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Assessment of the vulnerability to predation by carrion crow, magpie, jackdaw and jay of Red and Amber-listed Birds of Conservation Concern in Wales

Report No: 599

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- Continuing to review and add to our evidence to ensure it is fit for the challenges facing us; and
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Contents

About Natural Resources Wales.....	2
Evidence at Natural Resources Wales.....	3
Contents	6
Crynodeb Gweithredol	7
Executive Summary.....	8
Introduction	9
<i>Licensing regime</i>	9
The 2020 review of NRW’s approach to the shooting and trapping of wild birds in Wales.....	9
Methods.....	11
Step 1. Determination of breeding status for Red and Amber-listed BoCC3 W.	11
Step 2. Assessing ecological vulnerability to predation through ecological overlap....	11
Step 3 Assessing evidence of impact at national and local scales	12
Results.....	13
Step 1. Determination of breeding status for Red and Amber-listed BoCC3 W.	13
Step 2. Assessing ecological vulnerability to predation through ecological overlap....	13
Step 3 Assessing evidence of impact at national and local scales	17
Discussion	22
References	25
Appendices	27
Appendix I: Reference tables extracted from Birds of Conservation Concern3 Wales	27
Appendix II: Habitat use for each species in Wales from BirdFacts.....	32
Appendix III: Reference tables extracted from BTO BirdFacts	35
Appendix IV: Reference tables for review outputs	38

Crynodeb Gweithredol

Mae'r adroddiad hwn yn darparu asesiad o ba mor agored yw nythod (wyau a/neu gywion) adar sy'n bridio sydd ar restrau coch ac ambr diweddaraf yr *Adar o Bryder Cadwraethol yng Nghymru (BoCC3 W)* i gael eu hysglyfaethu gan bob rhywogaeth o deulu'r brain, neu'r *Corvidae* (y frân dyddyn *Corvus corone*, y bïoden *Pica Pica*, sgrech y coed *Garrulus glandarius* a jac y do *Corvus monedula*) a restrir ar hyn o bryd ar Drwydded Gyffredinol 004 CNC, a gyflwynwyd er mwyn gwarchod adar gwyllt.

Nodwyd bod cyfanswm o 98 o rywogaethau sydd ar y rhestr goch neu ambr yn bridio yng Nghymru i ryw raddau (mae hyn yn cynnwys tair rhywogaeth lle dosbarthwyd eu statws bridio fel achlysurol iawn, ond heb gadarnhad nad oeddent yn bridio o gwbl). Ar gyfer pob un o'r rhywogaethau hyn, aseswyd y tebygolrwydd y byddai'r pedwar rhywogaeth o deulu'r brain yn ysglyfaethu ar yr wyau neu'r cywion. Cyfrifwyd mynegai perygl o ysglyfaethu, yn seiliedig ar gyfuno sgoriau ar gyfer (a) faint oedd cynefin yr ysglyfaethwyr a chynefin yr ysglyfaethau'n gorgyffwrdd, a (b) pa mor agored oedd y nythod (p'un a oeddent yr un uchder â'r ddaear neu uwchben y ddaear a ph'un a oeddent yn agored neu'n amgaeedig/mewn ceudod). Yn seiliedig ar yr asesiad hwnnw, neu ar farn arbenigol lle roedd diffyg data i gyfrifo mynegai perygl o ysglyfaethu, mae cyfanswm o 58 o rywogaethau sy'n bridio sydd ar y rhestr goch neu ambr yng Nghymru wedi eu dosbarthu fel rhai y mae'n debygol iawn neu'n debygol y bydd un neu fwy o rywogaethau teulu'r brain yn ysglyfaethu ar eu hwyau neu eu cywion.

Yna, ar gyfer pob un o'r 58 o rywogaethau hynny, ystyriwyd y dystiolaeth oedd ar gael o ran effaith bod yn ysglyfaethu i rywogaethau teulu'r brain. Ar gyfer 25 rywogaeth, mae tystiolaeth ddemograffig y gallai dirywiad yn eu poblogaethau fod o ganlyniad i newidiadau o ran llwyddiant wrth fridio. Awgrymodd adolygiad byr o'r cyhoeddiadau a ymddangosodd yn Newson *et al.* (2019) yr ystyrir bod ysglyfaethu'n gysylltiedig neu'n cyfrannu at newid o ran poblogaeth mewn 19 rhywogaeth ar unrhyw gyfnod demograffig neu raddfa ofodol.

Er bod astudiaethau gwyddonol o rai rhywogaethau adar a/neu urddau adar wedi ceisio gwahaniaethu rhwng effeithiau rhywogaethau teulu'r brain sy'n ysglyfaethu ar nythod fel prif ffactor, ffactor eilaidd, ffactor cyfrannol neu ffactor nad yw'n arwyddocaol mewn gwirionedd ar gyfer sawl rhywogaeth o bryder cadwraethol, mae diffyg data priodol i allu gwahaniaethu fel hyn, yn enwedig ar ffurf astudiaethau gwyddonol sydd wedi'u hadolygu gan gymheiriaid sy'n nodi neu hyd yn oed yn awgrymu effeithiau achosol. Dylid ystyried hyn fel bwlch o ran tystiolaeth yn hytrach na thystiolaeth nad oes effaith. Fodd bynnag, o ystyried cymhlethdod rhyngweithiadau ecolegol, nid yw'n glir a fyddai estyniad sylweddol, hyd yn oed, i astudiaethau blaenorol o fudd mawr i'n dealltwriaeth o ran a yw cael eu hysglyfaethu gan frain tyddyn, pïod, sgrechod y coed a/neu jac dos yn ffactor cyfyngol allweddol ar gyfer rhywogaethau adar unigol sydd o bryder cadwraethol yng Nghymru.

Executive Summary

This report provides an assessment of the level of vulnerability of nest predation (eggs and/or chicks) of breeding red and amber-listed birds of the most recent *Birds of Conservation Concern in Wales (BoCC3 W)* by each of the corvid species (carrion crow, magpie, jay, and jackdaw) currently listed on NRW's General Licence 004, granted for the purpose of conserving wild birds.

A total of 98 red or amber-listed species were identified as breeding in Wales to some degree (this includes three species where breeding status was categorised as very occasional, not confirmed absent). For each of these species the likelihood of egg or chick predation by each of the four corvid species was assessed. A predation vulnerability index was calculated, based on combining scores for (a) the degree of habitat overlap between the prey species and the predator species, and (b) nest vulnerability (whether ground level or above ground and whether open or enclosed/cavity). Based on that assessment, or on expert judgement where there were insufficient data to calculate a predation vulnerability index, a total of 58 red or amber-listed species breeding in Wales are categorised as highly likely or likely to be vulnerable to egg or chick predation by one or more of the four corvid species.

For each of those 58 species, the available evidence of possible impact of corvid predation was then considered. For 25 species there is demographic evidence that population decline may be due to changes in breeding success. A brief review of the publications included in Newson *et al.* (2019) suggested predation is implicated or considered contributory to population change in 19 species at any demographic stage or spatial scale.

While scientific studies of some bird species and/or bird guilds have attempted to distinguish the impacts of corvid nest predation as a principal, secondary, contributory limiting or simply incidental factor for many bird species of conservation concern, the appropriate data to make such distinctions, particularly in the form of peer-reviewed scientific studies identifying or even implying causal effects, are lacking. This should be considered as an evidence gap rather than evidence of no impact. However, given the complexity of ecological interactions, it is unclear whether even a major extension to previous studies would add significantly to our understanding of whether predation by carrion crow, magpie, jay and/or jackdaw is a critical limiting factor for individual bird species of conservation concern in Wales.

Introduction

Licensing regime

All wild birds in Wales have legal protection under the Wildlife & Countryside Act 1981, as amended (hereafter “the Act”). Under section 16(1) of the Act, wild birds may only be lawfully killed or taken under a licence granted by Natural Resources Wales (NRW)¹. Licences for lethal control may only be granted for certain purposes, where there are no other satisfactory solutions. Those licences “*may be, to any degree, general or specific*” (s16(5)(a) of the Act). NRW currently grants two types of licences under section 16 allowing the killing or taking of wild birds and/or destruction of eggs and nests: specific licences (issued to a specific person, upon application, for a particular purpose) and general licences (able to be used by any authorised person, without application, for a particular purpose). Such licences are only issued if NRW is satisfied that there is no other satisfactory solution as regards the purpose.

In Wales, four general licences GL001, GL002, GL004 and GL005² give permission to authorised persons to, for certain purposes, take or kill certain wild birds, or damage, take or destroy their nests, or destroy their eggs. Purposes include to protect crops and livestock, to protect public health and safety, the conservation of other wild birds or for conserving fauna or flora. These licences are issued on an annual basis under Section 16(1) of the Act. Eight species are listed on one or more of these licences (carrion crow *Corvus corone*, magpie *Pica pica*, jackdaw *Corvus monedula*, jay *Garrulus glandarius*, feral pigeon *Columbia livia*, wood pigeon *Columba palumbus*, Canada goose *Branta canadensis* and ruddy duck *Oxyura Jamaicensis*).

The 2020 review of NRW’s approach to the shooting and trapping of wild birds in Wales

NRW is reviewing its approach to the permissions they give for the shooting and trapping of wild birds and the destruction of eggs and nests (hereafter “the wild bird review”). As part of this broad review, NRW will appraise how they exercise their licensing powers.

