would negatively alter the plant community structures of vegetated sea cliffs and certain species could potentially increase the rate of erosion of cliffs. Management of established IAPS on sea cliffs would be very challenging.	There is a potential risk of introduction/dispersal of IAPS due to the movement of traffic/visitors/equipment (e.g. fishing and watersports gear). Introduction/dispersal of IAPS would negatively alter the plant community structures of vegetated sea cliffs and certain species could potentially increase the rate of erosion of cliffs. Management of established IAPS on sea cliffs would be very challenging. Unmanaged increased visitor footfall in the vicinity of cliffs could also give rise to de-vegetation and soil erosion. However, much of the area of this habitat is inaccessible to visitors.	Moderate, negative
European dry heaths [4030]	There is a potential risk of introduction/dispersal of IAPS due to the movement of marine vessels/plant/equipment used during construction works and/or by the importing of construction materials into the site. Introduction/dispersal of IAPS would negatively alter the plant community structures of this habitat type.	There is a potential risk of introduction/dispersal of IAPS due to the movement of traffic/visitors/equipment (e.g. fishing and watersports gear). Introduction/dispersal of IAPS would negatively alter the plant community structures of this habitat type. Unmanaged increased visitor footfall on open heathland could also give rise to de-vegetation and soil erosion.	Moderate, negative

7.7.4 Impacts on Population and Human Health

There is a growing body of research indicating that there are causative relationships between positive psychosocial health/wellbeing and (i) recreation in the natural environment (Coon *et al*., 2011; Hartig *et al*., 2014) and (ii) exposure to biodiversity (Sandifer *et ai*., 2015; Prescott *et al*., 2016). Thus, it is conceivable that biodiversity loss and/or habitat destruction/degradation can have negative implications for human health. Additionally, since the Study Area is a popular destination for nature-based recreation, particularly fishing, whale and dolphin watching and birdwatching, significant biodiversity loss (particularly of species of fish, marine mammals and birds) in the Zone of Influence will almost certainly diminish the recreational value of the area.

It is considered that, provided the mitigation measures set out in this Chapter are adhered to, no negative effects on population and human health related to biodiversity will occur.

7.8 Mitigation

This section describes the measures that are in place to mitigate any harmful or negative impacts associated with the proposed development and the identified Key Ecological Receptors, as described in the preceding sections. General mitigation measures included within the design of the proposed development are described first, with more specific measures to prevent or minimise impacts on the individual receptors provided subsequently.

7.8.1 Establishment of a Numerical Carrying Capacity for Dursey Island

As part of the mitigation measures for the operation of the proposed development set out in this Chapter (see Section 7.8.4), a monthly numerical visitor carrying capacity ('carrying capacity' hereafter) is prescribed for Dursey Island in order to conserve the resident chough population. This section explains how the carrying capacity has been calculated and why it is considered appropriate for the environmental context in question.

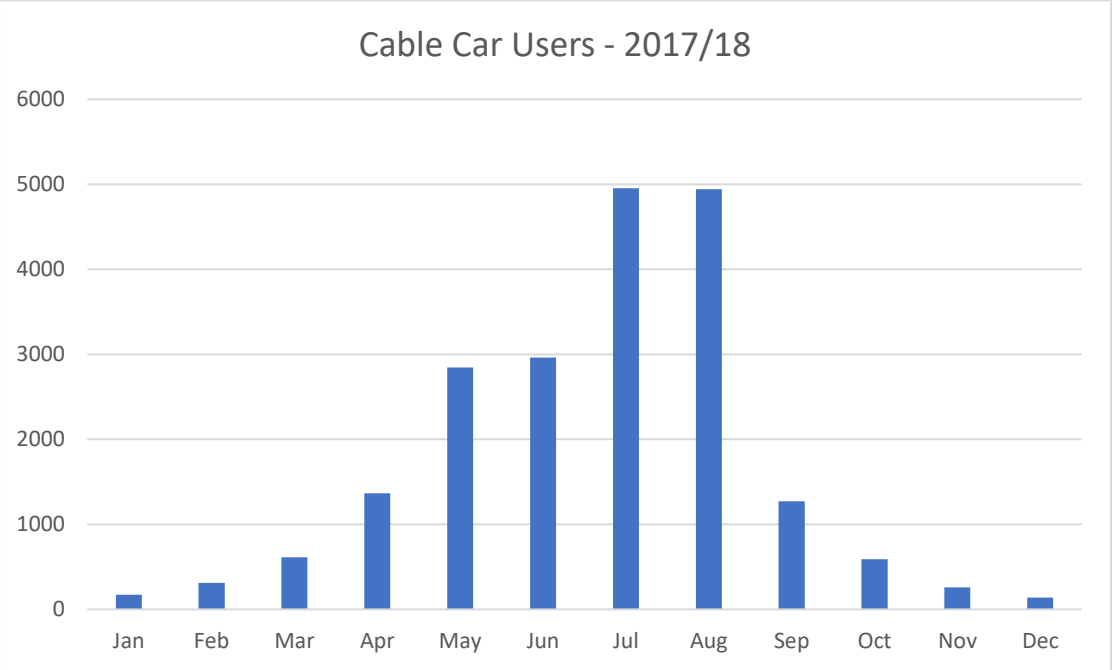

Plate 7.14 **Monthly visitor profile for Dursey Island Cable Car (based on 2017/18 ticket sales)**

Current visitor numbers (2017/18) to Dursey Island are approximately 20,424 per year (Table 7.28; Plate 7.14). Visitor numbers are highly seasonal, with between 140 and 313 visitors per month during the winter months (November – February; 2017/18) and 4,954 and 4,943 per month during the peak months of July and August, respectively – when the cableway operates continuously, at capacity, between the opening hours of 9.30am – 7.30pm Monday – Sunday[1] (Plate 7.14). Thus, over the two peak months of the year, Dursey receives approximately 50% of its annual visitor numbers. If it were not for the existing limited capacity and turnover of the cableway, it is highly likely that substantially more people would travel to the island during these peak months.

The proposed development will increase the capacity and turnover of the Dursey Island Cable Car substantially, allowing a greater number of annual visitors to the island. At the commencement of the Design Stage, CCC decided that the proposed development should be designed to accommodate no more than 100,000 annual visitors with no more than 80,000 of these being permitted to make the cable car journey to Dursey Island, in spite of the fact that the cableway infrastructure could potentially accommodate significantly more[2]. Assuming the monthly profile of visitor numbers (Plate 7.14) were to remain the same, there would be a fourfold increase in visitor numbers during each month of the year (including during the chough breeding and fledging season). However, it is unlikely that this increase in visitor numbers would be distributed proportionately across the year. Rather, it is most likely that demand would continue to be concentrated during the summer months of July and August. Thus, without control measures in place, the number of visitors on the island during July and August (when choughs are breeding, nesting and fledging) could be over four times greater than it is at present.

In their longitudinal study of the chough population of Ouessant Island, France, Keribiou *et al*. (2009; Appendix 7.3) estimated a numerical carrying capacity for the island in terms of human disturbance of chough. They did so by developing a numerical model based on data for chough breeding success and visitor numbers over 8 years. The study concluded that in order to sustain a viable chough population on Ouessant, the number of visitors to the island should not exceed 16,500 in August – the most sensitive period for the population in question.

The scope and breadth of data employed by Keribiou *et al*. (2009) to calculate a carrying capacity for Ouessant is not available for Dursey Island. Thus, the exact same methodology cannot be applied to calculate a carrying capacity for Dursey Island. It is possible, however, to extrapolate a carrying capacity based on one key variable – area of chough foraging habitat (km^2)[3]. Dursey Island has an area of 5.98km^2. The habitats on the island have been mapped and it is considered that, with the exception of roads, paths and artificial structures (which have a negligible area), the vast majority of land on the island constitutes suitable foraging habitat. Ouessant Island is approximately 2.6 times the size of Dursey, with an area of 15.41km^2. However, on Ouessant, suitable chough foraging habitat is restricted to 7.7km^2 of coastal habitat (Keribou *et al*., 2009, S1; Keribiou, pers. comm., 2019). Thus, Ouessant Island has about 1.3 times the area of chough foraging habitat as Dursey. Extrapolating accordingly, we

[1] 9.30am – 9.30pm on 5th – 7th of July and 2nd – 5th August

[2] Each carrier cabin in the proposed cableway will accommodate approx. 15 persons. Depending on the velocity of the cabins and the cabin layout, the cableway will be able to convey approx. 170 – 330 p/h in each direction, and there are two carrier cabins in the proposed design. Given typical operating hours (10h/day), the cableway could transport approx. between 3,400 – 6,600 persons to the island per day.

[3] This variable – rather than the absolute area of the island – was considered to provide a more accurate picture of the scenario on Dursey Island (in terms of chough conservation) relative to Ouessant, since only a proportion of the total area of Ouessant Island (approximately half) provides suitable chough foraging habitat.

can conclude that Dursey should accommodate no more than 12,835 visitors per month. A breakdown of the corresponding calculations are presented in Table 7.26 and 7.27, below.

Table 7.26 Information used to calculate numerical carrying capacity for Dursey Island in terms of human disturbance of chough

Information Available	Figure	Source
Carrying capacity of Ouessant Island, France, for month of August	16,500 people	Keribiou *et al*., 2009
Area of Ouessant Island	1541ha = 15.4100km²	Keribiou *et al*., 2009
Area of chough foraging habitat on Ouessant Island	7.6875km²	Keribiou *et al*., 2009
Area of Dursey Island	5.9800km²	Google Maps, 2019
Area of chough foraging habitat on Dursey Island	~ 5.9800km²	2019 habitat mapping of Dursey Island

Table 7.27 Extrapolation of numerical carrying capacity for Dursey Island in terms of human disturbance of chough, following Keribiou et al. (2009)

Calculations
$$\frac{7.6875}{5.9800} = 1.2855351171$$
→ Hence, Ouessant Island has 1.2855351171 times the area of chough foraging habitat of Dursey Island
$$\frac{16{,}500}{1.2855351171} = 12{,}835.121950788$$
→ Hence, the CC of Dursey Island for August = 12,835 people

It is considered that this carrying capacity constitutes a conservative number, since Ouessant Island differs substantially from Dursey Island in a number of respects which have negative implications in terms of human disturbance of chough in Ouessant, including the following:

(i) Unlike the chough population on Dursey Island, the population on Ouessant Island is essentially geographically restricted to the island and this isolation means birds are reliant on habitats on the island for their entire life cycle. Dursey Island is approx. 200m from the mainland and baseline studies (2003-04) conducted on the Beara Peninsula indicated that there is movement between Dursey Island and the mainland; especially during the post-fledging period in July and August when large post-fledgling flocks were recorded foraging on the western gorse (*Ulex galli*) dominated dry heaths of the interior spine of the peninsula (Trewby *et al*. 2005). During the 2019 breeding season survey, choughs were observed to fly back-and-forth between island and mainland. Ouessant, in contrast, is located 20km from the French coastline; and this distance combined with the absence of a chough population on the adjacent mainland means the Ouessant choughs are essentially isolated to the island (Plate 7.16).

(ii) The existing network of paths/roads on Ouessant Island is much more extensive than that on Dursey Island (Plate 7.15). On Dursey, walking routes used by visitors are largely situated inland, along the high elevation spine of the island

and immediately south of it, while on Ouessant, there are cliff-side walking trails along the entire coastline. As such, a much greater proportion of chough foraging habitat is affected by human disturbance on Ouessant (up to 97% (Keribiou *et al*., 2009)) than on Dursey (22%). However, it should be noted that, while the current walking routes on the island are geographically fairly restricted, it cannot be guaranteed that visitors to Dursey Island will not forge new paths on the island in future.

Plate 7.15 Satellite image of Ouessant Island, France, showing extent of roads and paths. Source: Google Maps

(iii) Ouessant has much more developed transport infrastructure than Dursey. The island has an airport and an extensive network of roads. Noise generated by cars and airplanes may cause some degree of disturbance of the Ouessant choughs. On Dursey, there is only one public road, which is restricted to the inland high elevation spine of the island and used only by residents and one private bus which operates seasonally.

(iv) Results from breeding bird surveys indicate that the average flush distance of choughs on Dursey Island during the breeding season (31.6m (N = 49 observations; min. = 10m; max. = 150m; median = 30m)) is less than that of choughs on Ouessant (147 ± 23m for flocks with juveniles and 75 ± 9m for flocks without juveniles), suggesting that the Dursey choughs may be more tolerant of or habituated to the presence of humans.

Plate 7.16 **Satellite image of Dursey Island (top) and Ouessant Island (bottom) showing comparative distances from the mainland (185m and 18km, respectively). Source: Google Maps**

It should also be noted that, while the environmental context on Ouessant differs substantially from that on Dursey Island, there are similarities between the two cases which have permitted the extrapolation of a numerical carrying capacity:

- Both are offshore islands with resident breeding populations of red-billed chough; and,
- Both are popular destinations for walkers with increasing visitor numbers over time.

Thus, it is considered that, if visitors numbers to Dursey Island are capped at 12,835 per month, the viability of the resident chough population will not be threatened by human disturbance. This is assuming that (i) mitigation measures are implemented to minimise human disturbance (particularly to keep visitors on waymarked walking routes), and (ii) the existing grazing regime is maintained.

Assuming the current annual visitor number growth rate (24.67%; Plate 7.17) is maintained and that this growth rate is distributed evenly throughout the year, with the exception of months when the capacity is limited by (a) the capacity of the existing cable car or (b) the proposed monthly carrying capacity, visitor numbers in the first and second year of operation would be approx. 51,825 and 58,803, respectively (Table 7.28). Since it is anticipated that the proposed development will generate fresh interest in the site, and because enhanced facilities at the proposed development (e.g. toilets, shelter, café) are expected to 'broaden the peak' of the current visitor profile (i.e. there will likely be more visitors outside of the traditional peak months of July and August), it

is possible that annual growth will exceed 25% in the first few years of the operation of the proposed development. Resultant growth, however, is inestimable. Either way, visitor numbers can be restricted to 12,835 per month in each month of the year and (on Dursey Island) will not be allowed to exceed 80,000 in any one year – a level at which it is considered human disturbance will not jeopardise the viability of the chough population.

Since the cable car constitutes the only feasible means for visitors to access Dursey Island, and a web-based ticketing system will be employed, constraining visitor numbers will be straightforward.

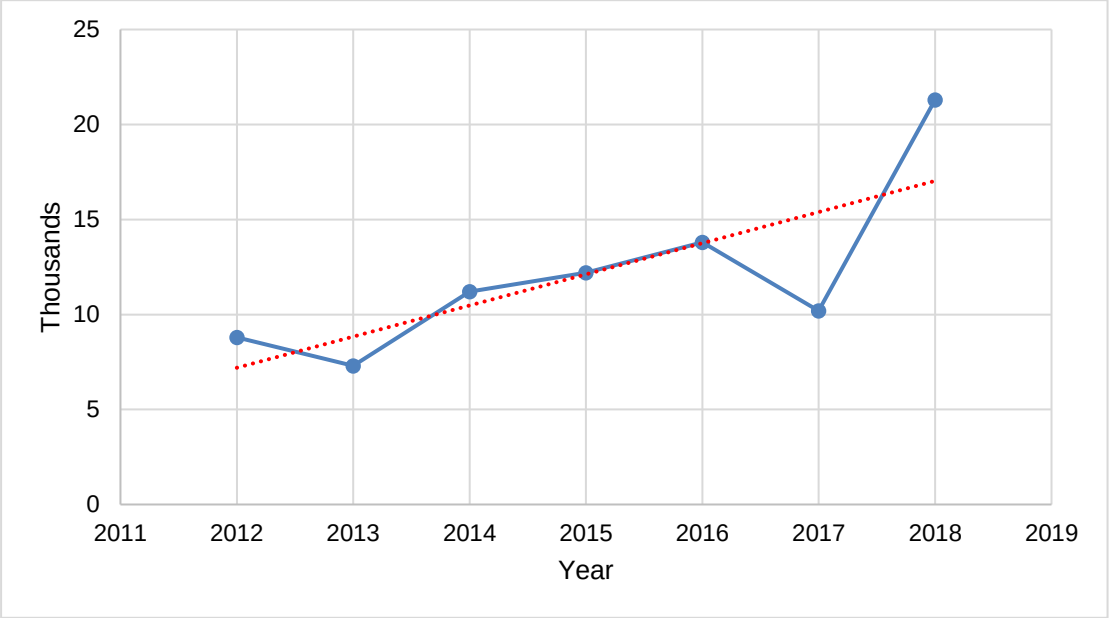

Plate 7.17 Annual number of trips made on Dursey Island Cable Car (2011 – 2019)

Table 7.28 Current and projected visitor numbers on Dursey Island with the proposed monthly carrying capacity imposed during the operation of the proposed development, assuming annual growth of 24.67% distributed evenly across months.

Month	Existing Cable Car – Year of Operation					Proposed Cable Car – Year of Operation	
	2017/18	2019 Projections (2017/18 + 24.67%)	2020 Projections (2019 + 24.67%)	2021 Projections (2020 + 24.67%)	2022 Projections (2021 + 24.67%)	2023 Projections [First Year of Operation] (2022 + 24.67%)	2024 Projections [Second Year of Operation] (2023 + 24.67%)
Jan	172	214	267	333	416	518	646
Feb	313	390	486	606	756	943	1,175
Mar	613	764	953	1,188	1,481	1,846	2,302
Apr	1,366	1,703	2,123	2,647	3,300	4,114	5,129
May	2,844	3,546	4,420	4,954*	4,954*	6,176	7,700
Jun	2,960	3,690	4,601	4,954*	4,954*	6,176	7,700
Jul	4,954*	4,954*	4,954*	4,954*	4,954*	12,835**	12,835**
Aug	4,943	4,954*	4,954*	4,954*	4,954*	12,835**	12,835**
Sep	1,271	1,585	1,975	2,463	3,070	3,828	4,772
Oct	589	734	915	1,141	1,423	1,774	2,212
Nov	259	323	403	502	626	780	972
Dec	140	175	218	271	338	422	526
Total	**20,424**	**23,032**	**26,270**	**28,968**	**31,225**	**51,825**	**58,803**

* = Numbers constrained by existing cable car capacity and would otherwise be higher

** = Numbers constrained by carrying capacity and would otherwise be higher

*** = 24.67% growth in each month of the year, excl. in months when numbers are

7.8.2 Mitigation by Design

The proposed development has been developed having regard to EU and Irish legislation and all relevant guidelines in relation to ecology and engineering best practice for the planning and construction of proposed developments. These guidelines provide practical measures that can be incorporated into the design to minimise impacts and protect the receiving environment. The following is an overview of the design measures that will be employed to minimise and avoid significant impacts on the ecological receptors within the Zone of Influence:

- It is proposed to carry out the most disruptive (i.e. noisy) elements of the construction works during the winter months. This will minimise associated disturbance on resident or regularly occurring breeding populations of wildlife.
- The lighting plan has been designed to minimise impacts on biodiversity and nature-related recreation. Low level bollard lighting has been selected for outdoor areas. No roadside lighting has been included in the design. Lighting design of the proposed development has been executed in accordance with *'Guidance Notes For The Reduction Of Obtrusive Light'* (Institution of Lighting Engineers, 2011) and '*Guide on the Limitation of the Effects of Obtrusive Light from Outdoor Lighting Installations'* (Pollard *et al*., 2017). Use of low level lighting will minimise potential negative effects on bats and prevent any potential light pollution or visual intrusion at the nearby Kerry Dark Sky Reserve, an important site for star-gazing.
- The drainage and wastewater treatment system has been designed to provide a high level of attenuation and water quality controls. The surface water drainage system is comprised predominantly of Sustainable Drainage Systems (SuDS) technology. The proposed drainage system of the retaining wall includes a hydrocarbon interceptor. After passing through these elements, run-off will percolate through soil before being discharged to sea.
- Of the design options considered for the proposed development at Options Stage (detailed in Chapter 3 of this EIAR), the smallest scale design has been chosen so as to minimise the area of natural habitat lost. Any areas of natural habitat degraded or destroyed as a result of the construction phase, that are not within the footprint of the proposed buildings/structural elements, will be restored to grassland/heathland.

