Addendum to the Environmental Impact Assessment Report

NISA
North Irish Sea Array

Volume 9 - Offshore Appendices

Appendix A15.4
Offshore Ornithology Migratory Collision Risk Modelling: Irish East Coast Phase One Offshore Wind Projects Cumulative Assessment

Statkraft
CIP Copenhagen Infrastructure Partners
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North Irish Sea Array Windfarm Ltd

Offshore Ornithology Migratory Collision Risk Modelling: Irish East Coast Phase One Offshore Wind Projects Cumulative Assessment

Irish East Coast Phase One Offshore Wind Projects

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Acronyms

Term	Definition
ABP	An Bord Pleanála
AR	Avoidance rates
CRM	Collision risk modelling
EIA	Environmental impact assessment
EIAR	Environmental impact assessment report
GIS	Geographical information system
JNCC	Joint Nature Conservation Committee
km	Kilometre
NPWS	National Parks and Wildlife Service
OWF	Offshore wind farm
RFI	Request for further information
RWE	RWE Renewables Ireland Ltd (a wholly owned subsidiary of RWE AG)
SD	Standard deviation
SPA	Special Protection Area
UK	United Kingdom
WTG	Wind turbine generator
ZOI	Zone of Influence

1 Introduction

North Irish Sea Array Windfarm Ltd (NISA, hereafter referred to as 'the Developer') has been considering the Request for Further Information (RFI) issued by An Bord Pleanála (now An Coimisiún Pleanála) as well as the third-party submissions received following public consultation. At An Coimisiún Pleanála's behest, the Developer has also continued to consult with stakeholders in respect of the 2024 planning application throughout 2024-2026. The Developer has refined elements of the design to respond to the third-party submissions, the continued public and stakeholder consultation and the RFI. Full details of consultation undertaken can be found in Appendix A.1.2 Consultation Report.

Any cross reference to a chapter, section, table, image, figure or appendix within this document is to another location within the Addendum to the EIAR unless explicitly stated otherwise. Any cross reference to anything included in the 2024 EIAR will be clearly labelled as such.

The sections relevant to Offshore Ornithology Migratory Collision Risk Modelling: Irish East Coast Phase One Offshore Wind Projects Cumulative Assessment in the RFI are included below.

RFI Section	RFI	Relevance to Chapter
1 (b)	The scientific information provided as part of the planning application documentation should be based on up-to-date survey reports and data. Accordingly, the applicant is requested to confirm/provide justification/verification that the information submitted in support of the planning application remains relevant and appropriate at the point of submitting further information or to update same as required.	The timeframes associated with the RFI have necessitated a review of the datasets previously used in the 2024 EIAR to ensure any necessary updates to the baseline environment are captured. This report ensures that additional data has fed into the ornithological assessment and therefore remains valid and representative of up to date information.
1 (c)	The applicant is requested to confirm whether any on-going or additional surveying has been carried out since the application was lodged and, if so, the applicant is invited to submit any further survey data results and analysis and update the planning application documentation, as appropriate.	Additional ornithological surveys have been undertaken since submission of the Application. These additional surveys are described in Section 15.2.5 of Chapter 15: Offshore Ornithology.
8 (a) iv	Migratory Waterbirds: Chapter 15 of the EIAR, and NIS Appendix 19 Offshore and Intertidal Ornithology Migration Collision, address migratory waterbird species. The DAU notes that a significant number of migratory waterbirds (in terms of species and absolute numbers) migrate to and from Ireland across the Irish	The Developer has undertaken an updated assessment on migratory waterbirds using a bespoke modelling specific to Irish bird populations, detailed in this report. Likewise, the Developer has collected additional Vantage-point (VP) and Passive Acoustic Monitoring (PAM) data in autumn 2024 and 2025 (Appendix A15.7: Migratory Bird

	Sea. The DAU observation raises concerns in relation to the lack of sufficient collection of spatially relevant field data at key migration times (i.e. spring and autumn) in the EIAR, combined with the acknowledged low confidence levels applied in relation to avoidance rates in the migratory Collision Risk Modelling (mCRM) Tool. The DAU states the information submitted is insufficient to assess the migratory movements of birds through the development area. The DAU has concerns that the proposed development has the potential to have significant impacts upon migratory waterbirds and the Conservation Objectives of the SPAs for which they are listed. The DAU recommends that the applicant develops and implements more appropriate survey methodologies to detect and robustly characterise and assess the level of bird migration through the proposed development area, working collectively with the other Irish Sea ORE applicants. The Board notes the Vantage Point survey results submitted by the applicant have spatial limitations in terms of robustness and have not been used in quantifiable assessments. There is also limited information on flux or passage of birds through the proposed array area itself during migration (east-west and north-south). The data query is only partially filled by the applicant's approach to assessing collision risk, where GIS and straight-lines have been applied to identify potential migration pathways/flight routes to assess the proportion of flights (as a proxy for population) which may pass through the proposed array area. Having reviewed all the information presented, the Board requests that further assessment is carried out regarding impacts to migratory species. The applicant is requested to address the purported data gap relating to migratory birds to enable the assessment of potential impacts of the proposed development. Radar (horizontal and vertical surveys) (or similar) at the array area during peak migration periods should be utilised to	Survey Report 2026) which has been presented to DAU and used to inform the migratory bird assessment. Radar was considered but not utilised due to a number of technical and logistical reasons. While radar and other specialised survey techniques can provide general movement data, they do not reliably identify birds to species level, nor do they robustly characterise species-specific flight heights or behaviours required for quantitative CRM. Given the dispersed nature of migration across the Irish Sea, the absence of narrow, high-density migration fronts, and the inherently precautionary nature of the modelling applied, radar-based surveys would not meaningfully reduce uncertainty or alter the assessment conclusions. The Developer therefore considers that the existing empirical data, enhanced by additional VP and PAM surveys, together with the cumulative Irish-centric mCRM, provide a robust and proportionate evidence base for the assessment. Further site-specific migration surveys, including radar, would be unlikely to materially change the findings or improve the assessment of potential impacts on migratory waterbirds.

	provide site-specific data, which could be used to support the applicant's current assessment and provide quantitative information on passage of birds to feed into collision modelling. Should radar not be conducted and an alternative survey methodology utilised, comprehensive justification for the alternative should be provided. Peak migration periods during which data are to be collected can be further informed through review of existing data and published literature relevant to the project area and region. Whilst the DAU makes reference to the key migration times being spring and autumn, the Board considers that migration information during the winter months would also be of assistance to the assessment (e.g. irruptive cold weather movements from the continent and UK). The applicant is invited to consider this aspect for inclusion also. The applicant should note reliance on literature to fill knowledge gaps, while useful, does not provide adequate data to ensure a comprehensive assessment of potential effects on birds.	
8 (d) ii	Migratory Waterbird Species: Migratory birds have not been included in the Cumulative and Inter-related Effects Assessment presented in the application documentation. As stated previously (points a(iv) Migratory Birds and a(v) Terrestrial Birds), the Board has requested further assessment of the impact on migratory birds for the project, and further data to inform the assessment. The applicant is requested to assess cumulative impacts to migratory bird populations, considering effects of the Irish Sea Phase 1 ORE projects and other existing or currently proposed plans and projects that may affect the same migratory populations. The applicant is requested to update the application documentation, as required.	The Developer has provided a cumulative assessment on migratory waterbirds, considering cumulative effects from other Irish Sea Phase 1 ORE projects, presented in Section 15.9.9 of Chapter 15: Offshore Ornithology. The collision risk modelling has been fully updated within this report.

1.1 Project Background

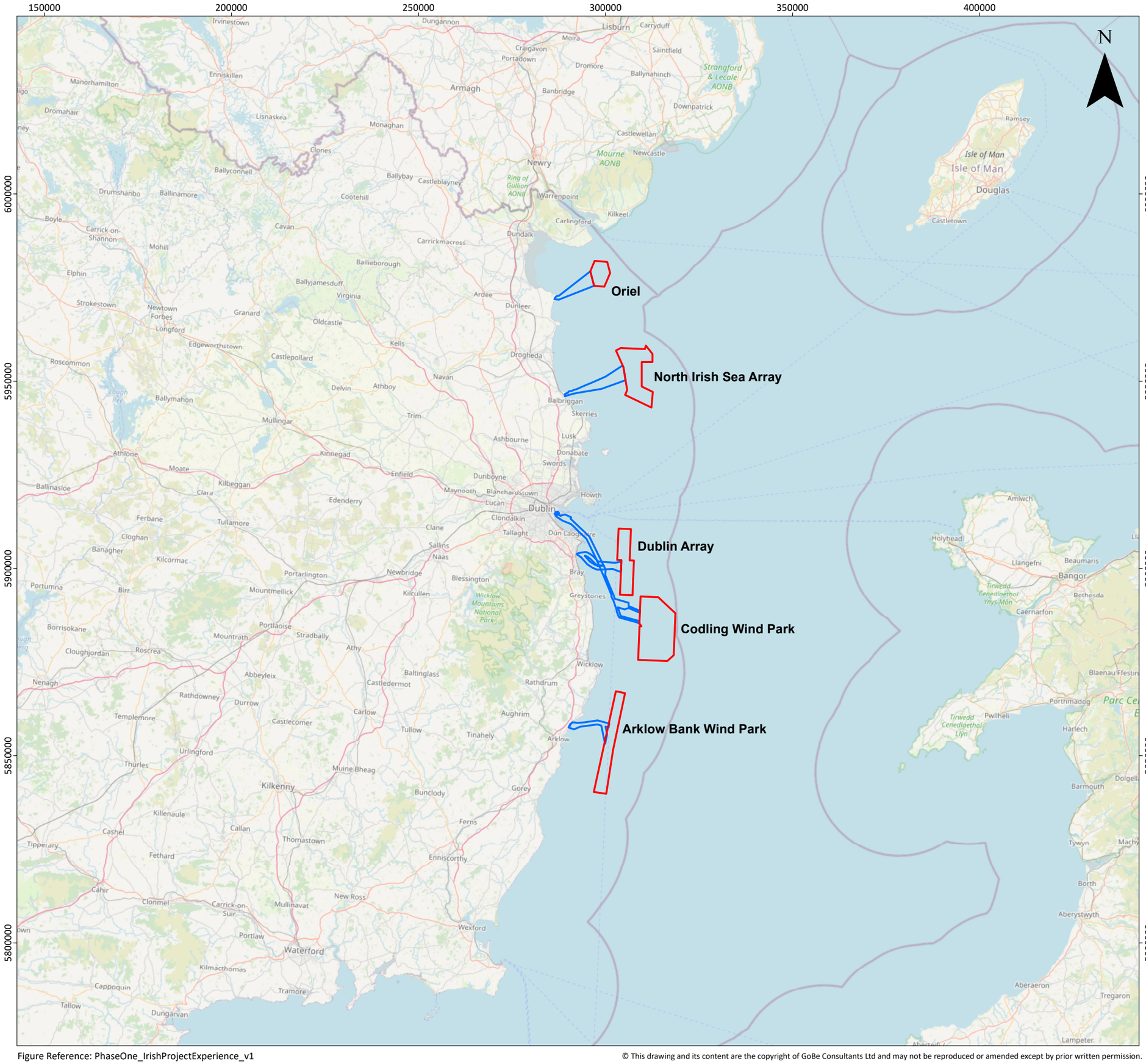
1.1.1 This document has been prepared by GoBe Consultants Limited (GoBe) on behalf of North Irish Sea Array Limited (NISA Ltd) to address specific concerns raised through submissions in response to the Irish East Coast Phase One Offshore Wind Projects planning applications. The two overarching issues raised in submissions, which this report aims to address are:

(1) differences in Developer approaches to a migratory collision risk assessment; and

(2) the absence of a cumulative assessment.