This report provides an evidence assessment of the level of vulnerability of nest predation (eggs and chicks) of breeding Red and Amber-listed *Birds of Conservation Concern 3 Wales* (hereafter “*BoCC3 W*”) identified by Johnstone and Bladwell (2016) by all corvids listed on GL004. Specifically we:

- Identify the Red and Amber-listed birds of *BoCC3 W* that breed in Wales;
- Summarise and combine evidence on the season of occurrence, breeding ecology and habitat preferences of Red and Amber-listed birds which breed in Wales, to calculate an index of ecological vulnerability to nest predation by carrion crow, magpie, jay, and jackdaw. This describes the likelihood of these corvids preying

¹The Wildlife and Countryside Act, 1981 (as amended), S27 defines a wild bird as any bird of a [F16species] which is ordinarily resident in or is a visitor to [F17the European territory if any member State] in a wild state but does not include poultry or, except in sections 5 and 16, any game bird;

²GL001 Licence to kill or take certain wild birds to prevent serious damage, or prevent the spread of disease, GL002 Licence to kill or take certain wild birds for the purpose of preserving public health and public safety, GL004 Licence to kill or take certain wild birds for the purpose of conserving wild birds and GL005 Licence to kill or take ruddy duck for the purpose of conserving flora and fauna.

the eggs and/or chicks of each breeding bird species on the Red and Amber lists of *BoCC3 W* which breeds in Wales.

- For species listed on the Red and Amber lists of *BoCC3 W* where predation vulnerability is considered likely, summarise the available **evidence of impact** from predation (of eggs or young) by carrion crow, magpie, jay, and jackdaw. In addition, we summarise **possible impact** by noting species where relevant breeding demographic rates may be driving population change, or where predation has been noted as a potential driver of change at any demographic stage or spatial scale.

Methods

BTO consulted with an internal expert panel including the authors of the SNH report (Newson *et al.*, 2019). We applied the following step-wise approach:

Step 1. Determination of breeding status for Red and Amber-listed BoCC3 W.

BoCC3 W contains details of all species currently on the Red and Amber lists. We assessed breeding evidence for each species on *BoCC3 W* and refined both Red and Amber lists on Annex 1 to GL004 so as to include **only** species breeding in Wales, which therefore have the **potential** for egg and/or chick predation to occur in Wales.

Breeding status in Wales was assigned using information from the Welsh Ornithological Society (<https://birdsin.wales/wp-content/uploads/2019/12/Welsh-List-2020-v1.1.xlsx>). Breeding codes were assigned to each species as follows: regular breeding in Wales (code = 1); breeding in Wales but categorised rare/scarce (code = 0.75); occasionally breeding in Wales (code = 0.5); very occasional, not confirmed absent (code = 0.25) and not breeding in Wales (code = 0). All species with breeding codes of 0.25, 0.5, 0.75 and 1 were included in Step 2.

Step 2. Assessing ecological vulnerability to predation through ecological overlap

We assessed ecological vulnerability to predation by corvids for each *BoCC3 W* Red and Amber-listed species breeding in Wales in three stages:

- i) For each Red and Amber-listed *BoCC3 W* breeding species, and the named corvid species on GL004, we extracted **habitat use data** from BTO's BirdFacts (Robinson, 2005) which measured proportional habitat use derived from Breeding Bird Survey (BBS) data in 2011. Where species are recorded at rates below BBS data thresholds or not recorded in sufficient numbers for proportional habitat analysis, breeding habitats were taken from the Handbook of Birds of the World (HBW) (Online edition <https://birdsoftheworld.org/>). Where neither source was available, internal experts at the BTO were consulted. A **habitat overlap score** for each corvid-*BoCC3 W* breeding species pair was calculated as the sum of the *BoCC3 W* species' habitat association scores for each of the principal habitats listed for the corvid species. For species where published or BBS habitat data are not available, expert opinion was applied to generate three classes for habitat overlap where * = *unlikely*, ** = *likely*, *** = *highly likely*. The mobility of bird species made the expert panel unwilling to define or use a zero category (*highly unlikely*) in this assessment.
- ii) **Nest vulnerability** (to generalist avian predation) was calculated for each breeding Red and Amber-listed *BoCC3 W* species using the BTO's field guide to monitoring nests, HBW and internal expertise (Ferguson-Lees *et al.*, 2011, HBW Online edition). Summary categories were assigned according to a) the position of the nest (value = 1 if on the ground; value = 0.5 if on sea-cliff; value = 0 if above ground) and b) the type of nest (1 = open nest and 0 = cavity or covered nest).

- iii) Where data were sufficient, these ecological indices were combined into a single, categorical **predation vulnerability index** for each corvid-BoCC3W species pair. The index was calculated as the species' 'habitat overlap' score multiplied by the 'open nest' value (ecological vulnerability), summarised under four categories where 1=0-10% (highly unlikely); 2=10-20% (not likely); 3=20-40% (likely) and 4=40-100% (highly likely). For species where habitat overlap had been categorised by expert opinion (* = *unlikely*, ** = *likely*, *** = *highly likely*) we made the assumption that predation by generalist predators is also a function of opportunity, and evaluated predation vulnerability using expert opinion, considering habitat overlap and nest type information. In all cases the use of a categorical vulnerability index reflects a degree of uncertainty, particularly at site level.

Step 3. Assessing evidence of impact at national and local scales

We assessed **population impacts** by considering BoCC3 W breeding species trends alongside the summarised 'vulnerability to nest predation (eggs or chicks)' information already provided, as follows:

- i) We selected the species identified as being ecologically vulnerable to predation (predation vulnerability *likely* or *highly likely*) by the process described in Step 2 and examined the BoCC3 W list to identify Welsh breeding species for which listing is based on either a) breeding population decline or b) breeding range decline in Wales. For these species, it is possible that nest predation may be a contributory factor to their status. This excludes species which are included on the BoCC3 W lists because of their small population sizes (e.g. Dartford warbler *Sylvia undata*, firecrest *Regulus ignicapillus*) rather than because they are declining.
- ii) For the declining BoCC3 W breeding species we extracted and summarised: a) data from BTO data holdings (demographic monitoring) b) published studies and c) expert knowledge to provide a summary of the evidence that population declines **are (or may be) driven by breeding failure** at some spatial scales.

This stepwise process culminates in the presentation of a table of species that are a) species of conservation interest in Wales; b) breeding in Wales; c) have habitat preferences that overlap with the corvid species of interest; d) have nesting behaviour that does not limit access by avian predators; e) are declining and f) have nest-failure, predation or predation risk noted as an actual or potential driver of their decline.

Results

Step 1. Determination of breeding status for Red and Amber-listed BoCC3 W.

There are currently 144 species either Red or Amber-listed in *BoCC3 W*, of which 54 are Red-listed and 90 are Amber-listed, from these we identified 95 species (66% of all Red and Amber-listed *BoCC3 W*) that breed in Wales (85 species were considered to regularly breed and 10 species were occasional/scarce breeders) (Table 1). Three species (garganey *Spatula querquedula*, quail *Coturnix coturnix* and turtle dove *Streptopelia turtur*) were classified with the breeding code 'very occasional, not confirmed absent'. All species with a breeding code of 0.25, 0.5, 0.75 and 1 were included in Step 2. The breeding status for all Red and Amber-listed species of *BoCC3 W* are summarised in Table 1 and the full species tables are presented in Appendix I (see App.I Table 1 (Red-listed species); App.I Table 2 (Amber-listed species)). The scientific names of all Red and Amber-listed species of *BoCC3 W* are tabulated (see App.I Table 3).

Table 1. Summary of breeding codes for Red and Amber-listed *BoCC3 W* species.

BoCC3	Breeding code					Total
	1 (Regular)	0.75 (Rare/scarce)	0.5 (Occasional)	0.25 (very occasional, not confirmed absent)	0 (Non-breeder)	
Red	35	3	4	1	11	54
Amber	50	1	2	2	35	90

Step 2. Assessing ecological vulnerability to predation through ecological overlap

The nest types (i.e. ground and open) for all Red and Amber-listed breeding species of *BoCC3 W* are presented in Appendix II (see App.II Table 1). Summarised habitat-use data for all corvids listed on GL004 were determined from BTO's BirdFacts (Robinson *et al.*, 2005) and are tabulated in Table 2. All relative habitat association scores for Red and Amber-listed *BoCC3 W* breeding species are presented in Appendix III (see App. III Table 1).

Table 2. Habitat associations for carrion crow, magpie, jay and jackdaw, based on habitat information recorded during BBS surveys in 2011 (BTO BirdFacts; Robinson, 2005). Habitat scores are provided in Appendix III (see App. III Table 1).

