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National Parks and Wildlife Service

Status and Distribution of Chough in Ireland: Results of the National Survey 2021

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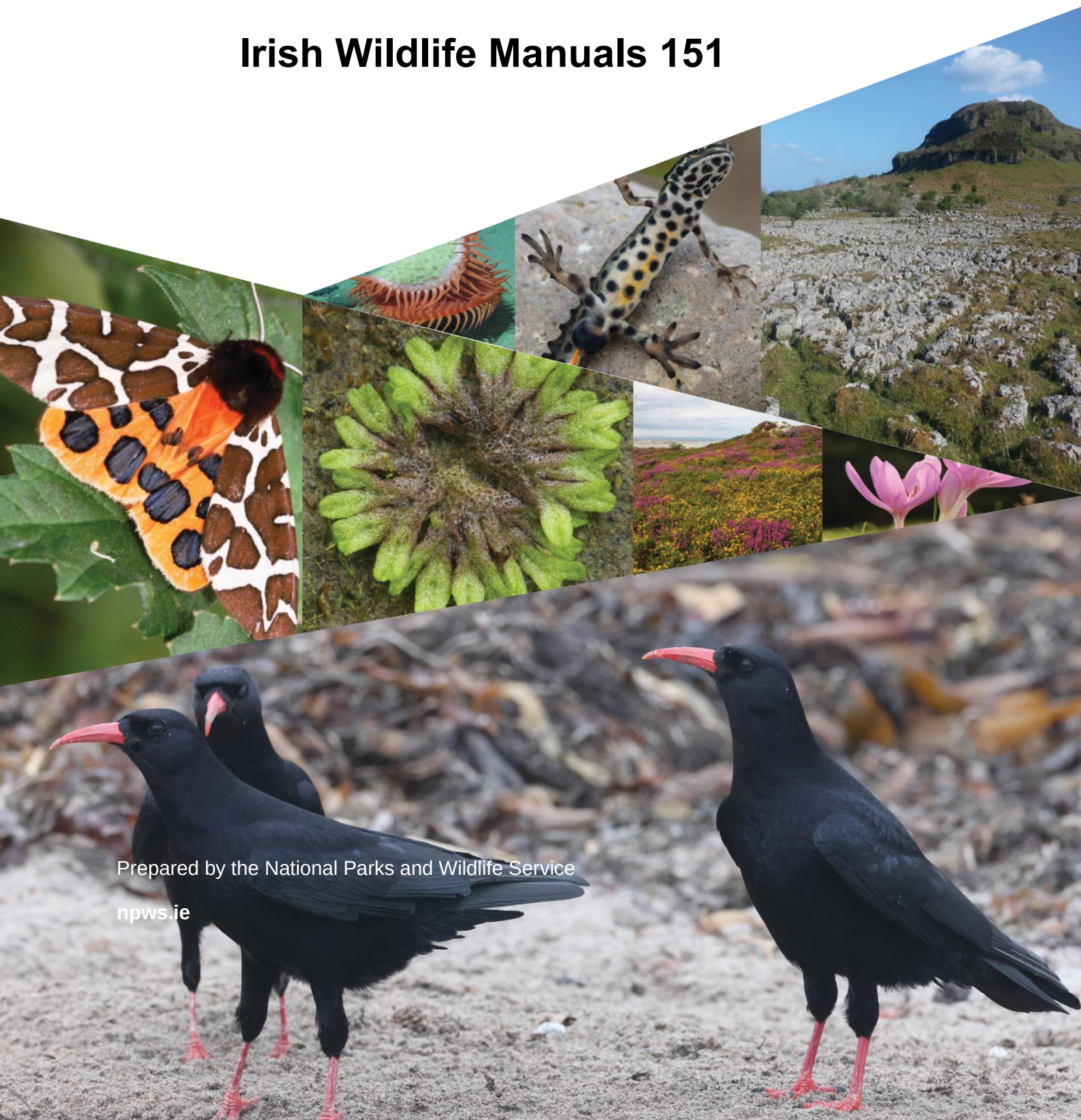

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Front cover, small photographs from top row:

A deep water fly trap anemone *Phelliactis* sp., Yvonne Leahy; **Common Newt** *Lissotriton vulgaris,* Brian Nelson; **Limestone pavement**, Bricklieve Mountains, Co. Sligo, Andy Bleasdale; **Garden Tiger** *Arctia caja,* Brian Nelson; **Violet Crystalwort** *Riccia huebeneriana*, Robert Thompson; **Coastal heath**, Howth Head, Co. Dublin, Maurice Eakin; **Meadow Saffron** *Colchicum autumnale*, Lorcan Scott

Bottom photograph: **Chough**, Co. Kerry, Kendrew Colhoun.

The Status and Distribution of Chough in Ireland: Results of the national survey 2021

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Executive Summary

The Red-billed Chough, more commonly referred to as Chough, is the rarest member of the crow family that breeds in Ireland. Found along our Atlantic coasts and islands from counties Donegal to Wexford, it is a species primarily associated with a range of coastal grassland and montane habitats including maritime grassland, machair, sand dunes, dry heath and vegetated cliffs. Throughout its global range, Chough is closely associated with low-intensity pastoral agricultural landscapes. Historically, there has been a gradual westward contraction in its breeding range since the first half of the 19th century in Ireland, with a similar contraction occurring in Britain on the same timescales. Successive national surveys since the 1960s have indicated the population in Ireland lies broadly in the range 560 – 906 pairs. National populations of 904 and 838 pairs, as determined by summation of total numbers recorded, were estimated in the 1992 and 2002/03 surveys, respectively. In 2021, the National Parks & Wildlife Service of the Department of Housing, Local Government and Heritage commissioned a National Chough Survey, the findings of which are presented here.

The primary aims of the National Chough Survey 2021 were to establish the numbers of breeding and non-breeding birds across the national population and to compare results with previous surveys at a number of scales, including those at national and regional levels. Surveys of this nature and scale *i.e.* large-scale national surveys, covering often remote and inaccessible sites, cannot determine in absolute terms population sizes. Rather the results presented in this report, reflect in general terms the numbers detected under the sampling approach taken and patterns of likely change and/or stability since previous national surveys.

Previous standardised methods employed to survey breeding Chough were also followed for this national survey but with some modest refinements in the categorisation of breeding status. These changes to the breeding criteria assessment allow for comparison with other population assessments across the biogeographical range of the Red-billed Chough. Potentially suitable breeding habitats in 10 km grid units, which were occupied in either the 2002/03 national survey and/or the *Bird Atlas* 2007-11, were surveyed (typically over at least two visits *i.e.* early and later in the nesting season between early April and mid-June). Additional information provided by casual observers proved useful to help inform searches of potential inland locations. Evidence of breeding was established based on the behaviours recorded during survey visits.

As referenced above, the methods for the 2021 National Chough Survey broadly followed previous surveys (*i.e.* 1992, and 2002/03), but with a more strict interpretation of evidence of possible breeders, than heretofore. However, one of the primary aims of the 2021 national survey was also to compare results with previous national surveys at a number of scales, including national and regional. Thus, to generate such change metrics (*e.g*. 2002/03 to 2021), the records for 2021 were also reviewed applying 2002/03 criteria. A total of 2,184 1 km squares (201 10 km squares) were surveyed along coasts and at known or likely inland breeding sites in 2021. The estimated national population size, as determined by summing all categories of breeding records for the 2021 survey and applying the 2002/03 criteria, is at least 900 pairs. The largest concentrations of pairs were recorded in counties Cork and Kerry, which combined, held circa 54% of the breeding population. An additional 1,008 non-breeding birds were counted nationally. The number of non-breeding birds was around 10% higher than in both previous censuses at circa 44%. Overall, the estimated breeding population lies between the 1992 and 2002/03 totals, and circa 9% above the total recorded in 2002/03. Thus, in the national context, the population can be considered stable. The regional picture is somewhat more complicated, with total numbers of pairs recorded being lower in four counties and higher in six.

Comparison of the 2021 distribution with the *Bird Atlas* 2007-11, indicates the population has contracted, with fewer 10 km squares showing evidence of occupation in 2021. However, some observed changes may be due, in some part, to differences in the breeding criteria

assessments used in both these surveys, with more strict criteria applied in the 2021 national survey. Where declines are most apparent are in some areas of the north (*i.e.* north and west Co. Donegal, and inland Cos. Leitrim and Sligo) and west (Co. Clare).

Collectively, the 15 Special Protection Areas (SPAs) for which Chough is a special conservation interest (SCI) held 382 of 900 pairs, a significant proportion (42%) of the estimated national breeding population. However, the proportion occurring within the SPA network has declined by around 22% on the equivalent proportion in 2002/03. The Cliffs of Moher SPA (Co. Clare; SPA 004005) and Horn Head to Fanad Head SPA (Co. Donegal; SPA 004194) were amongst those sites with the largest recorded declines. There was also evidence of an increased frequency of occupation of man-made nest sites inland from the traditional 'coastal breeding sites', particularly in Co. Cork (where a targeted local publicity campaign yielded additional nest records) but also elsewhere.

The national population of Chough appears to be relatively stable, though a number of regional changes in both distribution and overall abundance were detected. Areas where numbers appear to be in decline are of concern, and highlight the need for more regular monitoring at key sites. A combination of factors are likely responsible for these declines, such as changes in land-use and associated farming practices (*e.g.* agricultural intensification in some areas; land abandonment in others), together with increased recreational pressure at some coastal sites. The national census provides a snapshot in time of how the population is faring in broad terms, but a more targeted programme of monitoring at both protected sites and other sites representative of each region, on site occupation, non-breeders and communal roosts is also required. Further, autecological research examining foraging behaviour, nest site-selection and key demographics (including productivity) will improve our understanding of local and national population dynamics and the possible role of underlying anthropogenic factors that may influence them.

Acknowledgements

A survey of this type requires considerable manpower and resources and we are extremely grateful to the co-ordination team, the field surveyors and members of the public for their contribution.

We would like to extend our thanks to everyone who contributed to the national survey effort, for their time, skills and expertise, and to those who shared their local knowledge of Chough and information on breeding sites during the course of the project.

Regional management staff and scientific unit staff of NPWS undertook a great deal of coverage around the entire coastline and inland parts of the country:

Penny Bartlett, Dermot Breen, Philip Buckley, Helen Carty, Jay Cornish, Sinéad Cummins, Hazel Doyle, Dave Duggan, Leonard Floyd, Kathryn Freeman, Patrick Graham, Seamus Hassett, Clare Heardman, James Hegarty, Evelyn Joyce, Elaine Keegan, David Lyons, Emer Magee, Éamonn Meskell, Lee McDaid, Eoin McGreal, David McDonagh, David MacNamara, Tony Murray, Cliona O'Brien, Irene O'Brien, Aonghus O'Donaill, Declan O'Donnell, Danny O'Keeffe, Dave Rees, Tim Roderick, Andrew Speer, David Tierney, Alyn Walsh and Rob Wheeldon.

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Our sincere thanks and gratitude to Declan McGrath, a local ornithologist in Co. Waterford, for sharing his records from his 2021 survey on breeding Chough along the Waterford coast, which was subsequently published in Irish Birds (please refer to the bibliography of this report for full details). We are also appreciative of Declan taking the time to review the 2021 national survey collected data for the county and in doing so, help corroborate the figures presented for the county in this report.

Dr Claire Lauder developed the online app and provided GIS support.

We are also extremely grateful to the many people who provided data and observations on Chough and in particular, nest sites throughout the country.

Figure 1 Chough nesting and foraging habitat, the Iveragh peninsula, Co. Kerry. Photograph © John Collins.

1 Introduction

The Red-billed Chough *Pyrrhocorax pyrrhocorax* (hereafter Chough) occupies an extensive range across Europe and Asia, extending from the Atlantic coasts of Western Europe to eastern Asia and North Africa (Cramp & Perrins, 1994). The occurrence of Chough within its range is local and patchy, mostly associated with pastoral-dominated farming systems with short grazed vegetation in either coastal or mountainous landscapes. In Europe, the species is most closely associated with coastal cliff habitats including the Atlantic coasts of Ireland, western Britain, northwest France, northern Spain and Portugal (Keller *et al.*, 2020). In Ireland and Britain, the current distribution of Chough is restricted to the western seaboard. This is within an oceanic climatic zone heavily influenced by the moderating effects of the Gulf Stream, characterised by being comparatively mild and humid with a modest temperature range.

The current Irish distribution of Chough is restricted to the western and southern coasts, extending from north-east Donegal to south Wexford, with most Chough occurring within the coastal fringes and islands of this Atlantic coast (Gray *et al.*, 2003). Successive national surveys since the 1960s have indicated the population in Ireland lies in the range 560 – 906 pairs (Cabot, 1965; Bullock *et al.*, 1983; Berrow *et al.*, 1993). The most recent national surveys were in 1992 and 2002/03 when, respectively, totals of 904 and 838 pairs were estimated. In Northern Ireland, a contrasting picture exists for Chough, where the population has been in steady decline from 20-22 pairs in the early 1960s, and has been lost as a breeding bird for around ten years (Colhoun & Donaghy, 1996; Bareham *et al.*, 2008).

Historically, Chough occurred around most shorelines of Ireland and Britain in the first half of the 19th century. By 1852, Chough no longer bred in Co. Dublin (Hutchinson, 1989) and no longer bred on the east coast of Ireland by the end of the 19th century. A similar westerly shift occurred in Britain at the same time, when former occupied coastlines along the east coast of Scotland, Yorkshire, and the south coast from Sussex west to Cornwall lost their breeding populations. Though records are sparse, there were likely breeding Chough in these regions until at least the early 1900's (Sharrock, 1976; Bullock *et al.*, 1983). These historical declines have been attributed to a range of factors, including human persecution (*e.g.* egg-collecting, setting of traps for rabbits on cliffs inadvertently killing Chough, shooting of Chough by farmers targeting crows) in addition to land-use change through intensification or abandonment, leading to loss in the quantity and quality of foraging habitats (Bullock *et al.*, 1983).

The most recent survey of Chough in Britain, undertaken in 2014, showed that the population there is stable overall, with the largest proportions in Wales (55%) and the Isle of Man (31%) (Hayhow *et al.*, 2018). The breeding range remains limited to four small, discrete populations in the Inner Hebrides of Scotland (Islay and Colonsay), on the Isle of Man, in Wales and in southwest England (Cornwall). Regional trends were also evident, with populations in Scotland and parts of north and mid-Wales showing declines, with increases detected in South Wales, Cornwall and on the Isle of Man. There was also a difference in trends between inland and coastal sites in Wales – the former category showing a negative trend to 2014.

The species' close association with low-intensity pastoral farming landscapes throughout its global range has made it vulnerable to changes in agricultural practices. In combination with local climatic effects (*i.e.* exposure to the sea), coastal grasslands, which are also grazed/mowed, provide short swards (< 5 cm) and improved accessibility to invertebrate fauna for Chough. However, the management of these grasslands can have negative effects (*e.g.* use of antihelminthics or very intensive grassland management regimes), so the quality of these habitats for Chough may be variable.

Despite the prevalence of such conditions in the stronghold of the Scottish population on the island of Islay, the population declined there from 95 pairs in 1986 (Monaghan *et al.,* 1989) to 46 in 2016 (Hayhow *et al.*, 2018). Fortunately, a long-term colour-marking programme initiated there in 1983, combined with other studies, has facilitated a programme of unique research, which has helped diagnose the drivers, and proven to be a very valuable illustration of the

application of population ecology to inform the development of conservation actions (Reid *et al.*, 2021). On Islay, low first-year survival during the post-fledging period was a key driver of declines that threatened the viability of the population (Reid *et al.*, 2011). First-year survival increased with prey abundance, which implied that population growth rate was constrained by food limitation. Supplementary feeding led to increased survival in some but not all years, and also increased adult survival and the probability of successful reproduction (Reid *et al.*, 2021). Loss of genetic variation through inbreeding manifested itself in blindness in Chough chicks, most of which did not survive to post-fledging. Combined with the ecological threats posed by insufficient food availability, for example, these genetic constraints threaten the viability of this population (Reid *et al.*, 2021).