1.1.2 Other requests within submissions, for example, the request for further monitoring etc., are not addressed within this report.

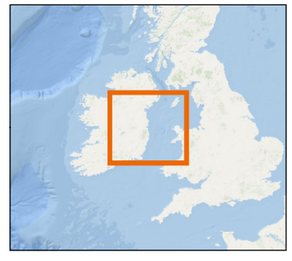
1.1.3 There are five Irish East Coast Phase One Offshore Wind Projects, which have submitted planning applications, these include Oriel Windfarm (hereafter 'Oriel'), North Irish Sea Array (hereafter 'NISA'), Dublin Array (hereafter 'Dublin'), Codling Wind Park (hereafter 'Codling'), and Arklow Bank Wind Park 2 (hereafter 'Arklow'). The locations of these projects are presented in Figure 1 and each have been included within the assessments contained within this report.



Locations of the five East Coast Phase One Projects

Legend

- Offshore Wind Farm Project
- Export Cable Corridors



Notes

Coordinate System:
WGS 1984 UTM Zone 30N

0 25 50 km

0 10 20 nm

Scale	Date	Drawn by	Checked by	Approved by
1:1,000,000@A3	04/03/2025	BPHB	JM	GB

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Figure 1

Figure Reference: PhaseOne_IrishProjectExperience_v1

1.2 Migratory Collision Risk Modelling

1.2.1 This technical appendix has been prepared to support the Request for Further Information (RFI), from An Bord Pleanála (ABP). It examines the potential project-specific and cumulative impacts of all Irish East Coast Phase One Offshore Wind Projects on migratory bird species. These migratory species are often not recorded in site-specific monthly surveys due to their movements occurring over short periods that may be missed by snap-shot survey methods, and movements may occur at night with limited methods to detect them or during weather conditions that do not allow for any surveys to collect data in (Woodward *et al.*, 2023; Wright *et al.*, 2012).

1.2.2 The Irish Sea experiences significant passage of migratory birds travelling between the United Kingdom (UK), Europe and other distant regions (Stienen *et al.*, 2007). This includes the movements of non-seabird species such as waders, wildfowl, other non-passerines, and passerines and non-passerines. As part of the environmental impact assessment (EIA) process, evaluating the potential impact of collision risk mortality with wind turbine generators (WTGs) is critical. Collision risk modelling (CRM) is used to estimate the level of bird strikes that lead to mortality events for different migratory bird species. The resultant mortality rates can then be used to estimate the impact on particular species in relation to their overall populations at varying levels from specific assemblages of interest to wider regional, national and international populations.

1.2.3 To model the movements of migratory birds within the proposed development areas, a modified version of the Marine Scotland Avian Migration Collision Risk Model Shiny Application, hereafter referred to as the mCRM tool (HiDef Aerial Surveying Ltd., 2024), was employed. Throughout this report, 'mCRM tool' refers specifically to the software application, whereas 'migratory CRM' refers to the collision risk modelling methodology.

1.2.4 This Marine Scotland mCRM tool is a stochastic adaption of the Band (2012) migration collision risk worksheet that allows for a precautionary way to quantify impacts to migratory species by making several assumptions about flight paths and species avoidance rates (AR). The mCRM tool generates robust population estimates, of birds passing through the array area, using a bootstrapping technique which randomly samples 1,000 potential flight lines. These flight lines are generated from 10,000 random lines that comprise a birds' potential migration pathway to and from Ireland. Furthermore, the default AR values set within the mCRM tool are used for each species. These values have been checked by an ornithological expert (Cook per comms, 2023) and closely align with NatureScot guidance which is based on several literature sources that incorporate collision data from all suitable terrestrial, coastal and marine offshore wind farms.

1.2.5 The mCRM tool is not suitable for modelling all bird species, particularly those that do not follow point-to-point migration patterns (Newton, 2023). Some species, such as seabirds, adopt longer routes that follow coastlines instead of direct overland paths. This analysis focused solely on migratory birds that tend to migrate over land and are considered within the mCRM tool for the evaluation of potential Phase One project-specific and cumulative impacts.

1.3 Bespoke mCRM tool

1.3.1 A bespoke version of the mCRM tool was developed in order to tailor the flight lines within the tool to suit an Irish assessment, which in turn allowed known Irish populations to be used as model inputs. The alternative, i.e. maintaining the UK-centric flightlines would necessitate the allocation of an arbitrary proportion of the UK population to the Irish Sea, in addition to the Irish population. It was considered that a more appropriate and accurate assessment could be carried out through the use of the Irish populations alone (where these are available).

1.3.2 The modified version of the tool provides an assessment using Irish populations and uses an Ireland-centric version of the model where flight lines converge on Ireland (rather than the UK) (Figure 2). The rationale for this approach is that by adapting the model to focus on flights into and out of Ireland, Irish population estimates can be used to inform the model. This provides a potentially more realistic presentation of the volume of passage over Irish waters and the populations of the birds involved.

1.3.3 A key benefit of this approach therefore is that an estimate of the UK population overflying Irish waters may not be necessary. Birds moving from the UK to Ireland are very likely to be recorded in Ireland and therefore included within the Irish population estimates that underpin these assessments. Movement of birds between the two countries is therefore already accounted for.

1.3.4 For migratory species that rely on terrestrial, estuarine or inshore habitats (such as the species considered by the mCRM tool), it is considered highly unlikely that birds would undertake long, indirect sea crossings that brought them close to an abundance of suitable habitat on the Irish east coast without utilising these habitats. The Irish coastline adjacent to the Irish East Coast Phase One Offshore Wind Projects hosts a number of special protection areas (SPAs) that are estuaries or wetlands designated for passage populations of many of the species considered herein, demonstrating that these species utilise Irish SPAs (and therefore contribute to the Irish population) while migrating. Finally, given that the Phase One developments are positioned relatively close inshore to the Irish east coast means that the likelihood of UK birds passing through these development areas, but without contributing to the Irish population, is very small.

2 Species selection and screening process

2.1 Screening methodology

2.1.1 All species that are presented in the latest version of the mCRM tool (v1.0.0) were considered for assessment within this technical appendix. The modified tool uses robust migratory routes updated from Wright *et al.* (2012) and Woodward *et al.* (2023). Species were then screened out based upon the likelihood that there would be connectivity between migratory populations and the Irish East Coast Phase One Offshore Wind Projects. Where species have been screened out, justifications have been presented in section 2.2. Likelihood of connectivity has been based upon the species population and distribution in Ireland, the location of the Phase One developments, and data presented within the BTO Migration Atlas (which covers movements of Irish birds and movements from Great Britain to Ireland) and The Eurasian African Bird Migration Atlas https://migrationatlas.org/.

2.1.2 Seabird species, for which CRM can be informed by site-specific survey data are also screened out.

2.2 Screening results

2.2.1 The migratory species considered for CRM analysis, with regards to potential Phase One project-specific and cumulative impacts, are presented in (Table 1). The scientific names for each bird species are presented in Appendix A. Justifications for species that have been screened out are presented in section 2.2.3 to 2.2.29.

Table 1: Species considered for migratory CRM assessment.

Migratory Species		
Bar-tailed godwit	Black-tailed godwit (islandica)	Canadian light-bellied brent goose
Common scoter	Corncrake	Curlew
Dunlin	Eider	Golden plover
Goldeneye	Great crested grebe	Great northern diver
Greenland white-fronted goose	Greenshank	Grey plover
Hen harrier	Knot	Lapwing
Long-tailed duck	Mallard	Merlin
Oystercatcher	Pintail	Pochard
Purple sandpiper	Red-breasted merganser	Redshank
Red-throated diver	Ringed plover	Ruff
Sanderling	Scaup	Shelduck
Short-eared owl	Shoveler	Slavonian grebe
Snipe	Teal	Tufted duck
Turnstone	Whimbrel	Whooper swan
Wigeon		

Species screened out of assessment

2.2.2 The following species or taxa can be assessed using the mCRM tool but have not been considered further due to a lack of connectivity.

Avocet

2.2.3 Maps from the latest Bird Atlas (Balmer *et al.,* 2013) show no breeding birds and one wintering record in Ireland. The species is not common enough in Ireland as a non-breeding species to have been covered by Burke et al (2018). The Migration Atlas (Wernham *et al.,*2002) shows no ring recoveries in Ireland from the UK. The Eurasian African Bird Migration Atlas (accessed November 2025) Shows no movement of UK (or any other) avocet into Ireland and all movements relating to UK birds appear to avoid Ireland and Irish waters. As such, avocet has been screened out of this assessment due to its scarcity in Ireland meaning that connectivity is unlikely.

Bewick's swan

2.2.4 This species has traditionally wintered in Ireland in relatively large numbers, for example in 1984, the wintering population was 1,224 birds. Since then the species has declined rapidly, with 101 counted during the 2010 International Swan Census (ISC) and 21 during the 2015 ISC (Burke *et al.,* 2021). During the winter of 2024/25, no birds were reported in Ireland (Birdguides 2025), and to date no birds have been reported during the winter of 2025/26. Declines in Bewick's swan are considered highly unlikely to recover given the flyway level population declines, and that an increasing proportion of the western European wintering population is short stopping due to milder continental winters (Burke *et al.,* 2021). Given the likelihood that future occurrences of Bewick's swan in Ireland are likely to represent overshooting or vagrancy, rather than a genuine, recurring, non-breeding population and that there is no guarantee that any birds will occur within the existing Irish SPA for this species, this species has been screened out of this assessment.

Black-throated diver

2.2.5 The black-throated diver is a rare visitor to Ireland during the non-breeding season and it was deemed uncommon enough not to be treated in Burke *et al.*, 2018. Irish WeBS data suggest that fewer than 12 birds occur per year, with many of these wintering on the west coast, and thus unlikely to interact with the Phase One developments. As such, this species has been screened out of this assessment.