Corvid Species	Habitat categories observed
Carrion Crow	Arable Farmland, Villages & Rural Areas, Towns & Cities, Scrub & Bushy Commons, Broad-leaved Woodland
Magpie	Open Coastal Habitat, Pasture & Grazed Fields, Arable Farmland, Reed Swamp & Fen, Villages & Rural Areas, Towns & Cities, Scrub & Bushy Commons, Broad-leaved Woodland
Jay	Open Coastal Habitat, Arable Farmland, Villages & Rural Areas, Towns & Cities, Scrub & Bushy Commons, Broad-leaved Woodland
Jackdaw	Scrub & Bushy Commons, Broad-leaved Woodland, Coniferous Woodland

We found **58 of the 98 Welsh breeding species, listed as Red or Amber in *BoCC3 W*, had vulnerability to nest predation** (eggs and/or chicks) assessments ranked either ‘Highly likely’ (vulnerability score 4 or ***) or ‘likely’ (vulnerability score 3 or **) for at least one of the four GL004 listed corvid species. Of these 58 species, 25 are Red-listed and 33 Amber-listed *BoCC3 W* (Table 3). The predation vulnerability index for each Red and Amber-listed species of *BoCC3 W* is presented in Appendix IV (see App. IV Table 1). Table 3 provides the vulnerability to nest predation by carrion crow, magpie, jay and jackdaw of all *BoCC3 W* Red or Amber-listed species.

Table 3. Vulnerability to nest predation (eggs and/or chicks) by the four corvid species of interest, of *BoCC3 W* Red and Amber listed species. Cells shaded in red are Red-listed species of *BoCC3 W*; Cells shaded in Amber are Amber-listed species of *BoCC3 W*, cells shaded in blue are predator-prey combinations where vulnerability to nest predation is ranked either ‘**Highly likely**’ (vulnerability score 4 or ***) or ‘**likely**’ (vulnerability score 3 or **).

Species	Vulnerability to nest predation			
	Magpie	C. crow	Jackdaw	Jay
Arctic tern	*	**	**	*
Black grouse	**	**	**	**
Black-headed gull	2	3	2	1
Bullfinch	4	4	4	4
Cuckoo	3	4	3	3
Curlew	2	3	2	1
Grasshopper warbler	2	4	1	2
Great black-backed gull	2	3	2	1
Grey partridge	3	4	3	2
Herring gull	3	3	3	1
Kittiwake	*	**	**	*
Lapwing	2	3	2	1
Linnet	3	4	4	2
Little tern	*	*	**	*
Redshank	1	3	3	1
Ring ouzel	**	**	**	**
Ringed plover	*	**	**	*
Roseate tern	*	**	**	*
Short-eared owl	*	*	*	**
Spotted flycatcher	4	4	4	4
Turtle dove	4	4	3	3
Whitethroat	4	4	3	3
Woodcock	***	***	***	***
Yellow wagtail	1	3	1	1
Yellowhammer	4	4	3	3
Bearded tit	*	**	*	*
Bittern	*	**	*	*
Black guillemot	*	**	**	*
Chough	*	**	**	*
Common tern	*	**	**	*
Cormorant	*	**	**	*
Dartford warbler	**	**	**	**
Eider	*	**	**	*

Species	Vulnerability to nest predation			
	Magpie	C. crow	Jackdaw	Jay
Fulmar	*	**	**	*
Gannet	*	**	**	*
Goldcrest	4	4	3	4
Greenfinch	4	4	4	3
Grey heron	3	3	2	2
Grey wagtail	3	3	3	2
Guillemot	*	**	**	*
Hawfinch	**	**	**	**
Honey buzzard	**	**	**	**
Lesser black-backed gull	3	3	3	1
Lesser redpoll	3	4	2	4
Long-eared owl	**	**	**	***
Manx shearwater	*	*	**	*
Meadow pipit	2	3	2	1
Mistle thrush	***	***	***	***
Osprey	**	**	**	***
Red kite	***	***	***	***
Reed bunting	2	4	3	2
Sandwich tern	*	**	**	*
Shag	*	**	**	*
Shelduck	*	*	**	*
Skylark	2	4	3	2
Song thrush	4	4	4	3
Storm petrel	*	*	**	*
Tree pipit	3	3	2	4

Table 4. Vulnerability to nest predation by magpie, carrion crow, jackdaw and jay of *BoCC3 W* Red and Amber listed Welsh breeding species. Figures in brackets relate to percentages of the total number of breeding Red or Amber listed species of *BoCC3 W* that are considered vulnerable to corvid nest predation (eggs and/or chicks).

	Vulnerability to nest predation			
	Magpie	carrion crow	Jackdaw	Jay
Number of Red-listed breeding species of <i>BoCC3 W</i>	12 (48%)	23 (92%)	18 (72%)	10 (40%)
Number of Amber-listed breeding species of <i>BoCC3 W</i>	15 (46%)	30 (91%)	27 (82%)	12 (36%)
Total number of Red and Amber-listed breeding species of <i>BoCC3 W</i>	27 (47%)	53 (91%)	45 (78%)	22 (38%)

Step 3. Assessing evidence of impact at national and local scales

A total of 59 Welsh breeding species are included in *BoCC3 W* due to declines in breeding population, breeding range or both (App. IV Table 2). **BTO demographic data suggests that for 25 of these species, there are measurable trends in demographic parameters of breeding success** (failure at egg or chick stage, or overall productivity declines). A brief review of the publications included in Newson *et al.* (2019) **suggested predation is implicated or considered contributory to population change in 19 species** (Table 5).

Interpretation of Table 5

This presentation of species information combined with the predation vulnerability index calculated above, is intended to clarify where different levels and types of data agree or disagree with each other at different spatial scales. This is perhaps best clarified by taking two species examples:

Black-headed Gull is Red-listed for declines in both breeding population and breeding range. No demographic trend relating to eggs or chicks or productivity has been identified in BTO data (either data are insufficient for analysis, no data are available, or available data have not been analysed, or there are no observed trends in data analysed). The species is considered 'likely' to be vulnerable to predation by carrion crow, but no studies mentioning corvid predation were found in the updated review of Newson *et al.* (2019) and nest predation is not mentioned on the BTO Bird Trends online portal: [BirdTrends 2020: trends in numbers, breeding success and survival for UK breeding birds | BTO - British Trust for Ornithology](#) of drivers of population change. Data and scientific evidence for

either national or local impacts are lacking and are an evidence gap rather than evidence of no impact.

Table 5. 19 *BoCC3 W* Red and Amber-listed breeding species for which nest or chick predation is implicated or may be contributory to population change (Newson *et. al.* 2019). It should be noted that for six of these species known predators are not corvids (see cells shaded in green), and in eight the potential predatory species are unknown.

Species	Population Decline	Range Decline	Breeding failure trend (egg/chick)	Breeding failure (text: nest predation)
Red grouse	No	Yes		Predation from Corvids noted in some studies
Grey partridge	Yes	Yes		Predation is a secondary driver
Lapwing	Yes	Yes	Increasing (Egg)	Chick mortality is important in some studies
Curlew	Yes	Yes	Decreasing (Egg)	Predation is a secondary driver, locally important
Redshank	Yes	Yes	Decreasing (Egg)	Vulnerability to predators is suggested to increase due to habitat loss
Little tern	No	Yes		JNCC - predation (inc. corvid) driving low prod.
Roseate tern	Yes	Yes		JNCC - predation may have played a role
Arctic tern	No	Yes		JNCC - mink predation in West Scotland
Kittiwake	Yes	No		JNCC - Crow predation noted in one location
Herring gull	Yes	No		JNCC - ground predators at some colonies
Great black-backed gull	Yes	No		JNCC - some effects of mink on nests (low)
Lesser spotted woodpecker	Yes	Yes		Predation but not by corvids one of several potential drivers
Willow tit	Yes	Yes		Jays implicated in predation in one study
Wood warbler	Yes	No	Increasing (Chicks) Decreasing (Eggs)	Avian predators may be important
Spotted flycatcher	Yes	No	Increasing (Chicks) Decreasing (Eggs)	Some evidence for importance from predator removal studies
Bullfinch	Yes	No		Possible role of predation, but by sparrowhawk
Snipe	No	Yes	Decreasing (Egg)	Predator removal increased numbers in one study
Common tern	No	Yes		Predation but by rats and gulls may be important
Tree pipit	Yes	No	Decreasing (Egg)	High failure rate at chick stage implicates predation

Curlew is Red listed for declines in both breeding population and breeding range. BTO demographic data suggests a fall in egg-stage nest failure rate (small improvement). The species is considered 'likely' to be vulnerable to predation by carrion crow, and two studies in the updated review of Newson *et al.* (2019) mention corvid nest predation. Finally, BTO BirdTrends text notes that nest predation is a secondary driver of population change (cf. recent consideration of broader habitat and agricultural management change) but certainly it may be locally important. Data and evidence for national impacts in Wales are weak, but nest / chick failure rates are generally considered significant in waders (Roodbergen *et al.* 2012) and other ground-nesting birds (Roos *et al.*, 2018) while specific negative associations have been identified between crows and curlew population change (Franks *et al.*, 2018) and the productivity gap that exists in curlew populations (Cook *et al.*, 2021).

In total, 33 species are a) red or amber listed in BoCC3 W; b) breeding in Wales; c) 'likely' or 'highly likely' to be ecologically vulnerable to corvid predation owing to i) habitat preferences that overlap with the corvid species of interest and ii) nesting behaviour that does not limit access by avian predators; and d) present in BoCC3 W because of declines in either population or range (Table 6). Predation is specifically implicated in these declines for 15 species, of which corvid predation is implicated or considered contributory to population change for five of these species (red grouse *Lagopus lagopus*, curlew *Numenius arquata* (included here as recent evidence has been collected in breeding studies using nest cameras), little tern *Sterna albifrons*, kittiwake *Rissa tridactyla* and willow tit *Parus montanus*).