The Chough population in Ireland is extremely important in the overall biogeographical context and the species remains amber-listed at an all-Ireland level due to their SPEC 3 status and short and long-term all-Ireland breeding population declines of around 30% (Gilbert *et al.*, 2021). In 2002/03, the 838 pairs recorded in the national survey accounted for 63% of the NW European population (Gray *et al.*, 2003). National reporting under the Birds Directive (2009/147/EC) in 2019 indicated broadly stable national population trends for Ireland since circa 1992 (NPWS, 2019).

A total of 15 Special Protection Areas (SPAs) in Ireland list breeding Chough as a qualifying/special conservation interest and, based on 2002/03 figures, these sites held around 65% of the national population. The absence of a national survey since 2002/03, and the negative trends in some Chough populations elsewhere (including the loss of Chough as a breeding bird in Northern Ireland), highlighted the critical need to assess the current status of the population.

The main aims of the fourth national census undertaken in 2021 and reported here, were to:

- generate robust population estimates at national and county levels and for the Chough SPAs
- determine the distribution of breeding Chough in Ireland in 2021
- evaluate population and distributional changes, which may have occurred since previous Chough censuses

Figure 2 In some areas around the coast, particularly during the non-breeding season, Chough forage along sandy beaches, machair and dune slacks, foraging on invertebrates in the grassland or seaweed habitats. Photograph © Brian Power.

Figure 3 Non-breeding birds (usually sub-adults) can be found feeding in flocks near coastal breeding sites in spring and early summer, as well as breeding pairs. Photograph © Sinéad Cummins, NPWS.

Figure 4 The North Inishowen peninsula, Donegal holds one of the largest communal roosts of Chough in Ireland (>100 birds). The mix of heather moorland, grazed cliff slopes, sand dunes and both semi-natural and intensive grassland provide a wide range of foraging opportunities throughout the annual cycle of Chough. Photograph © Kendrew Colhoun.

Figure 5 Coastal cliff habitat in southwest Donegal. Photograph © Emer Magee, NPWS.

Figure 6 Inland Chough habitat at Healy's Pass, Co. Cork. The short-grazed pastures and micro-topography create good feeding opportunities for Chough. Photograph © Clare Heardman, NPWS.

Figure 7 Inland Chough foraging and nesting habitat at Hungry Hill in Co. Cork. Cliffs and farm buildings create good nesting opportunities and the grazed landscape provides access to soil invertebrates for foraging Chough. Photograph © Clare Heardman, NPWS.

Figure 8 Coastal Chough habitat on the Iveragh peninsula, Co. Kerry. Photograph © John Collins.

Figure 9 More intensively managed arable land and grasslands are characteristic of coastal landscapes along the south and southeast coastlines in particular. Photograph © Sinéad Cummins, NPWS.

2 Methods

The National Chough Survey 2021 used a census approach whereby recently occupied Ordnance Survey (OS) 10 km grid square units were surveyed. Our primary sources of information on recent range were the *Bird Atlas 2007-11* (Balmer *et al.*, 2013) and the 2002/03 national survey (Gray *et al.,* 2003).

We prioritised 10 km units for coverage on three levels; firstly, 10 km squares in which breeding status was *confirmed* or *probable* in the *Bird Atlas 2007-11* (Balmer *et al.*, 2013) or in the 2002/03 survey within the SPA network (Priority 1), or secondly those classified as *confirmed* or *probable* 10 km squares outside the SPA network (Priority 2). Finally, any other 10 km squares within which breeding was classified as at least *possible* (from the 2002/03 survey) were surveyed, where feasible. The distribution of these 10 km squares and SPAs in which Chough are a qualifying interest species are shown in Figures 10 and 11, with additional regional maps in Appendix 1.

Most surveys were undertaken by NPWS conservation staff or sub-contracted fieldworkers who were tasked with surveying much of the Irish coastline and islands from Inishowen Head, Co. Donegal, anticlockwise to Hook Head and the Saltee Islands, Co. Wexford and at inland areas known to be used by Chough, mostly in the south-west. Supplementary information was also sought via public appeals for records on a variety of social media platforms and in print media.

The methodology for the national survey, and indeed coverage historically, has been primarily targeted at coastal sites. However, it is acknowledged that along with pairs breeding at inland natural nest sites in upland areas (*e.g.* Sligo/Leitrim Uplands), pairs are using man-made nest sites, more so than in the past, particularly in some regions (*i.e.* West Cork and Iveragh Peninsula, Co. Kerry). Due to time constraints in 2021, and coverage of coastal sites required of surveyors, complete coverage of inland areas in that southwest region was not possible, though a sample of the inland areas outside of the SPAs known to be used by Chough were surveyed. Additional monitoring and surveys post 2021 (not reported here) reveal a significant number of additional pairs in this region (Clare Heardman *pers. comm.*).

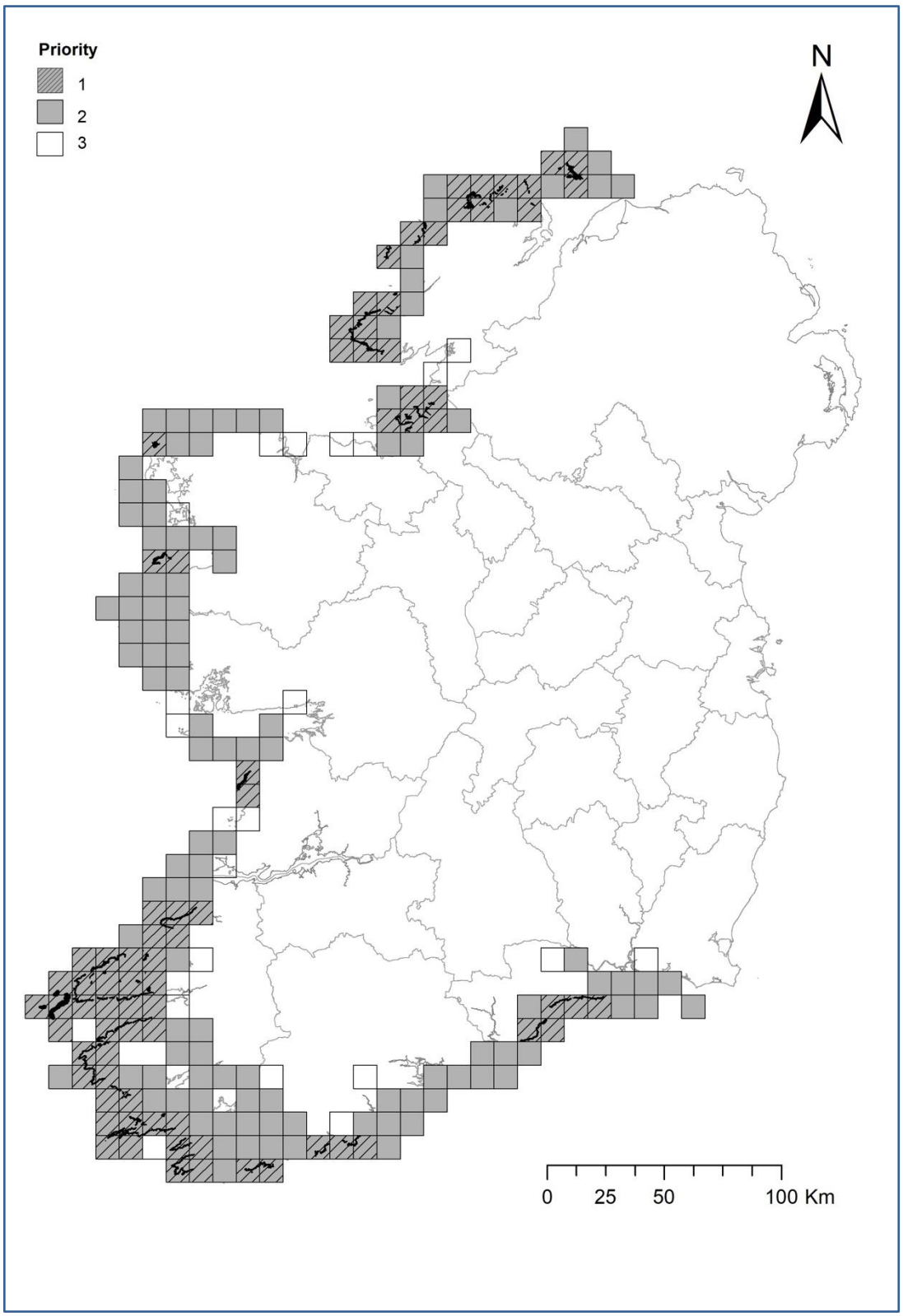

Figure 10 Distribution of 10 km survey squares which were targeted for the 2021 National Survey. SPAs in which Chough is a Qualifying Interest (QI) are shaded in black. Hatched squares (n=80) indicate those 10 km squares prioritised for coverage *i.e*. priority 1 squares (see text for rationale), unhatched grey-shaded squares were priority 2 (n=112) and open squares (n=23) were the lowest priority. Note that survey coverage within 10 km squares was variable. Higher resolution regional maps are shown in Appendix 1.

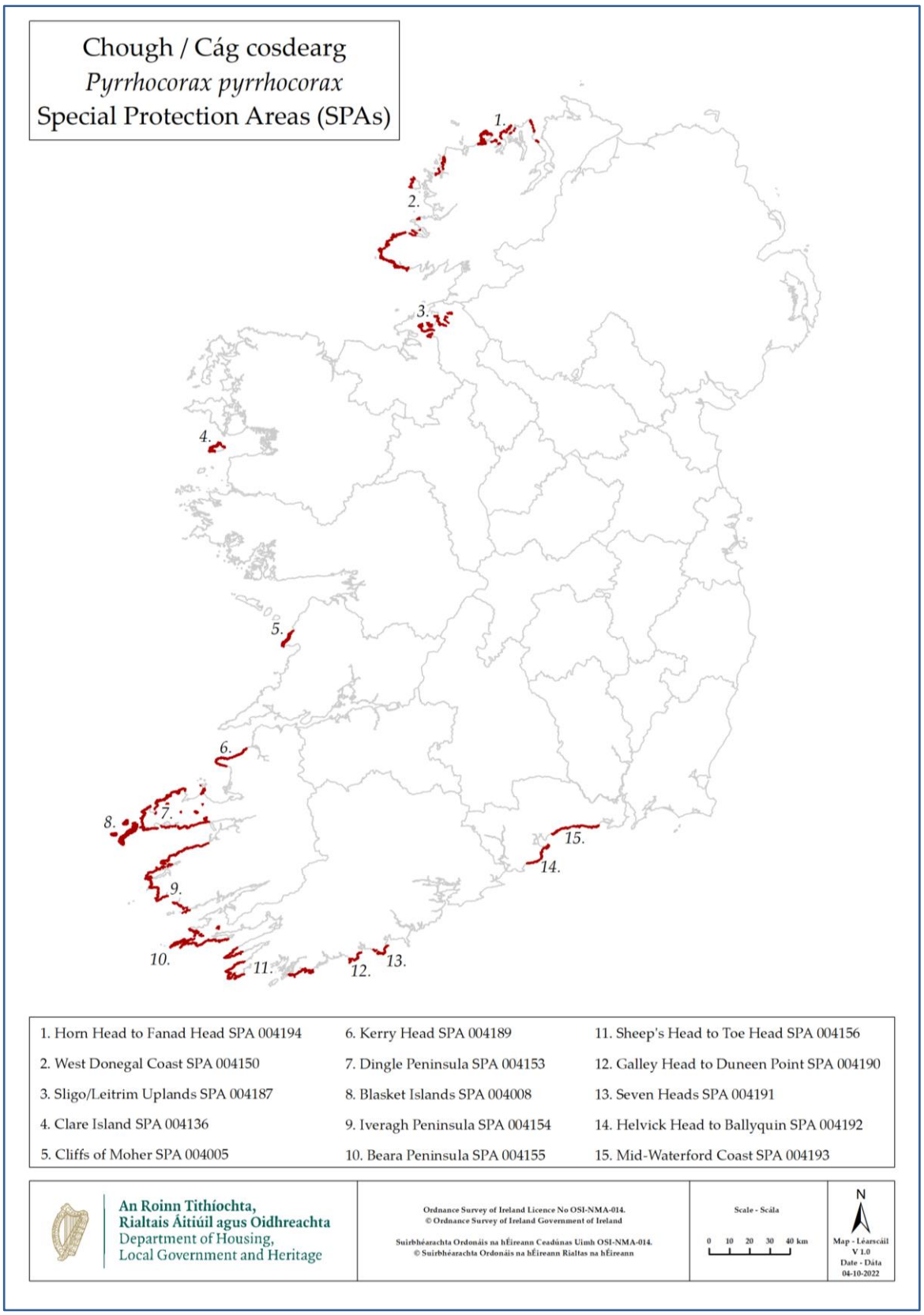

Figure 11 Special Protection Areas (SPAs) in which breeding Chough is listed as a Qualifying Interest (QI) in Ireland.

2.1 Surveying adult breeding and non-breeding Chough

2.1.1 Surveying breeding territories and estimation of the number of pairs

Field surveys aimed to record the numbers and breeding status of Chough nationally, at county-level and within designated sites. In addition, flocking non-breeding individuals, were recorded. The survey method required observers to slowly walk along suitable routes, away from cliff edges, listening and watching for Choughs, recording transect routes followed. By walking slowly and stopping regularly to scan suitable habitats, observers were increasing the length of time when they may have been within suitable breeding habitats. Observers were required to spend at least one hour observing close to known or possible nest sites/territories unless confirmation was possible in a shorter period. In areas where it was thought that more than one pair may be nesting in close proximity, observers were asked to increase the time spent to 1.5 to 2 hours to confirm breeding activity and numbers of pairs. Surveys in some inland areas, in particular West Cork, also made extra efforts to survey wider areas, often where information (including that provided via public media appeal) indicated Chough may be present. If time permitted, such areas were searched to identify potentially suitable man-made structures for nesting birds and observations recorded.

Survey periods were divided into two main time blocks, each lasting around five weeks: April 5th to May 10th and May 11th to June 14th; these time blocks are considered broadly coincident with the nest-building and incubation stages, and the chick provisioning to fledging period, respectively. Evidence from colour-ringing studies elsewhere suggests that visits after mid-June may result in double-counting of mobile family groups. Thus, the majority of surveys were completed by mid-June with exceptions for surveyors that were specifically documenting nest productivity outcomes.

Surveyors were asked to record survey data digitally via an online ArcGIS app[1] and/or on paper copies of data forms and maps, annotating maps with survey start and end points, cross-referencing observation points and Chough sightings as numbered locations on digital and paper copy forms.

2.1.2 Surveying flocking (non-breeding) Chough and communal roosts

As the proportion of non-breeding Chough can be a useful indication of the overall 'health' of local populations, all flocks of birds (defined as three birds or more, not part of a family unit and not associated with a nest site) were counted along with flock size and location. Particular attention was given in the later summer period (*i.e.* June/July) when apparent sub-adult flocks (non- or failed-breeders) may be comprised of single or multiple family groups. Behaviour, flight pattern and plumage characteristics made it possible to distinguish these non-breeding adults from post-breeding family flocks in many cases. Where flocks were observed, especially near dawn or dusk, observers recorded the direction of flight and, where safe to do so, attempted to identify communal roost sites, counting the numbers of birds using them.

Records of additional species of interest such as those that may compete for nest sites (*e.g.* Jackdaw *Corvus monedula*), predate upon adults or young (*e.g.* Buzzard *Buteo buteo*, Peregrine *Falco peregrinus*) or are otherwise scarce or declining (*e.g.* Rock Dove *Columba livia*, Kestrel *Falco tinnunculus*) were also requested.