European white-fronted goose

2.2.6 This taxon is a sufficiently rare visitor to Ireland that Burke *et al.* (2018) did not estimate a non-breeding population, and it does not feature on BirdWatch Ireland's 'List of Ireland's Birds'. Balmer *et al.,* (2013) shows only two wintering locations in Ireland for the period of 2007 to 2011, which may only refer to two individual records. With this taxon only wintering in the UK in relatively small numbers (2,400 birds, Musgrove *et al.,* 2011) and so few making it as far west as Ireland, this taxon has been screened out of the assessment.

Pink-footed goose

2.2.7 This species is a rare winter visitor to Ireland (Balmer *et al.,* 2013) and Burke *et al.,* (2018) consider it sufficiently uncommon to not estimate an Irish population. Birdwatch Irelands list the species as a scarce winter visitor. As such, this species is unlikely to interact with the Phase One developments and has therefore been screened out of the assessment.

Nightjar

2.2.8 The nightjar is an extremely rare breeding bird in Ireland, with birds on territory at only two sites and breeding at only one site during dedicated survey work in 2024 (Irish Rare Bird Breeding Panel (IRBBP), 2024). Movements informed by ringing and tracking, presented in Wernham *et al.,* (2002) and The Eurasian African Bird Migration Atlas suggest that migration is predominantly north to south. As such, with so few birds potentially crossing the Irish Sea, this species has been screened out of the assessment.

Dotterel

2.2.9 This species does not breed in Ireland (Balmer *et al.,* 2013) and there is just one ringing recovery, of a bird controlled in Russia. Irish Birding (2025) lists 143 observations since 2007 of birds passing through while on spring or autumn migration. Even if the potential for some of these records to relate to multiple reports of long staying birds is not considered, dotterel records in Ireland average approximately eight records per year. As such, it is considered that the potential for interaction between this species and the Phase One developments is very low. Therefore, this species has been screened out of the assessment.

Red-necked phalarope

2.2.10 This species is an extremely rare breeding bird in Ireland, with no confirmed breeding records during the most recent breeding atlas period (2007 – 2011, Balmer *et al.,* 2013). The IRBBP lists it as a rare breeder occasionally nesting in the west of Ireland. The species is also a very rare breeder in the UK, mostly confined to the Outer Hebrides and Shetland (Balmer *et al.,* 2013). Birds breeding in Shetland have been tracked migrating west across the Atlantic (towards tropical Pacific wintering grounds) rather than heading south (van Bemellen *et al.,* 2019). As such, the potential for birds to move between the UK and Ireland or to migrate through the Irish Sea is considered to be extremely low, and therefore this species is screened out of this assessment.

White-tailed eagle

2.2.11 This species was recently re-introduced to Ireland and is listed as a rare resident breeder (although it is not covered by the IRBPP to date). The scarcity of this species in Ireland, coupled with tracking data that show that birds crossing the Irish Sea is infrequent (and has not occurred within the area covered by the Phase One developments) suggest that the likelihood of interaction between this species and the Phase One projects is very low. As such this species has been screened out of the assessment.

Honey buzzard

2.2.12 This species does not breed in Ireland (Balmer *et al.,* 2013) and it appears to be extremely uncommon during spring and autumn passage, with just 15 records listed on Irish Birding (2025) since 2008. As such, it is considered that the potential for interaction between this species and the Phase One developments is very low. Therefore, this species has been screened out of the assessment.

Marsh harrier

2.2.13 This species is an irregular and extremely uncommon breeder in Ireland, with just one confirmed breeding record during the most recent Breeding Atlas period (Balmer *et al.,* 2013). The Eurasian African Bird Migration Atlas shows just three recoveries of UK ringed marsh harriers from Ireland, and describes a predominantly NE-SW migration route, both of which suggest that, for a species mainly found in southern England, interaction with the Phase One developments is very unlikely. As such this species has been screened out of this assessment.

Northern gannet

2.2.14 CRM for this species will be based upon site-specific data, and therefore it is not considered in this assessment.

Spotted crake

2.2.15 This species does not breed in Ireland and is an extremely rare breeder in the UK (Balmer *et al.,* 2013). There are no ringing records from Ireland. Irish Birding lists 23 records since 2009, although 11 of these records are likely to relate to the same long staying bird. As such, it can be considered to be a very scarce visitor to Ireland and therefore it has been screened out of this assessment.

Bittern

2.2.16 This species does not breed in Ireland and there were only four non-breeding season records during the latest Breeding Atlas period (2007 to 2011). The Eurasian African Bird Migration Atlas shows just one ringing recovery of a UK bird from Ireland. Irish Birding lists 94 records since 2008, suggesting on average between five and six bittern occur in Ireland each year (although many of the 94 records will not refer to unique birds so the actual level of occurrence is likely to be somewhat below this number). As such, interaction with the Phase One developments is very unlikely, and this species has been screened out of this assessment

Goosander

2.2.17 This is a rare breeding bird in Ireland with fewer than ten breeding pairs. Winter records are more frequent however it is still classed as a rare winter visitor throughout Ireland by Birdwatch Ireland (Birdwatch Ireland 2025). Ringing data presented on The Eurasian African Bird Migration Atlas show that UK birds predominantly make movements towards the east, and as such, it is considered that the potential for interaction with the Phase One developments is very low. Therefore, this species is screened out of this assessment.

Gadwall

2.2.18 This species is a scarce breeding bird in Ireland with approximately 250 breeding pairs (IRBBP 2025). The wintering population is 890 birds (Burke *et al.,* 2018). With a breeding population of 500 birds (and not considering the presence of Irish bred juveniles within the wintering population) it appears that flux of gadwall into Ireland during the non-breeding season happens at a relatively small scale. Ringing data informing the source locations of birds migrating to Ireland, and the locations where recoveries were made in Ireland, suggests that the potential for interaction with the Phase One developments is low. As such this species has been screened out of the assessment.

Greenland barnacle goose

2.2.19 This taxon does not breed in Ireland. During the winter Greenland barnacle geese winter in small numbers on Irelands west coast, with very few records of any barnacle geese on the Irish Sea coast of Ireland (Balmer *et al.,* 2013). As such, it is considered that the potential for interaction with the Phase One developments is very low. Therefore, this taxon is screened out of this assessment.

Svalbard light-bellied brent goose

2.2.20 This taxon in not known to occur in Ireland, with the non-breeding population centred around Lindisfarne, in Northumberland. As such, it is considered that the potential for interaction with the Phase One developments is very low. Therefore, this taxon is screened out of this assessment.

Dark-bellied brent goose

2.2.21 This taxon is a rare winter visitor to Ireland, with the non-breeding population centred around the south and east coasts of England. As such, it is considered that the potential for interaction with the Phase One developments is very low. Therefore, this taxon is screened out of this assessment.

Icelandic greylag goose

2.2.22 There appears to be little difference between the breeding and non-breeding populations of greylag goose in Ireland, in terms of size and distribution. As such, the majority of Irelands greylag geese in the non-breeding season should be considered resident feral birds rather than migrants from Iceland. A census of greylag geese between 2017 and 2020 (Burke *et al.,* 2022) counted a maximum of just 670 Icelandic greylag geese using coastal sites on the Irish Sea coast (2018 data). With a small population arriving from the north-west, and limited scope for birds to journey offshore (e.g. birds have not been recorded on Lambay Island since 2008 (Burke *et al.,* 2022)) it is considered that the potential for interaction with the Phase One developments is very low. As such this taxon is screened out of this assessment.

Stone curlew

2.2.23 This species does not breed in Ireland and Irish Birding lists just nine records since 2009. As such, with fewer than one record per year in Ireland, potential for interaction with the Phase One developments is very low. As such this taxon is screened out of this assessment.

Velvet scoter

2.2.24 This species is listed as a rare winter visitor to Ireland by Birdwatch Ireland with less than ten records annually across the whole of Ireland (Birdwatch Ireland 2025). Balmer *et al.,* (2013) present very few records from Irish Sea coasts during the most recent atlas period (2007 – 2011). As such it is considered that potential for interaction with the Phase One developments is very low, and therefore velvet scoter is screened out of this assessment.

Bean Goose

2.2.25 Bean geese of either taxon (tundra bean goose and taiga bean goose) are rare winter visitors to Ireland, with most records referring to the tundra bean goose (Irish Birding 2025). Balmer *et al.,* 2013 presented just three records for the atlas period 2007 to 2011, and Ennis et al, (2021) describe both taxa as less than annual. As such it is considered that potential for interaction with the Phase One developments is very low, and therefore both taxa of bean geese are screened out of this assessment.

Montagu's harrier

2.2.26 Montagu's harrier does not breed in Ireland and there were no breeding season records during the most recent atlas period (2007 to 2011). Given the recent declines in this species in the UK, with breeding now less than annual, and the species rarity in Ireland, interaction with the Phase One developments is considered highly unlikely. As such the Montagu's harrier is screened out of this assessment.

Osprey

2.2.27 This species does not breed in Ireland and occurs solely as a scarce passage migrant. As raptors tend to avoid long sea crossings, it is considered that the potential for interaction with the Phase One developments is very low. As such this species has been screened out of the assessment.

Svalbard barnacle goose

2.2.28 Barnacle geese from the Svalbard breeding population winter almost exclusively on the Solway, in the UK. As such, interaction with the Phase One developments is highly unlikely. For this reason, this taxon has been screened out of this assessment.

Wood sandpiper

2.2.29 This species does not breed in Ireland and occurs solely as a scarce passage migrant. Irish WeBS data suggest that fewer than ten birds occur per year. As such, interaction with the Phase One developments is highly unlikely. For this reason, this species has been screened out of this assessment.

3 Migratory CRM

3.1 Migratory CRM methodology

3.1.1 There is potential for migratory birds to be subjected to collision risk mortalities whilst on seasonal migrations through the Irish Phase One project array areas. The potential mortality rates can be estimated using CRM. The modified version of the mCRM tool (HiDef Aerial Surveying Ltd., 2024[1]), was used to undertake migratory collision risk modelling.

3.1.2 The migratory CRM was accessed through the mCRM tool's graphical interface, which is user-friendly and available via a standard web browser or within the R programming environment (R Core Team, 2021). The tool uses R code to estimate migratory collision risks (Donovan, 2018). For this assessment, the latest version of the mCRM tool (v1.0.1) at the time was downloaded and run locally within R (v4.3.3). The bespoke modifications to the tool (i.e. the converging of flight lines onto Ireland rather than the UK) were made locally within the R environment. This is a different version of the tool than that used by Phase One Projects in their submission. Previous mCRM estimates were calculated in an unmodified version of the tool and did not use the same reference populations as those presented herein. Therefore, the estimated number of birds passing through the array, and subsequent collisions, presented within this report differ to those within the application.