Table 6. Summary information for species remaining after three assessment stages. The 33 species presented in this table are a) **red or amber listed in BoCC3 W**; b) **breeding in Wales**; c) ‘likely’ or ‘highly likely’ to be **ecologically vulnerable to corvid nest predation** owing to i) habitat preferences that overlap with the corvid species of interest and ii) nesting behaviour that does not limit access by avian predators; and d) present *in BoCC3 W* because of **declines in either population or range**. The table summarises the *BoCC3 W* assessment, BTO demographic trends, ecological vulnerability and available information on nest predation as a cause of demographic change. N.B. in this table species are listed by list (red or amber) in alphabetical order rather than taxonomic order, for ease of reference. Cells shaded in green are species where predation may be a driver of change.

Species	GB data assessment						Predation vulnerability (by species)				Other data sources	
	BoCC3 W assessment			Demographic trend			Magpie	Carrion Crow	Jackdaw	Jay	Newson <i>et al.</i> (2019)	BTO assessment (BirdTrends text review for drivers of change: nest predation)
	BoCC3 W List	Population Decline?	Range Decline?	Breeding failure (egg)	Breeding failure (chick)	Productivity						
Arctic tern	Red		Yes				*	**	**	*		JNCC – mink predation W. Scotland
Black Grouse	Red		Yes				**	**	**	**		
Black-headed gull	Red	Yes	Yes				2	3	2	1		
Bullfinch	Red	Yes					4	4	4	4		Possible role of predation (Sparrowhawk)
Cuckoo	Red	Yes					3	4	3	3		Predation not implicated
Curlew	Red	Yes	Yes	▼			2	3	2	1	Fletcher <i>et al.</i> 2010; Parr 1993	Predation a secondary driver, locally important
Grasshopper warbler	Red	Yes					2	4	1	2		Drivers uncertain
Great Black-backed Gull	Red	Yes					2	3	2	1		JNCC – some effects of mink on nests (low)
Grey partridge	Red	Yes	Yes				3	4	3	2		Predation is a secondary driver
Herring gull	Red	Yes					3	3	3	1		JNCC – ground predators at some colonies
Kittiwake	Red	Yes					*	**	**	*		JNCC – crow predation noted at one location
Lapwing	Red	Yes	Yes	▲			2	3	2	1	Fletcher <i>et al.</i> 2010	Chick mortality is important in some studies
Linnet	Red	Yes		▲	▲	▼	3	4	4	2		Predation not implicated
Little tern	Red		Yes				*	*	**	*		JNCC – predation (inc. corvid) driving low productivity
Redshank	Red	Yes	Yes	▼			1	3	3	1	Ottvall 2005	Vulnerability to predators suggested, linked to habitat loss
Ring ouzel	Red		Yes				**	**	**	**		Drivers uncertain

Species	GB data assessment						Predation vulnerability (by species)				Other data sources	
	BoCC3 W assessment			Demographic trend			Magpie	Carrion Crow	Jackdaw	Jay	Newson <i>et al.</i> (2019)	BTO assessment (BirdTrends text review for drivers of change: nest predation)
	BoCC3 W List	Population Decline?	Range Decline?	Breeding failure (egg)	Breeding failure (chick)	Productivity						
Roseate tern	Red	Yes	Yes				*	**	**	*		JNCC – predation may have played a role
Spotted flycatcher	Red	Yes		▼	▲		4	4	4	4		Some evidence for importance (predator removal studies)
Turtle dove	Red	Yes	Yes				4	4	3	3		Predation not implicated
Whitethroat	Red	Yes					4	4	3	3		Predation not implicated
Woodcock	Red	Yes	Yes				***	***	***	***		Drivers unknown
Yellow wagtail	Red	Yes	Yes		▼	▲	1	3	1	1		Predation not important
Yellowhammer	Red	Yes	Yes	▼		▲	4	4	3	3		Predation not implicated
Common tern	Amber		Yes				*	**	**	*		Predation by rats and gulls may be important
Goldcrest	Amber	Yes					4	4	3	4		Predation not implicated
Greenfinch	Amber	Yes		▼			4	4	4	3		Predation not implicated
Grey heron	Amber		Yes	▲			3	3	2	2		Predation not implicated
Grey Wagtail	Amber	Yes		▼	▼	▲	3	3	3	2		Predation not implicated
Hawfinch	Amber	Yes					**	**	**	**		
Manx shearwater	Amber		Yes				*	*	**	*		Predation not implicated
Meadow pipit	Amber	Yes		▲	▼	▼	2	3	2	1		Predation not implicated
Reed bunting	Amber		Yes	▲	▲	▼	2	4	3	2		Predation is secondary driver
Tree pipit	Amber	Yes		▼		▼	3	3	2	4		High failure rate at chick stage implicates predation

Discussion

Ecological vulnerability, calculated using habitat overlap and nest-type information, is a relatively unbiased assessment and appropriate at national scale, but should be interpreted with caution at local scales. For example, above-ground nests are unlikely to have zero vulnerability to corvids, but their vulnerability is certainly considerably lower than that of a nest placed on the ground. Cavity nests are certainly much less vulnerable to corvid predation, but there will always be exceptions (for example, nest-damage from e.g. storms or treefalls; a poorly-chosen cavity with a wide entrance). This uncertainty is the reason for using a categorical index rather than presenting the index itself, since the use of precise numbers would represent a spurious level of precision.

Table 6, and the wider *BoCC3 W* list in Appendix IV (see App. IV Table 2), bring together four different sources of information about species of conservation concern in Wales. Species are present if they are Red or Amber-listed in Wales, and breed in Wales. Qualifying on both counts, Table 6 highlights a) conservation concern as a result of decline, b) decline as a result of breeding demographics, c) ecological vulnerability to corvid predation and d) what causal or implied evidence was found in the SNH review or BTO BirdTrends for those declines being associated with predation in general or by specific species. The table may be interpreted as a summary of available information to guide decision-making but does not attempt to derive conclusions about any likely positive impact of control of any corvid species on any individual *BoCC3 W* species, since such conclusions are outside the remit of the present report.

There are a small number of species perhaps unexpectedly absent from Table 6, as a result of a low ecological vulnerability index driven by low habitat overlap scores, that are nevertheless known to be vulnerable to corvid predation; for example golden plover *Pluvialis apricaria* and black grouse *Tetrao tetrix*. For these species, corvids present even at low densities may have impacts at site level (Bolton *et al.*, 2007), and experimental predator-removal studies have highlighted corvid predation in black grouse (Summers *et al.*, 2004). However, the evidence for a causal link between predation and population change is less clear: in the Summers *et al.* study a suite of other predators was implicated and on another study predator control included mammals and the study included habitat management (Pearce-Higgins *et al.*, 2019). Site management and site-specific effects may be particularly important for species such as black grouse, red grouse and golden plover with very spatially restricted distributions in Wales.

It is important to remember that lack of evidence (e.g., in the form of studies identifying or even implying causal effects) of corvid predation on population trends cannot be understood as evidence of no impact. It is exceptionally challenging to separate the impacts of a single species of predator on any prey species. As an example from Table 3, bullfinch *Pyrrhula pyrrhula* are ranked as highly likely to be ecologically vulnerable to predation by all four corvid species and are Red-listed in *BoCC3 W* for population decline but BTO BirdTrends shows no trend in breeding demographics and predation is only mentioned as a possible driver of population change, with sparrowhawk *Accipiter nisus* cited (corvids are not mentioned) (Table 5). At a local site level it is plausible that one or more corvid species might limit a bullfinch population; at national level evidence is lacking.

Even if perfect data were available on the local co-occurrence of corvids and potential prey, providing evidence for impact of a single species would be difficult because of the

natural systems which make one species' impact inherently difficult to separate from those of others. However, studies combining correlative and experimental responses have attempted to quantify the impacts of predation on populations with some success (Bolton *et al.*, 2007, Summers *et al.*, 2004, Fletcher *et al.*, 2010), so the information on ecological vulnerability coupled with productivity metrics and local predator abundance may be informative.

Site and local populations

Scientific studies determining that a single species of predator impacts on the conservation status of another species are rare and atypical, and therefore have limited relevance and applicability to local situations in Wales. While predation is a natural process, Britain supports relatively high densities of mesopredators (e.g. carrion crow) and an almost complete absence of apex predators compared to some other parts of Europe, including high densities of the four corvid species considered here (Roos *et al.*, 2018). This is likely to be the result of several underlying factors, including a) complex patterns of land use creating and maintaining habitat mosaics that support high densities of generalist predators; b) the removal of apex predators, and potentially c) high-yield gamebird management that may supplement the resources available to mesopredators (Roos *et al.*, 2018; Pringle *et al.* 2019). Associated with these high mesopredator densities, there is strong evidence that the impacts of predators can limit bird populations and impact the conservation status of some species (reviewed in Newson *et al.* 2019); although evidence is considerably stronger for ground-nesting seabirds, waders and grouse than for passerines. In most cases such impacts are cumulative, across multiple predators, and their interactions are poorly understood. An extensive review of published studies on predation as a limiting factor for bird populations in Britain concluded that the simultaneous control or management of multiple species of predators including mammals (notably foxes and corvids) was more likely to result in stable or increasing prey populations (Roos *et al.*, 2018). Identifying a single species of predator as impacting on a prey species of conservation concern arguably has considerable limitations, particularly if carried through to single-species focussed conservation management.