[1] https://clspatial.maps.arcgis.com/apps/GeoForm/index.html?appid=55cec283653c4ed0882eb6d2 48b243d8

2.2 Assessment of breeding status

The count unit for the survey, breeding pairs (bps), were classified according to well-established categories used for a range of breeding species based on characteristic behaviours (as outlined in Gilbert *et al.*, 1993). For Chough, these have been largely the same for successive Irish and British censuses (*e.g.* Berrow *et al.,* 1993; Gray *et al.,* 2003; Johnstone *et al.,* 2007; Hayhow *et al.,* 2018) with some subtle, but important, differences. Whilst the classification of *confirmed* and *probable* breeders has remained largely unchanged (typically based on strong evidence that birds are nesting), the classification of *possible* breeding has changed between surveys (see Appendix 2). In 1992 (Berrow *et al.*, 1993) a 'singleton or pair seen on the ground', and in 2002/03 (Gray *et al.,* 2003) 'pairs or singletons seen in suitable breeding habitat' were classified as *possible* breeders. A stricter interpretation of breeding evidence in the UK and the Isle of Man in 2002 (Johnstone *et al.,* 2007) did not classify such sightings as evidence of *possible* breeding. Appendix 2 shows a comparison of the breeding status classifications in each of the more recent Irish censuses *i.e.* 1992, 2002/03 and 2021. Aligned with that, and as adopted in the subsequent UK and Isle of Man survey in 2014 (Hayhow *et al.*, 2018), a similar more rigorous behavioural classification was applied to breeding status for the 2021 survey. Thus, the presence of 'single or pairs of chough on the ground or in flight in suitable habitat', in itself, was not considered to provide evidence of a breeding attempt.

The following breeding status and criteria were applied in 2021 (see also Appendix 3 for further detailed descriptions):

No evidence of breeding (*NBE*)

Single Chough observed on the ground or a single or pair of birds in flight, but with no evidence of breeding were classified as '*NBE*' records. NBE records differ from Vacant records *i.e.* where no birds were observed).

***Possible* breeding**

Pair of Chough on the ground or one or more birds apparently visiting potential nest sites

***Probable* breeding**

Behaviour indicative of a breeding attempt, which includes birds carrying nest material, mating, the male feeding the female or alarming/agitated behaviour in response to the presence of the surveyor or some other stimulus

***Confirmed* breeding**

Where eggs or faecal sacs are seen or chicks heard, food provisioning behaviour by adults, or nestlings or fledged young are seen

Figure 12 Chough are a characteristic bird of the Irish west and south coasts, where flocks of breeders, family groups and non-breeders wheel around clifftops. Photograph © Mike Sylvia.

With respect to any comparison of the 2021 national survey 10 km distribution with the *Bird Atlas 2007-11*, it is important to highlight that the classification of breeding status (particularly with respect to *probable* and *possible* breeding birds) differs between these surveys, with further details provided in Appendix 4. Thus, interpretation of any changes, should take these differences into consideration.

2.3 Productivity monitoring

Nesting success and/or number of chicks/fledglings seen, was recorded, where possible, but was not the main focus of the national survey. For a small number of man-made/artificial and a small number of natural nest sites where necessary NPWS licences[2] were in place, some productivity estimates were possible. Additional productivity assessments were made through remote examination of nests or through late season surveys when young had emerged from the nest.

In 2021, a Chough colour-ringing project was initiated in Co. Cork (Clare Heardman & Sam Bayley, *pers. comm.*) which focusses on colour-ringing chicks at accessible nests in man-made structures. Between 2021 and 2024, approximately 500 Chough pulli have been colour-ringed at nearly 100 nest sites including those in structures such as buildings and bridges visited. The aim of this project is to study juvenile dispersal, survivorship and future nesting behaviour (*e.g.* whether Chough fledged from buildings tend go on to nest in buildings subsequently). To date, more detailed information to estimate productivity has not been gathered *i.e.* the number of chicks ringed that successfully fledge, but this will be a future aim of the project.

[2] NPWS Licences and Consents. Further details at https://www.npws.ie/licencesandconsents/education-and-science.

Figure 13 Colour-ringed juvenile Chough in Co. Donegal. This was one of three in a single brood observed around 12 months later within 10 km of the nest site. Studies like these, especially the much larger ongoing colour-ringing project in Co. Cork, have the potential to provide extremely valuable information to aid our understanding of many elements of Chough demography including, for example, survival rates. Photograph © Kendrew Colhoun.

2.4 Nest site selection

Where nest sites could be identified, they were classified as natural or man-made. The latter category included nests in any man-made structure such as quarries, sheds and other farm buildings, mineshafts, any other built structures including houses and castles or specially-designed nest ledges or boxes. Nest sites were defined as coastal or inland, with inland sites defined as in previous surveys (*e.g.* Berrow *et al.,* 1993), as those that were 1 km or further from the mean high-water mark.

Figure 14 Natural cave nest site © Sinéad Cummins, NPWS.

Figure 15 Old homesteads such as these near Mizen Head (Co. Cork) make suitable nest sites for Chough, especially where part of the roof is intact. Photograph © Declan O'Donnell, NPWS.

Figure 16 Partly-roofed homesteads and farm buildings such as this one in Connemara (Co. Galway) provide good nesting opportunities for Chough. Photograph © Dermot Breen, NPWS.

Figure 17 More contemporary farm buildings such as this one in Co. Cork appear to provide acceptable nesting opportunities for Chough, even when being actively used by owners. Photograph © Sam Bayley, NPWS.

2.5 Current pressures and future threats

Observers were asked to make an assessment of the primary pressures (*i.e.* activities acting now) they observed that could be considered to have a negative effect on breeding Chough at the surveyed sites generally, or during the period of the survey. Surveyors were asked to note no more than five of the most important pressures they regarded as important at each site.

The list of pressures or threats used was the same as the standard list set out under the 2019 Article 12 reporting cycle (see European Environment Agency[3] (EEA) for further details), (see Appendix 5). The categories are defined by the EEA (not by the authors) and include (a) Agriculture, (b) Forestry, (c) Extraction of resources (minerals, peat, non-renewable energy resources), (d) Energy production processes and related infrastructure development, (e) Development, construction and use of residential, commercial, industrial and recreational infrastructure and areas, (f) Extraction and cultivation of biological living resources (other than agriculture and forestry), (g) Climate change, (h) Disturbance and abandonment and (i) Predation.

Figure 18 A Red Fox *Vulpes vulpes* (located on a ledge in centre of image) patrolling steep coastal cliff Chough breeding and foraging habitat. Photograph © Sinéad Cummins, NPWS.

[3] Reporting under Article 12 of the EU Birds Directive https://cdr.eionet.europa.eu/help/birds_art12

2.6 Data Analysis

2.6.1 Classification of breeding status and treatment for comparing populations with previous national surveys

Breeding status at each potential site was summarised, based on the highest classification of breeding evidence of the observations made following, in most cases, two or more visits. *Confirmed breeding* was the highest classification, followed by *probable*, *possible* and finally, *NBE* (no breeding evidence). All compiled data was carefully examined to avoid the risk of double-counting. Due to variation in the classification of breeding status across the last three national surveys (see Section 2.2), the assessment and subsequent presentation of pair totals was done in two ways.

Firstly, since the classification of *confirmed* and *probable* pairs has been more consistently applied across all surveys (refer to Appendix 2), we compared population size and distribution using only *confirmed* and *probable* categories. However, any variability in geographical coverage and/or survey effort across national surveys could lead to more variation in the way by which pairs were classified (*e.g.* if fewer visits were made in either survey or the timing of a record relative to breeding stage was imperfect, then pairs would be less likely to be classified as *probable* or *confirmed*).

Secondly, a less conservative approach (and following previous national surveys 1992; and 2002/03) compares all pair totals classified as *confirmed, probable* and *possible* across all time periods, including sightings of likely pairs which were classified as *NBE* (no breeding evidence) in 2021, as per the methodological approach described in Section 2.2. It is probable, that at least some of these NBE pairs could have been classified as *possible* under assessments in the previous national surveys, so this comparison is valid. A revisit of 2002 national survey data for the Beara Peninsula (West Cork), for example, found that out of a total of 74 sightings/records, four '*possible*' records would have been categorised as '*NBE*' under the 2021 criteria, and a total of five '*confirmed*' records would have been categorised as '*possible*' breeding records.

2.6.2 Non-breeding flocks

Early and late visit flocks were first considered separately in analysis. Flocks seen within 5 km of each other on the early visit were considered the same flock unless the surveyor saw the flocks on the same day and identified these as separate from one another. Using geo-referenced locations, where flocks recorded were <5 km apart, the flock with the largest number of individuals was considered the flock record for that site. This was then repeated for late visit flocks. Finally, the early and late visit flocks were plotted in ArcGIS and, where there was less than 5 km between sightings, the earlier sighting was considered the flock count, and the later visit removed for analysis. The early visit record was considered more likely to contain non-breeding birds, as flocks seen later in the season are more likely to contain a proportion of failed breeders and/or fledged young from the season. Where flocks were recorded on the second visit only, we included these counts if we were satisfied that the flock did not comprise failed breeders of family parties – such interpretation was done on a site-by-site basis using best judgement.

2.6.3 Calculating the number of pairs within SPAs

Chough are highly mobile, and widely dispersed across the SPAs. Breeding pairs generally feed within 1 km of their nest site (Bullock *et al.*, 1983). Evidence from more recent regional Irish studies (*e.g.* Trewby *et al.*, 2006b) and elsewhere, including Wales and Brittany, France (Kerbiriou *et al.*, 2009), points to coastal breeding pairs spending the majority (>80%) of their time within 350 m of nest sites, and pairs tending to prefer to commute along the coast from coastal breeding sites, rather than inland (Trewby *et al.*, 2006b). This latter study was based on focal observations[4] of 16 breeding pairs.

In addition to the obvious mobility of pairs from nest sites, locational data in this 2021 survey was provided at varying resolutions/levels of accuracy, and repeated visits may have been carried out by more than one observer. Records, therefore, had to be carefully scrutinised to avoid over- or under-estimation of the number of pairs which were located some distance away across the two (or more) visits. Any records from verified observers with precise locations of confirmed/probable breeding pairs were included in totals; providing if when buffered by 350 m and located in suitable breeding habitat these records did not overlap with existing known records from the core census team. For *possible* breeding records submitted by the public, records more than 1 km from existing core records were included in totals.

We considered Chough pairs within SPAs by applying the following rationale:

- All *confirmed* and *probable* pairs (detailed as separate records by observer) with nest locations within the boundary of the SPAs were included in SPA totals. This included records plotted in the sea, but near suitable coastal breeding habitats and perpendicular to the SPA boundary
- *Confirmed*, and *probable* man-made nest sites of pairs for which precise locations (8- or 10-figure Grid References) were available and fell within ≤ 40 m of the SPA boundary were interrogated using aerial imagery to corroborate the location (inside/outside SPA boundary) of the man-made nest site
- For records outside SPA boundaries, a 350 m buffer was applied to these nest locations; pairs were categorised as being *within* the SPA if ≥ 50% of the buffer centring on the nest location lay within the SPA boundary
- All records which lay >1000 m from the inland/landward SPA boundary were not considered part of SPA totals. All possible pairs with less precise Grid Reference locations (4- or 6-figure), and therefore reduced certainty as to the proximity of any possible nest sites to SPA boundaries, were also excluded from SPA totals
- An additional check was carried out for any *confirmed* and *probable* pairs with precise nest locations located close (<500 m) to the SPA boundary but outside the 350 m buffer. As there was less certainty that these birds utilised the SPA for foraging during the breeding season, these records were not included in totals for SPAs

[4] Focal watches, of 3-5 hours duration, were conducted between 15 Apr – 10 Jun, starting after the onset of incubation and covered chick provisioning up to fledging.

3 Results

3.1 Coverage

A total of 201 10 km squares were covered as part of the national survey, mainly via observers walking along clifftops and coastal sections which held likely suitable breeding habitat and foraging habitats (*i.e.* short grazed vegetation, suitable natural nest sites including sea-cliffs and man-made structures such as old ruins/dwellings). These squares extended along the coastline from Inishowen Head, Co. Donegal to the Saltee Islands, Co. Wexford, along the known breeding range for Chough (as per previous national surveys and breeding bird atlases). Coverage also extended inland in some mountainous areas, including the Sligo/Leitrim Uplands SPA, which had previous records of breeding birds. Furthermore, in 2021, additional new inland breeding records, especially in the southwest, were the result of a concerted local public campaign by NPWS regional staff for any records of birds nesting in sheds/barns/old ruins *etc*. Nationally, coverage was adequate for most areas, which was more remarkable in light of travel restrictions for the early season period (in place until May 10th), due to the Covid-19 pandemic. The survey methodology required two visits, separated by at least 14 days to each site. However, a small number of sites received only one visit, which may have resulted in some birds being overlooked and/or difficulty in obtaining sufficient breeding evidence. This included, for example, some offshore islands which could only be visited once. Conversely, in other areas, where more than two surveys were conducted, it is possible that more birds were recorded than would otherwise have been the case.

Field survey transects covered at least 1,737 km and passed through 1,904 1 km squares. Data was also provided for an additional 280 1 km squares containing records submitted by surveyors and reliable records submitted by casual observers – these included casual observations where, for example, survey routes were not marked. Therefore, a minimum of 2,184 1 km squares were visited and/or records provided across the 201 10 km squares. Omitted from this total are any 10 km squares in which no Chough were recorded (categorised as *vacant*) but where there was no more precise information on the locations checked and transects walked.

Seventy-five percent of previously occupied 1 km squares were visited at least twice during the survey period. The majority of 1 km squares visited once only (5%; *n*=109), were largely confined to remote offshore islands or some inland mountainous areas where coverage was more difficult to attain. In many cases, sites which received a single visit had confirmed occupancy (status *confirmed*) from observations recorded on the single visit, or had a low likelihood of occupancy given historical knowledge of distribution.

3.2 Breeding population size and range

The 2021 census found 387*confirmed/probable* breeding pairs (bp) distributed around all coastal counties from Donegal to Wexford (Figures 19 and 20). If *possible* breeding pairs are included, the total number of breeding pairs increases to 630 bp. Furthermore, applying the same criteria to the 2021 dataset as used previously by the 2002/03 national survey (*i.e.* where the 2021 *NBE* category equates to likely *possible* breeding in previous censuses; Table 1), the total number of pairs is 900 bp. At the 10 km square level, of 201 surveyed, 107 held confirmed bp, 31 in which breeding was *probable* and 13 *possible*. A further 19 squares held records where breeding evidence was classified as *NBE* (no breeding evidence but singletons/pairs in flight or singles on the ground in suitable habitat) and one square held a flock only. Finally, in 30 10 km squares, no Chough were seen and therefore classified as *vacant* (Figure 19).

The largest populations of breeding pairs (excluding NBE records) were in counties Cork (35.5%; 228 bp) and Kerry (21%; 134 bp), together accounting for 57% of the national total, with the third largest population in Co. Donegal (12.5%; 79 bp) (Table 1). The 10 km distribution of the population is similar to previous surveys, showing a near continuous distribution from

Inishowen (Co. Donegal) to the Saltees (Co. Wexford) with relatively few gaps other than in Galway Bay and northwest Co. Sligo. The highest numbers were mostly associated with the peninsulas in counties Kerry and Cork. The highest densities (numbers of breeding pairs excluding *NBEs* (bp)/10 km) were found in these counties including: 10 km square V54 (Allihies/Cod's Head: 37 bp), V72 (Mizen Head: 16 bp), Q30 (Three Sister's Dingle: 12 bp), X69 (East Waterford; 11bp) and V48 (Doulus Head; 15 bp).