7.8.3 Construction Phase Mitigation

The following general mitigation measures will be employed to minimize potential significant negative effects on biodiversity which might arise during the construction of the proposed development.

- A Construction Environmental Management Plan (CEMP) shall be developed by the Contractor prior to the commencement of works. This document serves to ensure that the construction of the proposed development does not lead to any unanticipated negative impacts on the environment. It shall be developed in accordance with the description of the CEMP set out in Chapter 4 of this EIAR – Description of the Proposed Development – and based on the Outline CEMP which has been included in Appendix 4.1 of this EIAR.
- An Environmental Operating Plan (EOP) shall be developed by the Contractor prior to the commencement of works. This document sets out the protocol for addressing environmental issues which may arise during the construction phase. This document shall be developed in accordance with the TII (formerly NRA) guidelines, '*Guidelines for the Creation and Maintenance of an Environmental Operating Plan*' and based on the Outline EOP which has been included in Appendix 4.2 of this EIAR.

- The Contractor will appoint a Site Environmental Manager (SEM) prior to the commencement of works. This person shall be responsible for carrying out environmental monitoring of the works and ensuring that the mitigation measures proposed in this EIAR (as well as the CEMP and EOP) are adhered to.
- An Ecological Clerk of Works (ECoW) shall be appointed by CCC prior to the commencement of works. It shall be their responsibility to supervise and provide recommendations on the execution of any and all works which have the potential to give rise to negative effects on biodiversity/ecological integrity.
- In order to prevent/minimise potential negative effects as a result of the introduction and/or spread of terrestrial and aquatic IAS during the construction of the proposed development:
    - An IAS Management Plan [Appendix 7.1] has been developed and shall be implemented, as required, during the construction of the proposed development.
    - Landscaping of the proposed development shall use native species of plants of national provenance only and, insofar as possible, soil reused from on-site excavations. If soil/substrate needs to be imported to the site for the purposes of the proposed development, the Contractor shall ensure that the imported soil/substrate is free from IAS.
    - All land-based construction works shall be executed in accordance with the TII guidelines, '*Guidelines on the Management of Noxious Weeds and Non-native Invasive Plant Species on National Roads'* (2010). The Contractor shall ensure that the hull of the vessel(s) used during proposed works is not fouled with any IAS prior to its arrival at the site. Efforts shall also be made to ensure that any plant/equipment (including PPE equipment) is not carrying seeds or plant materials from IAS. The Contractor shall refer to the Invasive Species Ireland '*Marina Operators Code of Conduct'* (Kelly & Maguire, 2009).
- In order to prevent any potential destruction of betony (Betonica officinalis) as a result of the construction of the proposed development, a pre-construction survey shall be carried out of the site of the proposed development, and any plants/clusters of plants of the species identified in vulnerable locations (i.e. where they are at risk of destruction as a result of the proposed works) shall be translocated under NPWS license by a suitably qualified, competent professional to area(s) where the destruction of the plants will be avoided. Additionally, if individual plants or clusters of betony (in addition to those already identified and translocated) are identified by the ECoW at vulnerable location(s) during the construction phase, they shall be translocated as described previously. If necessary, works at the location(s) in question shall be suspended until such time that it is considered ecologically appropriate (by the ECoW) to carry out translocations.
- In order to prevent significant, negative effects on bats as a result of the construction of the proposed development:
    - Demolition of existing buildings at the site of the proposed development shall be completed either during the autumn or spring months in order to minimise the risk of disturbance of roosting bats. Care shall be taken during the removal of rooves. If bats are identified in structures during demolition works, the local NPWS Conservation Ranger shall be contacted to facilitate safe translocation.
    - Bat boxes shall be erected in association with buildings/structures on the mainland side of the site of the proposed development. These shall be of a design and placement that is in accordance with the Bat Conservation

Ireland guidelines, '*Bat Boxes: Guidance Notes for: Agri-environmental Schemes*' (Bat Conservation Ireland, 2015) and the NRA guidelines, '*Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes*' (TII, n.d.). Bat boxes shall be inspected, maintained and relocated (if required) in accordance with the TII guidelines. Boxes shall be incorporated into or onto external walls away from artificial lighting. Recommended units (all available at nhbs.com) are as follows:

- 8 no. 2FE Schwegler Wall-mounted Bat Shelter (to be hung on external walls), or
- 6 no. 1FE Schwegler Bat Access Panel (with back plate) (to be hung on external walls), or
- 4 no. 2FR Schwegler Bat Tube (to be built into external walls), or
- 4 no. 1FQ Schwegler Bat Roost (to be hung on external walls).

- In order to prevent pollution of the marine environment and surface-groundwater during the construction of the proposed development, which could potentially give rise to negative effects on biodiversity in marine and freshwater aquatic habitats, all of the mitigation measures outlined in Chapters 8, 9 and 10 of this EIAR – Soils & Geology, Hydrogeology and Hydrology, respectively – shall be implemented.

7.8.4 Operational Phase Mitigation Measures

The following general mitigation measures will be employed to minimize potential significant negative effects on biodiversity which might arise during the operation of the proposed development.

In order to prevent/minimise potential negative effects as a result of the introduction and/or spread of terrestrial and aquatic IAS during the operation of the proposed development:

- CCC shall commit to undertaking treatment by a competent professional, in accordance with the recommended physical treatment set out in Appendix 7.1, with a view to eradicating the occurrence of hottentot-fig on Dursey Island prior to the commencement of operation of the proposed development (subject to agreement with the landowner). Monitoring shall be carried out by a competent professional for five years to ensure no re-growth occurs.
- An IAS Management Plan [Appendix 7.1] has been developed and shall be implemented during the operation of the proposed development, with the objectives of, (i) where possible, eradicating IAS (especially on Dursey Island), (ii) preventing the introduction of new IAS to the area (especially Dursey Island), and (iii) in all other instances, managing existing occurrences of IAS with a view to preventing their spread.

In order to prevent/minimise (i) terrestrial habitat degradation/destruction and (ii) disturbance of chough and ground-nesting species of birds as a result of increased numbers of visitors walking on open habitat, the following mitigation measures shall be implemented:

- Three looped, waymarked walking trails (as set out in Plate 7.17) shall be formalised on Dursey Island prior to the commencement of the operation of the proposed development. This approach is widely used in outdoor recreation areas (Slaymaker, 2017). According to the National Trails Office (NTO) '*Guide to Planning and Developing Recreational Trails in Ireland*', (2012, p.4), "*Developing recreational trails is a very effective way of managing recreational*

activity in the outdoors and protecting the natural environment". Indeed, research indicates that walkers tend to stick to established paths, even when they have the 'right to roam' (Keirle & Stephens, 2004; Synge, 2004; Kuba *et al*., 2018).

Formalisation of these trails shall not involve the creation of new paths, but rather the formal waymarking of routes on existing roads and paths. Formalisation of these paths shall involve the following:

1. Placement of suitably spaced colour-coded waymarker posts of recycled plastic, featuring directional arrows, at appropriate locations along the existing routes set out in Plate 7.18;
2. Erection of a mapboard at a clearly visible location at the trailhead (i.e. on CCC lands near the island-side cable car station) displaying a map of colour-coded routes with:
    i. approximate length (km),
    ii. duration (hours/minutes),
    iii. a conservative estimate of difficulty level from 'Easy' to 'Moderate' to 'Strenuous' to 'Very Difficult' (according to the NTO guidelines, '*Classification and Grading for Recreational Trails*' (2008)), and
    iv. a message instructing walkers to stay on the trails (according to the recommendations set out in Appendix 7.2, '*Design of Outdoor Signage*').;
3. Erection of 'minimum impact behaviour' (MIB) signage at key sensitive locations for chough and/or habitat conservation along trails. Research from Portugal has shown that erection of such signage can effectively reduce the impact of human disturbance on breeding little tern (*Sterna albifrons*), with a 34-fold greater likelihood of breeding success at nest sites with such protective measures in place (Medeiros *et al*., 2007). At a minimum, this MIB signage shall include:
    i. a note on the trailhead mapboard instructing visitors to stay on the trails; and
    ii. a sign at the western end of the Tillickafinna/Signal Tower Loop instructing walkers not to venture any further westward onto the chough 'hotspot'. The design of this signage shall be in accordance with the recommendations set out in Appendix 7.2, '*Design of Outdoor Signage*'.

Research conducted on Bear Island, Maryland, U.S.A. (Hockett *et al*., 2010), found that principle reasons for visitors to leave the established trail were:

i. to view and/or photograph a scenic vista;
ii. to pass other walkers on the trail;
iii. to avoid challenging trail conditions; and also
iv. because of poor waymarking.

Accordingly, trails should offer opportunities for scenic vistas/photos, should be well marked and should not be too challenging. The direction of all three looped trails shall be anticlockwise, with walkers travelling along the established off-road trails on the outbound journey, and returning to the trailhead via the public road on the return journey. Travelling in this direction, walkers undertaking the Tillickafinna/Signal Tower Loop will have had plenty of 'photo opportunities', and will have completed the most strenuous portion of the trail (the 'high route') by the time they reach Tillickafinna and,

for these reasons, may feel less inclined to venture further westward. As stated previously, formalisation of these trails shall not involve the creation of any new paths but rather, will serve to encourage walkers to stay on existing, established paths/roads, and provide options for walkers of varying abilities. Provision of complete (and conservative) information on the nature and duration of routes, coupled with the provision of two shorter options, may discourage certain walkers from attempting the full loop and travelling to the western end of the island. Any existing signage which contradicts these trails shall be removed, as required. CCC shall be responsible for the maintenance of these trails for the duration of the operation of the proposed development.

Additionally, an existing informal walking trail on Crow Head shall be more clearly marked using recycled plastic waymarkers. However, no sign (or other indicator which might draw attention to the walk) should be erected. Responses to the visitor survey indicate that this is not a very popular walk and no undue attention should be drawn to it. Instead, efforts should be made to control the movements of those few walkers who do venture onto the headland. This approach is supported by success elsewhere. In the Hohe Tauern National Park in Austria, for example "*Staff have found that without a trail, people wander in all directions, but if there is a clear and unmistakable path, nearly all stick to it*" (Synge, 2004). CCC shall be responsible for the maintenance of this trail.

- An education campaign shall be launched to inform visitors of the sensitivity of (i) species (i.e. choughs and ground-nesting bird species) to human disturbance and (ii) habitats to degradation as a result of visitor footfall. The objective of the campaign is to discourage visitors from wandering off the established walking routes on the island, particularly at sensitive locations for chough (i.e. at the western end of the island and potential roost sites). The campaign shall have the following characteristics:
    - It shall be three-tiered in that it will be featured in:
        1. Exhibition materials in the Visitor Centre;
        2. An audiovisual presentation in the outbound journey of the cable cars; and
        3. Outdoor signage on Dursey Island.
    - The educational materials used shall be aesthetically pleasing and emotionally engaging to encourage buy-in from visitors. The design of outdoor signage shall be in accordance with the recommendations set out in Appendix 7.2

  All outdoor signage shall be designed for the exposed and corrosive nature of the site.
- Not including island residents/farmers, no more than 12,835 persons shall be permitted to travel to Dursey Island in any month of the year during the operation of the proposed development (see Appendix 7.2). This numerical carrying capacity shall be implemented using a strictly enforced CCC ticketing system.
- Not including guide dogs, pets and/or working dogs of island residents and farmers, dogs shall be prohibited from travelling to Dursey Island. This restriction will be clearly displayed on the Dursey Island Cable Car and Visitor Centre website and promotional materials.
- Not including bicycles for the personal use of island residents/farmers, visitors shall be prohibited from bringing bicycles to the island in the cable cars. This restriction will be clearly displayed on the Dursey Island Cable Car and Visitor Centre website and promotional materials.

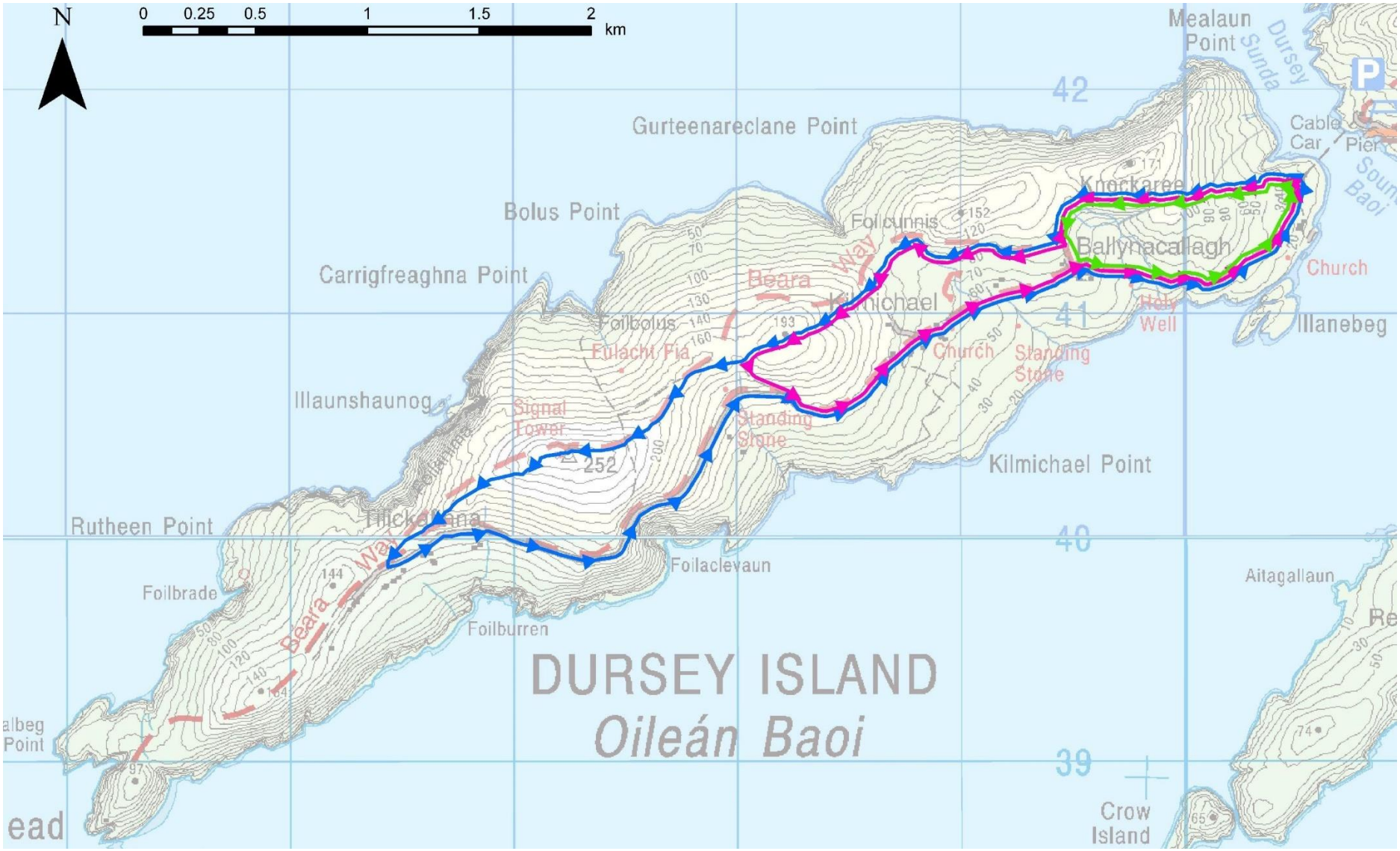

Plate 7.18 **Three waymarked loop walks for Dursey Island. Ballynacallagh Loop (green) = 2.7km; Kilmichael Loop (pink) = 6km; Tillickafinna/Signal Tower Loop (blue) = 10km**

In order to prevent/minimise any potential negative effects on bats as a result of the operation of the proposed development:

- Insofar as is possible in view of safety requirements, lighting shall be turned off at the closure of the proposed development each night (i.e. once all visitors have left).
- Bulbs used in outdoor lighting shall be of a type which does not emit ultraviolet (UV) light. No spotlights shall be used.

In order to prevent pollution of the marine environment and surface-groundwater during the operation of the proposed development, which could potentially give rise to negative effects on biodiversity in marine and freshwater aquatic habitats, all of the mitigation measures outlined in Chapters 8, 9 and10 of this EIAR – Soils & Geology, Hydrogeology and Hydrology, respectively – shall be implemented.

In order to minimise the volume of litter being discarded on Dursey Island and in the vicinity of the proposed development on the mainland, segregated waste bins (at a minimum, separate recycling and residual waste bins) shall be provided in the mainland-side Visitor Centre, café and at the island station. To prevent overflow, these bins shall be emptied regularly. An appropriate waste collection service shall be arranged by CCC.

7.9 Residual Impacts on Key Ecological Receptors

Table 7.29 Assessment of the Residual Impacts Scale and Significance based on EPA (2017) and TII (2009)

Key Ecological Receptor	Pre-Mitigation Impacts	Ecological Significance Following Mitigation
Bats	• Potential destruction of roosts during demolition works • Potential direct mortality of roosting bats during demolition works • Potential detrimental effects associated with lighting during operation	Since it is uncertain whether bats are using the existing structures for roosting (but cannot be ruled out) and existing outdoor lighting uses bulbs which emit UV light, provision of several bat boxes and use of bat-friendly lighting (along with other mitigation measures for bats) will result in a **Slight, Positive effect** on bats overall.
Red-billed chough, *Pyrrhocorax pyrrhocorax*	• Potential disturbance due to humans and dogs during operation • Potential destruction of foraging habitat due to visitor footfall during operation	By limiting monthly visitor numbers in accordance with best available scientific research, strongly encouraging visitors to stay on waymarked trails, discouraging visitors from wandering into chough 'hotspots', repeatedly informing visitors of the sensitivity of the species to human disturbance and prohibiting visitors from taking their dogs or bicycles to the island, it is considered that the degree of disturbance affecting choughs will not exceed **Imperceptible Negative effect** levels.
European herring gull, *Larus argentatus*	Food scraps left by visitors during operation potentially leading to population growth and potentially indirectly resulting in increased predation of other seabird species	By implementing litter prevention measures, occurrence of food scraps in the natural environment will be minimised. Thus, it is considered that the proposed development will have an **Imperceptible Negative effect** or **No effect** on this KER.
Great black-backed gull, *Larus marinus*	Food scraps left by visitors during operation potentially leading to population growth and potentially indirectly resulting in increased predation of other seabird species	By implementing litter prevention measures, occurrence of food scraps in the natural environment will be minimised. Thus, it is considered that the proposed development will have an **Imperceptible Negative effect** or **No effect** on this KER.
Ground-nesting Passerines	• Potential disturbance due to humans and dogs during operation • Potential destruction of nests due to visitor footfall during operation	By strongly encouraging visitors to stay on waymarked trails and prohibiting visitors from taking their dogs to the island, it is considered that the degree of disturbance and nest destruction affecting ground-nesting birds will not exceed **Imperceptible Negative effect** levels.
Raptors	Unmitigated negative effects on prey species potentially leading to reduction in availability of food items during operation	**Imperceptible Negative effect** or **No effect**

Key Ecological Receptor	Pre-Mitigation Impacts	Ecological Significance Following Mitigation
Common snipe, *Gallinago gallinago*	• Potential disturbance due to humans and dogs during operation • Potential destruction of nests due to visitor footfall during operation	By strongly encouraging visitors to stay on waymarked trails and prohibiting visitors from taking their dogs to the island, it is considered that the degree of disturbance and nest destruction affecting *G. gallinago* (if it does breed in the Zone of Influence) will not exceed **Imperceptible Negative effect** levels.
Eurasian oystercatcher, *Haematopus ostralegus*	• Potential disturbance due to humans and dogs during operation • Potential destruction of nests due to visitor footfall during operation	By strongly encouraging visitors to stay on waymarked trails and prohibiting visitors from taking their dogs to the island, it is considered that the degree of disturbance and nest destruction affecting *H. ostralegus* will not exceed **Imperceptible Negative effect** levels.
Betony, *Stachys officinalis*	• Potential destruction of plants due to construction works • Potential destruction of plants due to visitor footfall during operation	Monitoring of the site of the proposed development for the species, and execution of translocations under licence (as required) will prevent negative effects on the species during construction. By strongly encouraging visitors to stay on waymarked trails during the operation of the proposed development, it is considered that the proposed development will result in an **Imperceptible Negative effect** or **No effect**.
Invasive Alien Species	• Potential introduction and/or dispersal of IAPS during construction • Potential introduction and/or dispersal of IAPS due to visitor traffic during operation	It is considered that the implementation of best practice biosecurity protocols during the construction phase, and implementation of an IAS Management Plan during operation will result in the proposed development having an **Imperceptible or Slight Negative effect** in respect of this KER.
Large shallow inlets and bays [1160]	• Potential loss of ecological integrity due to run-off of pollutants during construction works • Potential loss of ecological integrity due to run-off of improperly treated/untreated wastewater during operation • Potentially altered community structures due to introduction/dispersal of marine IAS during construction and/or operation	While best practice pollution prevention measures will be implemented during the construction phase, and wastewater and surface run-off will be treated to a high standard prior to emission to the marine environment, wastewater emissions during operation will still serve to increase slightly the volume of organic matter in the marine environment in the vicinity of the Study Area. However, considering the high dilution factor and fast rate of movement of water in the Dursey Sound, it is considered that, with mitigation measures implemented, this aspect of the proposed development will have **No effect** on this KER. It is considered that the implementation of best practice biosecurity protocols during the construction phase, and implementation of an IAS Management Plan during operation will result in the proposed development having an **Imperceptible effect** or **No effect** on this KER.