It is perhaps more achievable and appropriate to focus on whether predation *in general* is having a negative effect on the conservation status of the prey species at the scale being considered (here both national and local contexts have been reviewed). In both Table 5 (and, for the wider *BoCC3 W* species list in Appendix IV Table 2) we have attempted to address this aim by including data and reviewing expert opinion on whether reduced egg and / or chick survival is driving observed population declines in the (prey) species of interest. For species where breeding demographics are implicated in declines, and predation is implicated as a causal factor in breeding failure, it may be appropriate to consider the complete assemblage of likely predators, and the conditions that determine or increase vulnerability of the prey species to cumulative predation risk at site or population level. It is appropriate to consider as an entirely conceivable scenario, the effective control of carrion crows (enacted because of a relatively strong evidence base of an impact on wild birds) releases competitive pressures on magpies (which were not controlled because of weak or weaker evidence), such that they increase in numbers and impact more heavily on the prey species or population of conservation interest. The authors are not aware of research on competitive relationships between the four corvids of interest in this report, although it is ecologically plausible; similarly we are not aware that very high densities of magpies have ever been causally linked to suppression or decline in prey bird species. We

further note that such scenarios cannot safely be restricted to the four species of corvid considered here but extended to include impacts and interactions with all avian and mammalian predators in the relevant ecological space.

Predation as a primary or contributory factor

Finally, as well as limitations to the identification of population impact by a single species of predator, there is the additional complication of identifying whether predation is a *primary* or *contributory* factor limiting populations of prey species of conservation interest. Most studies of the breeding biology of a species will record incidences of nest or young predation, since it is a natural and widespread phenomenon. In many cases, such predation events are simply incidental observations rather than the primary objective of the study. Relatively few studies have been designed or carried out with either the primary objective or investigative power to definitively establish whether predation is limiting a population. Even where there is compelling evidence that a single species of predator is limiting the population of a species of conservation concern, in most instances there will be other contributory factors affecting the status and vulnerability of the target species; such as underlying landscape structural change, specific management change (particularly in agricultural habitats), or climate change driving spatial distribution changes. While studies of some species and groups have attempted to distinguish predation in its wider context as a principal, secondary, contributory limiting or simply incidental factor (cited by Roos *et al.* 2018), for many species of conservation concern, the appropriate data to make such distinctions is lacking. Given the complexity of ecological interactions, it is also unclear whether even a major extension to the review of Newson *et al.* (2019) would add significantly to our understanding of whether predation by carrion crow, magpie, jay and/or jackdaw is a critical limiting factor for individual bird species of conservation concern in Wales.

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Appendices

Appendix I: Reference tables extracted from Birds of Conservation Concern3 Wales

App.I Table 1. *Birds of Conservation Concern3 Wales: Red list.*

Breeding status in Wales assigned using information from the Welsh Ornithological Society (<https://birdsin.wales/wp-content/uploads/2019/12/Welsh-List-2020-v1.1.xlsx>) and BTO expert opinion. Breeding codes were assigned to each species as follows: **1** = regular breeding in Wales; **0.75** = breeding in Wales but categorised rare/scarce; **0.5** = occasionally breeding in Wales; **0.25** = very occasional, not confirmed absent and **0** = not breeding in Wales. Cells shaded in blue represent breeding Red-listed species of *BoCC3 W* ($N = 43$ species). Scientific names are listed separately below in App.I Table 3.

Species	Breeding Status in Wales	Species	Breeding Status in Wales
Bewick's swan	0	Black-headed gull	1
White-fronted goose	0	Common gull	0
Pochard	0.5	Herring gull	1
Long-tailed duck	0	Great black-backed gull	1
Red grouse	1	Turtle dove	0.25
Black grouse	1	Cuckoo	1
Grey partridge	1	Short-eared owl	0.5
Balearic shearwater	0	Lesser spotted woodpecker	0.75
Slavonian grebe	0	Kestrel	1
Hen harrier	1	Merlin	1
Corncrake	0	Willow tit	1
European golden plover	1	Marsh tit	1
Grey plover	0	Wood warbler	1
Lapwing	1	Willow warbler	1
Ringed plover	1	Whitethroat	1
Curlew	1	Grasshopper warbler	1
Bar-tailed godwit	0	Starling	1
Knot	0	Ring ouzel	1
Dunlin	0.75	Spotted flycatcher	1
Common sandpiper	1	Pied flycatcher	1
Redshank	1	Whinchat	1
Woodcock	0.75	Tree sparrow	1
Puffin	1	Yellow wagtail	0.5
Little tern	1	Bullfinch	1
Roseate tern	0.5	Linnet	1
Arctic tern	1	Yellowhammer	1
Kittiwake	1	Corn bunting	0

App.I Table 2. *Birds of Conservation Concern3 Wales: Amber list.*

Breeding status in Wales assigned using information from the Welsh Ornithological Society (<https://birdsin.wales/wp-content/uploads/2019/12/Welsh-List-2020-v1.1.xlsx>) and BTO expert opinion. Breeding codes were assigned to each species as follows: **1** = regular breeding in Wales; **0.75** = breeding in Wales but categorised rare/scarce; **0.5** = occasionally breeding in Wales; **0.25** = very occasional, not confirmed absent and **0** = not breeding in Wales. Cells shaded in blue represent breeding Amber-listed species of *BoCC3 W* ($N = 55$ species). Scientific names are listed separately below in App.I Table 3.

Species	Breeding Status in Wales	Species	Breeding Status in Wales
Shelduck	1	Green sandpiper	0
Wigeon	0	Spotted redshank	0
Teal	1	Jack snipe	0
Mallard	1	Snipe	1
Pintail	0	Pomarine skua	0
Garganey	0.25	Arctic skua	0
Shoveler	0.5	Long-tailed skua	0
Scaup	0	Black guillemot	1
Eider	1	Razorbill	1
Common scoter	0	Guillemot	1
Velvet scoter	0	Sandwich tern	1
Smew	0	Common tern	1
Red-breasted merganser	1	Little gull	0
Quail	0.25	Lesser black-backed gull	1
Red-throated diver	0	Long-eared owl	1
Black-throated diver	0	Nightjar	1
Great Northern diver	0	Swift	1
Fulmar	1	Kingfisher	1
Sooty shearwater	0	Green woodpecker	1
Manx shearwater	1	Chough	1
Storm petrel	1	Hooded crow	0
Leach's petrel	0	Goldcrest	1
Gannet	1	Firecrest	1
Cormorant	1	Bearded tit	1
Shag	1	Skylark	1
Bittern	1	Long-tailed tit	1
Grey heron	1	Dartford warbler	1
Spoonbill	0	Dipper	1
Red-necked grebe	0	Fieldfare	0
Black-necked Grebe	0	Song thrush	1
Honey-buzzard	0.75	Redwing	0
Red kite	1	Mistle thrush	1
Marsh harrier	1	Black redstart	0.5
Osprey	1	House sparrow	1
Coot	1	Grey wagtail	1
Avocet	1	Tree pipit	1
Oystercatcher	1	Meadow pipit	1

Species	Breeding Status in Wales	Species	Breeding Status in Wales
Dotterel	0	Brambling	0
Whimbrel	0	Hawfinch	1
Black-tailed godwit	0	Greenfinch	1
Turnstone	0	Twite	1
Ruff	0	Lesser redpoll	1
Curlew sandpiper	0	Snow bunting	0
Sanderling	0	Lapland bunting	0
Purple sandpiper	0	Reed bunting	1

App.I Table 3. Scientific names of BoCC3 W species listed in Red and Amber lists.