Of the 2,184 1 km squares included as part of this survey, 1,449 were deemed *vacant*. Within the 735 occupied 1 km squares, there were 237 in which the maximum breeding evidence was *confirmed*, 104 with maximum breeding evidence *probable*, 170 *possible* and 172 *NBE* (no breeding evidence). The average breeding density within occupied 1 km squares was 1.31 pairs/km^2 (range 1-7) in which the majority of 1 km squares (77%) held just one pair, 17% held two pairs and just 6% of squares held three or more pairs. Additional surveys in 2022 by NPWS in west Cork and the Iveragh Peninsula, found an additional 43 bp, with a further 25 inland bp for the Beara Peninsula alone (Clare Heardman, *pers. comm.*).

An independent survey of the Co. Waterford coastline was also carried out in 2021 (McGrath, 2022) and results were received with thanks after the completion of the national survey. This information is not reflected in the survey results presented above. However, the two datasets were compared and an adjusted figure for Co. Waterford was calculated (see Table 1). The full details including the adjusted figure for relevant sections of the Waterford coast are presented in Appendix 6. There were deemed to be 12 additional breeding pairs for Co. Waterford. Where these supplementary records are incorporated into results presented in this report, they are identified in footnotes throughout, unless otherwise specified.

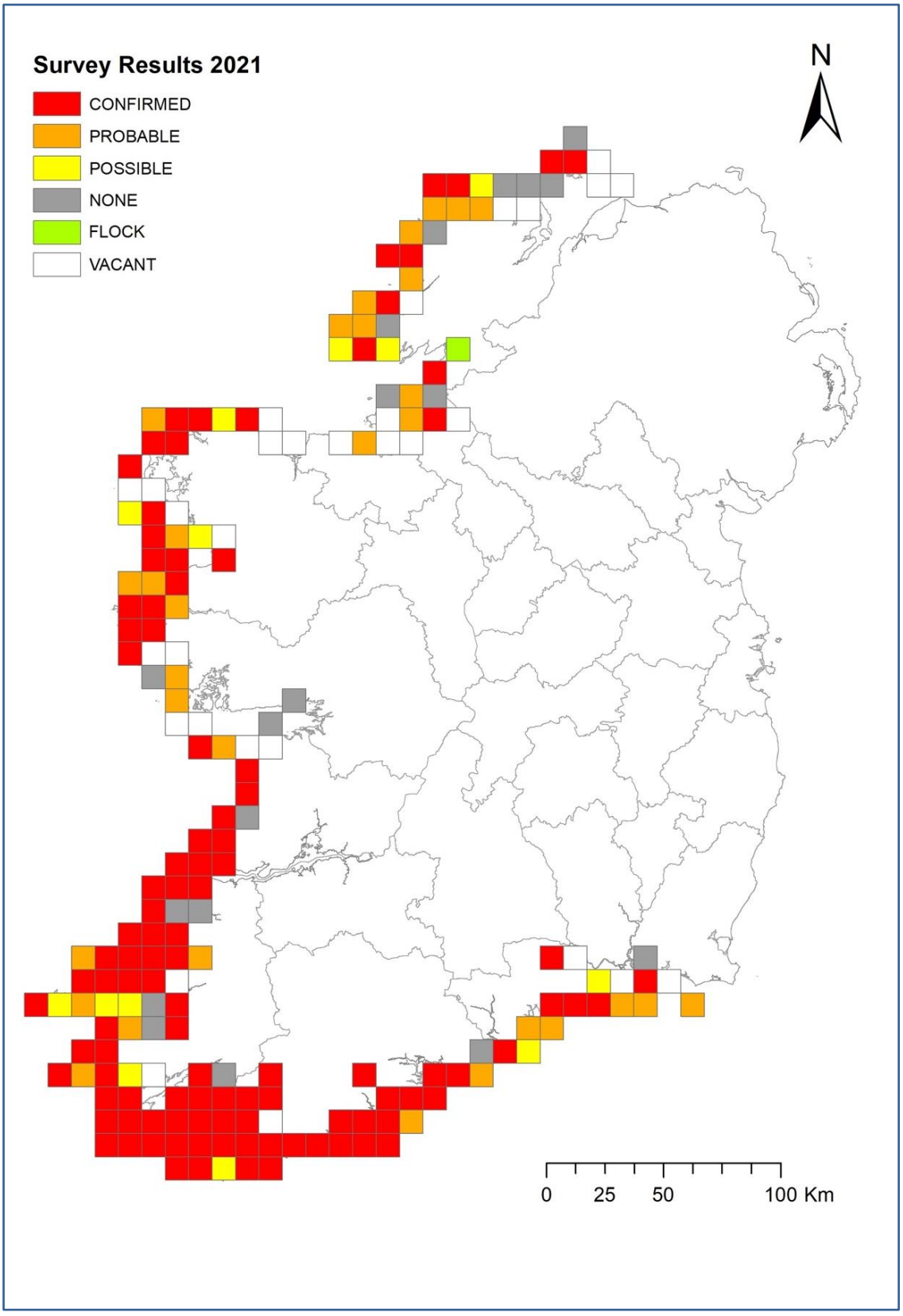

Figure 19 The breeding distribution of Chough in Ireland in 2021, showing broad survey coverage across 10 km squares and the highest level of breeding status (i.e. confirmed, probable, possible, 'NBE' or flock) in coastal and inland areas in all 10 km squares which were surveyed.

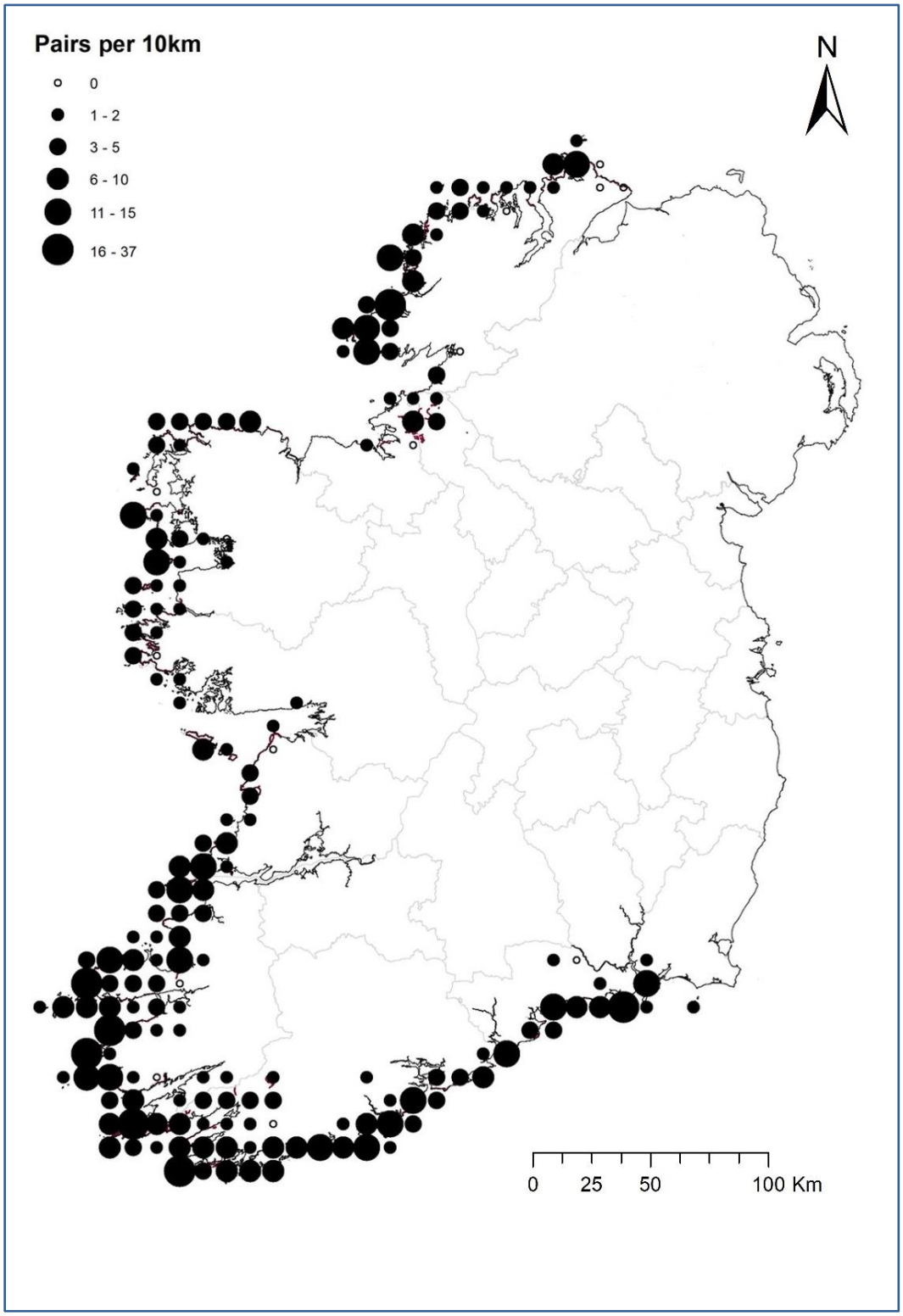

Figure 20 Breeding distribution of Chough in Ireland in 2021, showing survey coverage and estimated numbers of breeding pairs detected in surveyed 10 km squares (see text for further details).

Table 1 Numbers of breeding and non-breeding Chough by county in Ireland, recorded in 2021. Totals presented are derived mostly from two standard visits in the period early April to mid-June and using all additional records (*e.g.* reviewed and validated public information). Pairs were classified as *confirmed, probable, possible* or *NBE* using standard behavioural classifications (see Appendix 3). Note that *NBE* refers to no breeding evidence but differs from Vacant (no birds observed); in previous national surveys (see Appendix 2), records classified as such (*i.e.* Chough present but no evidence of breeding) would largely have been classified as possible breeders. The number of non-breeding birds is also shown, as is the proportion of non-breeders (expressed as a percentage) per county and the national total (includes total numbers of breeding birds (c, pr, po) by county).

	Total Numbers of pairs (% of total pairs)								
County	**Confirmed (C)**	**Probable (Pr)**	**Possible (Po)**	**NBE**	**Non-breeders (No.)**	**Proportion of non-breeders %** [5]	**C & Pr**	**C, Pr & Po**	**C, Pr, Po & NBE**
Donegal	20 (25)	24 (30)	35 (44)	60	88	35.8	44	79	139
Leitrim	1 (33)	0 (0)	2 (67)	3	3	33.3	1	3	6
Sligo	0 (0)	3 (60)	2 (30)	4	0	0.0	3	5	9
Mayo	16 (28)	15 (26)	26 (46)	20	56	32.9	31	57	77
Galway	10 (48)	4 (19)	7 (33)	5	20	32.2	14	21	26
Clare	22 (45)	9 (18)	18 (37)	11	124	55.8	31	49	60
Kerry	39 (29)	29 (22)	66 (49)	85	272	50.3	68	134	219
Cork	144 (63)	29 (13)	55 (24)	41	358	44.0	173	228	269
Waterford	11 (23)	7 (15)	29 (62)	32	77	45.0	18	47	79
Wexford	0 (0)	4 (57)	3 (43)	9	6	30.0	4	7	16
ALL	**263 (42)**	**124 (20)**	**243 (38)**	**270**	**1,004**	**44.3**	**387**	**630**	**900**
Waterford[6] (Adjusted)	16 (27)	9 (15)	34 (58)	32	81	40.7	25	59	91
All (Adjusted)	**268 (42)**	**126 (20)**	**248 (38)**	**270**	**1,008**	**44.0**	**394**	**642**	**912**

[5] The percentage of non-breeders is expressed as the sum of non-breeders combined with two times the sum of confirmed, probable and possible breeders (to represent pairs).

[6] We have amalgamated this survey data with that from McGrath (2022) to produce Co. Waterford totals (the adjusted figure produces +5 confirmed pairs, +2 probable pairs and + 5 possible pairs). Please refer to Appendix 6 for further details.

3.3 Numbers of breeding birds within the SPA network

A total of 168 *confirmed* or *probable* pairs were recorded across the 15 SPAs (Table 2). Including *possible* records, this total rises to 280 bp and to 382 bp overall if *NBE* records are included. With a further three pairs classified as nearby but *confirmed* (known nest sites >350 m but less than 1 km from the SPA boundary), the overall total is 385 pairs.

Table 3 shows the changes between national surveys in the number of pairs across the breeding Chough SPAs between 2002/03 and 2021. Overall the 15 SPAs hold around 42% of the total breeding population (382 of 900 pairs), which is approximately 23% down on the equivalent proportion held in 2002/03 (546 of 838 pairs). Trends within SPAs were quite variable, with an average population decline of around 30% across all sites, with an increase in just three SPAs (Mid-Waterford Coast SPA, Seven Heads SPA and Beara Peninsula SPA), no change in one (West Donegal Coast SPA) and declines across the remainder. The most marked apparent declines were the following SPAs: Counties Clare (Cliffs of Moher SPA; -75%), Donegal (Horn Head to Fanad Head SPA; -69%), inland sites of Leitrim/Sligo Uplands SPA (-67%) and Cork (Sheep's Head to Toe Head SPA; -66%).

Table 2 Number of pairs of Chough categorised according to breeding status (C: confirmed, Pr: probable, Po: possible, NBE: no breeding evidence) across the breeding Chough SPA network, using 2021 national survey data. Please also refer to Section 2.2 - Assessment of Breeding Status. The values in parentheses in the total column refer to pairs with known nest sites which were >350 m but within 1 km of the SPA boundary. The percentage of non-breeding birds is expressed as a proportion of the sum of 'C, Pr & Po' x 2 + the number of non-breeders and excluding the pairs in parentheses.

County	SPA Name	C	Pr	Po	NBE	No. of non-breeders (No.)	Proportion of non-breeders (%)	Total C, Pr, Po & NBE
Donegal	Horn Head – Fanad Hd	1	2	2	4	0	0	9
Donegal	W Donegal Coast	10	12	13	23	21	24.7	58 (+1)
Leitrim/Sligo	Sligo/Leitrim Uplands	1	0	3	1	0	0	5
Mayo	Clare Isl	4	0	4	2	0	0	10
Clare	Cliffs of Moher	1	0	1	1	3	42.8	3
Kerry	Kerry Hd	1	0	0	12	15	88.2	13
Kerry	Dingle Peninsula	4	13	19	23	98	57	59 (+1)
Kerry	Blasket Isl's	1	0	2	4	0	0	7
Kerry	Iveragh Peninsula	13	12	34	13	59	33	72
Cork	Beara Peninsula	40	7	11	0	46	28.4	58 (+1)
Cork	Sheep's Hd – Toe Hd	14	5	4	2	32	38.1	25
Cork	Galley Hd – Duneen Pt	4	3	1	2	4	20	10
Cork	Seven Heads	6	3	4	4	49	51.6	17
Waterford	Helvick Hd – Ballyquin	0	3	4	2	17	54.8	9
Waterford	Mid-Waterford Coast	7	1	10	9	44	53.6	27
ALL		**107**	**61**	**112**	**102**	**388**	**40.7**	**382(+3)**

Table 3 Number of breeding Chough (total pairs: C, Pr, Po and NBE) in the SPA network in 2002/03 compared to 2021 and the percentage change. The value in parentheses refer to pairs with known nest sites, which fell >350 m outside but were located within 1 km of the SPA boundary.