3.1.3 One key advantage of the mCRM tool over the Band (2012) model is its ability to provide a clear and transparent audit trail for all modelling runs. This ensures that regulators and other stakeholders can readily access and reproduce the results of any modelling scenario, enhancing transparency and accountability.

3.1.4 The mCRM tool provides two main functions to estimate collision risk mortality:

- The creation of population estimates for bird species moving through selected offshore wind farms (OWFs) by sampling migratory pathways via straight lines drawn between Ireland, the UK and European countries of interest; and
- The implementation of a stochastic version of the migratory CRM (Band, 2012) based on generated population estimates, OWF and WTG parameters and species-specific information (e.g. wingspan and avoidance rate).

3.2 Migratory CRM inputs

Turbine parameters

3.2.1 A geographical information system (GIS) shapefile of the Phase One OWF footprints was added to the mCRM tool. The OWF and WTG parameters used in the migratory CRM are presented in Table 2 and Table 3. These values are based on the worst-case scenario with regards to bird collisions from the project options. A 'Large Array Correction' factor was applied to the migratory CRM.

[1] Accessed via https://blackbawks.shinyapps.io/mCRM/ [Last accessed January 2025].

Table 2: Project WTG parameters used for the migratory CRM assessment.

Parameter	Arklow	Dublin	Codling	NISA	Oriel
Latitude (deg)	52.81	53.23	53.10	53.70	54.06
Mean array width (km)	18.87	8.98	9.60	8.18	5.05
Percentage of upwind flights (%)	50	50	50	50	50
Number of turbines	56	45	75	49	25
Number of blades	3	3	3	3	3
Rotor radius (m)	118	125	125	125	118
Blade width (m)	6.8	9.0	7.0	7.0	7.0
Average Rotation speed (rpm)	5.73 (SD 0.00)	4.70 (SD 0.00)	6.80 (SD 1.25)	8.30 (SD 1.45)	8.10 (SD 0.30)
Average Blade pitch (deg)	10.00 (SD 0.00)	2.40 (SD 0.00)	6.74 (SD 5.04)	5.60 (SD 0.50)	10.00 (SD 0.00)

Table 3: Project predicted mean wind availability and downtime for cumulative CRM scenario.

Project	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Arklow	Wind availability (%)	95.8	99.4	95.9	92.1	90.6	91.6	86.3	91.8	93.1	98	95.9	96.9
	Mean downtime (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dublin	Wind availability (%)	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0
	Mean downtime (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Codling	Wind availability (%)	89.4	89.8	86.5	83.6	82.5	81.5	81.1	82.7	85.3	88.7	89.5	90.6
	Mean downtime (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NISA	Wind availability (%)	95.7	95.7	95.7	95.7	95.7	93	93	93	95.7	95.7	95.7	95.7
	Mean downtime (%)	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3
Oriel	Wind availability (%)	95.0	96.0	95.0	93.0	92.0	90.0	90.0	90.0	93.0	95.0	95.0	95.0
	Mean downtime (%)	1.0	1.0	2.0	1.0	2.0	2.0	3.0	4.0	4.0	3.0	1.0	1.0

Bird parameters

Migration periods and population size

3.2.2 The defined pre-breeding and post-breeding migration seasons that are default within the mCRM tool, and which were used for migratory CRM, are presented in Table 4.

3.2.3 The populations used in the mCRM tool are primarily drawn from Burke *et al*. (2018). The Irish populations were considered the most appropriate for this assessment because the Phase One developments are located relatively close inshore to Ireland, within the Irish Sea. It is highly unlikely that significant migration through the development area would involve birds other than those contributing to the Irish population.

3.2.4 Although it is not possible to completely rule out the presence of individual UK-origin birds during migration periods, the likelihood of a significant proportion of UK populations occurring within the Zone of Influence (ZOI) is considered very low. This conclusion is based on species-specific migration patterns and the absence of evidence for regular or substantial cross-border movements into the assessment area during relevant seasons. Where movements between the UK and Ireland do occur, those birds are already accounted for within the Irish population definitions. Consequently, UK populations have not been included in this assessment. This approach aligns with the requirements of the EIA Directive and EPA guidelines, which stipulate that population-level assessments should focus on the relevant national population (in this case, the Irish population) because transboundary contributions that are negligible do not materially affect significance determinations. Furthermore, this methodology is consistent with standard practice in Irish environmental impact assessment reports (EIARs), where only populations with a demonstrable ecological or conservation relevance to the project area are considered for impact evaluation.

3.2.5 Where a species does not have a population defined by Burke *et al.,* (2018), populations have been sourced from Irish Wetland Bird Survey data, or from species specific bespoke monitoring (for example for hen harrier and corncrake).

3.2.6 For the remaining species for which an Irish population could not be derived (merlin, snipe and short-eared owl) the approach adopted by Codling has been implemented (Codling Wind Park Limited, 2024). This approach defines a precautionary proportion of the UK population which may pass through Irish waters and uses this to inform the migratory CRM. In the case of the three species, 50% of the UK population was used.

3.2.7 The final populations being considered within the assessment are presented in Table 4.

Table 4: Defined migration seasons, and considered populations, used within migratory CRM.

Species	Pre-breeding migration	Post-breeding migration	Other migration period	Migratory Irish population
Bar-tailed godwit	Mar - Apr	Jul - Oct	NA	16,530
Black-tailed godwit	Mar - May	Jun - Oct	NA	19,800
Canadian light-bellied brent goose	Mar - May	Aug - Oct	NA	35,150
Corncrake	Apr - May	Jul - Aug	NA	436[2]
Common scoter	Apr - May	Jun - Oct	NA	7,500
Curlew	Mar - May	Jun - Oct	NA	35,240
Dunlin	Mar - May	Jun - Oct	NA	45,760
Eider	Mar - Apr	Oct - Nov	NA	5,660
Golden plover	Feb - May	Jul - Oct	NA	92,060
Goldeneye	Feb - May	Aug - Dec	NA	3,820
Great crested grebe	Mar - Jun	Jul - Nov	Feb - Mar	2,930
Great-northern diver	Dec - Jun	Aug - Nov	NA	2,240
Greenland white-fronted goose	Mar - Apr	Sep - Nov	NA	9,590
Greenshank	Mar - Jun	Aug - Nov	NA	1,320
Grey plover	Mar - May	Jul - Sep	NA	2,940
Hen harrier	Mar - May	Sep - Nov	NA	222[3]
Knot	Feb - May	Jun - Oct	NA	16,270
Lapwing	Jan - May	Oct - Nov	NA	84,690
Long-tailed duck	Mar - May	Sep - Oct	NA	38[4]
Mallard	Apr - Jun	Sep - Oct	Jan - Mar	28,230
Merlin	Mar - May	Aug - Nov	NA	4,128[5]
Oystercatcher	Jan - Mar	Jul - Nov	NA	60,540

[2] BirdWatchIreland: https://birdwatchireland.ie/corncrake-population-update/
[3] The 2022 National Survey of breeding Hen Harrier in Ireland: https://www.npws.ie/sites/default/files/publications/pdf/IWM147.pdf
[4] Irish Wetland Bird Survey data
[5] Codling approach

Species	Pre-breeding migration	Post-breeding migration	Other migration period	Migratory Irish population
Pintail	Mar - May	Aug - Nov	NA	1,570
Pochard	Mar - May	Aug - Nov	NA	11,150
Purple sandpiper	Mar - May	Jul - Nov	NA	660
Red-breasted merganser	Apr - Jul	Aug - Nov	NA	2,430
Redshank	Mar - May	Jul - Sep	NA	23,800
Red-throated diver	Feb – Jun	Jul - Sep	NA	770
Ringed plover	Mar - May	Aug - Oct	NA	11,660
Ruff	Mar - May	Jul - Nov	NA	39[4]
Sanderling	Apr - Jun	Jul - Oct	NA	8,420
Scaup	Feb - May	Sep - Nov	NA	2,485
Shelduck	Jan - Feb	Jun - Jul	Aug - Dec	10,160
Short-eared owl	Mar - May	Jul - Oct	NA	7,440[5]
Shoveler	Mar - Jun	Jul - Aug	Sep - Dec	2,240
Slavonian grebe	Feb - Apr	Aug - Oct	NA	42[4]
Snipe	Mar - May	Aug - Oct	Oct - Dec	3,052,500[5]
Teal	Feb - May	Jul - Dec	NA	35,740
Tufted duck	Apr - Jun	Sep - Oct	NA	27,470
Turnstone	Jan - Jun	Jul - Aug	NA	9,480
Whimbrel	Apr - Jun	Jun - Oct	NA	53[4]
Whooper swan	Feb - Apr	Sep - Nov	NA	15,370
Wigeon	Mar - Apr	Aug - Nov	NA	55,730

Species-specific biometric parameters

3.2.8 The species-specific biometric input parameters used in the migratory CRM are presented in Table 5. The parameters are preloaded using the mCRM tool, which collates biometric information. The biometrics for all species (body length and wingspan) are derived from recently updated biometric data sources (BTO, 2023). Each flight type was set as "flapping".

3.2.9 Species-specific flight speeds used in the migratory CRM assessment are presented in Table 5. Flight speeds presented within the mCRM tool are defined by Aonghais Cook (pers. comms, 2023) and- closely match those presented in Woodward *et al.* (2023).

3.2.10 AR are a key parameter in the migratory CRM, they take into consideration that birds will undertake avoidance behaviour in response to the presence of an OWF to prevent collision (Ozsanlav-Harris *et al.*, 2023). This can occur at three scales: micro-avoidance (avoiding individual turbine blades); meso-avoidance (avoiding whole WTGs, not just the rotor-swept area) and macro-avoidance (avoiding the whole OWF array area) (Cook *et al.*, 2014). This adjustment is required since baseline survey data are collected before WTGs are present. The AR used in migratory CRM for each species, presented in Table 5, are set in the mCRM tool as recommended by NatureScot and checked by Aonghais Cook (pers. comms, 2023). The AR used in the tool closely match the most recent evidence available (Woodward *et al.,* 2023) (see Appendix B for a comparison).

Table 5: Species biometrics used in the mCRM tool.