Species	Scientific name	Species	Scientific name
Bewick's swan	<i>Cygnus columbianus</i>	Black-headed gull	<i>Chroicocephalus ridibundus</i>
White-fronted goose	<i>Anser albifrons</i>	Common gull	<i>Larus canus</i>
Pochard	<i>Aythya farina</i>	Herring gull	<i>Larus argentatus</i>
Long-tailed duck	<i>Clangula hyemalis</i>	Great black-backed gull	<i>Larus marinus</i>
Red grouse	<i>Lagopus lagopus scotica</i>	Turtle dove	<i>Streptopelia turtur</i>
Black grouse	<i>Lyurus tetrix</i>	Cuckoo	<i>Cuculus canorus</i>
Grey partridge	<i>Perdix perdix</i>	Short-eared owl	<i>Asio flammeus</i>
Balearic shearwater	<i>Puffinus mauretanicus</i>	Lesser spotted woodpecker	<i>Dendrocopos minor</i>
Slavonian grebe	<i>Podiceps auritus</i>	Kestrel	<i>Falco tinniculus</i>
Hen harrier	<i>Circus cyaneus</i>	Merlin	<i>Falco columbarius</i>
Corncrake	<i>Crex crex</i>	Willow tit	<i>Poecile Montana</i>
European golden plover	<i>Pluvialis apricaria</i>	Marsh tit	<i>Poecile palustris</i>
Grey plover	<i>Pluvialis squatarola</i>	Wood warbler	<i>Phylloscopus sibilatrix</i>
Lapwing	<i>Vanellus vanellus</i>	Willow warbler	<i>Phylloscopus trochilus</i>
Ringed plover	<i>Charadrius hiaticula</i>	Whitethroat	<i>Sylvia communis</i>
Curlew	<i>Numenius arquata</i>	Grasshopper warbler	<i>Locustella naevia</i>
Bar-tailed godwit	<i>Limosa lapponica</i>	Starling	<i>Sturnus vulgaris</i>
Knot	<i>Calidris canutus</i>	Ring ouzel	<i>Turdus torquatus</i>
Dunlin	<i>Calidris alpina</i>	Spotted flycatcher	<i>Muscicapa striata</i>
Common sandpiper	<i>Actitis hypoleucos</i>	Pied flycatcher	<i>Ficedula hypoleuca</i>
Redshank	<i>Tringa tetanus</i>	Whinchat	<i>Saxicola rubetra</i>
Woodcock	<i>Scolopax rusticola</i>	Tree sparrow	<i>Passer montanus</i>
Puffin	<i>Fratercula arctica</i>	Yellow wagtail	<i>Motacilla flava flavissima</i>
Little tern	<i>Sterna albifrons</i>	Bullfinch	<i>Pyrrhula pyrrhula</i>
Roseate tern	<i>Sterna dougallii</i>	Linnet	<i>Carduelis cannabina</i>
Arctic tern	<i>Sterna paradise</i>	Yellowhammer	<i>Emberiza citronella</i>
Kittiwake	<i>Rissa tridactyla</i>	Corn bunting	<i>Emberiza calandra</i>
Shelduck	<i>Tadorna tadorna</i>	Green sandpiper	<i>Tringa ochropus</i>
Wigeon	<i>Anas Penelope</i>	Spotted redshank	<i>Tringa erythropus</i>
Teal	<i>Anas crecca</i>	Jack snipe	<i>Lymnocyptes minimus</i>
Mallard	<i>Anas platyrhynchos</i>	Snipe	<i>Gallinago gallinago</i>
Pintail	<i>Anas acuta</i>	Pomarine skua	<i>Stercorarius pomarinus</i>
Garganey	<i>Anas querquedula</i>	Arctic skua	<i>Stercorarius parasiticus</i>
Shoveler	<i>Anas clypeata</i>	Long-tailed skua	<i>Stercorarius longicaudus</i>
Scaup	<i>Aythya marila</i>	Black guillemot	<i>Cephus grylle</i>
Eider	<i>Somateria mollissima</i>	Razorbill	<i>Alca torda</i>
Common scoter	<i>Melanitta nigra</i>	Guillemot	<i>Uria aalge</i>

Species	Scientific name	Species	Scientific name
Velvet scoter	<i>Melanitta fusca</i>	Sandwich tern	<i>Thalasseus sandvicensis</i>
Smew	<i>Mergellus albellus</i>	Common tern	<i>Sterna hirundo</i>
Red-breasted merganser	<i>Mergus serrator</i>	Little gull	<i>Hydrocoloeus minutus</i>
Quail	<i>Coturnix coturnix</i>	Lesser black-backed gull	<i>Larus fuscus</i>
Red-throated diver	<i>Gavia stellata</i>	Long-eared owl	<i>Asio otus</i>
Black-throated diver	<i>Gavia pacifica</i>	Nightjar	<i>Caprimulgus europaeus</i>
Great Northern diver	<i>Gavia immer</i>	Swift	<i>Apus apus</i>
Fulmar	<i>Fulmarus glacialis</i>	Kingfisher	<i>Alcedo atthis</i>
Sooty shearwater	<i>Ardenna grisea</i>	Green woodpecker	<i>Picus viridis</i>
Manx shearwater	<i>Puffinus puffinus</i>	Chough	<i>Pyrrhocorax pyrrhocorax</i>
Storm petrel	<i>Hydrobates pelagicus</i>	Hooded crow	<i>Corvus cornix</i>
Leach's petrel	<i>Oceanodroma leucorhoa</i>	Goldcrest	<i>Regulus regulus</i>
Gannet	<i>Morus bassanus</i>	Firecrest	<i>Regulus ignicapilla</i>
Cormorant	<i>Phalacrocorax carbo</i>	Bearded tit	<i>Panurus biarmicus</i>
Shag	<i>Phalacrocorax aristotelis</i>	Skylark	<i>Alauda arvensis</i>
Bittern	<i>Botaurus stellaris</i>	Long-tailed tit	<i>Aegithalos caudatus</i>
Grey heron	<i>Ardea cinerea</i>	Dartford warbler	<i>Sylvia undata</i>
Spoonbill	<i>Platalea leucorodia</i>	Dipper	<i>Cinclus cinclus</i>
Red-necked grebe	<i>Podiceps grisegena</i>	Fieldfare	<i>Turdus pilaris</i>
Black-necked grebe	<i>Podiceps nigricollis</i>	Song thrush	<i>Turdus philomelos</i>
Honey buzzard	<i>Pernis apivorus</i>	Redwing	<i>Turdus iliacus</i>
Red kite	<i>Milvus milvus</i>	Mistle thrush	<i>Turdus viscivorus</i>
Marsh harrier	<i>Circus aeruginosus</i>	Black redstart	<i>Phoenicurus ochruros</i>
Osprey	<i>Pandion haliaetus</i>	House sparrow	<i>Passer domesticus</i>
Coot	<i>Fulica atra</i>	Grey wagtail	<i>Motacilla cinerea</i>
Avocet	<i>Recurvirostra avosetta</i>	Tree pipit	<i>Anthus trivialis</i>
Oystercatcher	<i>Haematopus ostralegus</i>	Meadow pipit	<i>Anthus pratensis</i>
Dotterel	<i>Charadrius morinellus</i>	Brambling	<i>Fringilla montifringilla</i>
Whimbrel	<i>Numenius phaeopus</i>	Hawfinch	<i>Coccothraustes coccothraustes</i>
Black-tailed godwit	<i>Limosa limosa</i>	Greenfinch	<i>Chloris chloris</i>
Turnstone	<i>Arenaria interpres</i>	Twite	<i>Linaria flavirostris</i>
Ruff	<i>Calidris pugnax</i>	Lesser redpoll	<i>Acanthis cabaret</i>
Curlew sandpiper	<i>Calidris ferruginea</i>	Snow bunting	<i>Plectrophenax nivalis</i>
Sanderling	<i>Calidris alba</i>	Lapland bunting	<i>Calcarius lapponicus</i>
Purple sandpiper	<i>Calidris maritima</i>	Reed bunting	<i>Emberiza schoeniclus</i>

Appendix II: Habitat use for each species in Wales from BirdFacts

App.II Table 1. Breeding and nest-type information for *BoCC3 W* species breeding in Wales, plus the four general licence corvid species. BTO two letter species code is included for reference as it is used in subsequent tables.

Species	BTO code	BoCC3 W	Breeding in Wales?	Ground Nest	Open Nest
Carrion crow	C.	Green	1	0	1
Magpie	MG	Green	1	0	1
Jackdaw	JD	Green	1	0	0
Jay	J.	Green	1	0	0.75
Pochard	PO	Red	0.5	1	1
Red grouse	RG	Red	1	1	1
Black grouse	BK	Red	1	1	1
Grey partridge	P.	Red	1	1	1
Hen harrier	HH	Red	1	1	1
European golden plover	GP	Red	1	1	1
Lapwing	L.	Red	1	1	1
Ringed plover	RP	Red	1	1	1
Curlew	CU	Red	1	1	1
Dunlin	DN	Red	0.75	1	1
Common sandpiper	CS	Red	1	1	1
Redshank	RK	Red	1	1	1
Woodcock	WL	Red	0.75	1	1
Puffin	PU	Red	1	0.5	0
Little tern	AF	Red	1	1	1
Roseate tern	RS	Red	0.5	1	1
Arctic tern	AE	Red	1	1	1
Kittiwake	KI	Red	1	0.5	1
Black-headed gull	BH	Red	1	1	1
Herring gull	HG	Red	1	1	1
Great black-backed gull	GB	Red	1	1	1
Turtle dove	TD	Red	0.25	0	1
Cuckoo	CK	Red	1	1	1
Short-eared owl	SE	Red	0.5	1	1
Lesser spotted woodpecker	LS	Red	0.75	0	0
Kestrel	K.	Red	1	0	0.25
Merlin	ML	Red	1	1	1
Willow tit	WT	Red	1	0	0
Marsh tit	MT	Red	1	0	0
Wood warbler	WO	Red	1	1	0
Willow warbler	WW	Red	1	1	0
Whitethroat	WH	Red	1	1	1
Grasshopper warbler	GH	Red	1	1	1
Starling	SG	Red	1	0	0
Ring ouzel	RZ	Red	1	1	1