County	SPA Name	Total Pairs		% change
		2021	**2002/03**	**2002/03 - 2021**
Donegal	Horn Head – Fanad Head	9	29	-68.9
Donegal	West Donegal Coast	58 (+1)	58	0 (+1.7)
Leitrim/Sligo	Sligo/Leitrim Uplands	5	15	-66.7
Mayo	Clare Island	10	16	-37.5
Clare	Cliffs of Moher	3	12	-75.0
Kerry	Kerry Head	13	30	-56.6
Kerry	Dingle Peninsula	59 (+1)	105	-43.8 (-42.8)
Kerry	Blasket Islands	7	9	-22.2
Kerry	Iveragh Peninsula	72	88	-18.1
Cork	Beara Peninsula	58 (+1)	54	+7.4 (+9.2)
Cork	Sheep's Head – Toe Head	25	73	-65.7
Cork	Galley Head – Duneen Point	10	11	-9.1
Cork	Seven Heads	17	15	+13.3
Waterford	Helvick Head – Ballyquin	9	11	-18.2
Waterford	Mid-Waterford Coast	27	21	+28.6
ALL		**382 (+3)**	**547**	**-30.2 (-29.6)**

3.4 Numbers and distribution of non-breeding birds

A total of 1,004[7] non-breeding Chough were recorded in 122 flocks (Table 4), 23% more than were recorded in 1992 (Berrow *et al.*, 1993) and 33% more than in 2002/03 (Gray *et al.*, 2003). The overall proportion of non-breeders in the 2021 national survey (44%) was considerably higher than in the average proportion of 31% in both previous surveys (Table 4). Regional changes are evident in the short-term (compared to 2002/03), with increases for most counties, except Sligo and Wexford, and most notably in Cork, Clare and Kerry where the proportions of non-breeders were considerably higher in 2021.

Table 4 Number of non-breeding Chough by county in 2021, 2002/03 and 1998. Proportions are the number of non-breeding birds as a percentage of the total number of adult breeders and non-breeders combined.

	Number of non-breeding Chough					
County	**2021**		**2002/03**		**1992**	
	No.	**%**	**No.**	**%**	**No.**	**%**
Donegal	88	35.7	73	22.0	164	33.3
Leitrim	3	33.3	0	0.0	0	0.0
Sligo	0	0.0	29	54.7	22	44.0
Mayo	56	32.9	51	28.8	66	33.7
Galway	20	32.2	9	18.4	28	26.9
Clare	124	55.8	27	29.7	17	23.3
Kerry	272	52.5	233	30.4	122	16.2
Cork	358	44.0	251	32.8	292	34.1
Waterford	77	45.0	63	39.1	93	48.7
Wexford	6	30.0	20	76.9	15	48.4
ALL	**1,004**	**44.3**	**756**	**31.1**	**819**	**31.2**

3.5 Locations of occupied nest sites

Nest locations were broadly classified as coastal or inland for *confirmed*, *probable* and *possible* pairs, depending on where birds were observed. A total of 76 (12%) nest sites were classified as inland (≥1 km from Mean HWM), the remainder were coastal (<1 km from Mean HWM). Of *confirmed* and *probable* nest locations (the majority of which had known or highly probable nest locations), 323 (83%) were classified as coastal nesting.

In total, 27% of nests where locations were known (*n*=387; Table 5) were classified as located in man-made structures. The numbers of breeding Chough using such nest sites was more pronounced in counties Cork (39% of known nests there) and to a lesser degree in Kerry (18%), though it is not known to what degree the greater coverage of potential inland nest sites in these counties by surveyors may have contributed to those higher totals.

[7] An additional four non-breeding chough were calculated in the amended Waterford figures

Table 5 Chough nest site types recorded in 2021, classified as built in man-made structures (MM: *e.g.* buildings), natural locations (Nat) or unknown (Un).

County	Confirmed			Probable			Con & Pr		
	MM	Nat	Un	MM	Nat	Un	MM	Nat	Un
Donegal	2	15	3	0	17	7	2	32	10
Leitrim	0	1	0	0	0	0	0	1	0
Sligo	0	0	0	0	2	1	0	2	1
Mayo	6	9	1	1	14	0	7	23	1
Galway	6	4	0	3	1	0	9	5	0
Clare	4	17	1	1	8	0	5	25	1
Kerry	9	26	4	3	25	1	12	51	5
Cork	62	79	3	5	23	1	67	102	4
Waterford	2	8	1	1	6	1	3	14	2
Wexford	0	0	0	0	2	1	0	2	1
ALL	**91**	**159**	**13**	**14**	**98**	**12**	**105**	**257**	**25**

3.6 Changes in abundance, distribution and range between the 1992, 2002/03, the 2007-11 *Atlas* and 2021 surveys

The overall population of *confirmed* and *probable* breeding pairs has fluctuated either side of a peak in 2002/03 but the longer- or shorter-term trend shows an overall decline of at least 8%. If all categories are included (*confirmed, probable, possible* and *NBE*) then the between-survey changes are more modest, with 2021 totals similar to 1992, but an increase of 5% since 2002/03 (Table 6). Regional changes in breeding populations have occurred when examined at the county level, with long-term increases (based on all breeding status categories) between 1992 and 2021 evident in six counties and decreases in four (Table 6).

With respect to changes in range, comparison with the *Bird Atlas 2007-11* (Balmer *et al.*, 2013) shows an apparent reduction in the number of occupied squares nationally from 157 10 km squares in which breeding status was *confirmed/probable in 2008-11,* to 138 10 km squares in 2021. If *possible breeders* are also included, the total is 170 10 km squares in 2008-11 versus 151 10 km squares in 2021.

In 2021, 133 10 km squares were *retained*, 30 *lost*, 18 *gained* and a total of seven were not visited (so status cannot be compared) relative to the distribution in the *Bird Atlas 2007-11* (Figure 21). Of the apparent new gains, two 10 km squares were occupied in 1992, but not in either 2002/03 or the *Bird Atlas 2007-11*, and two other squares held birds in 2002/03 but none reported in the *Bird Atlas 2007-11*. The primary changes in 2021 were increased numbers of vacant 10 km squares in north Donegal, west Donegal and north Clare, whilst gains were concentrated in the south-west and chiefly in inland areas.

Table 6 Changes in the numbers of pairs of Chough between the 1992, 2002/03 and 2021 surveys. Comparisons are made on two breeding status categorisations – *confirmed* and *probable* records ONLY across all surveys, and all breeding records (*confirmed, probable, possible* and *NBE*). As highlighted elsewhere, it is likely a higher number of sightings were classified as *possible* breeding records as opposed to *NBE*, in 2002/03. [N.B. The adjusted 2021 totals* for Co. Waterford are included here].

County	Confirmed/Probable			All (C, Pr, Po & NBE)			Confirmed/Probable		All (C, Pr, Po & NBE)	
							% change		% change	
	2021	2002	1992	2021	2002/03	1992	1992-2021	2002-2021	1992-2021	2002-2021
Donegal	44	78	47	139	129	101	-6	-44	38	8
Leitrim	1	4	1	6	6	4	0	-75	50	0
Sligo	3	7	10	9	12	14	-70	-57	-36	-25
Mayo	31	43	34	77	63	65	-9	-28	18	22
Galway	14	16	26	26	20	38	-46	-13	-32	30
Clare	31	11	19	60	32	28	63	182	114	88
Kerry	68	141	112	219	267	315	-39	-52	-30	-18
Cork	173	134	153	269	257	282	13	29	-5	5
Waterford	25*	11	18	91	49	49	39	127	20	20
Wexford	4	0	8	16	3	8	-50	400	100	433
ALL	**394**	**445**	**428**	**912**	**838**	**904**	**-8**	**-11**	**1**	**9**

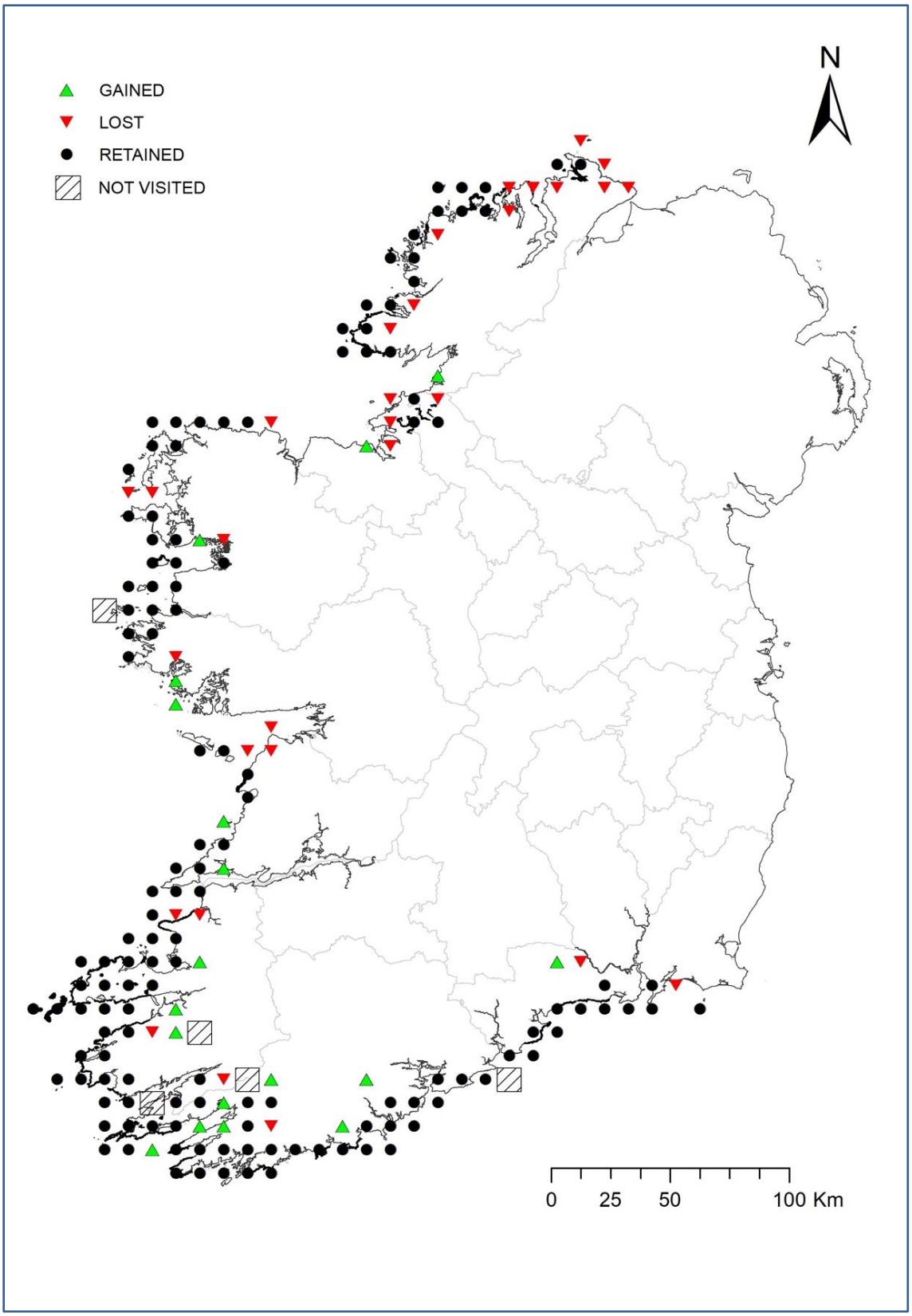

Figure 21 Changes in apparent range between *Atlas* coverage (2007-11) and the current survey, showing status changes in surveyed 10 km squares as either gained, lost, retained or where not visited.

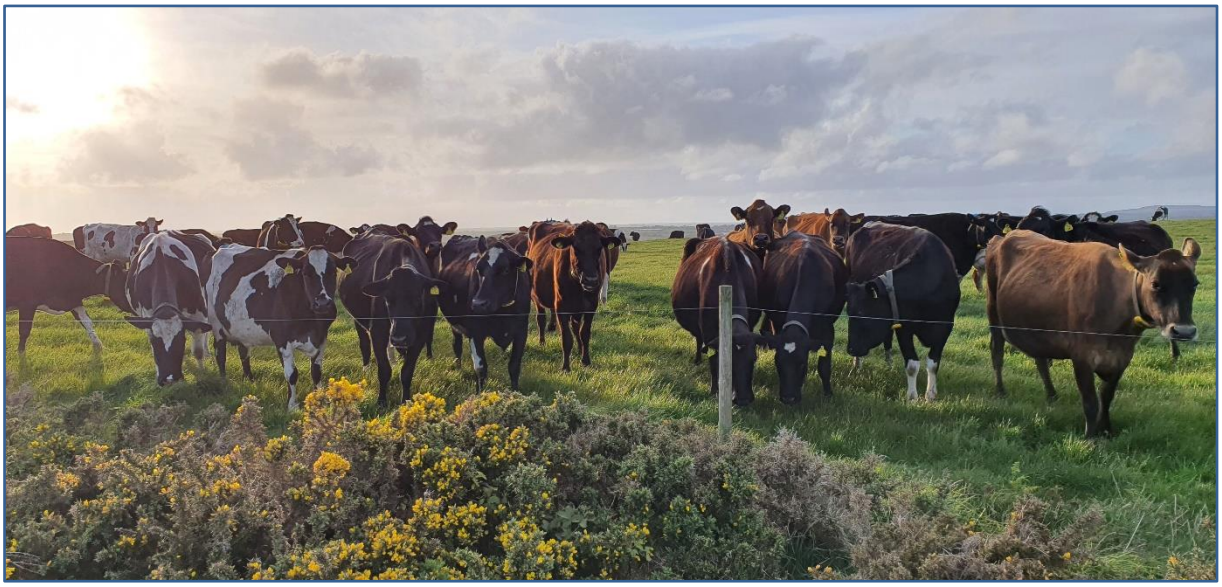

Figure 22 Fencing of clifftops has led to a reduction in the extent of available grazed cliff and clifftop habitats for foraging Chough © Sinéad Cummins, NPWS.

Figure 23 Coastal clifftops choked with Bracken, Bramble and Gorse are commonplace along the south coast © Sinéad Cummins, NPWS.

4 Discussion

The coverage achieved by the 2021 national survey, in broad terms, was comparable to that of recent national surveys (1992, 2002/03). The *Breeding Bird Atlas 2007-11* (Balmer *et al.*, 2013) was also useful to identify any additional 10 km squares with records of breeding Chough for the 2008-11 period, though the determination of breeding status under the *Bird Atlas* differs from that of the national surveys. Nevertheless, in broad terms, the national survey targeted areas within the known/likely range of breeding Chough in Ireland.

National surveys of Chough (or indeed of any bird species/group) are constrained by a number of biases/factors (as set out in sections below). Chough are highly mobile and can easily avoid detection by surveyors, depending on timing and length of visit, topography, and visibility, amongst other factors. The standardised methods of survey employed by this survey aimed to reduce this potential bias, though it was impossible to eliminate altogether.

National surveys do not present 'absolute counts' of a species but provide, in broad terms and as accurately as possible, snapshots of numbers detected at a site/local and regional level. The limitations of the survey and data collected are clearly set out in this report. Figures are presented for populations and population changes at the 10 km square, site, county and national levels, allowing for consistency with previous reporting. Any interpretation of percentage change figures presented should thus consider these constraints and not regard them as absolute.

4.1 Coverage

Survey coverage in 2021 was broadly similar to that achieved by previous national surveys with several exceptions. Offshore islands were less well covered than in previous surveys with a larger proportion either not covered at all or visited only once. This was chiefly the case for the Blasket Islands SPA (Co. Kerry) and some islands off the west coast of Co. Donegal. Furthermore, though coverage of SPAs was prioritised, access restrictions either due to difficult terrain and/or landowner resistance to allow access, resulted in less than complete coverage of some known important breeding areas compared to previous censuses. This was the case for Kerry Head SPA and mid-Waterford Coast SPA, where total coverage was not possible due to such restrictions, though reasonable coverage was still achieved. This survey was initiated at the tail-end of the last major period of Covid-19 pandemic travel restrictions, so it is unsurprising that there were some ongoing and variable consequences for access and travel. For the mid-Waterford Coast SPA, coverage gaps were addressed by having access to data from more intensive monitoring undertaken by a local ornithologist (*i.e*. McGrath, 2022).