Key Ecological Receptor	Pre-Mitigation Impacts	Ecological Significance Following Mitigation
Reefs [1170]	• Potential loss of ecological integrity due to run-off of pollutants during construction works • Potential loss of ecological integrity due to run-off of improperly treated/untreated wastewater during operation • Potentially altered community structure due to introduction/dispersal of marine IAS during construction and/or operation	While best practice pollution prevention measures will be implemented during the construction phase, and wastewater and surface run-off will be treated to a high standard prior to emission to the marine environment, wastewater emissions during operation will still serve to increase slightly the volume of organic matter in the marine environment in the vicinity of the Study Area. However, considering the high dilution factor and fast rate of movement of water in the Dursey Sound, it is considered that, with mitigation measures implemented, this aspect of the proposed development will have **No effect** on this KER. It is considered that the implementation of best practice biosecurity protocols during the construction phase, and implementation of an IAS Management Plan during operation will result in the proposed development having an **Imperceptible effect** or **No effect** on this KER.
Vegetated sea cliffs of the Atlantic and Baltic coasts [1230]	Potentially altered plant community structure and erosion regime due to introduction/dispersal of terrestrial IAPS during construction and/or operation	It is considered that the implementation of best practice biosecurity protocols during the construction phase, and implementation of an IAS Management Plan during operation will result in the proposed development having an **Imperceptible effect** or **No effect** on this KER.
European dry heaths [4030]	Potentially altered plant community structure due to introduction/dispersal of terrestrial IAPS during construction and/or operation	It is considered that the implementation of best practice biosecurity protocols during the construction phase, and implementation of an IAS Management Plan during operation will result in the proposed development having an **Imperceptible effect** or **No effect** on this KER.

7.10 Monitoring

In order to support environmentally sustainable development and management of future developments on the west coast – particularly of tourism and recreation-related developments – CCC shall commit to implementing a 10-year monitoring scheme at the site of the proposed development, including the following:

1. Monitoring of visitor movements and activities in the vicinity of the proposed development, involving the following methods:
    - Trail counters shall be installed at suitable locations on walking trails on Dursey Island, on the Garinish Loop walk and on the walk at Crow Head. On Dursey Island, a trail counter shall be placed at an appropriate location on the western end of the island, so as to record approximately how many visitors leave the established trail (disregarding the MIB sign) to wander onto this key area for chough. CCC shall be responsible for the maintenance of these counters.
    - A visitor survey shall be carried out on an annual basis, to establish approximately how visitors respond to MIB signage, what proportion of visitors follow each of the three looped trails, and what proportion of visitors remain on established trails and vice versa.
2. The conservation status of the Dursey Island chough population shall be monitored on an annual basis (during the breeding season). The monitoring programme in question shall, at a minimum, involve the measurement (by a suitably qualified and competent ecologist) of the following parameters:
    - Number of breeding pairs (confirmed, probable and possible);
    - Locations of nest sites; and
    - Productivity of population.
3. The conservation status of the habitats on Dursey Island shall be monitored on an annual basis. The monitoring programme in question shall, at a minimum, involve identification (by a suitably qualified and competent ecologist) of any areas where the ecological integrity of habitats is being negatively affected by land use (especially grazing regime) and/or any other pressures/threats.

The data gathered as a result of all monitoring undertaken shall be shared with Fáilte Ireland so that it can feed into their WAW Environmental Surveying and Monitoring Programme, and can inform the development and management of similar/related developments, plans and projects. Information should also be shared with NPWS and, upon request, and as appropriate, with research institutions and state authorities. Results of monitoring shall be analysed and conclusions drawn in terms of management implications for developments of a similar nature/environmental context.

7.11 Assessment of Cumulative Effects

Cumulative effects are those which accrue to KERs as a result of incremental changes caused by other existing or proposed plans or projects together those caused by the proposed development. For the purposes of this Chapter, the cumulative impact assessment considers cumulative impacts on biodiversity which are:

(a) Likely;

(b) Significant; and

(c) Relating to a future event, reasonably foreseeable.

None of the developments identified during the cumulative assessment were determined to result in significant negative cumulative effects with regard to biodiversity, as defined in Chapter 17 of this EIAR – Interactions, Major Accidents and Cumulative Impacts.

Chapter 17 of this EIAR – Interactions, Major Accidents and Cumulative Impacts – presents an in-depth assessment of potential cumulative effects.

7.12 Conclusion

It is considered that provided the mitigation measures set out in this Chapter, in the Outline CEMP in Chapter 4 and in the NIS for the proposed development are adhered to, the construction and operation of the proposed development will not have a significant negative impact on the biodiversity in the Zone of Influence.

7.13 References

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Appendix 7.1 Invasive Alien Species Management Plan

Cork County Council
Comhairle Contae Chorcaí

Fáilte Ireland
National Tourism Development Authority

ROD
ROUGHAN & O'DONOVAN

APPENDIX 7.1
IAS Management Plan

Statement of Purpose

The Invasive Alien Species (IAS) Management Plan outlines the management measures to be followed to manage and control the spread of identified IAS during construction and operation phase of the proposed development. The primary objectives of this Plan are to facilitate the (i) prevention of the spread of the IAS as a result of the construction and operation of the proposed development, and (ii) eradication of High Risk IAPS, where possible. CCC is the authority responsible for the implementation of this Plan.

Legislative Context

In the course of devising and implementing the most effective eradication methods, the Invasive Alien Species (IAS) Management Plan must comply with all legislation regulating the treatment and management of IAS. The relevant standards and legislation that will dictate how eradication is undertaken include:

- *European Communities (Plant Protection Products) Regulations, 2012 (SI No. 159/2012);*
- *European Communities (Sustainable Use of Pesticides) Regulations, 2012 (SI No. 155/2012);*
- *Waste Management Acts, 1996 to 2013, and related legislation;*
- *Safety, Health and Welfare at Work Act, 2005;*
- *Safety, Health and Welfare at Work (Construction) Regulations, 2013;*
- *Safety, Health and Welfare at Work (General Application) Regulations, 2007;*
- *Safety, Health and Welfare at Work (Chemical Agents) Regulations, 2001;*
- *European Communities (Birds and Natural Habitats) Regulations, 2011 to 2015; and,*
- *Wildlife Acts 1976-2012.*

To comply with Sustainable Use of Pesticides Legislation, the application of herbicide should only be undertaken by registered professional users. Only a Registered Pesticide Advisor (RPA) should approve procedures prior to Works commencing. All professional users should demonstrate proper use, ensuring only authorised products are used and all treatments are catalogued and documented pursuant to the requirement of Plant Protection Products Regulations.

In scenarios where disturbance, movement and disposal of IAS material is required, the RPA will review applications submitted to the relevant licensing authorities prior to the commencement of such disturbance, movement and disposal.

Introduction

In October 2018, Invasive Plant Solutions were appointed by CCC, through Roughan & O'Donovan Consulting Engineers (ROD), to carry out an Invasive Alien Plant Species (IAPS) survey for the purposes of the Environmental Impact Assessment for the proposed Dursey Island Cable Car and Visitor Centre development. A survey was undertaken on the R572 approach road between the junction with the R572 (Bealbarnish Gap) and the site, and on the CCC lands in the vicinity of the mainland side of the site, in October 2018. EirEco Environmental Consultants were also appointed through ROD and carried out further IAPS surveys on Dursey Island in May 2019.

Site Description

The study area comprises the R572 between Castletownbere and the mainland side of the existing Dursey Island Cable Car Station on the mainland at Ballaghboy and the landing station at Ballylean East, on Dursey Island. The topography of the lands surveyed mainly comprised public lands and paths. All lands associated with the survey were sufficiently accessible to enable the undertaking of the survey.

Survey Results

A walkover survey was conducted within the study area, including a drive through inspection of the R572 approach road, as well as areas immediately beyond the defined boundaries, where these could be identified and where the areas were either easily or safely accessible from the study area. This survey confirmed the presence of five Third Schedule S.I. 477/2011 invasive alien species; Japanese knotweed (*Fallopia japonica*), Rhododendron (*Rhododendron ponticum*), Three-cornered leek (*Allium triquetrum*), Giant-rhubarb (*Gunnera tinctoria*), and Hottentot-fig (*Carpobrotus edulis*).

Japanese Knotweed

Japanese knotweed (*Fallopia japonica*) is a fast growing, perennial, herbaceous plant, with a vast underground rhizome system, originating from East Asia. It was introduced to Ireland as an ornamental plant in mid to late 1800s and is now well established in the natural/semi-natural environment. Although there are only female plants in Ireland, the species is able to successfully reproduce at a rapid rate by rhizome extension and vegetative propagation (new plants can grow from small fragments of rhizomes and stems). The species is known to colonise a wide range of habitats in Ireland, including riparian habitats, low-lying and disturbed areas, roadsides, and coastal shores and islands. The species is particularly harmful in riparian habitats, where it outcompetes native species by forming dense stands, creating shade and reducing species diversity.

In total, thirteen sites within the study area were found to contain stands of Japanese knotweed (Table 7.30).

Table 7.30 Details of identified sites with Japanese Knotweed in the Study Area

Japanese Knotweed	X Co - ordinates	Y Co-ordinates	Description
JK1	463057	543661	Mature stand (10 x 5m) growing within roadside hedgerow on eastern side of R572, extending eastwards down steep sloping ground.
JK2	463044	543566	Several related stands (15 x 3m) growing on both sides of stone walls forming northern and eastern sides of viewing point, on east side of R572. Growing from field into lay-by area, through stone walls.
JK3	461345 / 461269	541912 / 541856	Series of stands (1km in length) on north side of R572. Main easterly stand set back form roadside on fringe of woodland and extending northwards along stream. Central stand being cut as part of management of residential boundary. Westerly stand interspersed amongst native vegetation of hedgerow.
JK4	461221	541790	Single stand (8 x 2.5m) on north side of R572, at stream crossing. Growing on eastern side of stream, directly behind bridge wall. Likely to be spreading downstream and potentially present upstream.

Japanese Knotweed	X Co - ordinates	Y Co-ordinates	Description
JK5	460075 / 460011	541314 / 541269	Series of stands (stretching for 75m) on both sides of R572. Main stand on north side of road on rough ground adjacent to house entrance. Southerly stand very extensive, encroaching onto roadway and spreading south towards stream. Secondary growth within and above stone boundary wall of house. Also likely to be present in stream.
JK6	459586 / 459551	441266 / 541267	Stands (30m in length) on both sides of R572. Stand on north side of road at stream crossing and extending almost continuously northwards along stream. Southerly stand very extensive and spreading south towards related stream. Both stands encroaching onto roadway, with evidence of cutting and re-growth, particularly on south side. Full extent likely to be much greater, with further presence downstream. Significant spread risk from cutting.
JK7	452796	541814	Single strand (8 x 7m), growing within native scrub on elevated ground along southern side of R572. Northern limit of stand currently set back approx. 2m from roadside. Evidence of spread northwards towards roadway, with potential for encroachment in future growing seasons.
JK8	454471	541018	Large stands around cottage to south of road. Outside of parking bay location. Subject to treatment but still extant.
JK9	451700	541861	Extensive stand in vicinity of derelict cottage immediately west of junction.
JK10	452120	542644	Small stand alongside drain downstream of road culvert at White Strand.
JK11	452077	542054	Moderate stand around farm buildings at top of laneway (Garinish Loop Walk) leading from Garinish to R572. Subject to treatment but still extant.
JK12	451924	541841	Small amount of stems in edge of garden on north side of road.
JK13	449459	541927	Stands in garden on Dursey Island, just outside Ballynacallagh. Present both at front and rear of house. Not very well established and may be of recent origin.

Rhododendron

Rhododendron (*Rhododendron ponticum*) is a large perennial evergreen shrub, which originates from the Iberian Peninsula and Asia. It was introduced to Ireland as an ornamental plant during the 1700s due to its brightly coloured flowers. The species has become established in the natural/semi-natural environment and is invasive in the west, north-west and south-west of the country. The species is typically found in areas with acidic soil conditions; mild, moist climatic conditions; and may be present in a variety of habitats, including urban areas, agricultural land, grasslands, wastelands and roadsides. Plants outcompete native flora by forming large, dense thickets which shade a wide area underneath, preventing growth. *Rhododendron* is capable of reproducing by seeds and by vegetative means via suckering of roots and layering where its branches touch the ground.

In total, nine sites within the study area were found to contain stands of Rhododendron (Table 7.31).

Table 7.31 Details of identified sites with Japanese Knotweed

Rhododendron	X Co - ordinates	Y Co- ordinates	Description
RHO 1	466915	545345	Mature stand (5 x 8m) on northern side of R572, immediately west of Castletownbere, growing within native hedgerow by town identification sign. Some spread westwards along and behind roadside margin.
RHO 2	4669 / 465995	545345 / 544699	Series of small stands and individual plants interspersed amongst 1km of native hedgerows and grass margins, scattered mainly along northern roadside on R752, between larger, established stands of RHO 1 and RHO 3.
RHO 3	465995 / 465959	544699 / 544645	Large, linear, mature stand (70 x 2m) on northern side of R572, west of Castletownbere. Interspersed with and growing within native hedgerow and roadside margin.
RHO 4	465750 / 465704	544498 / 544492	Large, linear, mature stand (75 x 2m) on northern side of R572, interspersed with and growing within native hedgerow and roadside margin. On roadside, rock outcrops, and in woodland on southern side of roadway.
RHO 5	465504 / 465456	544489 / 544456	Long, linear, mature stand (50 x 2m) on northern side of R572, interspersed with and growing within native hedgerow and roadside margin.
RHO 6	465206 / 464694	544374 / 544480	Series of stands and individual plants interspersed amongst 1km of native hedgerows and grass margin, scattered along northern side of R572. Also a significant presence to south of road, spreading across open ground.
RHO 7	464109	544294	Single mature stand (3m in diameter) on northern side of R572, immediately east of driveway entrance to cottage.
RHO 8	453442	544048	Single mature stand (8 x 6m) on north-eastern side of R572, growing amongst native upland scrub on fringe of nearby woodland. Located approx. 4m in from roadside. Evidence of new plants spreading southwards.
RHO 9	461261	541846	Single mature stand (9 x 2m) on northern side of R572, immediately west of driveway entrance to a bungalow.

Three-cornered Leek

Three-cornered leek (*Allium triquetrum*) is a spring-flowering, bulbous, perennial herb originating from the west and central Mediterranean. It is a garden plant and often found in long grasses, and in the natural environment can be found along roadsides, hedgerows and disturbed ground. The species is capable of reproducing by both seed, and via its long-lived bulbs.

In total, two sites within the study area have been found to contain Three-cornered leek (Table 7.32).

Table 7.32 Details of identified sites with Three-cornered leek

Three-cornered leek	X Co - ordinates	Y Co-ordinates	Description
TCL 1	451924	541841	Reasonably abundant within garden.
TCL 2	448999	541065	Stems recently dumped on grass verge on opposite side of road

Giant-rhubarb

Giant-rhubarb (*Gunnera tinctoria*) is a large, perennial plant originating from Argentina and Chile. It was introduced to Ireland in the 1800s as an ornamental plant due to its exotic features. However, this species is now very prominent along the west coast of Ireland. It proliferates in constantly moist environments, often occupying grassland areas, waterways, coastal cliffs, heaths and bogs. It outcompetes native flora by forming large, dense stands which shade a wide area underneath, preventing growth Giant-rhubarb can spread by both sexual and asexual reproductive methods, and can also regenerate from root fragments, leaf cuttings and rhizomes.

In total, two sites within the study area have been found to contain Giant-rhubarb (Table 7.33).

Table 7.33 Details of identified sites with Giant-rhubarb

Giant - rhubarb	X Co - ordinates	Y Co-ordinates	Description
GR 1	453141	541445	Single young plant on southern roadside within passing bay site.
GR 2	451300	541798	Small number of young plants along northern side of road in footprint of passing bay. Larger stand to south of road adjacent to boundary wall of Coast Guard houses.

Hottentot-fig

Hottentot-fig (*Carpobrotus edulis*) is a ground-creeping plant originating from South Africa. It was introduced to Ireland as an ornamental plant and as a dune stabiliser and is often found in coastal habitats. It outcompetes native species due to its aggressive growth and ability to propagate both vegetatively from fragments and via seed production. One site within the study area was found to contain Hottentot-fig. The occurrence is in a private garden on Dursey Island (coordinates: 448999; 541065), where the plant may be seen growing on a roadside stone wall and spilling out onto the road.

Distribution of the species in Ireland is quite limited and it was believed that the species had been eradicated in Ireland following a concerted eradication effort (W. Earle, pers. comm., 2019); however, this record on Dursey Island reveals that, regrettably, this is not the case. It is not known whether the IAPS occurs elsewhere in Ireland at present, but every effort should be made by CCC and the landowner in question to eradicate this occurrence. The localised occurrence of the species on Dursey Island should facilitate complete and successful eradication.

Brief Description of Invasive Alien Species (IAS) Management Plan

The measures to be implemented in the management plan are based on '*The Knotweed Code of Practice: Managing Japanese knotweed on development sites'* (EA, 2013), '*Best Practice Management Guidelines for Japanese Knotweed'* (Kelly *et al*., 2008) and '*Guidelines on the Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads'*

(TII, 2010b). These documents provide very detailed information on the control of Japanese knotweed and Rhododendron, and Giant–rhubarb, including instructions for chemical treatment and non-chemical control. They have been developed by experts in the control of IAPS and informed by the successes and failures of hundreds of IAS management plans, and are widely accepted to represent the current best practice in the management of such species.

The Knotweed Code of Practice provides some general guidance on the preferred treatment options that should be used:

> "*Unless an area of Japanese Knotweed is likely to have a direct impact on the development, you should control it in its original location with herbicide over a suitable period of time, usually two - five years.*
>
> *You should only consider excavating Japanese Knotweed as a last resort, and if so you should keep the amount of knotweed excavated to a minimum.*
>
> *Soil containing Japanese Knotweed material may be buried on the site where it is produced to ensure that you completely kill it. In this case, you must bury material at least 5m deep, or at 2m if enclosed in a root barrier membrane*
>
> *Where local conditions mean you cannot use burial as an option, it may be possible to create a Japanese Knotweed bund. The purpose of the bund is to move the Japanese Knotweed to an area of the site that is not used. This 'buys time' for treatment that would not be possible where the Japanese Knotweed was originally located.*
>
> *Sometimes, due to shortage of time and location, landfill is the only reliable option, but it should be treated as a last resort. Landfill is very expensive for the development industry, and needs haulage, which increases the risk of Japanese Knotweed spreading.*
>
> *When you transport soil infested with Japanese Knotweed to landfill, it is essential to carry out strict hygiene measures. If you do not follow these standards, this may lead to Japanese Knotweed spreading. Japanese Knotweed is a particular problem along transport corridors, where it interferes with the line of vision and can cause accidents*."