Species	BTO code	BoCC3 W	Breeding in Wales?	Ground Nest	Open Nest
Spotted flycatcher	SF	Red	1	0	1
Pied flycatcher	PF	Red	1	0	0
Whinchat	WC	Red	1	1	0
Tree sparrow	TS	Red	1	0	0
Yellow wagtail	YW	Red	0.5	1	1
Bullfinch	BF	Red	1	0	1
Linnet	LI	Red	1	0	1
Yellowhammer	Y.	Red	1	1	1
Shelduck	SU	Amber	1	1	0
Teal	T.	Amber	1	1	1
Mallard	MA	Amber	1	1	1
Garganey	GY	Amber	0.25	1	1
Shoveler	SV	Amber	0.5	1	1
Eider	E.	Amber	1	1	1
Red-breasted merganser	RM	Amber	1	1	1
Quail	Q.	Amber	0.25	1	1
Fulmar	F.	Amber	1	0.5	1
Manx shearwater	MX	Amber	1	0.5	0
Storm petrel	TM	Amber	1	0	0
Gannet	GX	Amber	1	0.5	1
Cormorant	CA	Amber	1	0.5	1
Shag	SA	Amber	1	0.5	1
Bittern	BI	Amber	1	1	1
Grey heron	H.	Amber	1	1	1
Honey-buzzard	HZ	Amber	0.75	0	1
Red kite	KT	Amber	1	0	1
Marsh harrier	MR	Amber	1	1	1
Osprey	OP	Amber	1	0	1
Coot	CO	Amber	1	1	1
Avocet	AV	Amber	1	1	1
Oystercatcher	OC	Amber	1	1	1
Snipe	SN	Amber	1	1	1
Black guillemot	TY	Amber	1	0.5	0
Razorbill	RA	Amber	1	0.5	0.25
Guillemot	GU	Amber	1	0.5	1
Sandwich tern	TE	Amber	1	1	1
Common tern	CN	Amber	1	1	1
Lesser black-backed gull	LB	Amber	1	1	1
Long-eared owl	LE	Amber	1	0	1
Nightjar	NJ	Amber	1	1	1
Swift	SI	Amber	1	0	0
Kingfisher	KF	Amber	1	0	0
Green woodpecker	G.	Amber	1	0	0
Chough	CF	Amber	1	0	0
Goldcrest	GC	Amber	1	0	1
Firecrest	FC	Amber	1	0	1
Bearded tit	BR	Amber	1	0	1
Skylark	S.	Amber	1	1	1

Species	BTO code	BoCC3 W	Breeding in Wales?	Ground Nest	Open Nest
Long-tailed tit	LT	Amber	1	0	0
Dartford warbler	DW	Amber	1	0	1
Dipper	DI	Amber	1	1	0
Song thrush	ST	Amber	1	0	1
Mistle thrush	M.	Amber	1	0	1
Black redstart	BX	Amber	0.5	0	0
House sparrow	HS	Amber	1	0	0
Grey wagtail	GL	Amber	1	1	1
Tree pipit	TP	Amber	1	1	1
Meadow pipit	MP	Amber	1	1	1
Hawfinch	HF	Amber	1	0	1
Greenfinch	GR	Amber	1	0	1
Twite	TW	Amber	1	1	1
Lesser redpoll	LR	Amber	1	0	1
Reed bunting	RB	Amber	1	1	1

Appendix III: Reference tables extracted from BTO BirdFacts

App. III Table 1. Proportional habitat use for some *BoCC3 W* breeding species reported from BTO Breeding Bird Surveys in 2011 (Robinson, 2005).

Species below the BBS reporting threshold are absent from this table.

Species listed by BTO two-letter code. Habitat codes as follows:

CA Open Coastal Habitat	HR Villages & Rural Areas,
CE Coastal Estuaries	HU Towns & Cities
CO Rocky and Sandy Shoreline	RR Rivers (2m wide or more)
FA Arable Farmland	RS Streams (less than 2m)
FG Pasture & Grazed Fields	SC Scrub & Bushy Commons
GB Boggy Moorland	WB Broad-leaved Woodland
GD Heath & Dry Grassland	WC Coniferous Woodland
GF Marsh and Wet Grassland,	WL Lakes & Large Waterbodies
GM Open Upland Moor	WS Ponds & Small Waterbodies
GR Reed Swamp & Fen	OW* Other Wetlands

**This additional category was applied to highlight species that occupy other wetland habitats other than that used in the published categorisation*

Species (BTO 2-letter code)	Relative habitat associations ("habitat use")																			
	Open Coastal	Arable Farmland	Pasture & grazed fields	Boggy Moorland	Heath & Dry Grassland	Marsh & Wet Grassland	Open Upland Moor	Reed, Swamp & Fen	Villages and Rural Areas	Towns & Cities	Scrub & Bush Commons	Broad-leaved Woodland	Coniferous Woodland	Coastal Estuaries	Rocky & Sandy Shoreline	Rivers >2m wide	Streams <2m wide	Lakes & large waterbodies	Ponds & small waterbodies	Other Wetlands*
C.	0.08	0.08	0.11	0.02	0.06	0.04	0.05	0.07	0.12	0.13	0.08	0.11	0.05	.	.	.	.	.	.	.
MG	0.06	0.07	0.11	0.02	0.06	0.04	0.02	0.08	0.14	0.19	0.10	0.10	0.03	.	.	.	.	.	.	.
JD	0.10	0.08	0.13	0.03	0.05	0.04	0.03	0.03	0.19	0.11	0.07	0.11	0.03	.	.	.	.	.	.	.
J.	0.01	0.06	0.07	.	0.05	0.03	0.02	0.06	0.09	0.09	0.13	0.24	0.15	.	.	.	.	.	.	.
BH	.	0.03	0.03	0.03	0.03	0.05	0.02	0.09	0.02	0.04	0.04	0.02	0.02	0.26	0.09	0.08	0.02	0.08	0.05	.
BF	0.03	0.07	0.09	0.02	0.05	0.04	0.01	0.08	0.12	0.06	0.17	0.16	0.12	.	.	.	.	.	.	.
CN	.	.	.	.	.	.	.	.	.	.	.	.	.	0.41	0.13	0.12	0.02	0.15	0.18	*
CO	.	.	.	.	.	.	.	.	.	.	.	.	.	0.11	0.07	0.19	0.03	0.33	0.27	*
CA	.	.	.	.	.	.	.	.	.	.	.	.	.	0.40	0.21	0.17	0.01	0.12	0.10	*
CK	0.09	0.07	0.05	0.02	0.09	0.13	0.05	0.17	0.05	0.01	0.12	0.06	0.10	.	.	.	.	.	.	.
CU	0.06	0.01	0.07	0.14	0.14	0.17	0.25	0.09	0.01	0.00	0.03	0.01	0.02	.	.	.	.	.	.	.
GP	.	.	0.01	0.28	0.23	0.31	0.13	0.01	0.01	.	0.00	.	0.01	.	.	.	.	.	.	.
GC	.	0.04	0.06	0.03	0.04	0.03	0.03	0.01	0.09	0.06	0.13	0.13	0.34	.	.	.	.	.	.	.
GH	.	0.02	0.03	0.12	0.02	0.07	0.03	0.53	0.01	.	0.13	0.01	0.04	.	.	.	.	.	.	.
GB	.	0.02	0.03	0.05	0.05	0.02	.	.	0.04	0.06	0.03	0.02	0.01	0.06	0.40	0.05	0.01	0.11	0.02	.
G.	0.00	0.08	0.08	0.01	0.11	0.04	0.02	0.02	0.13	0.08	0.13	0.22	0.08	.	.	.	.	.	.	.
GR	0.03	0.11	0.11	0.01	0.04	0.03	0.01	0.06	0.21	0.17	0.08	0.09	0.03	.	.	.	.	.	.	.
H.	0.01	0.03	0.05	0.04	0.02	0.09	0.01	0.08	0.04	0.04	0.06	0.06	0.02	0.07	0.03	0.13	0.03	0.12	0.08	.
P.	0.07	0.32	0.09	.	0.04	0.08	0.09	0.11	0.07	0.01	0.05	0.06	0.02	.	.	.	.	.	.	.
GL	.	0.02	0.06	0.06	0.05	0.09	0.09	0.04	0.06	0.06	0.08	0.06	0.05	.	0.00	0.13	0.05	0.05	0.03	.
HG	.	0.02	0.04	0.03	0.02	0.01	0.00	0.03	0.05	0.12	0.03	0.02	0.00	0.18	0.33	0.04	0.01	0.05	0.03	.
HS	0.03	0.09	0.11	0.01	0.03	0.03	0.01	0.05	0.22	0.29	0.05	0.07	0.01	.	.	.	.	.	.	.
K.	0.01	0.13	0.10	0.08	0.06	0.10	0.07	0.03	0.11	0.06	0.13	0.08	0.05	.	.	.	.	.	.	.
KF	.	.	.	.	.	.	.	.	.	.	.	.	.	0.0	0.0	0.51	0.12	0.11	0.26	*
L.	0.03	0.05	0.04	0.02	0.06	0.10	0.07	0.09	0.02	0.01	0.02	0.02	0.01	0.11	0.04	0.06	0.07	0.08	0.09	.
LB	.	0.02	0.04	.	0.02	0.03	0.01	.	0.05	0.12	0.03	0.01	0.01	0.25	0.23	0.06	0.01	0.09	0.03	.
LR	.	0.01	0.05	0.11	0.06	0.06	0.08	0.07	0.04	0.01	0.19	0.04	0.28	.	.	.	.	.	.	.
LI	0.17	0.13	0.09	0.02	0.08	0.06	0.04	0.10	0.11	0.04	0.09	0.04	0.03	.	.	.	.	.	.	.
LT	0.02	0.08	0.09	0.01	0.06	0.05	0.01	0.04	0.12	0.10	0.14	0.20	0.08	.	.	.	.	.	.	.
MA	.	.	.	.	.	.	.	.	.	.	.	.	.	0.16	0.06	0.24	0.10	0.22	0.22	*
MT	.	0.07	0.07	.	0.06	0.04	0.02	.	0.06	0.01	0.13	0.41	0.13	.	.	.	.	.	.	.
MP	0.10	0.01	0.04	0.19	0.14	0.15	0.19	0.07	0.01	0.01	0.04	0.01	0.04	.	.	.	.	.	.	.
OC	.	0.03	0.04	0.03	0.07	0.08	0.04	0.01	0.02	0.01	0.02	0.01	0.00	0.27	0.23	0.05	0.02	0.06	0.02	.
RG	.	.	0.00	0.22	0.24	0.34	0.17	.	.	.	0.00	0.00	0.02	.	.	.	.	.	.	.
RK	0.19	0.00	0.01	0.00	0.03	0.13	0.01	0.12	0.00	0.00	0.02	0.00	0.00	0.25	0.09	0.03	0.01	0.07	0.01	.
RB	0.10	0.06	0.04	0.08	0.05	0.13	0.04	0.35	0.03	0.01	0.07	0.02	0.02	.	.	.	.	.	.	.