Species	Body length (m)	Body length SD (m)	Wingspan (m)	Wingspan SD (m)	Flight speed (ms^{-1})	Flight speed SD (ms^{-1})	Proportion at PCH	Avoidance Rate	Avoidance Rate SD
Bar-tailed godwit	0.38	0.02	0.75	0.02	18.3	2.1	1	0.999	0
Black-tailed godwit	0.42	0.02	0.76	0.02	18.1	6.0	1	0.999	0
Canadian light-bellied brent goose	0.58	0.02	1.15	0.02	17.9	6.1	0.5	0.999	0.0001
Corncrake	0.28	0.02	0.50	0.02	13.0	2.0	1	0.995	0.00001
Common scoter	0.49	0.03	0.84	0.03	22.1	4.0	1	0.985	0.0008
Curlew	0.55	0.02	0.90	0.02	15.4	3.3	1	0.999	0
Dunlin	0.18	0.01	0.40	0.01	15.3	1.9	1	0.999	0
Eider	0.60	0.03	0.94	0.03	17.3	2.4	0.25	0.985	0.0008
Golden plover	0.28	0.01	0.72	0.01	16.5	1.8	1	0.999	0
Goldeneye	0.46	0.01	0.72	0.01	20.3	3.8	1	0.985	0.0008
Great crested grebe	0.48	0.02	0.88	0.02	21.1	1.6	1	0.995	0.00001
Great northern diver	0.80	0.02	1.37	0.02	19.5	1.6	0.25	0.995	0.00001
Greenland white-fronted goose	0.72	0.06	1.48	0.06	18.8	7.2	1	0.999	0.0001
Greenshank	0.32	0.01	0.69	0.01	12.3	3.3	1	0.999	0
Grey plover	0.28	0.01	0.77	0.01	16.5	1.8	1	0.999	0
Hen harrier	0.48	0.02	1.10	0.02	11.4	1.1	1	0.995	0.0001
Knot	0.24	0.01	0.59	0.01	24.6	3.3	1	0.999	0
Lapwing	0.30	0.01	0.84	0.01	12.8	1.3	1	0.999	0
Long-tailed duck	0.44	0.01	0.76	0.01	19.7	1.7	1	0.985	0.0008
Mallard	0.58	0.02	0.90	0.02	15.9	2.0	1	0.985	0.0008
Merlin	0.28	0.02	0.56	0.02	12.7	5.8	1	0.989	0.0003
Oystercatcher	0.42	0.02	0.83	0.02	13.0	2.5	1	0.999	0
Pintail	0.58	0.02	0.88	0.02	21.9	2.0	1	0.985	0.0008

Species	Body length (m)	Body length SD (m)	Wingspan (m)	Wingspan SD (m)	Flight speed (ms^{-1})	Flight speed SD (ms^{-1})	Proportion at PCH	Avoidance Rate	Avoidance Rate SD
Pochard	0.46	0.01	0.77	0.01	23.6	2.0	1	0.985	0.0008
Purple sandpiper	0.21	0.01	0.44	0.01	15.3	1.9	1	0.999	0
Red-breasted merganser	0.55	0.01	0.78	0.01	22.0	2.9	1	0.985	0.0008
Redshank	0.28	0.01	0.62	0.01	15.3	4.1	1	0.999	0
Red-throated diver	0.61	0.02	1.11	0.02	18.6	3.9	0.25	0.995	0.00001
Ringed plover	0.19	0.01	0.52	0.01	16.0	1.1	1	0.999	0
Ruff	0.25	0.01	0.53	0.01	16.9	1.8	1	0.999	0
Sanderling	0.20	0.01	0.42	0.01	21.4	1.1	1	0.999	0
Scaup	0.46	0.01	0.78	0.01	21.1	2.0	1	0.985	0.0008
Shelduck	0.62	0.02	1.12	0.02	18.2	4.3	0.5	0.985	0.0008
Short-eared owl	0.38	0.02	1.02	0.02	9.7	2.0	1	0.995	0.0001
Shoveler	0.48	0.02	0.77	0.02	18.3	2.0	1	0.985	0.0008
Slavonian grebe	0.34	0.02	0.62	0.02	21.1	1.6	1	0.995	0.00001
Snipe	0.26	0.01	0.46	0.01	17.1	2.7	1	0.999	0
Teal	0.36	0.02	0.61	0.02	17.4	1.6	1	0.985	0.0008
Tufted duck	0.44	0.01	0.70	0.01	21.1	1.1	1	0.985	0.0008
Turnstone	0.23	0.01	0.54	0.01	10.0	3.3	1	0.999	0
Whimbrel	0.41	0.02	0.82	0.02	13.8	0.4	1	0.999	0
Whooper swan	1.52	0.04	2.30	0.04	17.5	4.2	0.5	0.988	0.0009
Wigeon	0.48	0.02	0.80	0.02	18.5	2.0	1	0.985	0.0008

Migratory pathways

3.2.11 The default mCRM tool (v1.01) generates migratory pathways between UK and non-UK points within a species-specific migratory corridor (Marine Scotland Science, 2025). In order to create a more representative approach to compliment the use of Irish-specific migratory populations, the default tool was modified to generate pathways between Ireland and non-Ireland points (including the UK). Points on the east coast of the UK were excluded to avoid double-counting migration from the UK to Ireland via both the east and west coasts. A visual comparison of the two approaches is provided below (Figure 2). All other aspects of the methodology were left unchanged.

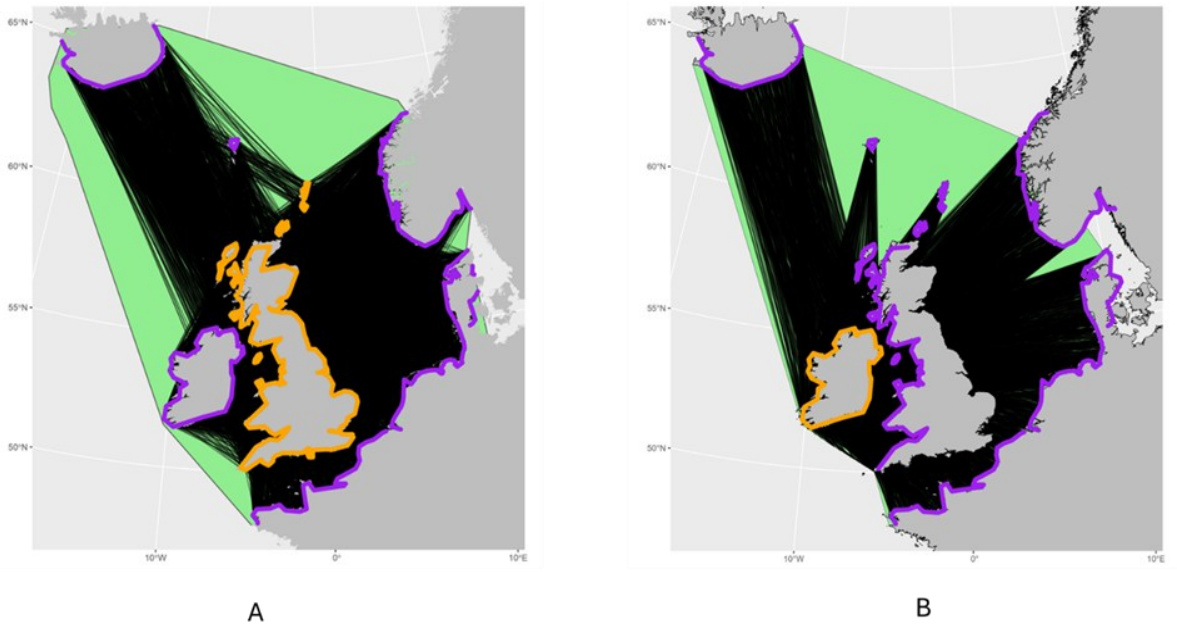

Figure 2. A comparison of the default mCRM tool (A) and Irish-specific (B) migratory pathways.

4 Migratory CRM results

4.1.1 This section presents the outputs from the migratory CRM analysis for all migratory species present within the mCRM tool. A summary of results on a Phase One project-specific (Table 6) and cumulative (

4.1.2 Table 7) level. Within the summary of cumulative migratory CRM impacts, the Irish proportion of the assessed combined population has also been provided for reference.

Table 6: Summary of Phase One project-specific annual collision estimates with standard deviation included.