The closing off of public access by some landowners may likely have been related to an increase in recreational pressure, particularly along coastal paths/cliffs during the Covid-19 travel restrictions period and subsequently post-pandemic. Not all such recreational activity was welcome, particularly for those landowners concerned with public liability risks, coupled with any associated damage to their properties linked to recreational use (*e.g.* damaged/broken fences), leading to a 'zero tolerance' approach to public access - even for surveyors. In addition, for surveyors, there was an element of reluctance to approach working farms and farmhouses so as to remain compliant with government social distancing guidelines and to help minimise any anxiety amongst the rural community with 'external' visitors.

4.2 Methodological approaches in 2021 and previous surveys

Adequate assessments of population trends and changes in distribution require a good understanding of any differences in coverage and/or methodologies that may have occurred between surveys. Standardised methods aim to reduce/remove the primary sources of potential bias but it is often difficult to exactly replicate survey approaches between surveys,

particularly when the gap between surveys is large (*i.e.* almost 20 years between the most recent national surveys). The field methods used in 2021 differed from the previous national surveys. In both 1992 and 2002/03, coverage was largely achieved by a small team of professional surveyors covering sections of suitable coastline in a systematic fashion. That confers some benefits including, for example, the consistency in approach with respect to application of survey methods across regions and the familiarity professionals have established with the species during the intensive survey periods. The Covid-19 pandemic travel restrictions and the necessity to minimise/avoid social mixing insofar as possible, dictated that a much more localised approach was required for surveys in 2021. Some of the potential benefits, in terms of consistency of approach are likely to have been more variable, with more observers involved, but this was likely counterbalanced by the local knowledge of potential breeding areas by local observers, with a likely positive influence. Overall, it is considered that on balance, this adapted approach in 2021 did not hinder achieving a reasonably comprehensive survey of previous known breeding sites.

The primary difference in the 2021 survey approach compared to that of previous surveys was the interpretation of those behaviours/records used to categorise breeding status. In 2021, a more rigorous classification than hitherto was adopted, and followed that defined in Hayhow *et al.* (2018). Single birds or pairs flying or seen on the ground in suitable breeding habitat were, with one exception (‘*pairs on the ground*’), not classified as *possible* breeders. The presence of birds was deemed not sufficient evidence to assume birds were ‘possibly’ breeding, under this classification.

Looking back at previous national surveys in Ireland, single birds or pairs on the ground would have been classified as *possible* breeders by the 1992 survey, whilst single or pairs in flight would not have been. In 2002/03, pairs or single birds on the ground, or in the air in likely suitable breeding territory, were classified as *possible* breeders. In 2021, pairs on the ground in suitable habitat were the minimum criteria considered to be *possible* breeders (Appendix 3). Otherwise, the 2021 classification system was similar to that used in 2002/03, which is regarded as more rigorous in its application of behavioural assignments than 1992. Notably that included considering “*1 in 1 out” and “2 in 2 out”* as only *possible* breeding in the two most recent censuses, when such behaviours were regarded as *probable* breeding in 1992. The consequence of this more rigorous and strict assignment for 2021 is inevitably a reduction in the number of probable breeders and apparent reduction in total numbers for that group.

Considering these differences in interpretation of sightings between surveys, it is important to compare like-with-like *i.e.* between 2002/03 and 2021, for the purposes of detecting any meaningful changes. Thus, it was necessary to group *possible* and *NBE* breeding records from 2021 to compare with all *possible* breeding records of 2002/03. However, the continuation of the 2021 methodological approach in future site monitoring activity and national surveys is important. Future comparisons can now be based on higher levels of confidence in the comparability of the classification of breeding status in the biogeographical context *i.e.* when results for Ireland are considered with those of UK surveys. Refinements to the existing methodology, to adapt and better capture potential changes in the population distribution for example (*e.g.* more targeted sampling of inland areas >1 km from the coast), and to strive for improved precision with respect to determination of breeding status for all sightings, are important. Future surveys should consider opportunities to accomplish these ambitions. For example, after several years of intensive surveys by a small team, Trewby *et al.* (2006b) concluded that higher levels of confirmation of breeding could have been achieved by incorporating an additional criterion: multiple visits by a single bird or pair to a nest site after normal hatching time in early May (which could be entitled ‘*repeated 1-1* or *2-2*’). In 1992, a single observation of these behaviours was considered *probable* breeding, but would have been considered *possible* in 2002/03 and 2021. The early May peak nesting period would target provisioning behaviour that could detect nesting without having to detect pair presence, though care would be needed to discount young pairs who may be prospecting for nests at this time (Trewby *et al.*, 2006b). On a cautionary note, a 20-year study of the reproductive performance of Chough in Britain (Reid *et al*., 2003) found that there was a cost to young

females, who were more productive when they were young, resulting in shorter lifespans. In the south of Ireland, the noticeable uptake of artificial nest sites by Chough in recent years, led to the initiation of a local colour-ringing project in 2021. Local resightings of young marked birds (2-years old) partaking in behaviours (*i.e.* nest building) akin to adult breeding birds (Sam Bayley, pers. comm.) suggests at least some two-year old birds attempt to breed. A Scottish study also found that Choughs can first breed when 2-3 years old (28-81%), with 97% of 4-year old birds breeding (Reid *et al*., 2004).

4.3 Changes in the number and distribution of breeding pairs

The methodological differences in how the breeding status of Chough was classified between national surveys (1992; 2002/03; 2021) means that the most valid comparisons of breeding pairs includes *confirmed*, *probable* and *possible,* from all surveys, and includes *NBE* records from 2021 (which would have been categorised as *possible* in 1992 and 2002/03). This comparison shows that the national Chough breeding population has increased by 9% since 2002/03 and is similar (+1%) to the 1992 total.

Regionally, the long-term population trends (1992 to 2021) show increases in most counties except Sligo, Galway, Kerry and Cork. In the shorter term (2002/03 to 2021), apparent stability or increases in all counties are evident, except Kerry and Sligo. Thus for these two counties trends have been consistently negative over both time periods. In making comparisons of changes in numbers and/or range at local levels, relatively small movements of breeding birds away from the coast to inland areas, or between 10 km grid squares can exaggerate changes and may give an indication of significant changes, when populations may have simply re-distributed at a local scale. On the other hand, regional movements do occur and could potentially lead to short or long-term changes in the degree of occupation of sites. For example, Carroll *et al.* (2010) indicated a possible link between Chough on the Aran Islands and the Cliffs of Moher (Co. Clare). Recorded fluctuations in these local populations between the different censuses may in fact be pairs and non-breeders relocating between these islands and the mainland in different years. As total numbers of pairs recorded for Co. Clare were up on the previous national census (2002/03), the noted decline recorded for the Cliffs of Moher SPA could be linked to pairs moving to other nest locations outside the SPA itself.

A total of 394 *confirmed* and *probable* pairs of Chough were recorded in Ireland in 2021 (including supplemented totals for Co. Waterford). The majority of the breeding population occurred in counties Cork and Kerry (southwest), which together held 241 c*onfirmed* and *probable* pairs or 61% of the national total. Comparison of these totals with the previous surveys of 1992 and 2002/03, shows a notable decline of 13% since 2002/03 for the southwest, and 10% over the longer-term since 1992. Remarkably, for counties Cork and Kerry, the proportions of the overall national total of *confirmed* and *probable* pairs have been almost identical across the last three national surveys (1992: 61.7%, 2002/03: 61.7% and 2021: 61.2%).

Applying the more strict breeding criteria *i.e. confirmed/probable* only, gives a more stark trend in total numbers of breeding pairs for counties since 2002/03, a short-term population trend (*i.e.* 19-year) with apparent declines of >50%, for counties Sligo, and Leitrim, with declines of >25% for counties Mayo and Donegal. However, comparison of all breeding totals for these four counties (*i.e.* all breeding categories, including '*possible*' and '*NBE*' records) indicates small to moderate increases. Over both the longer-term (29-year) and short-term (19-year) periods, counties Sligo and Leitrim, which have a relatively small inland (and relatively isolated) population, have shown consistent declines. Thus, it is not clear-cut if these changes in numbers of confirmed/probable pairs for these counties is reflecting population changes on the ground *i.e.* perhaps fewer experienced Chough successfully breeding in these counties. Alternatively, the different survey approach taken in 2021 (*i.e.* more surveyors with varying degrees of previous survey experience covering more sites nationally), may have contributed

to the lower number of proven (*i.e.* confirmed/probable records) which could be skewing observed trends for this category.

The total distribution (numbers of occupied 10 km squares) of breeding Chough in 2021 was down 11% on recorded occupation during the *Bird Atlas* 2007-11 (Balmer *et al*., 2013), irrespective of which breeding status categories are considered (*confirmed, probable* only or also including *possibles)*. Apparent losses occurred around all regions but appeared to be clustered in north Co. Donegal, west Co. Sligo and north Co. Clare. The declines in north Co. Donegal appear consistent with a general reduction in the numbers of non-breeders in flocks and in the sizes of the wintering flocks (comprising sub-adults, young and breeding adults) based on observations locally. There is supporting anecdotal evidence that at least one breeding pair at an increasingly popular tourist spot have experienced nest failure in multiple years likely due to repeated disturbance, and similarly this pressure for nesting pairs at/near other tourist hotspots could be problematic (McGrath, 2022). On the other hand, it is possible that a shift to breeding inland in some areas has occurred, with Chough nesting farther from the coast. These breeding pairs are more likely to be overlooked by the national surveys up to now, which largely focus on coverage of sections of suitable coastline (within the known historical range). Thus, future surveys will need to consider more targeted and standardised sampling approaches for likely suitable inland areas.

The breeding population in Co. Sligo nests along inland cliffs (the Dartry mountain range extending into Co. Leitrim). Numbers peaked in 1992 at 50 birds (14 pairs and 22 non-breeders), a probable increase from the 15-18 birds recorded in 1963 by Cabot (1965) and similar numbers in 1982 by Bullock *et al.* (1983). Though it appears that the number of breeding pairs has halved in 2021, returning to pre-1992 levels, up to an additional four pairs were recorded outside the SPA boundary. The non-breeding flocks – which comprise of recruits for the breeding population – have apparently disappeared. The difficulty of surveying this inland complex of breeding cliffs should not be underestimated and it is possible that birds (including roving flocks) were undetected. If the population is however, this reduced, with no non-breeding flocks, it raises concerns for the long-term viability of this population in the local area, part of which is designated an SPA for the species.

In the south of the country, the population in Co. Kerry has shown apparent declines over the short and long-term time periods, whilst in neighbouring Co. Cork, broad stability and further east, in Co. Waterford, short and long-term increases have been shown. An increase for the mid-Waterford Coast SPA (the larger of the two Co. Waterford SPAs) was noted by Trewby *et al*., (2010c) which held 32 pairs in 2009 (up 11 pairs on 2002/03), with totals for Helvick Head to Ballyquin SPA of 10-13 pairs, similar to reported 2002/03 totals. A recent survey by McGrath (2022) indicates similar numbers of breeding pairs on the Waterford coast in 2021 (48-52 bp), compared to the upper end of estimates of pairs in 1982, 1992 and 2002 (all approximately 49 bp) and the proportion of additional flocking non-breeding birds to fall into the range 39 – 49%. Within the county, McGrath (2022) suggests slight increases in the number of pairs from 1992 in the coastal cliff areas of the west and east of the county, but with overall numbers down in the central coastal section, albeit survey effort (*i.e*. up to three survey visits) was greater in the east of the county.

The degree to which any coverage gaps have contributed to these apparent changes is difficult to assess. The increasing proportion of pairs nesting farther from the coast in man-made structures, particularly notable in the southwest, and thus more likely to remain undetected by surveyors completing coastal transects, may partially explain the lower numbers of pairs recorded at some coastal sites. In 2021, the greater number of surveyors covering sites along the coastline could have led to some pairs being missed. Previously (*i.e.* in 2002/03), a small team of surveyors would likely have covered adjoining sites on subsequent field days, working systematically along the coastline.

Trewby *et al.* (2010c) demonstrated that along the Mid-Waterford Coast SPA, Chough were faithful to the coast with exceptionally high usage of vegetated sea cliffs (during the breeding

season) and year-round usage of the strand-line. Over half of the ground observations were within 50 m of mean high water (MHW) and 84% of the ground observations recorded within 300 m of MHW. This previous work along the southern coast appears to show that Chough in coastal Co. Waterford are more confined to the coastal strip than, for example, Chough farther west into Co. Cork. Thus any survey of this more range-restricted population in Waterford is likely less prone to missing breeding birds, compared to parts of coastal Cork which has an increasing proportion of inland-breeding pairs.

If we restrict our comparison to short and long-term changes in populations to the *confirmed* and *probable* breeding pair categories only (Table 6), those with the higher levels of breeding evidence, then the outlook is less positive for all counties except Clare, Cork and Waterford[8]. The total number of confirmed/probable pairs (excluding all other records) is 11% fewer than the previous survey (2002/03). However, given the inherent biases in such large-scale national surveys, as set out in this report, any definitive assessments of comparative change would need to consider the margin of error of surveys of this type.

4.4 Population changes in the SPA network

Given the importance of the Chough SPA network, the current breeding population of the network is estimated at 42% of the national total, which is approximately 23% down on the equivalent proportion held in 2002/03. The reasons for this change need to be determined for each SPA. For some SPAs, it may be that breeding birds have re-distributed to nest in areas adjacent to the SPA, but further along the coast, or in some instances, they have moved further inland. An examination of records for Sheep's Head to Toe Head SPA, for example, shows that number of pairs in the SPA has fallen from 73 pairs (NPWS, 2013) to 27 pairs in 2021. However, an additional 29 pairs were recorded inland of this SPA in 2021, bringing the total for the wider site to 56 pairs. It is possible that more pairs may be nesting outside of this SPA that were not detected by the 2021 survey, which was more focussed on repeating the coastal coverage for the SPA, which is where most of the breeding population were located in 2002/03. Previous surveys recorded some pairs breeding inland, but the proportion of pairs breeding inland (*i.e.* more than 1 km from the coast) appears to be on the increase, even accounting for the recent focussed efforts to detect inland breeding pairs in some counties (*e.g.* Cork). For some areas at least, this recorded shift in range (and breeding ecology), may be driven by changes to coastal foraging habitats (*e.g.* abandonment of coastal grazing along cliff tops) with pairs moving inland to optimise foraging opportunities. It is not likely that natural nest sites are limited along the Cork coastline, particularly given the historical distribution (Bullock *et al*., 1983; Berrow *et al*., 1993). The shift to using man-made nest sites, may also be related to those subsequent generations of chicks hatched from man-made nest sites, which are now returning to natal breeding sites which are no longer exclusively natural/coastal sites.

In one of the national strongholds for Chough, the Beara Peninsula, the determination of the number of flock birds is difficult and as described by Trewby *et al.* (2006b), “especially on this peninsula where flocks were found to be very mobile, ‘non-cohesive’ and foraging over mountainous terrain inland and so easily overlooked”. An examination of the numbers of breeding pairs for 2021 for the Beara Peninsula SPA, indicate broad stability (58 pairs in 2021; compared to 54 pairs in 2002/03, NPWS, 2013).

The numbers of breeding pairs for Seven Heads SPA and Galley Head to Duneen Point SPA were broadly stable between the two most recent national surveys; though total numbers at Galley Head recorded in 2008 (Trewby *et al.*, 2006a) were higher, at 14 pairs. The population at Seven Heads and Galley Head to Duneen Point SPAs have been recorded at high densities

[8] For the purposes of this comparison, the Co. Waterford totals include supplementary records from McGrath (2022)

beyond the boundaries of the SPAs, with only 45% and 47% of the observations recorded within the SPAs, respectively (Trewby *et al.*, 2006a).