The following sections contain descriptions of the most suitable control measures for the IAPS identified in the Study Area.

Japanese Knotweed

Construction Phase Management Measures

Management measures that should be implemented for Japanese Knotweed for the construction phase of the proposed development are as follows:

- The location of the stands should be circulated to all construction workers and involved parties, with their positions incorporated into relevant drawings and specifications, to ensure that the risk of disturbance as a result of project enabling works and design development is mitigated.
- With the nature of the locations, the absence of existing mitigation measures, and current encroachment onto the public road, the stands should be fenced off, incorporating recommended safe buffer zones, and with advisory / warning signage put in position.
- Discussions should be held with affected land and property owners, to ensure that any future actions on their part do not contribute to the further spread of viable plant material along the route.
- Where the Japanese Knotweed sites extend into the broader environment, further survey work should be carried out to establish the full extent of the Japanese Knotweed infestations.

- At these sites, ecological assessment and screening of the wider environment should be carried out, to identify the ecological sensitivities present, and to assess them in the context of any proposed Japanese Knotweed management programme.
- All land-based construction works shall be executed in accordance with the TII guidelines, '*Guidelines on the Management of Noxious Weeds and Non-native Invasive Plant Species on National Roads*' (2010). The Contractor shall ensure that the construction machinery during proposed works is not fouled with any IAS prior to its arrival at the site. Efforts shall also be made to ensure that any plant/equipment (including PPE equipment) is not carrying seeds or plant materials from IAS. The Contractor shall refer to the Invasive Species Ireland '*Marina Operators Code of Conduct*'
- the Contractor shall prepare a Biosecurity Method Statement and Invasive Species Management Plan detailing his/her proposed approach to ensuring that invasive species are not imported or spread during construction. These documents will be approved by the Project Ecologist prior to their acceptance and implementation.
- A construction stage inspection / monitoring programme should be put in place, to assess the identified locations for potential disturbance, and to inspect the works route for new infestations

Operational Phase Management Measures

Management measures that should be implemented for Japanese Knotweed for the operation of the proposed development are as follows:

- The relevant authorities and their contractors should be formally notified, to ensure that routine operations and maintenance at the locations do not contribute to the further spread of Japanese Knotweed.
- A multi-phase Japanese knotweed Management Plan should be developed and implemented by CCC prior to the operation of the proposed development. This Plan should consider:
    - The immediate management measures required to mitigate particular risks associated with the proposed development works at the site; and
    - Longer term management proposals, which would include broader habitat and catchment management measures, to ensure the effective control of the full extent of Japanese Knotweed present in the environment

Long-term Management Programme Options

Options for long-term management of Japanese knotweed are as follows:

- Chemical Control
- Excavation and burying;
- Excavation and disposal to licensed landfill/incinerator; and,
- Bunding and treatment.

The appropriate management strategy will be determined by site conditions and in consultation with NPWS in terms of the most suitable management strategy from a programme and cost perspective. There are a number of issues that will affect the management strategy on the site, including the following:

- Accessibility and space available;
- Proximity to open water;
- Land ownership and cooperation of private landowners;

- Proximity to designated sites and environmentally sensitive areas; and,
- Proximity to areas used by the general public and/or defined vulnerable groups.

Chemical Control Option

This option involves application of herbicides *in situ* until there is no re-growth of plant material. This may take c. 3-5 years and would require repeated survey and re-treatment each year until the occurrence has been eradicated from the location. If highly persistent herbicides are used, it may be possible to eradicate the plant within one or two years. However, since this will not be appropriate given the ecological significance of the wider area, the use of less-persistent herbicides, e.g. glyphosate, will be necessary to re-treat regularly in years two and three, and then to conduct annual spot-checks in May/June of subsequent years to identify and retreat any re-growth.

The current most widely recommended chemical for Japanese Knotweed control is glyphosate, which breaks down in the soil relatively quickly. Glyphosate is potentially damaging to non-target plants. Great care is therefore necessary during application of this herbicide and should be used in compliance with the product label in accordance with *Good Plant Protection Practice* as prescribed in the *European Communities (Authorization, Placing on the Market, Use and Control of Plant Protection Products) Regulations, 2003 (SI No. 83/2003).*

As the majority of herbicides rely on the presence of living foliage for them to be effective, it is important to consider whether the Japanese Knotweed is in leaf or is dormant when choosing a suitable herbicide. As the majority of herbicides are not effective during the winter dormant stage, the most effective time to apply a non-persistent herbicide is between May and September, when the plant is in leaf. This will stunt the growth of the plant, consequently reducing the amount of viable above ground material and the height of the stand.

For infestations, products containing 2,4-D amine can be used. 2,4-D amine has the advantage of being selective and specific to broad-leaved plants. However, in general, it has a greater persistency when compared to glyphosate. Products containing 2,4-D amine should be applied in May, with a follow up treatment in late September or early October. Care is required in the selection of the appropriate product and method of application.

In making the selection of which herbicide to use, regard should be given to, *inter alia*, the abundance of the plants, the location of the stand, the proximity and nature of sensitive receptors, and the season. When using herbicide treatment, plant and protection products and sustainable use of pesticides regulations as well as health and safety measures outlined in this Plan (below) must be followed at all times.

Non-Chemical Control

These options are applied in situations where eradication is required within a short space of time. Non-chemical methods typically involve excavation and disposal of infested topsoils and/or plant material.

Excavation & Burying at Depth

The Japanese Knotweed rhizome rarely penetrates deeper than 3m and in certain cases excavation is the best method for isolation and removal of the infestation. During this method it is advisable to apply a non-persistent herbicide at least once to reduce the growth of infestation. Avoiding excess spoil, and ensuring excavated material does not contaminate surplus soil that is free from infestation, is critical.

Disposal and treatment on site can be done through burying material at least 5m deep and covering it with a root barrier membrane layer to prevent any regeneration. This can involve large scale engineering operations and large holes within the site. Various root barrier membranes are available which can prevent plants penetrating. These membranes need to be specially laid under expert supervision in order to be effective, protecting the surrounding soil. Any burial must be accurately mapped and recorded to prevent potential disturbance through any future development. To be effective, the root barriers used need to be: undamaged; of a large size to minimise the need for seals; where necessary sealed securely; of material that remains fit for purpose (intact) for at least 50 years; and resistant to damage on exposure to ultra violet/sunlight. A vertical root barrier membrane can be been used to prevent the horizontal growth of Japanese knotweed.

Excavation and Burying at Shallow Depth

Where it is not possible to bury 5m deep, it may be possible to bury 2m deep if the contaminated soil is completely sealed in a proprietary root barrier membrane in an area that can be guaranteed will not be disturbed by building work or excavation for services, etc. The excavation and shallow burial option involves a series of 8 stages:

Stage 1: Calculate volume required and excavate site, allowing for 2m depth of burial.

Stage 2: Protect the integrity of the root barrier membrane with a layer of sand and provide shutter ply supports for the edge of the cell.

Stage 3: Put root barrier membrane in place, allowing enough material along the edges to eventually provide a seal.

Stage 4: Protect the root barrier membrane from tyre damage with a layer of sand.

Stage 5: Fill the cell with the knotweed infested soil. No other material, contaminants, or wastes should be included.

Stage 6: Make sure that dedicated vehicles are used and cleaned properly after they have been used. Haulage routes must be protected.

Stage 7: Put the surface of the root barrier membrane in place and make sure the cell is adequately sealed.

Stage 8: Protect the surface of the cell with sand and bury deep enough to prevent disruption in the future.

Excavation and Disposal Off-Site

In scenarios where there are constraints on available space and/or the programme of site works and no other alternatives exist, then excavation and disposal of contaminated soil at a licensed landfill facility is an effective but expensive option.

Bunding

Bunding is a method designed to concentrate the rhizome into the upper surface of a raised or excavated shallow area of contaminated soil typically 0.5m deep where Japanese Knotweed will grow and be controlled by herbicide. This method is used where conditions do not allow for burial and is usually only suitable for large sites as even small infestations, with limited above ground growth, can be very large. The bund method is used when it is not possible to treat Japanese knotweed in the area where it was originally located by moving it to an area that is not used. Bunds should be located at least 10m away from site boundaries to prevent spread. The bund can be raised, on top of the ground or placed within an excavation. The material within the bund is treated as often as is necessary to prevent growth and spread. Bunds should use a root barrier membrane if being constructed in an area free of Japanese Knotweed.

Rhododendron

Construction Phase Management Measures

Management measures that should be implemented for Rhododendron for the construction phase of the proposed development are as follows:

- The location of the stands should be circulated to all construction workers and involved parties, with their positions incorporated into relevant drawings and specifications, to ensure that the risk of disturbance as a result of project enabling works and design development is mitigated
- The stands should be fenced off, with advisory/ warning signage put in position, to protect the stands from the risk of third party disturbance
- All land-based construction works shall be executed in accordance with the TII guidelines, '*Guidelines on the Management of Noxious Weeds and Non-native Invasive Plant Species on National Roads*' (2010). The Contractor shall ensure that the construction machinery used during proposed works is not fouled with any IAS prior to its arrival at the site. Efforts shall also be made to ensure that any plant/equipment (including PPE equipment) is not carrying seeds or plant materials from IAS. The Contractor shall refer to the Invasive Species Ireland '*Marina Operators Code of Conduct*'
- the Contractor shall prepare a Biosecurity Method Statement and an Invasive Species Management Plan detailing his/her proposed approach to ensuring that invasive species are not imported or spread during construction. These documents will be approved by the Project Ecologist prior to their acceptance and implementation.
- A construction stage inspection / monitoring programme should be put in place, to assess the identified locations for potential re-growth, and to inspect the works route for new infestations

Operational Phase Management Measures

Management measures that should be implemented for Rhododendron for the operation of the proposed development are as follows:

- The relevant authorities and their contractors should be formally notified, to ensure that routine operations and maintenance at the locations do not contribute to the further spread of the plants
- A management plan should be developed and implemented, to seek to have the sites physically remediated by the controlled removal of plants, in conjunction with stump treatment and multi-annual follow up inspections

Long-term Management Programme Options

The physical removal of above-ground Rhododendron can be achieved by cutting and removing the stems by hand or chainsaw as close to the ground as possible. The cut material will need to be removed from the site for effective follow-up work. Flailing is another successful method of clearing Rhododendron and involves flailing the thickets down to ground level, using mechanical flail head mounted on a tracked machine. However, this method is not suitable for use in sloping or wet areas.

The removal of above-ground biomass of Rhododendron will not prevent re-growth as the species is able to proliferate from cut stems and stumps. There are four management options that can be applied to prevent re-growth:

1. Digging the stumps out;
2. Direct stump treatment;
3. Spraying of re-growth and large seedlings; and,

4. Stem injection.

Each of these options is discussed in turn below[4].

Digging the stumps out

The digging out of stumps is an effective method of eradicating Rhododendron from the area as it maximises the removal of all viable roots. The digging out can be carried out manually or assisted by machinery if the terrain allows it. To prevent re-growth, as much soil as possible must be removed from the dug-out root system, while the stumps should be turned upside down to expose roots to the air, as well as removing as much soil as possible. The removed roots and stumps should be burned at a licensed facility to prevent re-growth. Although effective, this method results in high degree of soil disturbance, and may not be suitable in sensitive areas.

Direct stump treatment

Direct stump treatment involves the application of herbicide solution or spot spraying of freshly cut stumps (i.e. within minutes of it being cut). When using herbicide treatment, health and safety measures outlined in this Plan (below) must be followed at all times. This method should be implemented in dry conditions so as to prevent wash-off of applied solution. The direct stump treatment has been observed to be most effective outside the spring sap flow timeframe. It is recommended to use vegetable dye to mark treated stumps, as all stumps should be targeted to maximise eradication of Rhododendron. The following herbicides can be applied to treat the stump:

- Glyphosate (20% solution): can be applied to all freshly cut stump surfaces using a knapsack sprayer at low pressure, a forestry spot gun fitted with a solid stream nozzle, a cleaning saw fitted with a suitable spray attachment, or a paint brush. For best results, the application should occur between October and February.
- Triclopyr 'Garlon 4' (8% solution): can be applied to all freshly cut stump surfaces using a knapsack sprayer at low pressure, a forestry spot gun fitted with a solid stream nozzle, a cleaning saw fitted with a suitable spray attachment, or a paint brush. The herbicide can be applied any time between cutting and appearance of new growth.
- Ammonium sulphamate (40% solution): when applied, this herbicide has the best results between June and September.

Although this method often results in complete lysis of the stumps, re-growth has been observed at times, which is usually slow and stunted. To achieve complete kill, carefully timed foliar application of herbicides to the re-growth must occur. When using herbicide treatment, plant and protection products and sustainable use of pesticides regulations as well as health and safety measures outlined in Plan (below) must be followed.

Spraying of re-growth and large seedlings

Spraying of herbicide, typically glyphosate on re-growth (stumps and seedlings of less than 1.5m in height) can be achieved once the re-growth is allowed to proliferate for 1-3 seasons before spraying. Spraying should not be delayed for more than three years after initial cutting, as this can often result in a more severe infestation.

To efficiently spray the re-growth to achieve complete kill, several factors need to be taken into consideration:

[4] Maguire, C.M., Kelly, J. and Cosgrove, P.J. (2008). Best Practice Management Guidelines Rhododendron *Rhododendron ponticum* and Cherry Laurel *Prunus laurocerasus*. Prepared for NIEA and NPWS as part of Invasive Species Ireland.

- Glyphosate must be sprayed in dry weather. Additionally, the plant must be dry at the time of herbicide application and remain dry for at least 6 hours to allow for complete absorption of solution by the plant.
- The addition of a surfactant can reduce the amount of dry time required by increasing the absorption of solution into the plant. However, surfactants are often more environmentally damaging than herbicides, and must be handled with care, especially in proximity to aquatic habitats.
- Spraying of herbicide must occur in near windless conditions to maximise contact with the plant, and its absorption. Spraying in windy conditions should not be practiced as this is likely to result in damage to nearby native flora.
- At all times, measures should be in place to prevent the chemical solutions from entering aquatic habitats.

Spraying is often not fully effective, and will require two or more applications, before the plant is killed completely. Other common herbicides used for spraying are ammonium sulphamate, Imazapyr and Triclopyr. When using herbicide treatment, plant and protection products and sustainable use of pesticides regulations as well as health and safety measures outlined in Plan (below) must be followed.

Stem injection

Stem injection is a method often used to manage Rhododendron where terrain is sloping, and where other methods are impractical. This method uses the 'drill and drop' methodology[5] to control the growth of established Rhododendron bushes with access to the main stem which is large enough for drilling a hole. The equipment to be used comprises a handheld cordless drill and a spot gun. It is recommended that a glyphosate (25% solution) is to be applied. The methodology used for stem injection treatment is as follows:

- Inspect the size of the Rhododendron stems, to ensure that they are more than 3cm in diameter.
- Position the drill as close to the main root system as possible.
- To effectively hold and insert the herbicide solution, drill as vertically as possible with a drill bit of 11 -16mm in diameter.
- The herbicide solution must be inserted into the hole immediately after drilling. The recommended amount of herbicide to be inserted into each stem is 2ml
- To prevent the overflow of herbicide, a spot gun with a calibrated 10ml chamber should be used as it permits accurate application of herbicide solution.
- Each treated plant should be marked immediately with either coloured paint or by attaching a biodegradable tape.
- Stem injection can be carried out in dry weather or light rain conditions.

This method has been observed to be the most effective during the months of March, April and May. Although the treated Rhododendron bushes can be left on site to decay, they may persist for approximately 10 – 15 years. Alternatively, the recommended option is to cut and remove the treated Rhododendron off site and assess the effectiveness of the treatment every 12 months. When using herbicide treatment, plant and protection products and sustainable use of pesticides regulations as well as health and safety measures outlined in Plan (below) must be followed.

[5] Edwards, C. (2006). Managing and Controlling Invasive Rhododendron. Forestry Commission Practice Guide, Forestry Commission, Edinburgh.

Three-cornered Leek

Three-cornered leak can be managed via an herbicide treatment or mechanical control.

Mechanical control

The species can be removed from site mechanically by digging, which is recommended to be carried out in spring when surface vegetation is present. Removal by excavation should ensure that all plant material and bulbs are to be removed from site. It is likely that follow up mechanical cutting will be required to ensure reduction of the seed bank.

Herbicide Treatment

A solution of Glyphosate should be sprayed in April before flowering. To maximise absorption of the herbicide by the plant, the leaves should be slightly bruised before treatment. The application of herbicide treatment should be repeated every 2-3 months to prevent re-growth and bulb bank left by this species. When using herbicide treatment, plant and protection products and sustainable use of pesticides regulations as well as health and safety measures outlined in Plan (below) must be followed.

Giant- rhubarb

Giant-rhubarb can be permanently removed from the Study Area through application of several commonly used methods: mechanical control, chemical or biological control, or a combination of these[6].

Mechanical Control

Physical removal of smaller plants can be achieved using spades by cutting the above-ground biomass at an angle as close to the root as possible. The area must be monitored as plant material can be missed during the first removal, which will subsequently need to be removed. If a large area of land is to be cleared from Giant-rhubarb, it is recommended that a restoration protocols to be implemented to prevent reinvasion of Giant-rhubarb or of any other unwanted flora on the bare area.

Chemical Control

Chemical control experiments have been carried out on Achill Island[7], to identify the effectiveness of herbicide treatments on controlling Giant-rhubarb infestation. Glyphosate-based herbicides have been shown to be effective in treating this species. The end of growing period between August to September has been shown to be an optimum timeframe to apply the treatments, with re-growth observed after two years. The re-growth is attributed to the presence of viable rhizomes in the ground, as well as subsequent seedling germination, prompting further application of herbicide to stunt the growth. There are three methods that can be used to apply chemical control for Giant-rhubarb:

1. Spraying;
2. Cut-and-paint method; and,
3. Rhizome injection.

Each of these options of discussed in turn below:

[6], Armstrong, C., Osborne, B., Kelly, J. and Maguire, C.M. (2009). Giant Ruhbarb (*Gunnera tinctoria*) Invasive Species Action Plan. Prepared for NIEA and NPWS as part of Invasive Species Ireland.

[7] Armstrong, C., Osborne, B., Kelly, J. and Maguire, C.M. (2009). Giant Ruhbarb (*Gunnera tinctoria*) Invasive Species Action Plan. Prepared for NIEA and NPWS as part of Invasive Species Ireland.

Spraying

Spraying of herbicide-based solution (see manufacturers recommended dosage) is often carried out using a backpack sprayer, which is applied on all leaves. Spraying of this species must occur in dry, and windless weather conditions to prevent run-off of herbicide solution and to avoid damage to nearby native flora.

Cut-and-paint method

This method involves the cutting of the leaf stalk at the base and immediately applying the herbicide on the remaining surface using either a brush or a sponge. This method can be useful when the large size of the plant makes it too difficult and/or too dangerous for spraying. Additionally, this method proves to be cost-effective due to the small quantities of herbicide used.

Rhizome injection

Using a hand-held drill, small holes are drilled into the rhizome of the Giant-rhubarb plant. The herbicide is immediately injected into the wells. Refer to the section on Rhododendron control, where a similar method is applied for the treatment of rhizomes.

When using herbicide treatment, plant and protection products and sustainable use of pesticides regulations as well as health and safety measures outlined in Plan (below) must be followed.