Species	Arklow			Dublin			Codling			NISA			Oriel		
	Pre-breeding migration	Post-breeding migration	Other migration period	Pre-breeding migration	Post-breeding migration	Other migration period	Pre-breeding migration	Post-breeding migration	Other migration period	Pre-breeding migration	Post-breeding migration	Other migration period	Pre-breeding migration	Post-breeding migration	Other migration period
Bar-tailed godwit	0.019 ± 0.002	0.019 ± 0.002	0.000 ± 0.000	0.037 ± 0.004	0.037 ± 0.004	0.000 ± 0.000	0.037 ± 0.004	0.037 ± 0.004	0.000 ± 0.000	0.025 ± 0.004	0.024 ± 0.003	0.000 ± 0.000	0.007 ± 0.001	0.007 ± 0.001	0.000 ± 0.000
Black-tailed godwit	0.018 ± 0.003	0.017 ± 0.003	0.000 ± 0.000	0.030 ± 0.004	0.030 ± 0.004	0.000 ± 0.000	0.031 ± 0.007	0.031 ± 0.007	0.000 ± 0.000	0.034 ± 0.007	0.033 ± 0.007	0.000 ± 0.000	0.012 ± 0.004	0.011 ± 0.004	0.000 ± 0.000
Canadian light-bellied brent goose	0.015 ± 0.006	0.016 ± 0.006	0.000 ± 0.000	0.026 ± 0.006	0.026 ± 0.006	0.000 ± 0.000	0.034 ± 0.013	0.034 ± 0.013	0.000 ± 0.000	0.031 ± 0.013	0.030 ± 0.013	0.000 ± 0.000	0.013 ± 0.006	0.013 ± 0.006	0.000 ± 0.000
Corncrake	0.002 ± 0.000	0.002 ± 0.000	0.000 ± 0.000	0.004 ± 0.000	0.004 ± 0.000	0.000 ± 0.000	0.005 ± 0.001	0.005 ± 0.001	0.000 ± 0.000	0.004 ± 0.001	0.004 ± 0.001	0.000 ± 0.000	0.002 ± 0.000	0.002 ± 0.000	0.000 ± 0.000
Common scoter	0.112 ± 0.013	0.113 ± 0.013	0.000 ± 0.000	0.186 ± 0.023	0.186 ± 0.023	0.000 ± 0.000	0.189 ± 0.028	0.191 ± 0.028	0.000 ± 0.000	0.000 ± 0.000	0.191 ± 0.027	0.000 ± 0.000	0.064 ± 0.013	0.064 ± 0.013	0.000 ± 0.000
Curlew	0.043 ± 0.005	0.043 ± 0.005	0.000 ± 0.000	0.069 ± 0.007	0.069 ± 0.007	0.000 ± 0.000	0.065 ± 0.011	0.065 ± 0.011	0.000 ± 0.000	0.075 ± 0.011	0.074 ± 0.011	0.000 ± 0.000	0.027 ± 0.005	0.026 ± 0.005	0.000 ± 0.000
Dunlin	0.039 ± 0.004	0.038 ± 0.004	0.000 ± 0.000	0.069 ± 0.008	0.069 ± 0.008	0.000 ± 0.000	0.070 ± 0.009	0.070 ± 0.009	0.000 ± 0.000	0.070 ± 0.009	0.069 ± 0.009	0.000 ± 0.000	0.024 ± 0.005	0.023 ± 0.005	0.000 ± 0.000
Eider	0.025 ± 0.003	0.026 ± 0.003	0.000 ± 0.000	0.042 ± 0.005	0.042 ± 0.005	0.000 ± 0.000	0.044 ± 0.006	0.046 ± 0.007	0.000 ± 0.000	0.049 ± 0.007	0.049 ± 0.007	0.000 ± 0.000	0.016 ± 0.003	0.017 ± 0.003	0.000 ± 0.000
Golden plover	0.09 ± 0.010	0.088 ± 0.009	0.000 ± 0.000	0.147 ± 0.018	0.147 ± 0.018	0.000 ± 0.000	0.167 ± 0.023	0.164 ± 0.022	0.000 ± 0.000	0.133 ± 0.017	0.131 ± 0.017	0.000 ± 0.000	0.045 ± 0.010	0.044 ± 0.010	0.000 ± 0.000
Goldeneye	0.058 ± 0.007	0.058 ± 0.007	0.000 ± 0.000	0.103 ± 0.012	0.103 ± 0.012	0.000 ± 0.000	0.108 ± 0.014	0.110 ± 0.015	0.000 ± 0.000	0.110 ± 0.014	0.110 ± 0.014	0.000 ± 0.000	0.042 ± 0.007	0.041 ± 0.007	0.000 ± 0.000
Great crested grebe	0.020 ± 0.002	0.020 ± 0.002	0.021 ± 0.002	0.032 ± 0.003	0.032 ± 0.003	0.032 ± 0.003	0.033 ± 0.004	0.034 ± 0.004	0.035 ± 0.004	0.033 ± 0.004	0.032 ± 0.004	0.033 ± 0.004	0.013 ± 0.002	0.013 ± 0.002	0.013 ± 0.002
Great-northern diver	0.003 ± 0.000	0.003 ± 0.000	0.000 ± 0.000	0.005 ± 0.001	0.005 ± 0.001	0.000 ± 0.000	0.006 ± 0.001	0.006 ± 0.001	0.000 ± 0.000	0.005 ± 0.001	0.005 ± 0.001	0.000 ± 0.000	0.002 ± 0.000	0.002 ± 0.000	0.000 ± 0.000
Greenland white-fronted goose	0.003 ± 0.002	0.003 ± 0.002	0.000 ± 0.000	0.012 ± 0.005	0.012 ± 0.005	0.000 ± 0.000	0.008 ± 0.005	0.008 ± 0.005	0.000 ± 0.000	0.018 ± 0.011	0.018 ± 0.011	0.000 ± 0.000	0.010 ± 0.007	0.010 ± 0.007	0.000 ± 0.000

Species	Arklow			Dublin			Codling			NISA			Oriel		
	Pre-breeding migration	Post-breeding migration	Other migration period	Pre-breeding migration	Post-breeding migration	Other migration period	Pre-breeding migration	Post-breeding migration	Other migration period	Pre-breeding migration	Post-breeding migration	Other migration period	Pre-breeding migration	Post-breeding migration	Other migration period
Greenshank	0.001 ± 0.000	0.002 ± 0.000	0.000 ± 0.000	0.002 ± 0.000	0.002 ± 0.000	0.000 ± 0.000	0.002 ± 0.001	0.003 ± 0.001	0.000 ± 0.000	0.003 ± 0.001	0.003 ± 0.001	0.000 ± 0.000	0.001 ± 0.000	0.001 ± 0.000	0.000 ± 0.000
Grey plover	0.003 ± 0.000	0.003 ± 0.000	0.000 ± 0.000	0.005 ± 0.001	0.005 ± 0.001	0.000 ± 0.000	0.005 ± 0.001	0.005 ± 0.001	0.000 ± 0.000	0.006 ± 0.001	0.005 ± 0.001	0.000 ± 0.000	0.002 ± 0.000	0.002 ± 0.000	0.000 ± 0.000
Hen harrier	0.001 ± 0.000	0.002 ± 0.000	0.000 ± 0.000	0.002 ± 0.001	0.002 ± 0.001	0.000 ± 0.000	0.003 ± 0.000	0.003 ± 0.000	0.000 ± 0.000	0.003 ± 0.000	0.003 ± 0.000	0.000 ± 0.000	0.001 ± 0.000	0.001 ± 0.000	0.000 ± 0.000
Knot	0.015 ± 0.002	0.014 ± 0.002	0.000 ± 0.000	0.024 ± 0.003	0.024 ± 0.003	0.000 ± 0.000	0.025 ± 0.003	0.025 ± 0.003	0.000 ± 0.000	0.025 ± 0.003	0.025 ± 0.003	0.000 ± 0.000	0.008 ± 0.002	0.008 ± 0.001	0.000 ± 0.000
Lapwing	0.099 ± 0.010	0.101 ± 0.010	0.000 ± 0.000	0.169 ± 0.019	0.169 ± 0.019	0.000 ± 0.000	0.175 ± 0.024	0.181 ± 0.025	0.000 ± 0.000	0.168 ± 0.019	0.168 ± 0.019	0.000 ± 0.000	0.063 ± 0.011	0.063 ± 0.011	0.000 ± 0.000
Long-tailed duck	0.001 ± 0.000	0.001 ± 0.000	0.000 ± 0.000	0.001 ± 0.000	0.001 ± 0.000	0.000 ± 0.000	0.002 ± 0.001	0.002 ± 0.001	0.000 ± 0.000	0.001 ± 0.000	0.001 ± 0.000	0.000 ± 0.000	0.001 ± 0.000	0.001 ± 0.000	0.000 ± 0.000
Mallard	0.517 ± 0.058	0.540 ± 0.060	0.548 ± 0.061	0.784 ± 0.102	0.784 ± 0.102	0.784 ± 0.102	0.864 ± 0.134	0.911 ± 0.141	0.927 ± 0.144	0.893 ± 0.123	0.902 ± 0.124	0.902 ± 0.124	0.358 ± 0.058	0.367 ± 0.059	0.372 ± 0.060
Merlin	0.050 ± 0.054	0.051 ± 0.055	0.000 ± 0.000	0.071 ± 0.063	0.071 ± 0.063	0.000 ± 0.000	0.087 ± 0.097	0.089 ± 0.100	0.000 ± 0.000	0.087 ± 0.098	0.086 ± 0.098	0.000 ± 0.000	0.036 ± 0.036	0.036 ± 0.036	0.000 ± 0.000
Oystercatcher	0.066 ± 0.007	0.064 ± 0.007	0.000 ± 0.000	0.103 ± 0.014	0.103 ± 0.014	0.000 ± 0.000	0.115 ± 0.018	0.111 ± 0.018	0.000 ± 0.000	0.120 ± 0.015	0.119 ± 0.015	0.000 ± 0.000	0.041 ± 0.008	0.040 ± 0.008	0.000 ± 0.000
Pintail	0.025 ± 0.003	0.025 ± 0.003	0.000 ± 0.000	0.039 ± 0.006	0.039 ± 0.006	0.000 ± 0.000	0.042 ± 0.007	0.043 ± 0.007	0.000 ± 0.000	0.042 ± 0.006	0.042 ± 0.006	0.000 ± 0.000	0.015 ± 0.003	0.015 ± 0.003	0.000 ± 0.000
Pochard	0.263 ± 0.024	0.269 ± 0.024	0.000 ± 0.000	0.467 ± 0.057	0.467 ± 0.057	0.000 ± 0.000	0.554 ± 0.059	0.570 ± 0.060	0.000 ± 0.000	0.393 ± 0.046	0.390 ± 0.046	0.000 ± 0.000	0.140 ± 0.023	0.140 ± 0.023	0.000 ± 0.000
Purple sandpiper	0.001 ± 0.000	0.001 ± 0.000	0.000 ± 0.000	0.001 ± 0.000	0.001 ± 0.000	0.000 ± 0.000	0.001 ± 0.000	0.001 ± 0.000	0.000 ± 0.000	0.001 ± 0.000	0.001 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
Red-breasted merganser	0.034 ± 0.004	0.036 ± 0.004	0.000 ± 0.000	0.061 ± 0.008	0.061 ± 0.008	0.000 ± 0.000	0.055 ± 0.008	0.058 ± 0.009	0.000 ± 0.000	0.068 ± 0.010	0.069 ± 0.010	0.000 ± 0.000	0.026 ± 0.004	0.026 ± 0.004	0.000 ± 0.000
Redshank	0.021 ± 0.003	0.021 ± 0.003	0.000 ± 0.000	0.037 ± 0.004	0.037 ± 0.004	0.000 ± 0.000	0.042 ± 0.007	0.042 ± 0.007	0.000 ± 0.000	0.041 ± 0.007	0.040 ± 0.007	0.000 ± 0.000	0.015 ± 0.003	0.015 ± 0.003	0.000 ± 0.000
Red-throated diver	0.001 ± 0.000	0.001 ± 0.000	0.000 ± 0.000	0.002 ± 0.000	0.002 ± 0.000	0.000 ± 0.000	0.002 ± 0.000	0.002 ± 0.000	0.000 ± 0.000	0.002 ± 0.000	0.002 ± 0.000	0.000 ± 0.000	0.001 ± 0.000	0.001 ± 0.000	0.000 ± 0.000