4.5 Potential drivers of changes in abundance and range

Throughout their range, Chough are associated with low-intensity managed agricultural landscapes. Access to year-round short vegetation (allowing access to soil or surface invertebrates) is a requirement for Chough, but critically during the nesting and chick-rearing period, when they are more closely tied to nest sites and the availability of sufficient foraging habitat, particularly 1 km from nest sites is important (Trewby *et al.*, 2006b). Consequently, reductions in grazing intensity (such as fencing off cliff-tops) and wintering of cattle in sheds, has the potential to reduce the availability of suitable foraging habitats for Chough. More traditional hay and for Chough at least silage crops can be utilised, particularly where cutting dates are staggered to extend the period when a freshly-cut crop is available (particularly so during the chick-rearing period). Where livestock are removed for longer periods, swards in the majority of habitats rapidly become too tall and dense in habitat structure for Choughs to find soil-invertebrates easily and these habitats become progressively more unsuitable as Bracken *Pteridium aquilinum* and dense scrub take over. As previously stated, provisioning Chough adults tend to heavily utilise foraging areas within 1 km of their nests sites (Trewby *et al.*, 2006b), and thus, more subtle changes in grazing management can have an impact on the suitability of habitat. This could include, for example, enclosing land for winter fodder where the grass growth at its peak in May and June can create a sward wholly unsuitable for Chough. The abundance and quality of prey items available is also clearly important for adults to adequately provision chicks in the nest and support overall productivity. Given the relatively restricted foraging ranges of provisioning adults, maintaining access to high quality invertebrate resources proximate to nesting cliffs/sites is likely critical for breeding Chough and presents challenges for conservation managers.

There has been growing awareness of the negative impacts of macrocyclic lactone treatments (*e.g.* avermectins) for livestock on arthropod populations associated with livestock faeces (*e.g.* McCracken, 1988). The invertebrate community associated with dung is important for Chough throughout the year, especially in the fledging period when cow pats are relatively easily exploited food resources for recently fledging and inexperienced young. A number of studies have shown that dung beetles are an especially important component of Chough diet, as are earthworms associated with dung across Europe (Garcia, 1983; Gilbert *et al*., 2019). Experimental studies on Islay in 1988 (McCracken, 1988) and 2014-15 (Gilbert *et al.*, 2019) showed that many dung-associated invertebrates are severely impacted even at low drug concentrations. Gilbert *et al.* (2019) showed that the density of arthropod larva was significantly reduced by several treatments, and by as much as 86%, though copper-containing boluses did not consistently affect abundance of arthropod larvae. To what degree veterinary treatments have reduced invertebrate abundance and diversity in habitats used/previously used by Chough and the implications for the overall fitness and survival rates of Chough is unknown and warrants further study.

Whilst Chough commonly occur in coastal areas, and often in close proximity to areas heavily trafficked by humans, one could be mistaken for assuming that there is no conflict. Clearly, some individuals can habituate to human activities locally, and humans they recognise – this is evident at man-made nesting sites (*e.g.* in cattle sheds, with farmers going about daily tasks without unduly perturbing breeding birds) and along some coastal tourist sites, where in some cases, individual birds do not appear to be displaced by humans. However, the population-level consequences of increased levels of sustained disturbance, particularly near/at breeding sites, on populations of Chough is less well known. Kerbiriou *et al*. (2009), working at a French tourist spot, showed negative consequences of tourism on foraging and survival rates and models predicted unviability of the local population if tourism rates continued to grow at the

rates they were. It is likely that above a threshold of disturbance levels, to for example core feeding areas near nesting cliffs, those areas become wholly unsuitable and thus unavailable to Chough.

There has been a general increase in the promotion and usage of coastal recreational sites, particularly during the Covid-19 pandemic, and against a background of growth in the tourism sector in general over recent years. In the west, the Wild Atlantic Way initiative by Fáilte Ireland and county-level initiatives has led to a substantial increase in recreational activity in many areas within the breeding range of Chough. Heatmaps (*e.g.* Strava and other activity tracker apps) suggest an increasing footfall in areas that were perhaps more off-the-beaten-track in the past and tourism initiatives have opened up new areas for recreation *e.g.* county greenways and coastal walking paths. These are examples of the increasing potential pressure on Chough, with further encroachment by an increasing number of humans, close to nests sites, and in their territories, causing additional disturbance and ultimately leading to potential displacement.

Monitoring of a minimum sample of suitable and representative breeding areas nationally, of both natural and man-made nest sites, across multiple years is needed to help define minimum productivity targets for the population, and particularly for the SPAs. Though previous national surveys have provided some figures for productivity, these have been based on a more limited number of nests. More recently, more targeted monitoring was carried out for some of the SPAs (formerly Important Bird Areas or IBAs) in the late 2000s (*e.g.* Trewby *et al.* 2006b; Carroll *et al.*, 2010; Trewby *et al.* 2010a, 2010b, 2010c), though usually for no more than two consecutive years, with some measures of productivity *i.e.* as the number of fledglings per successful breeding attempt provided. As the results of this latest survey suggest that populations may be faring better in some sites (including SPAs) than others, it is timely to revisit those areas where estimates of productivity have been previously captured and to expand into other areas not previously covered.

4.6 Current pressures and future threats

The results of the 2021 national survey point to broad stability in population trends in the national context. However, with more variation regionally, some of which may be related to breeding pairs re-locating further inland, these changes could also be early warning signs that some local populations are being affected more by environmental changes or otherwise *e.g.* agricultural land abandonment or recreational pressure. In 2019, in reporting to the EU Commission as per obligations under the Birds Directive (2009/147/EEC), Ireland set out what it considered the key pressures and threats affecting Chough. At the time, without a recent national update, the data used to inform that assessment of trends was a combination of national survey data (*e.g.* 2002/03; 1992) and breeding bird atlases for Britain and Ireland (Sharrock *et al.*, 1976; Gibbons *et al.*, 1993; Balmer *et al.*, 2013). The most relevant pressures and threats detailed in that report included:

- changes in agriculture, particularly the loss of grasslands and/or changes in grassland management,
- the use of plant protection chemicals (and indirect negative effects on the invertebrate communities of suitable grassland foraging habitats),
- and agricultural abandonment, which has been highlighted as a growing concern, particularly along western seaboards, and which could result in less available foraging habitat for Chough.

Since then, the 2021 national survey has highlighted considerable variation at a county and SPA level, with for example, some counties exhibiting breeding population declines (*e.g.* Kerry, Sligo, Leitrim, Donegal), with others showing broad stability (*e.g.* Cork) and a handful showing an increase (*i.e.* Clare, Waterford).

Figure 24 Dense impenetrable Western Gorse (*Ulex gallii*) is nowadays more commonplace along coastal clifftops, which is not suitable for foraging Chough. Photograph © Sinéad Cummins, NPWS.

The Chough is dependent on open habitats shaped by traditional agriculture and pastoralism. Chough prefer extensively managed unimproved grassland habitats often with heath, scrub and Bracken (Woodhouse *et al.*, 2005). Closely tied to nesting sites during the breeding season, close proximity of suitable foraging habitat to the nest site is essential for Chough (Trewby *et al.*, 2006b) with changes from more mixed farming to intensive grasslands along coastal margins not likely to benefit breeding Chough. Fields with hay/silage are unsuitable through most of the breeding season (when vegetation length inhibits foraging; Rylands *et al.*, 2012). This pressure is considered to be a potential limiting factor to pairs continuing to nest along some coastal sections, with changes in agricultural practices leading to either abandonment of agricultural grazing (Kerbiriou & Julliard, 2007), particularly along cliff tops, or changes in quality of foraging grasslands (through overgrazing, application of pesticides, anthelminthic usage *etc*.). Choughs feed largely on invertebrates including beetles, dipterous larva, especially tipulids/cranefly with seasonal differences in their diet with more hymenoptera (*e.g.* ants) consumed in summer and early autumn, and more spiders and beetles consumed through winter and early spring (Meyer *et al.*, 1994; Kerbiriou & Julliard, 2007). The use of chemicals in agriculture such as avermectin (*i.e.* worming treatment for livestock) affects the dung fauna on which Chough feed. Dung fauna play an important role in dung decomposition, a key ecosystem process in nutrient cycling in grazed grasslands. Furthermore, the application of fertilisers produces a taller sward with lower invertebrate density and therefore not as suitable for feeding Chough (Moore, 1983).

A significant reduction in grazing pressure has the potential to negatively affect the distribution of Chough (Rylands *et al.*, 2012) through rendering large areas with vegetation too long to enable access to the soil surface. Management at appropriate levels, allowing grazing in areas where vegetation is getting too long, for example along coastal headlands with rank vegetation, can create some areas of short sward (< 5cm) and patches of bare ground, allowing birds to access the soil and providing a source of dung and associated invertebrates. The occurrence of some invasive non-native plant species (*e.g.* Hottentot Fig *Carpobrotus edulis*) along some coastal headlands (*e.g.* Old Head of Kinsale) could be problematic for coastal breeding pairs in the future. If such succulent plants proliferate to an extent that native coastal-slope flora are outcompeted, then the access to soil invertebrates for insectivores such as Chough, will likely become more limited in affected areas.

Human-related disturbance at breeding locations of Chough in Ireland has not been comprehensively studied, though some monitoring at sites *e.g.* Cliffs of Moher SPA, has been undertaken in recent years (BirdWatch Ireland, unpublished report). At some favoured locations and/or tourist hotspots, recreational pressure may be causing some level of disturbance to breeding Chough. Kerbiriou *et al.* (2009) found a significant relationship between peak visitor numbers and reduced foraging time for breeding Chough, resulting in lower juvenile survival rates. However, in Ireland, there has been no broad assessment of whether visitor numbers may be contributing to lower breeding success at heavily trafficked sites, though this possibility has been highlighted previously (Carroll *et al.*, 2010). Due to the dispersed nature of Chough breeding along the coastline, in the national context, this particular pressure and threat has been regarded as quite low up to recent times. However, human-related activities may negatively impact Chough numbers at the local level, where they occur at or close to the nest sites or at communal roosting areas (leading to nest or roost abandonment). Any sustained increase in that pressure, particularly at sites with higher densities of Chough, could have significant implications, not just at the local level in terms of site fidelity and usage and overall productivity, but also for the wider meta-population.

Additional pressures and threats for nest sites in artificial or man-made structures include the following: restoration of buildings leading to loss of nest sites; decline in building condition *e.g.* roof collapsing leading to nest sites becoming unsuitable; predation risks *e.g.* by other birds, and mammals (*e.g*. rats and cats), especially as the nests are often out in the open rather than in inaccessible crevices; disturbance caused by general surroundings/farming environment *e.g.* floodlighting, farm activities, visitors to historic buildings (include castles and Martello towers).

The above factors singly/or in combination, could indirectly affect fitness of individuals and overall survival and/or breeding productivity at a local and/or regional level.

Figure 25 A breeding pair of Chough on The Magharees, Co. Kerry. Photograph © Kendrew Colhoun.

5 Recommendations

Between 1982 and 2002/03, breeding populations of Chough were monitored via a national census at ten-year intervals. The gap between the 2002/03 and 2021 national censuses was much greater, at 19 years, though monitoring work was carried out in the now breeding Chough SPA network during the period 2004-2010. National surveys that aim to survey possible/known sites within the known breeding range of Chough, are not without their challenges and limitations, as described earlier. However, such surveys provide necessary updates to assess the overall national Conservation Status. We thus recommend national survey cycles at a minimum of ten-year intervals, with the next survey to take place in 2030 or 2031. The survey approach may need to adapt, to take into account the changing distribution of breeding pairs in some counties (*i.e.* more inland pairs), but also aim to capture records for more offshore islands, where possible.

Establishing a more frequent (*e.g.* bi-annual/minimum five-yearly) repeatable programme of monitoring at a range of sites (to include the SPAs) around the country, and on a rotational basis, would help to better gauge inter-annual variability in the breeding population and provide a mechanism to detect declines at an early stage. These regional studies could focus on surveying a sample of breeding areas, with multiple visits through a season, determining occupancy and productivity rates, and monitoring numbers at communal roosts. Such surveys could also allow for statistical analyses with associated confidence intervals.

An understanding of demographic rates is key to understanding observed and future trends in Chough populations. In particular, first-winter survival, the age profile of breeding birds, and an understanding of how those parameters vary regionally and the underlying causes for observed differences is needed, particularly with respect to locally-acting and/or wider environmental pressures. This would require some localised efforts at continuing/expanding colour-ringing programmes for example – ideally at various locations around Ireland – but combined with a coordinated resightings programme. The value of long-term demographics (including productivity monitoring), highlighted by the Islay study in Scotland, is critically important to understand what is going on in the population and should be expanded in Ireland to include more regional representation.

A detailed autecological study investigating breeding biology of Chough across a range of environments could greatly increase understanding of the determinants of productivity and first-year survival. In doing so, a study could focus on habitat use and selection and underlying drivers such as food availability, disturbance and agricultural management and also consider diet, dietary choices and invertebrate availability. The contrasting changes in previous strongholds in the numbers of breeding pairs (*i.e.* declines versus increases) could provide a useful opportunity to better understand the potential local drivers of change. A more in-depth examination of any changes in the availability and quality of foraging habitats, which support breeding birds, particularly across the SPAs would be timely, particularly with more emphasis on results-based agri-environmental schemes such as the Department of Agriculture, Food and the Marine (DAFM) ACRES[9].

Increasing knowledge of the usage of foraging and nesting sites in coastal areas away from cliff-line areas themselves would also be useful. The apparent increasing importance of nesting in man-made structures poses conservation challenges and opportunities, as well as surveying difficulties. As occupancy of available nest sites more than 1 km from traditional cliff-nesting and cliff-top foraging areas increases, so too does the likelihood of undercounting birds during national surveys. Adapting or adding to the current methodological approach for national censuses, will need to be considered in advance of the next national survey.

[9] DAFM ACRES https://www.gov.ie/en/service/f5a48-agri-climate-rural-environment-scheme-acres/#what-the-difference-is-between-acres-general-and-acres-co-operation

In terms of conservation measures, the potential shift in some parts of their breeding range to utilise more man-made sites brings its own challenges, but also, the reasons which may be behind this change need to be further examined. Managed and extensive grazing, for conservation management purposes, particularly along coastal grassland and coastal heath sites, would likely benefit local populations at some sites through increased availability of foraging habitat near coastal breeding sites. As mentioned above, agri-environment schemes (most recently DAFM's ACRES General) could help towards supporting Chough with general landscape actions such as 'extensive grazing' in coastal grasslands. However, the most likely benefits to Chough are through the targeted results-based scheme (*i.e.* ACRES Co-operation) and particularly where this scheme overlaps with the Chough breeding range. For those Chough strongholds (including the Cliffs of Moher SPA, Kerry Head SPA and along the south coast Galley Head to Duneen Point SPA, Helvick Head to Ballyquin SPA) which fall outside the Co-operation Project Scheme areas, a higher-level agri-environment scheme is needed. In areas that have shown substantial declines, supporting actions for Chough should include working with farmers to support traditional extensive grazing of coastal grassland and heath foraging habitats; the protection of habitat features which support Chough (*e.g.* earth banks, traditional stone-walls) in the wider farmed landscape; tackling avermectin usage in livestock; in order to support recovery of populations in former strongholds.