Hottentot-fig

Hottentot-fig has a very limited distribution in Ireland and it was thought the IAPS had been eradicated from the country (W. Earle, pers. comm., 2019). This confirmed record on Dursey Island reveals that, unfortunately, this is not the case. However, it is possible that this occurrence is the only occurrence or one of a few occurrences in Ireland. Additionally, it is the first record of the species on the west coast of Ireland. As such, it is imperative that every effort is made to eradicate this localised occurrence, in agreement with the private landowner in question. Hottentot-fig can be effectively removed off site via physical removal, and chemical means can be employed for control in cases in which physical removal is not practical (e.g. on inaccessible sea cliffs)[8]. In this case, since the occurrence in question is quite localised and is situated in a fully accessible location, it is considered that physical removal would be practical and effective and should be undertaken in agreement with the landowner in question. The situation of the occurrence on a public roadside creates the risk of dispersal by tourists who may pick the attractive flowers or foliage or inadvertently transport plant fragments or seeds on boots/clothing. Therefore, every effort should be made to treat the occurrence at the earliest possible convenience. Early, appropriate treatment of this species will avoid medium to long-term ecological impacts and financial costs.

Physical Removal

The most effective and typical means of eradication of Hottentot-fig from an area is through removal by hand. It is important to ensure that no fragments of this species are left behind during removal, and no plant fragments are transported to a different site. Matting can be placed to ensure no plant fragments remain at the site. Absolutely all plant material should be removed in sealed bags and disposed of appropriately. It is vital that the biosecurity measures outlined in this Plan (see '*Biosecurity Protocols for Invasive Alien Species'* below) are followed.

[8] Kelly, J. and Maguire, C.M. (2009). Hottentot Fig (Carpobrotus edulis) Invasive Species Action Plan. Prepared for NIEA and NPWS as part of Invasive Species Ireland.

Limitations and Threats to Control Measures

The primary risk is during the site preparation and construction phases when the excavation of materials and movement of vehicles potentially transporting contaminated material can facilitate the spread of IAS. The presence of Japanese Knotweed and Rhododendron, in particular, may result in limitations to overall site management objectives during the construction process, in particular, through the following:

- Delays in scheduling of works, due to treatment of identified locations;
- Structural damage or future potential damage caused by IAPS (particularly Japanese Knotweed); and,
- Potential for spread of IAPS from within and outside the site boundary, e.g. within the site or from adjacent land.

The type of herbicide applied, and the timing of treatment should be cognisant of the receiving environment. The Japanese Knotweed and Rhododendron should be treated with a non-persistent herbicide (certain plant protection products containing glyphosate are non-persistent). It is important to note that certain plant protection products have a specified period of activity, which will be described on the product label and which will dictate when the product can be applied.

Biosecurity Protocols for Invasive Alien Species

Personnel entering an area infested within IAS must take precautionary measures to avoid their spread to wider areas. An exclusion zone or a buffer zone must be set up around the IAS. For instance, in the case of Japanese Knotweed, a 7m buffer zone must be in place. Exclusion zones should be clearly marked and fenced off in order to prevent accidental incursion. Routes within the exclusion zone should be overlaid with a geotextile that has a layer of sand on-top to protect it from being damaged by heavy machinery. The geotextile will prevent potentially contaminated soil/spoil from being transferred onto tracks, tyres or boots.

The following measures are to be followed by all persons entering any infested zones:

- The traffic volume in and out of the zones should be kept to a minimum all times and should remain outside the zone where possible.
- All PPE, other equipment and machinery that enter an infested zone must be cleaned before entering;
- *Inspect, Remove Dispose, Report*: Before leaving an infested area, individuals must thoroughly inspect their clothing, PPE, any equipment and their footwear for rhizomes, or other plant fragments that may be stuck on;
- All personnel should carry a hoofpick or similar implement to thoroughly clean the treads of their footwear with. All footwear must be thoroughly cleaned before leaving an infested zone.
- All PPE, other equipment and machinery, clothing and footwear must be thoroughly cleaned with soapy water and a stiff bristled brush at designated wash-down area(s) before leaving an infested zone.
- As good practice, all staff should follow Inland Fisheries Ireland Biosecurity Protocols when they have entered water or a riparian zone;
- If machinery/plant has entered or worked in an infested zone, it must be thoroughly washed down before leaving the area or working in an infested location; and
- A power washer must be provided for effective cleaning of machinery, along with stiff bristled brushes.

Key Legislation Related to the Use of Pesticides and Plant Protection Products:

Legislation regulating the use of herbicides (or 'plant protection products') have implications for the management of IAPS. As stated in the Preamble to the *Plant Protection Products Regulations*, the use of plant protection products (such as herbicides) *"may involve risks and hazards for humans, animals and the environment, especially if used incorrectly"*. As such, it is important that proper protocols and procedures are adhered to when undertaking chemical treatment of IAPS. Those involved in the management of IAPS will need to be aware of, and comply with (at a minimum), the following laws and policies:

- *Regulation (EC) No. 1107/2009 of the European Parliament and of the Council of 21 October 2009 concerning the placing of plant protection products on the market and repealing Council Directives 79/117/EEC and 91/414/EEC (hereinafter referred to as the 'Plant Protection Products Regulation')*; and,
- *European Communities (Plant Protection Products) Regulations, 2012 (S.I. No. 159 of 2012)*.
- *Directive 2009/128/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for Community action to achieve the sustainable use of pesticides ('Sustainable Use of Pesticides Directive')*; and,
- *European Communities (Sustainable Use of Pesticides) Regulations, 2012, (S.I. No. 155 of 2012)*.

This section outlines key stipulations of these regulations/policies related to the use of chemical control measures for the management of IAPS. However, it should be noted that this text serves as an overview only, and the respective policies should be consulted in their entirety prior to the planning or commencement of any chemical IAPS treatment measures.

According to the *Plant Protection Products Regulations*, plant protection products should be used:

1. In accordance with their authorisation;
2. Having regard to the principles of integrated pest management (IPM); and
3. Giving priority to non-chemical and natural alternatives wherever possible.

The Preamble to the Regulations also states that the user should follow instructions provided on the product label of plant protection products.

Those proposing to use plant protection products to manage IAPS should be well informed of the stipulations of the authorisation in question, should identify what plants and plant products are proposed to be used, and the land use type(s) in the area where the treatment is proposed to be applied.

When choosing the plant protection products, only those entered on a register of authorised and permitted plant protection products can be used, or those which have been granted a trial permit. Consequently, it is important to check that the proposed product is entered on the register[9], or has been granted a trial permit before application.

Article 31 (2) of *Plant Protection Product Regulations* states that the authorisation shall set out the requirements relating to the use of the plant protection product.[10] Furthermore, Article 31 (3) provides that the authorisation must also include, where applicable:

[9] Register of plant protection products: http://www.pcs.agriculture.gov.ie/products/

[10] Regulation (EC) No. 1107/2009 of the European Parliament and of the Council of 21 October 2009 concerning the placing of plant protection products on the market and repealing Council Directives 79/117/EEC and 91/414/EEC Article 31(2).

- The maximum dose per hectare in each application;
- The period between the last application and harvest; and,
- The maximum number of applications per year.[11]

Article 31 (4) provides further that the requirements relating to the use of the plant protection products may include, *inter alia*:

- a restriction with respect to the use of the plant protection products in order to protect the health of the users, bystanders, residents or the environment (such restrictions shall be included on the label);
- the obligation to provide prior notice to any neighbours who could be exposed to the spray drift and those who have requested to be informed;
- indications for proper use according to the principles of IPM;
- designation of categories of users, such as professional and non-professional; and,
- the approved label.[12]

According to Article 67 (1) of the *Plant Protection Product Regulations*, professional users need to practice record keeping of the plant protection products used for at least 3 years. Records should contain "*the name of the plant protection product, the time and the dose of application [and] the area and the crop where the plant protection product was used*".[13]

The *Sustainable Use of Pesticides Regulations* state that those persons seeking to manage IAPS using pesticides must ensure that they procure the services of registered and appropriately trained advisors and professional users. The professional user must be aware of the contents of any relevant Invasive Species Action Plan prior to commencing work. Additionally, the professional user must have pesticide application equipment[14] inspected and certified for compliance with the relevant standard by a registered inspector at least every five years up to the 1st of January 2020, and at least once in every three years following that date.[15]

Regulation 9 (2) provides further that "[a] *professional user shall only apply pesticides with equipment that is correctly calibrated and is appropriate for the use intended*."[16] Regulation 9 (3) provides that "[a] *professional user shall only apply pesticides with* [the equipment specified], *if it has been inspected and certified as satisfying the appropriate standard* [...]."[17]

[11] Regulation (EC) No. 1107/2009 of the European Parliament and of the Council of 21 October 2009 concerning the placing of plant protection products on the market and repealing Council Directives 79/117/EEC and 91/414/EEC Article 31(3).

[12] Regulation (EC) No. 1107/2009 of the European Parliament and of the Council of 21 October 2009 concerning the placing of plant protection products on the market and repealing Council Directives 79/117/EEC and 91/414/EEC Article 31(4).

[13] Regulation (EC) No. 1107/2009 of the European Parliament and of the Council of 21 October 2009 concerning the placing of plant protection products on the market and repealing Council Directives 79/117/EEC and 91/414/EEC Article 67(1).

[14] Schedule 1 to the European Communities (Sustainable Use of Pesticides) Regulations, 2012, (S.I. No. 155 of 2012).

[15] European Communities (Sustainable Use of Pesticides) Regulations, 2012, (S.I. No. 155 of 2012) Regulation 9(1).

[16] European Communities (Sustainable Use of Pesticides) Regulations, 2012, (S.I. No. 155 of 2012) Regulation 9(2).

[17] European Communities (Sustainable Use of Pesticides) Regulations, 2012, (S.I. No. 155 of 2012) Regulation 9(3).

Furthermore, it is very important to note that the *Sustainable Use of Pesticides Directive*[18] and related Irish transposing Regulations[19] place additional restrictions and, in some cases, prohibitions, on the use of pesticides in certain specified areas. Such areas include:

- Areas in or near the aquatic environment
- Areas for the abstraction of drinking water;
- Transport routes (such as railway lines);
- Areas with sealed or very permeable surfaces;
- Groundwater vulnerable areas;
- Areas used by the general public or defined vulnerable groups; and,
- European (i.e. Natura 2000) sites.

In this case, restrictions related to European sites (i.e. Natura 2000 sites) are especially relevant, due to the presence of a number of such sites within and immediately adjacent to the site of the proposed development. The following sections outline restrictions related to certain specified areas:

In or Near Aquatic Environment

The *Sustainable Use of Pesticides Directive* highlights that the aquatic environment is especially sensitive to pesticides, which means that particular attention is required to avoid polluting surface water and groundwater when using pesticides.[20] Measures to avoid such pollution may include, for example, the establishment of buffer zones and, the planting of hedges to reduce exposure of water bodies to spray drift, drain flow and run-off.[21] The Directive indicates that the dimensions of buffer zones will depend on the circumstances of each case.[22] It also indicates that the use of pesticides in areas for the abstraction of drinking water, on or along transport routes (such as railway lines); and on sealed or very permeable surface can lead to higher risks of pollution of the aquatic environment.[23] The Directive also states that, in such areas, pesticide use should be minimised, or eliminated, if appropriate.[24]

Near Wells, Boreholes, Abstraction Points, and Groundwater Vulnerable Areas

The *Sustainable Use of Pesticides Regulations* details "*Prohibitions on pesticides near aquatic environment and drinking water*".[25] The Regulations provide that a person shall not use a pesticide within specified distances of certain water sources.[26] The specified water sources and distances are listed in Schedule 2 to the Regulations:

[18] Directive 2009/128/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for Community action to achieve the sustainable use of pesticides.

[19] European Communities (Sustainable Use of Pesticides) Regulations, 2012, (S.I. No. 155 of 2012).

[20] Directive 2009/128/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for Community action to achieve the sustainable use of pesticides Recital 15 of the Preamble.

[21] Directive 2009/128/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for Community action to achieve the sustainable use of pesticides Recital 15 of the Preamble.

[22] Directive 2009/128/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for Community action to achieve the sustainable use of pesticides Recital 15 of the Preamble.

[23] Directive 2009/128/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for Community action to achieve the sustainable use of pesticides Recital 15 of the Preamble.

[24] Directive 2009/128/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for Community action to achieve the sustainable use of pesticides Recital 15 of the Preamble.

[25] European Communities (Sustainable Use of Pesticides) Regulations, 2012, (S.I. No. 155 of 2012) Regulation 11.

[26] European Communities (Sustainable Use of Pesticides) Regulations, 2012, (S.I. No. 155 of 2012) Regulation 11(1).

Table 7.34 Water sources listed in Schedule 2 of the *Sustainable Use of Pesticides Regulations*

Water Source	Distance
Abstraction point of any surface waters, borehole, spring or well used for the abstraction of water for human consumption in a water scheme supplying 100m^3 or more of water per day or serving 500 or more persons,	200m
Abstraction point of any surface waters, borehole, spring or well used for the abstraction of water for human consumption in a water scheme supplying 10m^3 or more of water per day or serving 50 —500 persons,	100m
Abstraction point of any surface waters, borehole, spring or well used for the abstraction of water for human consumption in a water scheme supplying 1-10m^3 of water per day or serving 10-50 persons,	25m
Abstraction point of any surface waters, borehole, spring or well used for the abstraction of water for human consumption in a water scheme supplying 1m^3 or less of water per day or serving 10 or less persons,	5m[27]

Regulation 11 (2) states further that "*A person shall not use a pesticide within 15 metres of a landscape feature that is known to be a ground water vulnerable area including karst areas, sinkholes and collapse features'"*[28] Regulation 11 (3) provides that "*Subject to paragraphs (1) and (2), a person shall not use a pesticide close to water other than in accordance with the conditions set out in the approved label for that pesticide*."[29]

'Specific Areas'

In relation to '*Specific Areas*', Regulation 12 (1) of the *Sustainable Use of Pesticides Regulations* provides that, subject to paragraph (2), a person shall not apply a pesticide in:

a) areas used by the general public or by defined vulnerable groups;[30] and,

b) a European (i.e. Natura 2000) site.[31]

Health and Safety

An appropriate risk assessment, which includes Health & Safety considerations, should be carried out before any control or survey work is undertaken. Protective clothing must be worn when attempting control. All works to be compliant with the *Safety, Health and Welfare at Work Act, 2005* as well as the *Safety, Health and Welfare at Work (General Application) Regulations, 2007.*

Chainsaws should only be used by competent persons. The use of chainsaws should adhere to the *Guide to Safe Working with Timber and Chainsaws* (HSA, 2010). Chainsaws and equipment should be maintained and correct protective equipment should be used at all times.

[27] Schedule 2 to the European Communities (Sustainable Use of Pesticides) Regulations, 2012, (S.I. No. 155 of 2012).

[28] Regulation 11(2) of the European Communities (Sustainable Use of Pesticides) Regulations, 2012, (S.I. No. 155 of 2012).

[29] Regulation 11(3) of the European Communities (Sustainable Use of Pesticides) Regulations, 2012, (S.I. No. 155 of 2012).

[30] Regulation 12(1)(a) of the European Communities (Sustainable Use of Pesticides) Regulations, 2012, (S.I. No. 155 of 2012).

[31] Regulation 12(1)(b) of the European Communities (Sustainable Use of Pesticides) Regulations, 2012, (S.I. No. 155 of 2012).

Health and Safety during Chemical Control

While using herbicide, it is paramount that clearly visible signs stating the use of herbicide and its risk to children and animals are in place until treated plants are dry. Symptoms of ingestion by human and animals consist of burns to the mouth and throat, salivating, nausea, vomiting and diarrhoea. If herbicide ingestion is suspected, medical treatment should be sought immediately.

Glyphosate has a low known toxic effect on aquatic life. However, water for mixing of a 10% solution should be sourced from a private source (pre-collected and stored).

It is very important that the *Safety, Health and Welfare at Work (Chemical Agents) Regulations, 2001* as well as the *European Communities (Authorisation, Placing on the Market, Use and Control of Plant Protection Products) Regulations, 2003* are consulted.

The success of the management plan for chemically treated stands will be based on the initial reduction in area IAS ascertained from annual pre-treatment monitoring followed by the complete eradication from the site within 5 years.

To comply with the Quality Control procedures for *Sustainable Use of Pesticides Legislation*, the application of herbicide can only ever be undertaken by registered professional users. Registered Pesticide Advisors (RPA) can provide Quality Control by approving procedures prior to works. Professional users will also demonstrate proper use, ensuring only authorised products are used and all Works are catalogued and documented pursuant to the requirement of *Plant Protection Products Regulations*.

These documents include measures to aid the identification of relevant species, with details for the timing, chemicals and methodology for chemical control and for measures to avoid environmental damage during the use of herbicides. It is recommended that the Contractor should prepare a specific plan in accordance with the relevant guidelines.

Appendix 7.2 Design of Outdoor Signage

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National Tourism Development Authority

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APPENDIX 7.2
Design of Outdoor Signage

Research indicates that MIB signage can be effective in promoting pro-environmental behaviour (Baltes & Hayward, 1976; Reiter & Samuel, 1980; Durdan *et al*., 1985; Austin *et al*., 1993; Sussman & Gifford, 2012; Meis & Kashima, 2017; Parker *et al*., 2018), including in natural recreation areas (McCool & Cole, 2000; Duncan & Martin, 2002; Bradford & McIntyre, 2007; Medeiros *et al*., 2007; Hockett *et al*., 2010). Research indicates that the vast majority of hikers (between 74 - 85%) stop to read trailside signs, regardless of sex or educational level (Cole, 1998; McCool & Cole, 2000). Various factors can influence the effectiveness of outdoor signage in promoting desirable behaviour:

> *"Variables influencing effectiveness may be broadly characterized as message, visitor, and situational characteristics. Message characteristics include design parameters such as color, size, length, number and placement of the message. Other important message attributes involve message content, the nature of the persuasive argument used, and message source characteristics. Situational characteristics involve not only the specific site of the bulletin board, but the social and behavioral context that affects decisions to engage in minimum impact behaviors. Visitor characteristics that may be influential when trying to encourage minimum impact behaviors include attributes of the visit itself (length of stay, for example), social-demographic background of the visitor, previous experience and level of knowledge and a host of social-psychological variables, such as involvement, motivation and existing belief systems). Ideally, each of these attributes is considered in a systems context when developing appeals to a specific audience, thereby increasing the probability that the message will be received, considered, adopted and acted upon."*
>
> – (McCool & Cole, 2000, p. 208)

Message Characteristics

The following message characteristics have been linked to effectiveness:

- Use of a clear behavioural recommendation (e.g. 'stop here', 'stay on the trail') (Meis & Kashima, 2017);
- Concise messaging (Cole *et al*., 1997; McCool & Cole, 2000);
- Inclusion of a persuasive explanation as to the reason for the recommendation being made (e.g. 'this is a chough hotspot', 'this area is being managed for chough', 'chough are sensitive to human disturbance', 'this habitat supports native wildlife') (Gramann *et al*., 1995; Duncan & Martin, 2002; Bradford & McIntyre, 2007);
- Use of a positive, encouraging tone (Winter *et al*., 2000);

Avoidance of 'plea' type messages (Cole, 1998; Bradford & McIntyre, 2007). In short, signage should be used which tells the walker *what* to do, tells them *why* they should do it, and encourages them to *feel good* about doing it.

Plate 7.19 provides a good example of outdoor signage for natural recreation areas. These signs are eye-catching, emotionally engaging, concise, clearly state a recommendation, and explain in a simple and persuasive tone why the recommendation has been made. In the case of the proposed development, outdoor signage related to chough should also emphasise the real threat posed by human disturbance to the conservation status of the population.