Species	Arklow			Dublin			Codling			NISA			Oriel		
	Pre-breeding migration	Post-breeding migration	Other migration period	Pre-breeding migration	Post-breeding migration	Other migration period	Pre-breeding migration	Post-breeding migration	Other migration period	Pre-breeding migration	Post-breeding migration	Other migration period	Pre-breeding migration	Post-breeding migration	Other migration period
Ringed plover	0.010 ± 0.001	0.010 ± 0.001	0.000 ± 0.000	0.017 ± 0.002	0.017 ± 0.002	0.000 ± 0.000	0.018 ± 0.002	0.018 ± 0.002	0.000 ± 0.000	0.017 ± 0.002	0.017 ± 0.002	0.000 ± 0.000	0.006 ± 0.001	0.006 ± 0.001	0.000 ± 0.000
Ruff	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
Sanderling	0.007 ± 0.001	0.007 ± 0.001	0.000 ± 0.000	0.014 ± 0.002	0.014 ± 0.002	0.000 ± 0.000	0.012 ± 0.001	0.013 ± 0.001	0.000 ± 0.000	0.013 ± 0.001	0.013 ± 0.001	0.000 ± 0.000	0.005 ± 0.001	0.005 ± 0.001	0.000 ± 0.000
Scaup	0.035 ± 0.004	0.035 ± 0.004	0.000 ± 0.000	0.050 ± 0.007	0.050 ± 0.007	0.000 ± 0.000	0.053 ± 0.008	0.054 ± 0.009	0.000 ± 0.000	0.066 ± 0.009	0.066 ± 0.009	0.000 ± 0.000	0.022 ± 0.004	0.022 ± 0.004	0.000 ± 0.000
Shelduck	0.087 ± 0.012	0.080 ± 0.011	0.085 ± 0.011	0.132 ± 0.017	0.132 ± 0.017	0.132 ± 0.017	0.161 ± 0.027	0.146 ± 0.024	0.157 ± 0.026	0.145 ± 0.023	0.141 ± 0.022	0.144 ± 0.023	0.054 ± 0.01	0.051 ± 0.010	0.053 ± 0.010
Short-eared owl	0.039 ± 0.006	0.039 ± 0.006	0.000 ± 0.000	0.071 ± 0.009	0.071 ± 0.009	0.000 ± 0.000	0.087 ± 0.016	0.087 ± 0.016	0.000 ± 0.000	0.083 ± 0.013	0.081 ± 0.013	0.000 ± 0.000	0.031 ± 0.007	0.031 ± 0.007	0.000 ± 0.000
Shoveler	0.038 ± 0.004	0.036 ± 0.004	0.039 ± 0.004	0.056 ± 0.007	0.056 ± 0.007	0.056 ± 0.007	0.059 ± 0.009	0.058 ± 0.009	0.063 ± 0.009	0.065 ± 0.008	0.064 ± 0.008	0.066 ± 0.008	0.028 ± 0.004	0.027 ± 0.004	0.029 ± 0.004
Slavonian grebe	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.001 ± 0.000	0.001 ± 0.000	0.000 ± 0.000	0.001 ± 0.000	0.001 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
Snipe	2.634 ± 0.277	2.675 ± 0.281	2.750 ± 0.289	4.701 ± 0.661	4.701 ± 0.661	4.701 ± 0.661	4.915 ± 0.629	4.995 ± 0.639	5.230 ± 0.669	4.880 ± 0.530	4.834 ± 0.525	4.880 ± 0.530	1.661 ± 0.294	1.649 ± 0.291	1.690 ± 0.299
Teal	0.578 ± 0.064	0.573 ± 0.063	0.000 ± 0.000	1.089 ± 0.125	1.089 ± 0.125	0.000 ± 0.000	1.309 ± 0.153	1.32 ± 0.155	0.000 ± 0.000	1.212 ± 0.135	1.201 ± 0.134	0.000 ± 0.000	0.638 ± 0.079	0.631 ± 0.078	0.000 ± 0.000
Tufted duck	0.372 ± 0.041	0.389 ± 0.043	0.000 ± 0.000	0.628 ± 0.090	0.628 ± 0.090	0.000 ± 0.000	0.638 ± 0.092	0.672 ± 0.097	0.000 ± 0.000	0.685 ± 0.082	0.692 ± 0.082	0.000 ± 0.000	0.238 ± 0.037	0.244 ± 0.038	0.000 ± 0.000
Turnstone	0.011 ± 0.003	0.010 ± 0.003	0.000 ± 0.000	0.015 ± 0.002	0.015 ± 0.002	0.000 ± 0.000	0.017 ± 0.006	0.017 ± 0.006	0.000 ± 0.000	0.018 ± 0.005	0.018 ± 0.005	0.000 ± 0.000	0.007 ± 0.003	0.007 ± 0.003	0.000 ± 0.000
Whimbrel	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
Whooper swan	0.091 ± 0.018	0.091 ± 0.018	0.000 ± 0.000	0.167 ± 0.030	0.167 ± 0.03	0.000 ± 0.000	0.154 ± 0.039	0.156 ± 0.040	0.000 ± 0.000	0.311 ± 0.07	0.311 ± 0.07	0.000 ± 0.000	0.118 ± 0.027	0.117 ± 0.027	0.000 ± 0.000
Wigeon	0.814 ± 0.099	0.820 ± 0.100	0.000 ± 0.000	1.414 ± 0.181	1.414 ± 0.181	0.000 ± 0.000	1.512 ± 0.216	1.539 ± 0.220	0.000 ± 0.000	1.399 ± 0.216	1.389 ± 0.214	0.000 ± 0.000	0.569 ± 0.094	0.564 ± 0.093	0.000 ± 0.000

Table 7: Summary of Phase One cumulative annual collision estimates with standard deviation included.

Species	Pre-breeding migration	Post-breeding migration	Other migration period	Annual migration
Bar-tailed godwit	0.125 ± 0.007	0.124 ± 0.007	0.000 ± 0.000	0.249 ± 0.010
Black-tailed godwit	0.125 ± 0.012	0.122 ± 0.012	0.000 ± 0.000	0.247 ± 0.017
Canadian light-bellied brent goose	0.119 ± 0.021	0.119 ± 0.021	0.000 ± 0.000	0.238 ± 0.030
Corncrake	0.017 ± 0.001	0.017 ± 0.001	0.000 ± 0.000	0.034 ± 0.002
Common scoter	0.742 ± 0.049	0.741 ± 0.049	0.000 ± 0.000	1.483 ± 0.069
Curlew	0.279 ± 0.018	0.277 ± 0.018	0.000 ± 0.000	0.556 ± 0.026
Dunlin	0.272 ± 0.016	0.269 ± 0.016	0.000 ± 0.000	0.541 ± 0.023
Eider	0.176 ± 0.011	0.180 ± 0.012	0.000 ± 0.000	0.356 ± 0.016
Golden plover	0.582 ± 0.037	0.574 ± 0.036	0.000 ± 0.000	1.156 ± 0.051
Goldeneye	0.421 ± 0.025	0.422 ± 0.026	0.000 ± 0.000	0.843 ± 0.036
Great crested grebe	0.131 ± 0.007	0.131 ± 0.007	0.134 ± 0.007	0.396 ± 0.012
Great northern diver	0.021 ± 0.002	0.021 ± 0.002	0.000 ± 0.000	0.042 ± 0.002
Greenland white-fronted goose	0.051 ± 0.015	0.051 ± 0.015	0.000 ± 0.000	0.102 ± 0.021
Greenshank	0.009 ± 0.001	0.011 ± 0.001	0.000 ± 0.000	0.020 ± 0.002
Grey plover	0.021 ± 0.002	0.020 ± 0.002	0.000 ± 0.000	0.041 ± 0.002
Hen harrier	0.010 ± 0.001	0.011 ± 0.001	0.000 ± 0.000	0.021 ± 0.001
Knot	0.097 ± 0.006	0.096 ± 0.006	0.000 ± 0.000	0.193 ± 0.008
Lapwing	0.674 ± 0.039	0.682 ± 0.040	0.000 ± 0.000	1.356 ± 0.056
Long-tailed duck	0.006 ± 0.001	0.006 ± 0.001	0.000 ± 0.000	0.012 ± 0.001
Mallard	3.416 ± 0.224	3.504 ± 0.230	3.533 ± 0.232	10.453 ± 0.396
Merlin	0.331 ± 0.165	0.333 ± 0.167	0.000 ± 0.000	0.664 ± 0.235
Oystercatcher	0.445 ± 0.029	0.437 ± 0.029	0.000 ± 0.000	0.882 ± 0.041
Pintail	0.163 ± 0.012	0.164 ± 0.012	0.000 ± 0.000	0.327 ± 0.017
Pochard	1.817 ± 0.100	1.836 ± 0.100	0.000 ± 0.000	3.653 ± 0.141
Purple sandpiper	0.004 ± 0.000	0.004 ± 0.000	0.000 ± 0.000	0.008 ± 0.000
Red-breasted merganser	0.244 ± 0.016	0.250 ± 0.017	0.000 ± 0.000	0.494 ± 0.023
Redshank	0.156 ± 0.011	0.155 ± 0.011	0.000 ± 0.000	0.311 ± 0.016

Species	Pre-breeding migration	Post-breeding migration	Other migration period	Annual migration
Red-throated diver	0.008 ± 0.000	0.008 ± 0.000	0.000 ± 0.000	0.016 ± 0.000
Ringed plover	0.068 ± 0.004	0.068 ± 0.004	0.000 ± 0.000	0.136 ± 0.005
Ruff	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
Sanderling	0.051 ± 0.003	0.052 ± 0.003	0.000 ± 0.000	0.103 ± 0.004
Scaup	0.226 ± 0.015	0.227 ± 0.016	0.000 ± 0.000	0.453 ± 0.022
Shelduck	0.579 ± 0.042	0.550 ± 0.040	0.571 ± 0.041	1.700 ± 0.071
Short-eared owl	0.311 ± 0.024	0.309 ± 0.024	0.000 ± 0.000	0.620 ± 0.034
Shoveler	0.246 ± 0.015	0.241 ± 0.015	0.253 ± 0.015	0.740 ± 0.026
Slavonian grebe	0.002 ± 0.000	0.002 ± 0.000	0.000 ± 0.000	0.004 ± 0.000
Snipe	18.791 ± 1.130	18.854 ± 1.133	19.251 ± 1.157	56.896 ± 1.975
Teal	4.826 ± 0.260	4.814 ± 0.260	0.000 ± 0.000	9.640 ± 0.368
Tufted duck	2.561 ± 0.162	2.625 ± 0.166	0.000 ± 0.000	5.186 ± 0.232
Turnstone	0.068 ± 0.009	0.067 ± 0.009	0.000 ± 0.000	0.135 ± 0.013
Whimbrel	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
Whooper swan	0.841 ± 0.092	0.842 ± 0.092	0.000 ± 0.000	1.683 ± 0.130
Wigeon	5.708 ± 0.380	5.726 ± 0.382	0.000 ± 0.000	11.434 ± 0.539

5 References

Band, W. (2012). Using a collision risk model to assess bird collision risks for offshore windfarms. The Crown Estate Strategic Ornithological Support Services (SOSS) report SOSS-02. http://www.bto.org/science/wetland-and-marine/soss/projects. Original published Sept 2011, extended to deal with flight height distribution data March 2012.

Birdguides (2025) https://www.birdguides.com/news/blank-winter-for-bewicks-swan-in-ireland/ (accessed November 2025)

BTO (2023) BirdFacts: profiles of birds occurring in the United Kingdom. BTO, Thetford https://www.bto.org/birdfacts (accessed March 2025).

Burke, B., Lewis, L. J., Fitzgerald, N., Frost, T., Austin, G. & Tierney, T. D. (2018). Estimates of waterbird numbers wintering in Ireland, 2011/12 – 2015/16. Irish Birds 11, 1-12.