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Appendix 1 Regional maps for prioritisation of survey areas

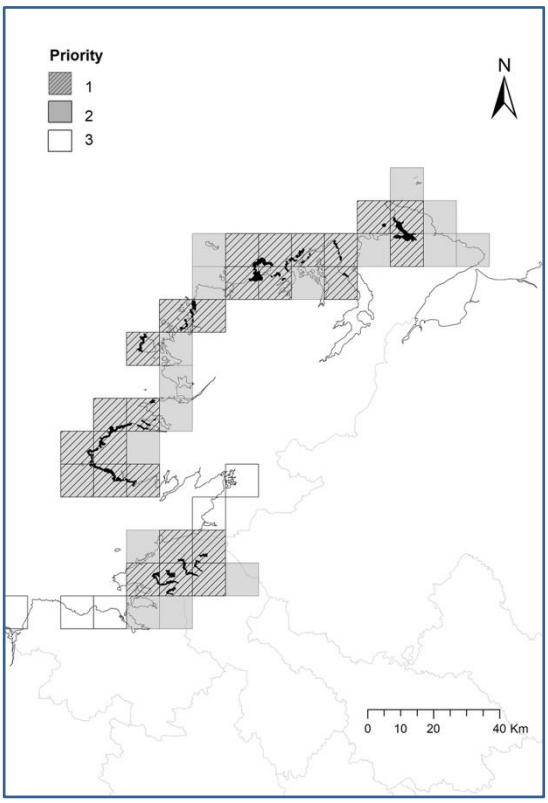

Figure A1 Map of 10-km prioritised survey areas in the north-west, showing 10-km squares selected for coverage in counties Donegal, Leitrim, Sligo and Mayo.

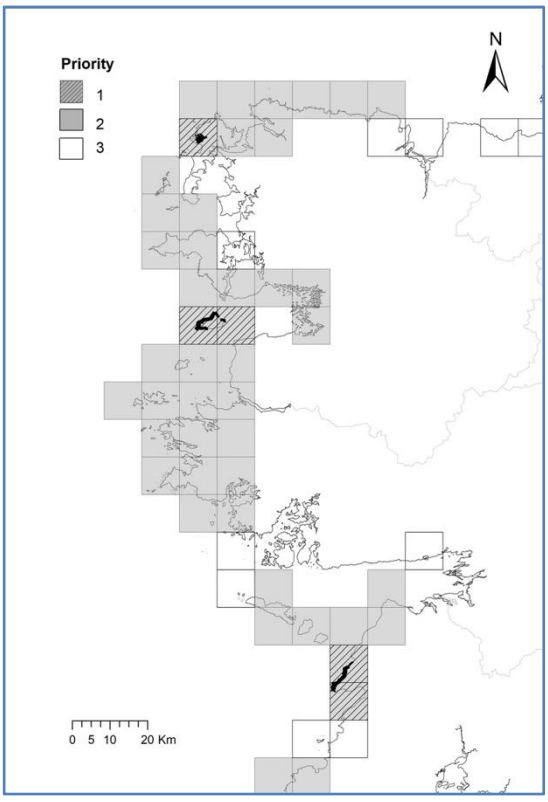

Figure A2 Map of 10-km prioritised survey areas in the west, showing 10-km squares selected for coverage in counties Mayo and Galway.

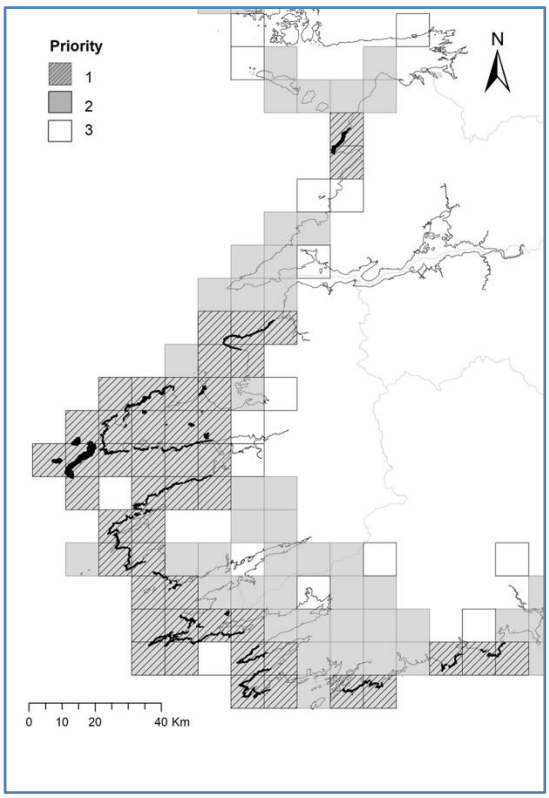

Figure A3 Map of 10-km prioritised survey areas in the south-west, showing 10-km squares selected for coverage in counties Galway, Clare, Kerry and Cork.

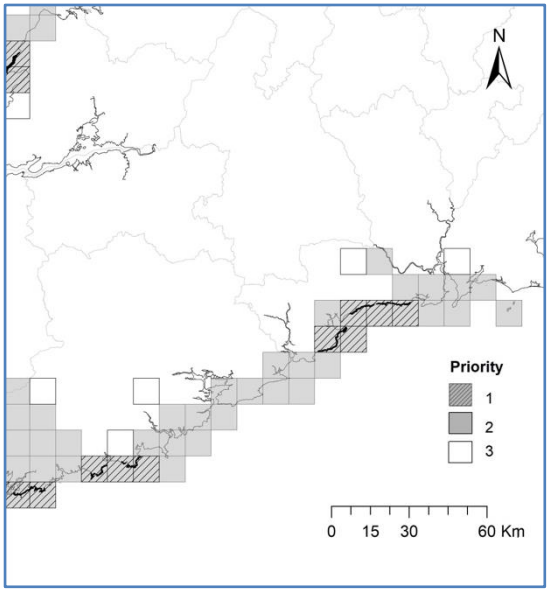

Figure A4 Map of 10-km prioritised survey areas in the south-west, showing 10-km squares selected for coverage in counties Cork, Waterford and Wexford.

Appendix 2 Comparison of breeding status categorisation criteria applied in the 1992, 2002/03 and 2021 National Chough surveys

Behavioural categories and their assignment to breeding status classification codes in 1992 (Berrow *et al.,* 1993), 2002/03 (Trewby *et al.*, 2006a) and 2021 (this study). Breeding evidence is used to categorise status into the following categories – *NBE* (no breeding evidence but one or more birds present), *possible*, *probable* and *confirmed* breeding. Probable and confirmed categories are highlighted and the main changes in classification are in **bold**. Substantially more pairs were assigned to the *probable* category in 1992 than in 2002/03 (Trewby *et al.*, 2006a).

Behaviour	**Code**	**Classification**		
		1992	**2002/03**	**2021**
Single bird on ground	SG	Possible	Possible	**NBE**
Single bird in flight	SF	n/a	Possible	**NBE**
Pair of birds in flight	PF	n/a	Possible	**NBE**
Pair on ground	PG	Possible	Possible	Possible
Single birds; '1 in, 1 out'	1-1	**Probable**	Possible	Possible
Pair; '2 in, 2 out'	2-2	**Probable**	Possible	Possible
Carrying nest material	CM	Probable	Probable	Probable
Male feeding female	MF	n/a	Probable	Probable
Mating	MT	n/a	Probable	Probable
Visits to potential nest sites '1 in, 2 out'	1-2	n/a	Probable	Probable
Territorial behaviour	CA	n/a	n/a	**Probable**
Nest with eggs	NE	Confirmed	Confirmed	Confirmed
Visits to potential nest sites '2 in, 1 out'	2-1	n/a	Confirmed	Confirmed
Visits to potential nest sites '1 in, stays in'	1-0	n/a	Confirmed	Confirmed
Bird carrying faecal sac or eggshell	FE	Confirmed	Confirmed	Confirmed
Nestlings heard begging	NH	Confirmed	Confirmed	Confirmed
Nestlings seen in the nest	NY	Confirmed	Confirmed	Confirmed
Fledged young	FY	Confirmed	Confirmed	Confirmed
Family group	FG	n/a	Confirmed	Confirmed (if within survey dates)

Appendix 3 Classification of breeding status in 2021

Behavioural codes assigned to non-flocking chough used to classify breeding status.

Behaviour	Code	Description	Breeding Evidence
Single bird on ground	SG		NBE
Single bird in flight	SF		
Pair of birds in flight	PF		
Pair on ground	PG	Paired birds fly in unison, feed and take flight together, and often preen each other (males slightly larger than females)	Possible
Single birds; '1 in, 1 out'	1-1	Visits to potential nest sites	
Pair; '2 in, 2 out'	2-2	Visits to potential nest sites	
Carrying nest material	CM	Birds carrying material swoop down to nest sites	Probable
Male feeding female	MF	Females beg by calling while crouched with quivering wings (not to be confused with young birds begging adults for food)	
Mating	MT	May be observed as is evidence of a likely breeding attempt	
Visits to potential nest sites '1 in, 2 out'	1-2	Represents the male returning to a nest-site. He often enters, then re-emerges, enticing the female off to feed her.	
Territorial behaviour	CA	Agitated behaviour incl anxiety calls by 1 or more adult birds which is indicative of the presence of an active nest/territory	
Nest with eggs	NE	Nests should NOT be visited as part of the survey; only do so if appropriate NPWS licence in hand, and are properly equipped and trained.	Confirmed
Visits to potential nest sites '2 in, 1 out'	2-1	Represents the pair entering a nest-site together and the male leaving once the female has settled on eggs	
Visits to potential nest sites '1 in, stays in'	1-0	More usually, the female returns alone to resume incubation	
Bird carrying faecal sac or eggshell	FE	A bird is seen flying out of the nest areas with a white faecal sac held in its bill is good evidence that young are present	
Nestlings heard begging	NH		
Nestlings seen in the nest	NY		
Fledged young	FY	In the first week after flying young Chough hide in crevices or under boulders close to the nest, calling and only emerging when parents return to feed them. These sometimes appear as nest-sites, but are just temporary refuges	
Family group	FG	After fledging, young Chough follow the breeding adults, often begging parents for food. Note young have darker legs and bills for several weeks after fledging. Those colours will change to adult-looking within 1 month; young can still be distinguished on close examination (incl by behaviour) and in flight by having shorter, rounder wing-tips.	

Appendix 4 Classification of breeding status in the Bird Atlas 2007-11

Please refer to Balmer *et al.* (2013) for more complete descriptions.

Code	Description	Breeding Evidence
F	Flying over	No Breeding Evidence
M	Species observed but suspected to be still on Migration	
U	Species observed but suspected to be summering non-breeder	
H	Species observed in breeding season in suitable nesting Habitat	Possible
S	Singing male present (or breeding calls heard) in breeding season in suitable breeding habitat	
P	Pair observed in suitable nesting habitat in breeding season	Probable
T	Permanent Territory presumed through registration of territorial behaviour (song *etc*) on at least two different days a week or more apart at the same place or many individuals on one day	
D	Courtship and Display (judged to be in or near potential breeding habitat; be cautious with wildfowl)	
N	Visiting probable Nest site	
A	Agitated behaviour or anxiety calls from adults, suggesting probable presence of nest or young nearby	
I	Brood patch on adult examined in the hand, suggesting Incubation	
B	Nest Building or excavating nest-hole	
DD	Distraction-Display or injury feigning	Confirmed
UN	Used Nest or eggshells found (occupied or laid within period of survey)	
FL	Recently Fledged young (nidicolous species) or downy young (nidifugous species). Careful consideration should be given to the likely provenance of any fledged juvenile capable of significant geographical movement. Evidence of dependency on adults (e.g. feeding) is helpful. Be cautious, even if the record comes from suitable habitat.	
ON	Adults entering or leaving nest-site in circumstances indicating Occupied Nest (including high nests or nest holes, the contents of which cannot be seen) or adults seen incubating	
FF	Adult carrying Faecal sac or Food for young	
NE	Nest containing Eggs	
NY	Nest with Young seen or heard	

Appendix 5 List of potential pressures – as defined under Article 12 reporting 2019

CODE	PRESSURE
	A - Agriculture
A01	Conversion into agricultural land (excluding drainage and burning)
A02	Conversion from one type of agricultural land use to another (excluding drainage and burning)
A03	Conversion from mixed farming and agroforestry systems to specialised (*e.g.* single crop) production
A04	Removal of small landscape features for agricultural land parcel consolidation (hedges, stone walls, rushes, open ditches, springs, solitary trees, *etc*.)
A05	Abandonment of grassland management (*e.g.* cessation of grazing or mowing)
A06	Abandonment of management/use of other agricultural and agroforestry systems (all except grassland)
A07	Mowing or cutting of grasslands
A08	Intensive grazing or overgrazing by livestock
A09	Extensive grazing or undergrazing by livestock
A10	Burning for agriculture
A11	Agricultural activities generating soil pollution
A12	Drainage for use as agricultural land
A13	Agriculture activities not referred to above
	B - Forestry
B01	Conversion to forest from other land uses, or afforestation (excluding drainage)
B02	Conversion to other types of forests including monocultures
B03	Replanting with or introducing non-native or non-typical species (including new species and GMOs)
B04	Illegal logging
B05	Burning for forestry
B06	Forestry activities generating pollution to surface or ground waters
B07	Forestry activities generating soil pollution
B08	Modification of hydrological conditions, or physical alteration of water bodies and drainage for forestry (including dams)
	C - Extraction of resources (minerals, peat, non-renewable energy resources)
C01	Peat extraction
C02	Extraction activities generating noise, light or other forms of pollution
C03	Abstraction of surface and ground water for resource extraction
	D - Energy production processes and related infrastructure development
D01	Wind, wave and tidal power, including infrastructure
D02	Energy production and transmission activities generating pollution to surface or ground waters
D03	Energy production and transmission activities generating noise pollution
D04	Utility and service lines (power-lines, pipelines)
D05	Energy production and transmission activities generating light, heat or other forms pollution
	E - Development, construction and use of residential, commercial, industrial and recreational infrastructure and areas
E01	Drainage, land reclamation and conversion of wetlands, marshes, bogs, *etc*. to settlement or recreational areas
E02	Drainage, land reclamation or conversion of wetlands, marshes, bogs, *etc*. to industrial/commercial areas

E03	Improved access to site
E04	Urbanisation, residential and commercial development
	F - Extraction and cultivation of biological living resources (other than agriculture and forestry)
F01	Illegal shooting/killing
F02	Hunting
F03	Illegal harvesting, collecting and taking
	G - Climate change
G01	Temperature changes (*e.g.* rise of temperature & extremes) due to climate change
G02	Droughts and decreases in precipitation due to climate change
G03	Increases or changes in precipitation due to climate change
G04	Other climate related changes in abiotic conditions
	H - Disturbance and abandonment
H01	Recreational activities (dog walkers - domestic and gun dogs *etc*)
H02	Clay pigeon shooting
H03	Wildlife photographers
H04	Intrusive surveyors/landowners
H05	Site or nest abandonment
	I - Predation
I01	Adult (Mammal/Avian)
I02	Chick/egg (Mammal/Avian) eg Fox, Mink, Pine Martin, Badger, Hooded crow, Magpie, Bird of Prey
XXX	Other threats and pressures not listed above

Appendix 6 2021 Waterford Chough counts (comparison of independent survey with 2021 national survey data)

Area	Independent Surveys (2021)[10]				NPWS /KRC (2021) – this survey				Amalgamated			
	Confirmed (C)	Probable (Pr)	Possible (Po)	Non-breeders (No.)	Confirmed (C)	Probable (Pr)	Possible (Po)	Non-breeders (No.)	Confirmed (C)	Probable (Pr)	Possible (Po)	Non-breeders (No.)
West	2	1	15-17	26	1	4	7	21-30	2	3	15	29
Mid	5	1	15-16	39	8	1	12	38	9	1	16	40
East	4	4	2	11	0	2	9	12	5	5	3	12
Inland sites*[11]	1		2		2		1					
ALL	**12**	**6**	**32-35**	**76**	**11**	**7**	**29**	**71-80**	**16**	**9**	**34**	**81**

[10] Surveys undertaken by D McGrath independently in 2021 and kindly supplied here for comparison/integration.

[11] Inland sites and totals are separate to the totals presented for coastal areas of West, Mid and East Waterford.

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