Plate 7.19 **Examples of emotionally engaging signage advising walkers of the sensitivity of species to human disturbance. Source: Stonehouse Designs**

Visitor Characteristics

It is important that the message used is persuasive in a general sense but also in terms of the typical 'type' of visitor to the island. Because of its rather isolated location, on the western tip of a peninsula on the west coast of Ireland, it may be assumed that the site attracts a relatively low proportion of casual, disinterested visitors. On the contrary, the site is popular among walkers, birdwatchers and whale and dolphin watchers, groups which may be assumed to largely exhibit positive attitudes with respect to environmental conservation, and to engage in relatively a lot of outdoor recreation activities in a given year (i.e. 'experienced visitors'). Indeed, during the breeding bird surveys, with the exception of two instances of littering, surveyors reported seeing no deliberately ecologically harmful behaviour. Visitors were observed to predominantly stay on established paths. Furthermore, of all of the visitors to Dursey Island, the subset who complete the entirety of the existing loop walk (approx. 10km + climb to a high point of approx. 250m), are likely to be predominantly more experienced walkers with an interest in the natural environment. Research has found that 'experienced visitors' (i.e. those who visit a higher number of natural recreation areas in a year) are more likely to attend to trailside signs (Mc Cool & Cole, 2000). Thus, it may be considered likely that, if outdoor signage is placed in an obvious location on Dursey Island, it will be read by the majority of walkers. It is also considered that the typical 'type' of visitor to Dursey Island is likely to be susceptible to pro-environmental messages regarding habitats and wildlife. Non-native English-speaking European nationalities (particularly Germans) constitute a significant cohort of site visitors (Germans being the second largest group after Irish). For this reason, signage should include German and French translations of the key message(s).

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British Ecological Society

Journal of Applied Ecology 2009, **46**, 657–665 doi: 10.1111/j.1365-2664.2009.01646.x

Tourism in protected areas can threaten wild populations: from individual response to population viability of the chough *Pyrrhocorax pyrrhocorax*

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Summary

1. Many protected areas are now faced with increasing pressure from visitors and tourism development. There is thus an urgent need for conservation biologists to evaluate the full impact of human disturbance not only on individual responses, but also on the viability of protected populations, so that relevant management measures can be proposed.

2. We studied the impact of tourism on the rare and endangered chough *Pyrrhocorax pyrrhocorax* on a protected French island to assess the relationship between visitor pressure, bird individual behaviour and fitness, and population viability. During 8 years, we monitored foraging behaviour and estimated monthly juvenile survival using mark–recapture data. Population viability was examined under different tourism scenarios, using a stochastic individual-based model that incorporated the impact of visitor numbers on juvenile survival.

3. In summer, the foraging probability of choughs was negatively correlated with the number of visitors. As a result, the time allocated to foraging during peak tourist season, adjusted to day length and prey availability, was 50% lower than expected.

4. Juvenile survival rates were lowest in August, the peak tourist season, and varied significantly across years. August survival rate and therefore annual survival were negatively correlated with the number of visitors on the island in August and, except for a minor negative effect of rainfall, were not influenced by other environmental variables.

5. Stochastic simulations predicted a low probability of extinction of the protected population if the number of visitors remains constant in the future. However, short-term viability would be dramatically reduced if the current rate of increase in visitor numbers is maintained.

6. *Synthesis and applications*. We show that a relatively minor human-induced disturbance (e.g. scaring individuals away) has dramatic effects on population viability in a protected area, even when breeding individuals are not directly affected. This suggests that the full impact of tourism in protected areas may be overlooked, and has direct consequences for the assessment of sustainable levels of human disturbance and the design of quantitative management options compatible with tourist activities in protected areas. We specifically emphasize the need for more integrative approaches combining research at individual and population levels.

Key words: tourism disturbance, population viability analysis, individual-based-model, sensitivity of growth rate, Biosphere Reserve, ecological compensation, visitor access, recreation, Ouessant Island

Introduction

Protected areas, which now cover more than 11% of the Earth's terrestrial surface (Rodrigues *et al*. 2004), play a crucial role in tourism and receive an ever-increasing number of visitors (Buckley 2003). Many protected areas were primarily designed to conserve species and habitats without consideration for visitor access (Boo 1990), which may result in significant wildlife disturbance and/or habitat degradation by visitors (Kelly, Pickering & Buckley 2002). Numerous studies have documented a negative impact of tourism on individual responses of disturbed animals, including behavioural changes (avoidance behaviour,

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Belanger & Bedard 1989; Beale & Monaghan 2004, Holm & Laursen 2009; reduction in feeding time, Duchesne, Cote & Barette 2000 or resting time, King & Heinen 2004; changes in social structure, Saltz *et al*. 2002) and physiological responses (e.g. modification of heart rate, McArthur, Geist & Johnston 1982, Thiel *et al*. 2008). Such information could be used by conservation biologists and/or managers to evaluate sustainable levels of disturbance or propose landscape management measures to ensure the viability of protected populations (Liley & Sutherland 2007; Mallord *et al*. 2007).

However, most studies of the impact of tourism have focused on individual response, with little consideration for population-level response (but see Carney & Sydeman 1999, Nisbet 2000, Patthey *et al*. 2008), so that studies concluding that tourism has negative effects on population viability are being questioned (Hill *et al*. 1997, Gill, Norris & Sutherland 2001). To demonstrate an effect of individual responses of disturbed animals on the dynamics and viability of populations, one should show that human disturbance reduces individual fitness, which, in turn, influences population dynamics and viability when summed over the entire population. However, the mean daily duration of disturbance of individuals is generally short (e.g. Hulbert 1990) and can be partly compensated for by behavioural changes (Riddington *et al*. 1996). Furthermore, human disturbance is generally confined to a small fraction of a given protected area, so that relatively few individuals of the population of concern are affected. Consequently, previous studies have generally failed to detect a decrease in fecundity or survivorship with increasing human disturbance (King & Heinen 2004).

In this study, we combine long-term population monitoring and modelling to document the impact of tourism on individual response and population viability of the red-billed chough *Pyrrhocorax pyrrhocorax* Linnaeus (hereafter name chough), a rare and declining bird species in Europe, and to propose management measures to protect the population in the long term. The study population breeds on Ouessant Island in Western France, a highly protected area where the number of visitors has increased considerably in recent years, so that tourism has become the main source of income for the islanders. We demonstrate that tourism-related disturbance affects the viability of the Ouessant chough population by characterizing changes in individual behaviour induced by the presence of visitors and examining the relationship between individual response and fitness. We used monthly juvenile survival, estimated with colour-mark resighting data, as a proxy for individual fitness. These data were then incorporated into a population dynamics model to project the influence of human disturbance on present and future population viability under different scenarios of tourism development.

Materials and methods

STUDY SITE

Ouessant is a small island (1541 ha) located 20 km west off the western coast of Brittany, France (48°28′N, 5°5′W). Due to the presence of rare species, high biological diversity and an exceptionally preserved coastal ecosystem, it is highly protected (Supporting Information, Fig. S1). During the last 50 years, the number of visitors on Ouessant has increased dramatically, due to a combination of (i) a general increased desire to explore natural environments, and (ii) the liberalization of passenger transport services in 1990, which resulted in increased ferry passenger carrying capacity (Levrel *et al.*, in press). The annual number of ferry passengers increased from 5000 in 1950 to 150 000 in 2005, with a constant annual increase of *c*. 2500 passengers during the last 20 years and no signs of levelling-off in the near future (Levrel *et al.* in press). High season runs from the second week of July to the end of August, with a peak in August (48% of annual visits). Tourism is currently the main source of income on the island. Most visitors take a 1-day excursion to the island; they are mostly interested in the spectacular coastline scenery, which they discover by following paths around the island, and are generally not aware of the presence of endangered species and habitats (C. Kerbiriou unpublished data).

FOCAL SPECIES

The chough has a scattered distribution, resulting from specific ecological requirements, (i.e. suitable nesting sites: shallow caves in cliffs) and foraging areas (short grassland with low cover, Blanco, Tella & Torre 1998). During the 19th and 20th centuries, the distribution and population sizes of the chough in Europe have declined drastically (Kerbiriou 2001; Burfield & Bommel 2004) and the species is now listed in Annex 1 of the European Union Directive on the Conservation of Wild Birds (79/409/EEC). This strong decrease is thought to result from changes in agricultural practices, notably abandonment of grasslands that used to provide suitable foraging habitats for choughs (Kerbiriou 2001). The western French population of chough is now confined to very few localities in Brittany and seems to have stabilized at a small size (39–55 pairs in 2002, Kerbiriou *et al*. 2005). The population is limited to coastal sites where short grassland habitat above cliffs is maintained by marine physical factors, such as wind and salt spray, i.e. precisely where visitors like to walk. In particular, choughs are never seen in inland agricultural grasslands, which tend to be undergrazed and too tall for choughs to forage (Kerbiriou *et al*. 2006a). Birds are typically distributed around the island coastline in pairs and in a few small cohesive flocks with immature birds.

DATA COLLECTION AND ANALYSIS

We monitored the chough population of Ouessant between 1993 and 2005, focusing on the potential impact of tourism on chough behaviour and demography.

Flush distance

Flush distance was defined as the distance at which a foraging bird or flock will fly off when approached by a person or group of persons. Flush distance was estimated to the nearest 10 m using take-offs caused unintentionally by visitors walking towards the choughs (n = 103) or triggered by a member of the research team to increase sample size (n = 63). We explored the effects of flock size, presence of dependent fledglings, visitor group size, type of disturbance (unintentional vs. intentional) and season on the flush distance using a linear model and analysis of variance.

Seasonal and daily variation in the spatial distribution of choughs

To study feeding habitat choice, we first examined the spatial distribution of choughs in relation to feeding habitat availability. We have shown previously that choughs avoid inland pastures and feed almost exclusively in very short swards (< 5 cm, Kerbiriou *et al*. 2006a) found exclusively on the coastline. Hence, we surveyed the coastline only, which was divided into 123 squares measuring 250 × 250 m (see Supporting Information, Appendix S1). During the summer in 1993 and 1994, and all year round between 1995 and 2001, each square was routinely surveyed for 10 to 30 min by the same observer at least once a month, yielding a total of ca. 80 000 data points. For each observation, we recorded date, time and number of choughs observed; when choughs were present (n = 8273), we also recorded the behaviour of each individual on first contact (foraging, resting or flying). The reproductive season of the chough (mid-March to early July) was excluded because (i) the bird distribution is controlled mainly by territorial defence (Kerbiriou *et al*. 2006a), and (ii) the number of visitors is intermediate and concentrated on a few specific dates (public holidays).

Short grasslands (< 5 cm) and paths were mapped from field observations and aerial photographs (IGN 2002), and the map was implemented in a GIS (ARCGIS9·1/ESRI). We also measured the area of feeding habitat in each 250 × 250 m square. We studied the spatial distribution of birds in relation to their feeding habitat (i) in winter, when visitors are virtually absent, and (ii) in summer, during the peak tourist season, by using a Poisson linear mixed model (R, lme4 package), where the number of choughs observed in a square was a function of the area of feeding habitat in this square (m^2), time of the day, a random square effect, and the average number of choughs in adjacent squares, to account for possible spatial autocorrelation.

Impact of tourism on foraging behaviour

Simultaneously with bird counts, the number of visitors was recorded on areas about 10 times larger than those defined for chough observation, because visitors tend to move around more than foraging birds. These larger areas (hereafter 'visitor zones') are a combination of squares used for chough observation and correspond to the main points of interest on Ouessant (see Supporting Information, Fig. S1 and Kerbiriou *et al*. 2008).

As for each observation we have information of all bird behaviour, we used the proportion of foraging individuals as a proxy for foraging time, which, we assume, carries information on food intake. To study the impact of tourism on foraging, we first examined annual variation in foraging time and compared the peak tourist season (August) to neighbouring months (see Supporting Information, Appendix S2 for a description of how confounding effects of day length and prey availability were removed).

Secondly, we assessed the correlation between the number of choughs observed foraging and the number of visitors using a Poisson linear mixed model (R, lme4 package), as well as a Generalized Additive Model (GAM, Hastie & Tibshirani 1990, R package mgcv), because we expected a non-linear relationship due, for example, to threshold behavioural responses. Spatial autocorrelation was accounted for as described above.

Finally, we quantified the spatio-temporal decrease in available feeding habitat generated by the presence of visitors. To this end, we used the observed relationship between number of foraging choughs and number of tourists to assess the threshold number of visitors above which birds stop foraging in a given visitor zone. By combining this information and the observed daily number of visitors on the island, we estimated the total area of feeding habitat available for each hour of a day. For each day, this value was summed over all hours of daylight and compared to the total area of feeding habitat to generate a daily spatio-temporal decrease in feeding habitat.

Estimates of juvenile survival rates

Because the peak tourist season on Ouessant occurs simultaneously with the fledging period of the chough, we expected a strong impact of the presence of visitors on chough juvenile survival. Chough breeding success was monitored thoroughly from 1998 to 2005 (on average 12 breeding pairs each year). All accessible juveniles were colour-ringed a few days before fledging (n = 122, representing 72% of fledglings observed between 1998 and 2005). Juvenile survival was estimated through resighting of marked individuals (n = 2972 records), via a square-by-square survey similar to that used to collect behavioural data. Resighting data between Ouessant and the mainland coast (not shown) suggest that dispersal outside Ouessant is possible but occurs rarely (as in Reid *et al*. 2004) and is unlikely to remain undetected.

Monthly survival was estimated each year between June and December. The date of disappearance of a given individual was estimated accurately, thanks to very high resighting rates, that is, all living individuals were seen at least once every 30 days (between 1998 and 2003) or 60 days (in 2004–2005). We estimated monthly juvenile survival using the Cormack–Jolly–Seber (CJS) model (Pollock *et al*. 1995) implemented in program MARK (White & Burnham 1999). The following covariates were included in the survival analysis: (i) total number of visitors in August (ranging from 27 431 to 42 243 between 1998 and 2005, data from ferry companies and office of tourism), to test the impact of tourism on juvenile survival; (ii) annual productivity (number of fledglings on Ouessant, ranging from 15 to 32) to assess a possible year quality effect (as in Reid *et al*. 2003a); (iii3) climatic data (monthly rainfall, temperature and number of sunny days; data from the Ouessant meteorological station/Météo France), to investigate whether monthly survival depended on environmental conditions. For details on the goodness of fit, the model selection, and the design matrix see Supporting Information, Table S2.2.

Viability of the Ouessant chough population

We assessed the effects of tourism on chough population viability using two types of population models. First, a deterministic matrix model (computer program ULM; Ferrière *et al*. 1996) was developed to examine population equilibrium and sensitivity of the population growth rate to demographic parameters (Zambrano *et al*. 2007). Parameter values were obtained from this or previous experimental studies (see Supporting Information, Fig. S2.3).

Secondly, to examine the joint effects of population regulation (limited number of nesting sites, as suggested by a census of available nesting areas, Kerbiriou *et al*. 2006b), temporal and environmental variation (tourism), as well as demographic stochasticity, we developed a stochastic two-sex individual-based population model (IBM). The IBM allowed a complete description of sex, age, and reproductive status (nesting versus non nesting) of all individuals (see Supporting Information, Fig. S2.3). Because tourism was shown to strongly affect August juvenile survival (see Results), we modelled the expected August juvenile survival in year t as a function of the number of visitors in August (divided by 1000) the same year, using

results from the most parsimonious model of capture–recapture of monthly juvenile survival. The relationship between August juvenile survival in year t, $s_{a,t}$, and number of visitors in August, x_t, takes the form: $s_{a,t} = e^{ax_t+b}/(1 + e^{ax_t+b})$. For the sake of simplicity, we did not incorporate the effect of weather on juvenile survival, which was small compared to the effect of visitor number. Therefore, a and b coefficients used in the above equation were estimates from the survival model including the effect of tourism only (see model selection presented in Supporting Information, Table S3.3). The values of these coefficients were a = 0·29 (SE = 0·073) and b = 10·11 (SE = 2·56). The average juvenile survival rate in year t was thus $s_0(t) = s_r s_{a,t}$, where s_r = 0·509 is the juvenile survival rate for the rest of the year (constant across years). Different scenarios for the variation of number of tourist (x_t) through time were investigated to extrapolate the effects of tourism on population dynamics and viability. Scenario A: constant number of visitors; x_t was set to the average value estimated over the 8 years study period (32 150); Scenario B: stochastic annual variation in visitor numbers, no deterministic increase; x_t was varied stochastically across years, by sampling from a Normal distribution with mean 32 150 and standard deviation 5350 (estimated from data over the study period); Scenario C: deterministic increase in visitor number; x_t was a linear function of time, $x_t = 0{\cdot}7t + 32\,150$ (Supporting information, Fig. S1 and Levrel *et al.* in press), estimated from the observed trend in visitor numbers in Ouessant over the last 20 years; Scenario D: deterministic increase and stochastic variation in visitor numbers; x'_t was drawn from a normal distribution with mean $x_t = 0{\cdot}7t + 32\,150$ and standard deviation 5350. In each case, N_0 individuals (the current population size, n = 55) were initially present in the population.

Results

FLUSH DISTANCE

Flush distance was significantly increased by the presence of dependent juveniles in the flock ($F_{2,156} = 59{\cdot}60$, $P < 0{\cdot}0001$; average flush distance = 147 ± 23 vs. 75 ± 9 m for flocks with and without juveniles, respectively). Flush distance was not affected by visitor number ($F_{1,155} = 0{\cdot}69$, $P = 0{\cdot}41$), type of disturbance (unintentional vs. intentional, $F_{1,155} = 0{\cdot}01$, $P = 0{\cdot}91$) or flock size ($F_{1,155} = 2{\cdot}557$, $P = 0{\cdot}11$). By combining the average flush distance and the spatial distribution of paths on the coastline, we estimated that 97% of the main feeding habitat of the chough was potentially affected by human disturbance.

SPATIAL DISTRIBUTION OF CHOUGHS AND VISITORS

In winter, the spatial distribution of chough flocks was positively correlated with the amount of feeding habitat throughout the day, whereas in summer this correlation was significant in early morning or late afternoon only (Table 1 and Supporting Information, Table S3.1). In summer at midday when visitors were present, the largest number of choughs was observed on an inaccessible islet with small areas of feeding habitat. In summer afternoons, visitors were found almost everywhere, but highest densities occurred on the western part of the island, i.e. in places where choughs had disappeared (Supporting information, Table S3.1).

Table 1. Within-day correlation between the spatial distribution of choughs and feeding habitat areas in winter and summer. Linear mixed model with additive effect of average chough in neighbouring square, habitat areas and a random effect of square surveyed

	Winter correlation between chough and habitat		Summer correlation between chough and habitat	
Time	Estimate	P	Estimate	P
8	6·70	***	1·81	ns
9	3·98	***	2·35	***
10	3·43	***	2·49	***
11	2·38	***	1·16	ns
12	2·28	***	0·02	ns
13	2·20	***	–0·19	ns
14	2·40	***	–0·33	ns
15	1·86	***	–0·46	ns
16	2·15	***	0·71	ns
17	1·77	***	0·49	ns
18	3·17	***	1·39	ns
19	1·91	***	1·88	**
20	0·32	ns	3·00	*

ns, $P > 0{\cdot}05$; *$P < 0{\cdot}05$; **$P < 0{\cdot}001$; ***$P < 0{\cdot}0001$.

FORAGING BEHAVIOUR

We observed a large variation in the frequency of foraging behaviour, a lot of which was attributable to tourism disturbance. Two observations support a negative impact of visitors on foraging time.

First, comparisons in space or time showed that undisturbed choughs systematically forage (hence feed) for longer time periods than individuals that are disturbed by visitors. Temporally, this was true when comparing different hours within a day or different months within a year. In winter, on average 90% of individuals were observed foraging in a given flock, with little variation throughout the day (Fig. 1). In contrast, in summer, there was a large within-day variation in the frequency of foraging individuals, which was high (85%) in the morning and evening, but much lower (33%) in the middle of the day, during peak visitor hours; the remaining 67% individuals were seen in flight or resting (Fig. 1). In addition, a comparison of consecutive months, minimizing the variation of confounding factors, showed that only 58% of observed choughs were foraging in August (n = 7063) vs. 77% in June (n = 4770), 86% in September (n = 4874) and 91% in October (n = 3289). Even when the confounding effects of day length and prey availability were removed, the time allocated to foraging in August was still 56% lower than in June, 43% lower than in September and 37% lower than in October. Spatially, we compared foraging time during summer afternoons on the main island vs. on a small inaccessible islet on which most individuals were observed (Supporting Information, Fig. S2): 65% of observed choughs were foraging on the undisturbed islet vs. 33% on the main island.