Burke B., McElwaine J.G., Fitzgerald, N., Kelly S.B.A., McCulloch, N., Walsh, A.J. and Lewis, L.J. (2021) Population size, breeding success and habitat use of Whooper Swan Cygnus cygnus and Bewick's Swan Cygnus columbianus bewickii in Ireland: results of the 2020 International Swan Census. Irish Birds 43: 57–70 (2021).

Burke, B., Fitzgerald, N., Kelly, S. & Lewis, L.J. (2022) Greylag and Pink-footed geese in Ireland 2017/18-19/20. Irish Wetland Bird Survey (I-WeBS) Report. BirdWatch Ireland, Wicklow.

Codling Wind Park Limited (2024) Environmental Impact Assessment Report: Volume 4, Appendix 10.03 Collision Risk Modelling. Prepared by The Natural Power Consultants Ltd. Available at: https://www.pleanala.ie/publicaccess/EIAR-NIS/320768/Environmental%20Impact%20Assessment%20Report%20%28EIAR%29/Volume%204%20Appendices/Chapter%2010%20Ornithology/Appendix%2010.03%20Collision%20Risk%20Modelling.pdf (accessed November 2025).

Cook, A.S.C.P., Humphries, E.M., Masden, E.A. Burton, N.H.K. (2014). The avoidance rates of collision between birds and offshore turbines. BTO Research Report No 656 to Marine Scotland Science.

Donovan, C. (2018). Stochastic Band CRM – GUI User Manual, Draft V1.0, 31/03/2017.

Ennis, T., Shannon, T., Senfeld, T., and Collinson, J.M. (2021). First records of Tundra Bean Goose Anser serrirostris and Taiga Bean Goose Anser fabalis for Ireland and for Northern Ireland. Irish Birds 43.

HiDef Aerial Surveying Ltd. (2024). mCRM: Avian Migration Collision Risk Model. R package version 1.0.1, https://github.com/hiDef-Aerial-Surveying/mCRM (accessed November 2025)

Irish Birding (2025) https://www.irishbirding.com/birds/web (accessed November 2025)

Irish Rare Bird Breeding Panel (2024 & 2025) https://irbbp.org/latest-update/ (accessed November 2025)

Marine Scotland Science (2025). Avian migration collision risk model (mCRM). https://marinescotlandscience.github.io/mCRM/ (accessed November 2025)

Musgrove, A.J., Austin, G.E., Hearn, R.D., Holt, C.A., Stroud, D.A., and Wotton, S.R. (2011) Overwinter population estimates of British waterbirds. British Birds 104, July 2011, 364–397.

Newton, I. (2023). The migration ecology of birds. Elsevier.

Ozsanlav-Harris, L., Inger, R. & Sherley, R. (2023). Review of data used to calculate avoidance rates for collision risk modelling of seabirds. JNCC Report 732, JNCC, Peterborough, ISSN 0963-8091.

R Core Team (2021). 'R: A language and environment for statistical computing', R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

Stienen, E.W., Waeyenberge, V., Kuijken, E. and Seys, J. (2007). Trapped within the corridor of the southern North Sea: the potential impact of offshore wind farms on seabirds. In Birds and Wind farms. de Lucas, M., Janss, G.F.E. and Ferrer, M. (Eds). Quercus, Madrid.

van Bemmelen, R. S. A., Kolbeinsson, Y., Ramos, R., Gilg, O., Alves J. A., Smith, M., Schekkerman, H., Lehikoinen, A., Petersen, I.K., Þórisson, B., Sokolov A. A., Välimäki K., van der Meer, T., Okill, J. D., Bolton, M., Moe, B., Hanssen, A.A., Bollache, L., Petersen, A., Thorstensen, S., , González-Solís, J., Klaassen, R.H. G. , Tulp I. (2019) A Migratory Divide Among Red-Necked Phalaropes in the Western Palearctic Reveals Contrasting Migration and Wintering Movement Strategies. Frontiers in Ecology and Evolution. Volume 7 – 2019. DOI=10.3389/fevo.2019.00086

Woodward, I.D., Franks, S.E., Bowgen, K., Davies, J.G., Green, R.M.W., Griffin, L.R., Mitchell, C., O'Hanlon, N., Pollock, C., Rees, E.C., Tremlett, C., Wright, L. & Cook, A.S.C.P. (2023). Strategic study of collision risk for birds on migration and further development of the stochastic collision risk modelling tool (Work Package 1: Strategic review of birds on migration in Scottish waters). ISBN: 978-1-83521-034-5

Wright, L. J., Ross-Smith, V.H., Austin, G.E., Massimino, D., Dadam, D., Cook, A.S.C.P., Calbrade, N.A. and Burton, N.H.K. (2012). Assessing the risk of offshore wind farm development to migratory birds designated as features of UK Special Protection Areas (and other Annex 1 species). The Crown Estate Strategic Ornithological Support Services (SOSS) report SOSS-05.

A Species Scientific Names

Table 8: Scientific names of species considered for migratory CRM assessment.

Species	Scientific name
Bar-tailed godwit	*Limosa lapponica*
Bewick's swan	*Cygnus columbianus*
Black-tailed godwit	*Limosa limosa*
Black-throated diver	*Gavia arctica*
Canadian light-bellied brent goose[6]	*Branta bernicla hrota*
Common scoter	*Melanitta nigra*
Corncrake	*Crex crex*
Curlew	*Numenius arquata*
Dark-bellied brent goose	*Branta bernicla bernicla*
Dunlin	*Calidris alpina*
Eider	*Somateria mollissima*
European white-fronted goose	*Anser erythropus*
Gadwall	*Mareca strepera*
Golden plover	*Pluvialis apricaria*
Goldeneye	*Bucephala clangula*
Great crested grebe	*Podiceps cristatus*
Great northern diver	*Gavia immer*
Greenland white-fronted goose	*Anser albifrons flavirostris*
Greenshank	*Tringa nebularia*
Grey plover	*Pluvialis squatarola*
Hen harrier	*Circus cyaneus*
Knot	*Calidris canutus*
Lapwing	*Vanellus vanellus*
Long-tailed duck	*Clangula hyemalis*
Mallard	*Anas platyrhynchos*
Merlin	*Falco columbarius*
Nightjar	*Caprimulgus europaeus*
Osprey	*Pandion haliaetus*
Oystercatcher	*Haematopus ostralegus*
Pink-footed goose	*Anser brachyrhynchus*
Pintail	*Anas acuta*
Pochard	*Aythya ferina*
Purple sandpiper	*Calidris maritima*
Red-breasted merganser	*Mergus serrator*
Red-necked phalarope	*Phalaropus lobatus*
Redshank	*Tringa totanus*
Red-throated diver	*Gavia stellata*

[6] The Canadian light-bellied brent goose is a distinct population which has a unique migratory route.

Species	Scientific name
Ringed plover	*Charadrius hiaticula*
Ruff	*Calidris pugnax*
Sanderling	*Calidris alba*
Scaup	*Aythya marila*
Shelduck	*Tadorna tadorna*
Short-eared owl	*Asio flammeus*
Shoveler	*Spatula clypeata*
Slavonian grebe	*Podiceps auritus*
Snipe	*Gallinago gallinago*
Teal	*Anas crecca*
Tufted duck	*Aythya fuligula*
Turnstone	*Arenaria interpres*
Whimbrel	*Numenius phaeopus*
White-tailed eagle	*Haliaeetus albicilla*
Whooper swan	*Cygnus cygnus*
Wigeon	*Mareca penelope*
Wood sandpiper	*Tringa glareola*

B Comparison of Avoidance Rates

Table 9: Comparison of avoidance rates used in the mCRM tool and presented in Woodward *et al.*, 2023.

Species	Avoidance rate from model	Avoidance rate from model SD	Avoidance rate from Woodward *et al.*, (2023)	Avoidance rate from Woodward *et al.*, (2023) SD
Bar-tailed godwit	0.999	0	0.9996	0.00002
Black-tailed godwit	0.999	0	0.9996	0.00002
Canadian light-bellied brent goose	0.999	0.0001	0.9998	0.00001
Corncrake	0.995	0.00001	0.9875	0.00174
Common scoter	0.985	0.0008	0.9851	0.00088
Curlew	0.999	0	0.9996	0.00002
Dunlin	0.999	0	0.9996	0.00002
Eider	0.985	0.0008	0.9851	0.00088
Gadwall	0.985	0.0008	0.9851	0.00088
Golden plover	0.999	0	0.9999	0.00004
Goldeneye	0.985	0.0008	0.9851	0.00088
Great crested grebe	0.995	0.00001	0.9954	0.00002
Great northern diver	0.995	0.00001	0.9954	0.00002
Greenland white-fronted goose	0.999	0.0001	0.9998	0.00001
Greenshank	0.999	0	0.9996	0.00002
Grey plover	0.999	0	0.9996	0.00002
Hen harrier	0.995	0.0001	0.9957	0.00006
Knot	0.999	0	0.9996	0.00002
Lapwing	0.999	0	0.9996	0.00002
Long-tailed duck	0.985	0.0008	0.9851	0.00088
Mallard	0.985	0.0008	0.9801	0.00319

Species	Avoidance rate from model	Avoidance rate from model SD	Avoidance rate from Woodward *et al.*, (2023)	Avoidance rate from Woodward *et al.*, (2023) SD
Merlin	0.989	0.0003	0.9957	0.00006
Oystercatcher	0.999	0	0.9996	0.00002
Pintail	0.985	0.0008	0.9851	0.00088
Pochard	0.985	0.0008	0.9851	0.00088
Purple sandpiper	0.999	0	0.9996	0.00002
Red-breasted merganser	0.985	0.0008	0.9851	0.00088
Redshank	0.999	0	0.9996	0.00002
Red-throated diver	0.995	0.00001	0.9954	0.00002
Ringed plover	0.999	0	0.9996	0.00002
Ruff	0.999	0	0.9996	0.00002
Sanderling	0.999	0	0.9996	0.00002
Scaup	0.985	0.0008	0.9851	0.00088
Shelduck	0.985	0.0008	0.9851	0.00088
Short-eared owl	0.995	0.0001	0.9957	0.00006
Shoveler	0.985	0.0008	0.9851	0.00088
Slavonian grebe	0.995	0.00001	0.9954	0.00002
Snipe	0.999	0	0.9996	0.00002
Teal	0.985	0.0008	0.9851	0.00088
Tufted duck	0.985	0.0008	0.9851	0.00088
Turnstone	0.999	0	0.9996	0.00002
Whimbrel	0.999	0	0.9996	0.00002
Whooper swan	0.988	0.0009	0.9874	0.00138
Wigeon	0.985	0.0008	0.9851	0.00088

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