Secondly, when controlling for within-day variation, the frequency of observed foraging behaviour in summer was negatively correlated with visitor number (GLM $\chi^2 = 1582{\cdot}4$, d.f. = 1, $P < 0{\cdot}0001$ and Fig. 2). This result was true even

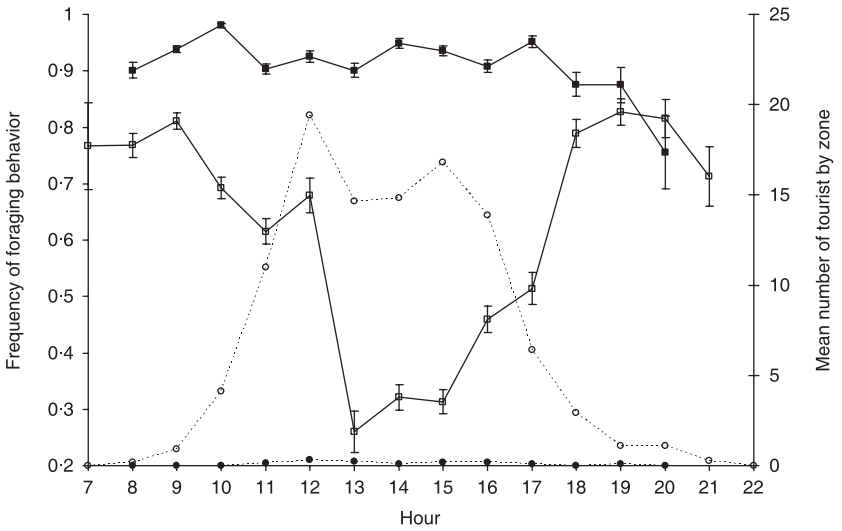

Fig. 1. Daily variation in the average observed proportion of foraging choughs (solid line: ■, winter, $n = 2183$; □, summer, $n = 1445$) and average number of visitors per zone (dotted line: ●, winter, $n = 2708$; ○, summer, $n = 2151$).

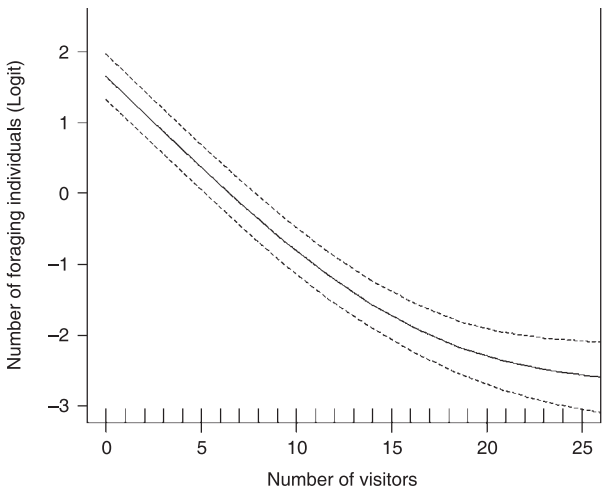

Fig. 2. Number of foraging individuals in summer as a function of the number of visitors per zone (Generalized Additive Model, adjusted for within-day variation). The dotted lines represent the 95% confidence interval. (GAM $\chi^2 = 1042$, d.f. = 1, $P < 0{\cdot}0001$.)

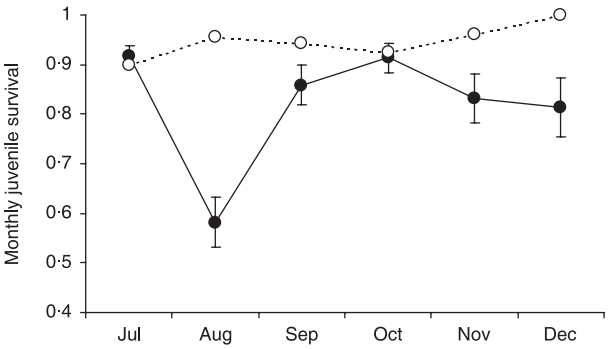

Fig. 3. Temporal changes in chough juvenile survival within a year. Closed circles: average survival rates in Ouessant (1998–2005, 122 fledglings), errors bars represent standard errors; open circles: Islay (1983–1985; $n = 173$, Bignal *et al.* 1987).

when controlling for pseudo-replication effects (see Supporting Information, Fig. S3.2). This negative impact of the number of visitors on foraging behaviour was due to a reduction in the area of available feeding habitat. With low visitor numbers (e.g. in June, September, and October, or in the early morning or late evening in August), there was 62 ha of feeding habitat available, of which choughs utilized 26 ha on average. In contrast, during peak visitor hours in summer days, the total area available was reduced to 4·8 ha, all of which was used by choughs. When summing available areas over time within a day, this resulted in a 41% spatio-temporal decrease in feeding habitat availability in summer vs. winter days.

CHOUGH DEMOGRAPHY

Juvenile survival, estimated from fledging data collected from June to December varied across months, with most variation due to the difference between survival in August and other months (58 vs. 81–94%, Fig. 3 and Supporting Information, Table S3.3). Monthly juvenile survival was constant across years for all months except for August: this significant yearly variation seemed to be attributable to variation in August visitor number (higher survival with lower visitor numbers, Fig. 3, ANODEV, $F_{1,4} = 78{\cdot}87$; $P < 0{\cdot}001$; $\beta = -0{\cdot}44 \pm 0{\cdot}09$; Fig. 4) but also to variation in August rainfall (higher survival with lower rainfall, ANODEV, $F_{1,4} = 13{\cdot}70$; $P = 0{\cdot}01$; $\beta = -0{\cdot}02 \pm 0{\cdot}01$). The effect of August rainfall on survival was nevertheless negligible compared to that of visitor number in August ($\beta = -0{\cdot}02$ vs. $-0{\cdot}44$, respectively). In contrast, the correlations between juvenile survival in August and breeding success, temperature or number of sunny days were not significant (ANODEV, $F_{1,4} = 1{\cdot}48$; $P = 0{\cdot}28$; $F_{1,4} = 1{\cdot}99$; $P = 0{\cdot}22$; and $F_{1,4} = 0{\cdot}53$; $P = 0{\cdot}50$, respectively). Note that we detected no significant correlation between visitor numbers and weather (rainfall and visitor number: $F_{1,6} = 0{\cdot}87$; $P = 0{\cdot}39$; temperature and visitor number: $F_{1,6} = 0{\cdot}004$; $P = 0{\cdot}95$; sunshine duration and visitor number: $F_{1,6} = 1{\cdot}07$; $P = 0{\cdot}34$).

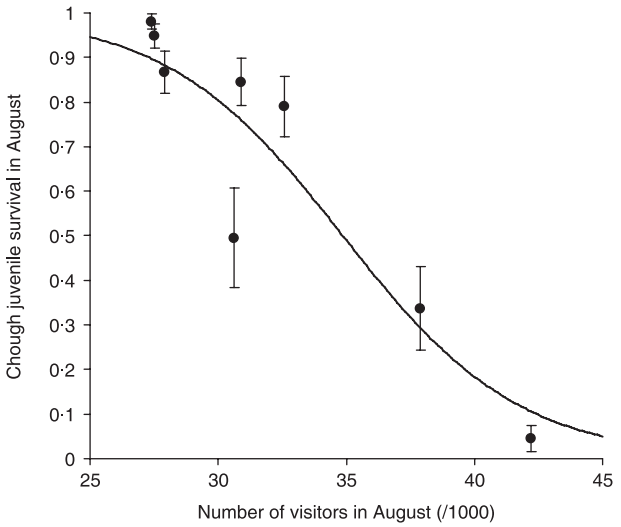

Fig. 4. Relationship between August juvenile survival and the number of visitors on Ouessant in August.

CHOUGH POPULATION VIABILITY

In the absence of regulation and inter-annual variation in demographic parameters, the deterministic matrix model predicted a slight annual increase of the population (asymptotic growth rate $\lambda = 1{\cdot}0189$) and a geometric increase in population size (Fig. 5). Moreover, the sensitivity of λ to adult survival rates was high (elasticity = 0·82), while variation in juvenile survival had a weak influence on the deterministic growth rate λ (elasticity = 0·17).

In contrast to the deterministic model, the IBM model included population regulation, which yielded density-dependent behaviours in some cases (Supporting Information, Fig. S3.4). However, density-dependence never affected the main prediction of the model, that is, a strong impact of tourism on short-term population dynamics and viability, which suggests an appreciable influence of reduced juvenile survival on chough population growth rate. We examined four scenarios regarding the future change in the number of visitors, x_t (Fig. 5). With no deterministic increase in visitor number, the IBM model predicted relatively stable chough population sizes (56·07 ± 0·06 individuals and 36·51 ± 0·03 breeders for Scenario A; 47·63 ± 0·49 individuals and 30·99 ± 0·56 breeders for Scenario B), but with stochastic variation the IBM model predicted much higher extinction probabilities (1% vs. 10% over 50 years in Scenarios A and B, respectively). When the current rate of increase in the number of visitors was considered (Scenarios C and D), the chough population size dropped rapidly, and extinction was almost unavoidable within 50 years. Scenario C (deterministic temporal increase in visitor number without stochastic variation) led to the lowest viability (100% extinction after 49 years). The differences among scenarios were little modified by changes in adult survival or nest limitation (Supporting Information, Fig. S3.4).

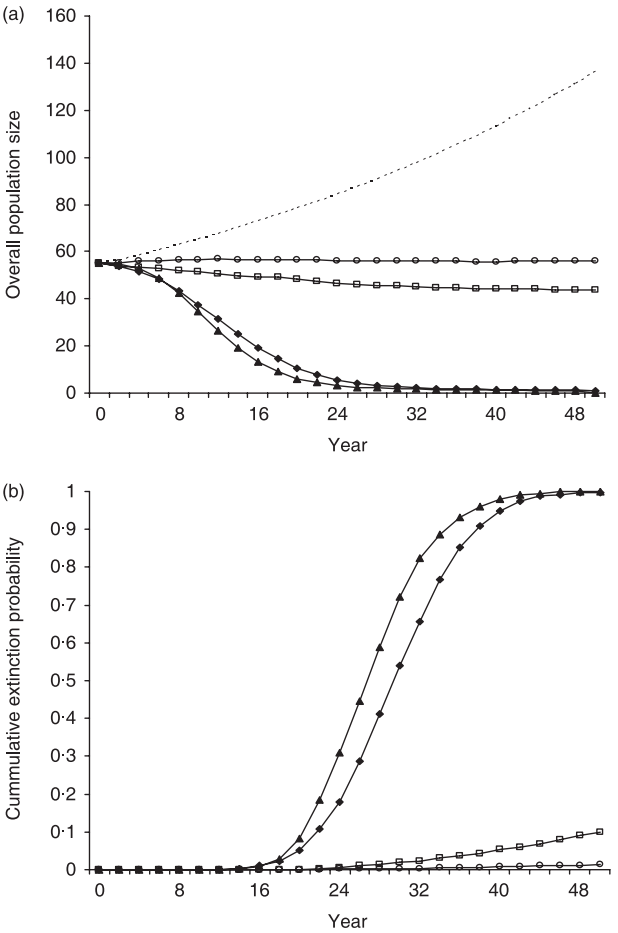

Fig. 5. Temporal variation in mean population size (a) and extinction probability (b) under the deterministic matrix (dashed line) and individual-based (solid lines) models. Parameter values are provided in Table 1. Standard errors were too small to be plotted. Open circles: constant number of visitors (Scenario A); open squares: stochastic variation in visitor number (Scenario B); solid triangles: deterministic increase in visitor number (Scenario C); solid diamonds: deterministic increase and stochastic variation in visitor number (Scenario D).

Discussion

Our results indicate that the presence of visitors on Ouessant Island resulted in a severe decrease in the area available for foraging in choughs and a reduction in the time allocated to foraging. This translates into reduced summer juvenile survival and, we predict, reduced population viability. Below, we discuss the relationship between the number of visitors and population viability, and derive recommendations to facilitate the coexistence of tourism and viable population of choughs.

REDUCED RESOURCE AVAILABILITY RESULTED IN REDUCED JUVENILE SURVIVAL

Visitor-induced disturbance is of conservation concern only if it actually affects population viability. This seemed to be the

case in the chough population of Ouessant, although the observed disturbance (birds fly off during their foraging time) may appear minor at first. First, the survival of juveniles in their first year was much lower in Ouessant (32%) than in a comparable island hosting choughs (Islay, UK, estimated juvenile survival = 71% in Bignal *et al.* 1987; 42% in Reid *et al.* 2003a,b), despite large differences in survival estimates in the latter. Secondly, survival rates in Ouessant varied from month to month, and were lowest (58%) in August. This again contrasted with the situation on Islay, where monthly juvenile survival rates were above 90% all year round. August mortality accounted for half of the total observed mortality on Ouessant between July and January. Most authors agree that the post-fledging period, when juvenile choughs become independent, is often critical for their survival (Holyoak 1971; Bullock, Drewett & Mickleburgh 1983; Robert 1985). However, the low juvenile survival in August is not merely the result of birds reaching nutritional independence, because in Ouessant more than half of yearlings become independent in September or July (Kerbiriou *et al.* 2006a,b), two months when high survival rates were recorded. Thirdly, the large difference in survival rates between August and other months (June, July, September and October) was not explained by changes in prey assemblages (see Kerbiriou & Julliard 2007), prey biomass, day length or weather conditions (temperature and rainfall), but was strongly correlated with the number of visitors on the island.

The most obvious physiological mechanism causing the observed excess juvenile mortality is severe undernourishment, due to the reduction in feeding time budget. On Ouessant, three ringed juveniles were found freshly dead in summer without any external parasite or wound. All three exhibited abnormally low weight (162 g, 184 g and 180 g vs. 261–295 g for healthy ringed fledglings) and had suffered severe weight loss since they were ringed 1 or 1 months earlier (–53 g, –94 g and –135 g, respectively). In addition, undernourishment may have acted in synergy with a production of corticoids, often associated with human disturbance (see Sapolsky 1992), to reduce juvenile survival.

REDUCED JUVENILE SURVIVAL AFFECTS POPULATION VIABILITY IN A LONG-LIVED SPECIES

Age-structured models of long-lived species predict that variation in juvenile survival rates should have little effect on population growth rate compared to variation in adult survival rates (Caswell 1989). In the Ouessant chough population, a species whose demographic parameters indicate that it is relatively long-lived (Bullock *et al.* 1983; Roberts 1985; Reid *et al.* 2003a,b), reduced juvenile survival may be considered of little consequence for the population growth at first, as suggested by results from the deterministic model. However, long-term studies of long-lived species have also shown that demographic parameters of high elasticity, such as adult survival, were often the least variable parameters (Hatter & Janz 1994; Gaillard, Festa-Bianchet & Yoccoz 1998), in agreement with theoretical expectations (Stearns & Kawecki 1994). As a result, population dynamics can be much more influenced by demographic parameters with smaller elasticity but larger variability (Gaillard *et al.* 1998), such as juvenile survival or fecundity. This pattern has been reported in various populations of long-lived birds, as exemplified by the California spotted owls (Blakesley, Noon & Shaw 2001) or the southern fulmar (Jenouvrier *et al.* 2005). We have no information regarding adult survival in the Ouessant population, but a long-term study on Islay showed that the contribution of between-year variation in first-year and second-year survival to the total variance in the population growth rate was similar to that of adult survival (Reid *et al.* 2004).

The Ouessant breeding population has been fairly stable in the last 50 years (10 to 13 pairs), but we observed a strong decrease in the number of non-breeders, from about 55 individuals in the 1970s to only 15 currently. Agricultural changes are probably an important driver of this loss, but we believe visitor disturbance is also involved, via a reduction in juvenile survival that could lead to a point where the production of juveniles does not compensate adult mortality and where the population is likely to go extinct rapidly. This is supported by our simulations, predicting a relatively large number of non-breeders under scenarios with a low probability of extinction (Fig. 5; 19·6 and 16·6 non-breeders without or with stochastic variation, respectively), that is, when the number of visitors remains at its current level. Under this model, non-breeders were expected to account for 35% of the population, of which 16% were old enough to reproduce (> 2 years old). In contrast, under scenarios with quasi-certain extinction (deterministic or stochastic increase in visitor numbers), non-breeders accounted for 11% only of the population, and were all ≤ 2 years old.

PERSPECTIVES FOR THE CONSERVATION OF CHOUGHS IN OUESSANT AND OTHER PROTECTED AREAS

Our study suggests that tourism threatens the chough population of Ouessant to the point where the short-term viability is endangered. This threat from visitors must be taken into consideration because the population of Ouessant is one of the core populations in western France, despite its small size and isolation. Several simple management actions could be taken to improve access to feeding areas for the choughs. First, footpaths could be redrawn to preserve feeding areas from visitor disturbance. However, given the chough flush distance and the coastal location of chough feeding sites, paths would always have to be located 150 m away from the coastline, which would obviously be detrimental for visitors to the spectacular coastline and has little chance of being accepted by Park managers and Ouessant residents. Secondly, large sections of the coastline (26 ha of short grassland, i.e. the area used by the chough population at a given time) could be closed to tourist access throughout August. Given the current distribution of the chough feeding habitat, this would result in a minimum of 3 km of coastline closed to visitor access, i.e. 8% of Ouessant coastline. Finally, it would be possible to

create 26 ha of short grassland, through grazing control, in inland areas, which are not attractive to visitors. A preliminary test (mowing of small inland areas in spring) showed that choughs do use these new foraging areas, although they are not adjacent to their former foraging sites, and suggested that this may result higher fledging success.

Conservation policies need not rely on complete separation of choughs and visitors, and there is hope that space can be shared between protected birds and visitors. Obviously, the latter should be informed about conservation issues and advised to avoid foraging flocks of choughs. In addition, the observed response of choughs to increasing visitor number (Fig. 3) indicates that birds could spend 92% of their time foraging (i.e. the time they spend without disturbance) if the number of visitors within 3 km of the coastline does not exceed 0·7 per hour. In addition, considering that the chough population requires 26 ha of short grassland at all times and that for a given number of visitors, the proportion of visitors within each zone does not change, we estimate that the number of tourists should not exceed 16 500 in August (i.e. half the current number). However, this solution is probably not economically sustainable because tourism is the main source of income on Ouessant. A realistic approach would be to combine different strategies defined with respect to local situation (reroute paths away from priority feeding areas, create feeding habitats on areas with low tourist interest, etc.). At the island level, an education programme to increase visitor awareness of the detrimental effects of wildlife disturbance must be launched.

Despite Caughley's (1994) recommendation to use a mixing of the two paradigms of conservation biology, the declining-population and the small-population paradigm, few studies have so far quantified the link between ultimate factors of species decline, stochastic processes and extinction risk for particular species or populations. By demonstrating how tourism pressure is related to both individual response and population dynamics in an endangered bird species, we hope that the present study is a step in the right direction.

Acknowledgements

Christian Kerbiriou thanks the 'Centre d'Etude du Milieu d'Ouessant' for funding between 1995 and 2005. We are grateful to Jacques Nisser for his help to work out ringing techniques; we thank Aurélien Audevard and Vincent Le Pennec for their important contribution to resighting of marked choughs, Emmanuel Girauded for help with GIS, Grégoire Lois and Hélène Pouliquen for an earlier reading of our manuscript and MétéoFrance for providing meteorological data. Finally, we wish to thank Jeremy Wilson, Paola Laiolo and Durwyn Liley for their constructive comments.

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Received 11 October 2008; accepted 17 February 2009
Handling Editor: Jeremy Wilson

Supporting Information

Additional Supporting Information may be found in the online version of this article:

Appendix S1. Location of the study area (Ouessant) and protection status levels (Fig. S1)

Appendix S2. Methodology details (one table and one figure)

Appendix S3. Results details (two tables and three figures)

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Appendix 7.4
Chough Survey Data

Cork
County Council
Comhairle Contae Chorcaí

Fáilte Ireland
National Tourism Development Authority

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APPENDIX 7.4
Chough Survey Data

Introduction

This Appendix presents the numerical data obtained with respect to (i) flock size; (ii) nest locations/breeding success; and (iii) flush distances, during the 2019 survey of breeding chough undertaken in the Study Area for the purposes of this EIA. For a description of the survey methodology and study area, please refer to Section 7.2.8 of this Chapter. Section 7.4.2.2 presents an overview of the findings of the surveys and their implications in terms of the proposed development. The data presented in this Appendix are derived from raw field survey notes, which can be made available upon request.

Flock Size

Table 7.35 Maximum chough flock sizes recorded during 2019 surveys

Maximum flock size recorded	Date
4	03/02/2019
13	17/05/2019
6	24/05/2019
6	27/05/2019
4	28/05/2019
2	29/05/2019
2	30/05/2019
14	31/05/2019
6	03/06/2019
2	04/06/2019
8	05/06/2019
6	06/06/2019
3	07/06/2019
2	10/06/2019
11	11/06/2019
4	12/06/2019
6	13/06/2019
2	14/06/2019
2	17/06/2019
19	18/06/2019
6	19/06/2019
2	20/06/2019
6	21/06/2019
6	24/06/2019
28	25/06/2019
12	26/06/2019

Maximum flock size recorded	Date
2	27/06/2019
6	28/06/2019
25	01/07/2019
28	02/07/2019
32	04/07/2019
7	05/07/2019
22	08/07/2019
6	09/07/2019
20	10/07/2019
6	11/07/2019
12	12/07/2019
32	15/07/2019
3	16/07/2019
6	17/07/2019
14	18/07/2019

→ Maximum flock size between 03/02/2019 and 18/07/2019 = 32

Breeding/Nests

Table 7.36 Details of chough nest sites (confirmed and discounted) identified during 2019 surveys [Precise locations redacted in public version]

Count	Status	Location	Date first recorded	No. juveniles fledged	Notes
1	Breeding	Dursey Island [Redacted]	17/05/2019	2	Faecal sac seen 17/05; Pair seen entering cliffs on eastern side of inlet on 27/05 and both seen entering/exiting separately on 30/05; pair seen entering/leaving nest on 12/06; juveniles heard and fecal sac sighted on 20/06; 2 juveniles sighted out of nest and being fed by parents on 24/06
2	Breeding	Dursey Island [Redacted]	03/06/2019	2	Chicks/feeding heard on 03/06; pair observed entering and leaving nest again on 11/06; Fledging later confirmed during nest watches.
3	Breeding	Dursey Island [Redacted]	05/06/2019	4	One bird seen entering crack in cliff on 05/06; Breeding and fledging later confirmed during nest watches.
4	Breeding	Dursey Island [Redacted]	03/06/2019	3	In most westerly derelict house; pair seen flying in and out and foraging in vicinity on 05/06, 10/06 and 13/06; 3 juveniles observed on 18/06 and again on 24/06; Fledging later confirmed during nest watches.
5	Breeding	Dursey Island [Redacted]	13/06/2019	4	Pair seen entering and exiting on 13/06. Pair seen to use rock immediately above nest site as landing and preening area. Breeding and fledging later confirmed during nest watches.
6	Breeding	Crow Head [Redacted]	24/05/2019	2	Two birds seen enter crack in cliff on eastern side of island on 24/05 and again on 29/05; 2 juveniles observed on 19/06; Fledging later confirmed during nest watches.
-	Discounted	Dursey Island [Redacted]	03/06/2019	-	Pair seen entering cliff. Chicks heard.
-	Discounted	Garinish Head [Redacted]	04/06/2019	-	Pair seen active in vicinity and one seen entering cliff (04/06).
-	Discounted	Crow Head	29/05/2019	-	1 bird seen entering and leaving cliff on SE side of headland.
-	Discounted	Dursey Island [Redacted]	30/05/2019	-	Pair seen going out of view at cliffs and emerging shortly after on 30/05.
-	Discounted	Dursey Island [Redacted]	10/06/2019	-	Pair seen entering inlet and not re-emerging on 10/06.

Count	Status	Location	Date first recorded	No. juveniles fledged	Notes
-	Discounted	Garinish Head [Redacted]	14/06/2019	-	Nest watch conducted on 14/06 but no evidence of nesting noted. Presume pair must have been seen entering cliffs in area.
-	Discounted	Dursey Island [Redacted]	18/06/2019	-	One bird seen entering crack in south-facing cliff on 18/06
-	Prospected; no breeding	Dursey Island [Redacted]	17/05/2019	-	Two birds seen enter cave on 17/05 and again on 29/05. According to first report, no breeding occurred here. May have been non-breeding pair simulating nesting.

→ Total number of breeding pairs/nests = 6
→ Mean no. juveniles fledged per nest = 3
→ Total no. fledglings = 17
→ 100% of confirmed breeding pairs successfully fledged offspring

Please note: coordinates of locations of nest sites have been omitted from Table 7.36 in order to protect the nest sites in question, and can be made available to the Competent Authority upon request, if required.

Flush Distance

Table 7.37 Flush distances of chough recorded during 2019 surveys

Date	Flush distance (m)	No. birds	Disturber	Notes
03/06/2019	40	4	Surveyors	
03/06/2019	40	1	Surveyors	
18/06/2019	5	12	Surveyors	Surveyor obscured from view of birds until that distance so exclude
18/06/2019	2	2	Surveyors	Disturbed birds were juveniles (one froze) so exclude
30/05/2019	150	2	Surveyors	
31/05/2019	40	1	Surveyors	
31/05/2019	25	9	Surveyors	
31/05/2019	45	10	Surveyors	
31/05/2019	25	2	Surveyors	
11/06/2019	10	2	Surveyors	
11/06/2019	20	2	Surveyors	
19/06/2019	80	2	Surveyors	
21/06/2019	30	2	Surveyors	
24/06/2019	25	1	Surveyors	
24/06/2019	35	3	Surveyors	
24/06/2019	30	6	Surveyors	
25/05/2019	40	5	Surveyors	
25/06/2019	25	7	Surveyors	
25/06/2019	25	5	Surveyors	
26/06/2019	25	3	Surveyors	
28/06/2019	50	4	Surveyors	
01/07/2019	40	5	Surveyors	
04/07/2019	25	2	Surveyors	
05/07/2019	12	6	Surveyors	
11/07/2019	10	3	Surveyors	One chough foraging 10m for observers simply alarm called, did not take flight as surveyors passed on the path
11/07/2019	10	5	Surveyors	
11/07/2019	20	2	Surveyors	
12/07/2019	20	4	Surveyors	
15/07/2019	15	12	Surveyors	
18/07/2019	20	1	Surveyors	
18/07/2019	25	5	Surveyors	
03/06/2019	30	2	Tourists	

Date	Flush distance (m)	No. birds	Disturber	Notes
03/06/2019	50	5	Tourists	
01/07/2019	30	6	Tourists	
01/07/2019	30	6	Tourists	
01/07/2019	30	6	Tourists	
01/07/2019	30	8	Tourists	
01/07/2019	35	8	Tourists	
02/07/2019	35	2	Tourists	
02/07/2019	45	16	Tourists	
02/07/2019	25	3	Tourists	
02/07/2019	30	5	Tourists	
02/07/2019	10	2	Tourists	
08/07/2019	30	9	Tourists	
08/07/2019	15	7	Tourists	
08/07/2019	15	7	Tourists	
10/07/2019	25	6	Tourists	
10/07/2019	30	20	Tourists	
11/07/2019	35	4	Tourists	

Key Notes

Key notes from survey field notes are as follows:

- Evidence was observed of illegal dumping on southern face of Crow Head (24/05/2019).
- Birds were observed flying between the island and mainland on a number of occasions, including 24/05, 09/07 and 18/07/2019.
- Interactions with other species:
    - Interactions between ravens and choughs were observed regularly, e.g.:
        - 27/05/2019 choughs mobbing raven
        - 31/05/2019 chough alarm calling while pursued by 2 ravens
    - Some antagonistic interactions were also observed between choughs and hooded crows and magpies.
    - Choughs were observed mobbing a peregrine falcon near *Drom Gabhair* nest site on 13/06/2019 and a peregrine was observed flushing choughs a number of times thereafter.
- In late June/early July, family groups were observed to start flocking on the western end of the island, and birds largely stayed around this area from this point onwards. One surveyor reported walking from the eastern to the western end of the island on 02/07/2019, observing no choughs until reaching the western end of the island.
- Birds were observed to display vigilance behaviour – calling more frequently than normal – when walkers were within 50m.
- Choughs were observed to become familiar with the surveyors over time, allowing surveyors to forage quite close by on a few occasions towards the end of the season.

- *Cuas na gColúr* and *Brann Righe* were identified as potential roosting sites, but no evidence was found of Foilnamuck being used as such.
- The extreme western end of the island (*Maoil, Maoil Mhór* and *Maoil Bheag*) is a key foraging and flock-forming area for choughs and the largest flocks were consistently seen here.
- From late June/early July, choughs appeared to be roosting in family groups, near their respective nests, from around sunset.

Appendix 7.5
Bird Survey Methodology

Cork County Council
Comhairle Contae Chorcaí

Fáilte Ireland
National Tourism Development Authority

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APPENDIX 7.5
Bird Survey Methodology

Overview

Bird surveys were undertaken on behalf of CCC for the purposes of this EIAR and for the Appropriate Assessment for the proposed development by the Project Ecologist, Paul Murphy (EirEco Environmental Consultants) with assistance by three ROD employees, Christina McKiernan, Tadhg Twomey and Jason Cahill, and a sub-consultant of ROD, John Deasy. Surveys commenced in March 2019 and will continue until November 2019. Table 7.38, below presents an overview of the surveys undertaken. While Red-billed Chough (*Pyrrhocorax pyrrhocorax*) was the focal species of these surveys, the occurrence and activity of other species of rare and protected birds was also observed and recorded during these surveys. Evidence of breeding was recorded for all species of bird. General data recorded during the surveys included:

- Number of birds observed;
- How birds first detected (seen or heard; flying or on the ground; distance from the observer);
- Location (grid reference and description/place name);
- Behaviour (foraging, flying, preening, vigilant, loafing, breeding or heard only);
- Habitat;
- Micro-habitat patch use;
- Land use;
- Grazing regime on land in question (including type of livestock, sward height, presence/absence of dung)
- Cultivation (if any) on land in question (cut silage, amenity grassland, etc.);
- Weather conditions (wind force, wind direction, visibility and occurrence of precipitation);
- General notes on other interesting aspects, including:
    - Specific features of land use and habitat e.g. poaching, strip grazing, out-wintering of livestock;
    - Timing of agricultural activities e.g. spring grazing, cutting of silage; and,
    - Behavioural aspects of the birds e.g. did the bird(s) move to different habitats or direction of flights.

The principal objective of the bird surveys was to obtain data with respect to the following in the study area:

- The abundance of chough;
- The number of breeding pairs of chough;
- The abundance and location of nests of breeding chough;
- The breeding success (productivity) of chough;
- The distribution of chough foraging habitat;
- The average flush distance of chough; and,
- The location(s) of communal chough roosting site(s).

The suite of surveys undertaken aimed to cover the entire breeding season of the species, from nest selection through to fledging of young, foraging habitat utilisation during breeding and subsequently by post-breeding communal flocks, and location of communal roost sites on

Dursey Island. The Sections below refer to surveys undertaken with respect to chough. During these surveys, the activity of other species of birds was recorded on an *ad hoc* basis, as described previously.

Table 7.38 Overview of breeding bird surveys undertaken Stage

	Period	Chough Activity Phase	Surveys Objectives	Surveyors
Breeding	March – June 2019	Breeding commences early to mid-April, when eggs are laid in the wool-lined nest cup. The female is solely responsible for incubating the eggs and during this time the male forages alone, returning to the nest periodically to feed the female and allowing her time to feed close to the nest.	• Abundance of chough • Breeding distribution and abundance • Foraging habitat utilisation by adult birds • Breeding & occurrence of other bird species	Paul Murphy
Fledging	June – August 2019	Nestlings start to fledge and form family groups which remains within their breeding season home range. Nursery flocks (comprising several family groups) beginning to form.	• Chough breeding success (productivity) • Flush distance by human disturbance • Foraging habitat utilisation by family groups • Total abundance of chough • Distribution and occurrence of other species	Paul Murphy Christina McKiernan Tadhg Twomey Jason Cahill John Deasy
Post-breeding/ Dispersal	August – November 2019	Flock utilisation of communal roosts. Potential dispersal to wintering areas such as sand dunes and machair.	• Location of communal roost sites on Dursey Island • Distribution and occurrence of other species	Paul Murphy

Study Area

The study area for the surveys took in the following areas:

- The entirety of Dursey Island;
- The immediate vicinity of the site of the proposed development (mainland and island);
- Crow Head; and,
- Garinish Head.

The primary focus of efforts was in the immediate vicinity of the existing cable car site. However, since there is evidence to suggest that chough may be sensitive to human disturbance (Keribiou et al., 2009), and since the proposed development will substantially increase the number of walkers on Dursey Island, and potentially on Garinish Head and Crow Head, it was considered necessary to include these areas in the study area also.

Transects

Existing walking trails on Dursey Island, and on Garinish Head and Crow Head, were used as transects for surveys, while off-transect observation were also made, as per Trewby *et al*. (2004) (Plate 7.20).

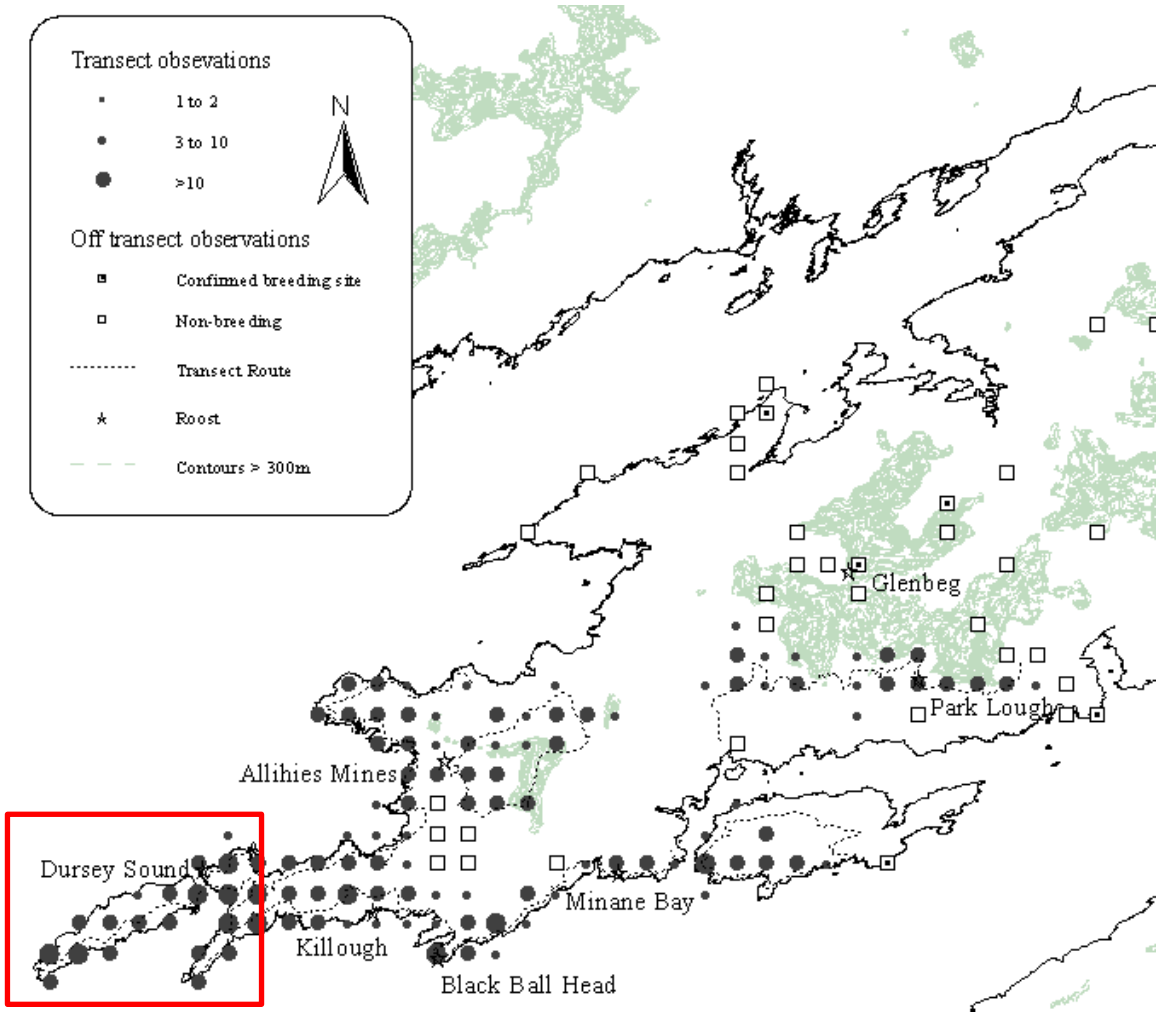

Plate 7.20 **Transects used in study area (study area in red; transects as per legend). Source: Trewby *et al*., 2004**

Surveys were not undertaken during periods of prolonged heavy rain or when wind speeds were at or in excess of Beaufort scale 6.

Abundance of Chough

Throughout the duration of the breeding and fledging periods, the maximum number of chough per flock was recorded on an ongoing basis. Towards the end of the fledging season, when non-breeding birds and family groups begin to gather in large communal flocks, this number serves as a proxy for the abundance of chough inhabiting a particular area.

Breeding Distribution & Abundance

In order to identify breeding pairs and locate nest sites, nest sites identified in previous studies (e.g. Trewby *et al*., 2004; Scott, 2017) were investigated and monitored to confirm/discount the presence of birds. In addition to the transects described in Section 1.3, the entire coastline was walked twice before the fledging period to ensure that all potential nest sites were identified. The location of confirmed and potential nest sites was recorded along with all observations of potential and confirmed breeding pairs. Criteria used to determine whether nests were breeding or non-breeding were based on Gray *et al.* (2003). Dedicated focal nest watches of 3 – 5 hours were undertaken once the locations of nests were identified to confirm whether breeding occurred. Behaviour of birds at nest sites including frequency of feeding visits, duration of visits, foraging in the vicinity of the nest, etc. was noted.

Breeding Success (Productivity)

Breeding success of confirmed breeding pairs was determined during the fledging period, by observing family groups consisting of adults and juveniles foraging in in the vicinity of nests. The number of juveniles successfully fledged by each pair was noted.

Distribution of Foraging Habitat

Detailed mapping of habitats was undertaken in the study area (see Section 7.4.1 of Chapter 7 of this EIAR) and habitats were classified according to potential suitability as chough foraging habitat, on the basis of a literature review undertaken on the ecology of the species (see Section 7.3.2.1, subheading 'Chough', of Chapter 7 of this EIAR). Additionally, throughout the breeding and post-fledging periods, birds were observed while foraging and the location, habitat use, land management and other relevant details were noted. The distribution of key areas of foraging habitat (particularly for family groups) was thus determined.

Flush Distance

Flush distance is defined as "*the distance at which a foraging bird or flock will fly off when approached [i.e. disturbed] by a person or group of persons*" (Keribiou *et al*., 2019; p. 658). During all surveys, flush distances (to the nearest 5 or 10m) were recorded whenever flushing was observed and these details could be judged accurately. Data recorded included the source of disturbance (individual or group of people), the number of birds flushed and the subsequent behaviour of the birds (re-settled or flew from the area).

Location of Roosts

During the post-breeding surveys, surveys were undertaken on Dursey Island with a view to identifying the location(s) of communal chough roosts.