Species (BTO 2-letter code)	Relative habitat associations ("habitat use")																			
	Open Coastal	Arable Farmland	Pasture & grazed fields	Boggy Moorland	Heath & Dry Grassland	Marsh & Wet Grassland	Open Upland Moor	Reed, Swamp & Fen	Villages and Rural Areas	Towns & Cities	Scrub & Bush Commons	Broad-leaved Woodland	Coniferous Woodland	Coastal Estuaries	Rocky & Sandy Shoreline	Rivers >2m wide	Streams <2m wide	Lakes & large waterbodies	Ponds & small waterbodies	Other Wetlands*
SU	.	.	.	.	.	.	.	.	.	.	.	.	.	0.63	0.17	0.06	0.02	0.06	0.06	*
S.	0.07	0.13	0.06	0.14	0.10	0.10	0.15	0.08	0.05	0.01	0.05	0.03	0.03	.	.	.	.	.	.	.
SN	0.01	0.00	0.02	0.14	0.09	0.15	0.11	0.04	0.00	.	0.02	0.00	0.01	0.02	0.03	0.05	0.09	0.17	0.03	.
ST	0.02	0.07	0.09	0.02	0.05	0.03	0.02	0.06	0.14	0.10	0.12	0.15	0.12	.	.	.	.	.	.	.
SF	.	0.06	0.14	0.03	0.05	0.04	0.05	0.01	0.18	0.02	0.08	0.20	0.12	.	.	.	.	.	.	.
SG	0.05	0.08	0.10	0.03	0.05	0.04	0.02	0.07	0.18	0.25	0.06	0.06	0.02	.	.	.	.	.	.	.
SI	.	0.07	0.08	0.00	0.02	0.05	0.02	0.10	0.18	0.29	0.11	0.07	0.02	.	.	.	.	.	.	.
TP	.	0.01	0.03	0.02	0.15	0.06	0.13	.	0.01	0.00	0.24	0.09	0.24	.	.	.	.	.	.	.
TS	.	0.30	0.17	.	0.04	0.05	.	0.02	0.19	0.08	0.08	0.07	0.01	.	.	.	.	.	.	.
TD	.	0.17	0.04	.	0.09	0.05	.	0.15	0.11	0.02	0.16	0.11	0.09	.	.	.	.	.	.	.
WC	.	0.01	0.03	0.11	0.25	0.12	0.34	.	0.02	0.00	0.04	0.01	0.07	.	.	.	.	.	.	.
WH	0.11	0.17	0.08	0.01	0.05	0.04	0.01	0.18	0.10	0.04	0.13	0.07	0.03	.	.	.	.	.	.	.
WT	.	0.07	0.06	.	0.06	0.01	0.01	0.09	0.04	0.03	0.26	0.18	0.17	.	.	.	.	.	.	.
WW	0.04	0.04	0.08	0.04	0.08	0.06	0.05	0.12	0.06	0.03	0.18	0.09	0.15	.	.	.	.	.	.	.
YW	.	0.21	0.02	.	0.01	0.04	0.00	0.05	0.02	0.01	0.01	0.01	0.00	0.21	0.02	0.08	0.16	0.08	0.07	.
Y.	0.03	0.31	0.13	.	0.06	0.02	0.02	0.05	0.11	0.02	0.11	0.08	0.05	.	.	.	.	.	.	.

Appendix IV: Reference tables for review outputs

App. IV Table 1. Vulnerability to (nest) predation by the four corvid species of interest, for *BoCC3 W* Red and Amber listed species.

The **predation vulnerability index** for each *BoCC3 W* species monitored by Breeding Bird Survey calculated as the sum of that species' habitat association scores for the principal corvid habitats (i.e. **habitat overlap**) multiplied by the 'open nest' value (**ecological vulnerability**), and categorised as 1=0-10% (highly unlikely), 2=10-20% (not likely), 3=20-40% (likely) and 4=40-100% (highly likely). For species where BBS habitat data are not available, expert opinion was applied to generate three classes for predation vulnerability where * = unlikely, ** = likely, *** = highly likely).

Cells shaded in blue represent *BoCC3 W*-corvid species pairs with an ecological vulnerability index ≥ 3 or an expert assessment classing predation vulnerability as *likely* or *highly likely*.

Species	Breeds in Wales?	Ground Nest	Open Nest	Ecological vulnerability to predation			
				Magpie	C. crow	Jackdaw	Jay
Arctic tern	1	1	1	*	**	**	*
Avocet	1	1	1	*	*	*	*
Bearded tit	1	0	1	*	**	*	*
Bittern	1	1	1	*	**	*	*
Black grouse	1	1	1	**	**	**	**
Black guillemot	1	0.5	0	*	**	**	*
Black-headed gull	1	1	1	2	3	2	1
Black redstart	0.5	0	0	*	*	*	*
Bullfinch	1	0	1	4	4	4	4
Chough	1	0	0	*	**	**	*
Common sandpiper	1	1	1	*	*	*	*
Common tern	1	1	1	*	**	**	*
Coot	1	1	1	*	*	*	*
Cormorant	1	0.5	1	*	**	**	*
Cuckoo	1	1	1	3	4	3	3
Curlew	1	1	1	2	3	2	1
Dartford warbler	1	0	1	**	**	**	**
Dipper	1	1	0	*	*	*	*
Dunlin	0.75	1	1	*	*	*	*
Eider	1	1	1	*	**	**	*
European golden plover	1	1	1	1	1	1	1
Firecrest	1	0	1	*	*	*	*
Fulmar	1	0.5	1	*	**	**	*
Gannet	1	0.5	1	*	**	**	*
Garganey	0.25	1	1	*	*	*	*
Goldcrest	1	0	1	4	4	3	4
Grasshopper warbler	1	1	1	2	4	1	2
Great black-backed gull	1	1	1	2	3	2	1
Green woodpecker	1	0	0	1	1	1	1
Greenfinch	1	0	1	4	4	4	3

Species	Breeds in Wales?	Ground Nest	Open Nest	Ecological vulnerability to predation			
				Magpie	C. crow	Jackdaw	Jay
Grey heron	1	1	1	3	3	2	2
Grey partridge	1	1	1	3	4	3	2
Grey wagtail	1	1	1	3	3	3	2
Guillemot	1	0.5	1	*	**	**	*
Hawfinch	1	0	1	**	**	**	**
Hen harrier	1	1	1	*	*	*	*
Herring gull	1	1	1	3	3	3	1
Honey buzzard	0.75	0	1	**	**	**	**
House sparrow	1	0	0	1	1	1	1
Kestrel	1	0	0.25	2	2	1	1
Kingfisher	1	0	0	*	*	*	*
Kittiwake	1	0.5	1	*	**	**	*
Lapwing	1	1	1	2	3	2	1
Lesser black-backed gull	1	1	1	3	3	3	1
Lesser redpoll	1	0	1	3	4	2	4
Lesser spotted woodpecker	0.75	0	0	*	*	*	*
Linnet	1	0	1	3	4	4	2
Little tern	1	1	1	*	*	**	*
Long-eared owl	1	0	1	**	**	**	***
Long-tailed tit	1	0	0	1	1	1	1
Mallard	1	1	1	*	*	*	*
Manx shearwater	1	0.5	0	*	*	**	*
Marsh harrier	1	1	1	*	*	*	*
Marsh tit	1	0	0	1	1	1	1
Meadow pipit	1	1	1	2	3	2	1
Merlin	1	1	1	*	*	*	*
Mistle thrush	1	0	1	***	***	***	***
Nightjar	1	1	1	*	*	*	*
Osprey	1	0	1	**	**	**	***
Oystercatcher	1	1	1	1	2	1	1
Pied flycatcher	1	0	0	*	*	*	*
Pochard	0.5	1	1	*	*	*	*
Puffin	1	0.5	0	*	*	*	*
Quail	0.25	1	1	*	*	*	*
Razorbill	1	0.5	0.25	*	*	*	*
Red grouse	1	1	1	1	1	1	1
Red kite	1	0	1	***	***	***	***
Red-breasted merganser	1	1	1	*	*	*	*
Redshank	1	1	1	1	3	3	1
Reed bunting	1	1	1	2	4	3	2
Ring ouzel	1	1	1	**	**	**	**
Ringed plover	1	1	1	*	**	**	*
Roseate tern	0.5	1	1	*	**	**	*
Sandwich tern	1	1	1	*	**	**	*
Shag	1	0.5	1	*	**	**	*

Species	Breeds in Wales?	Ground Nest	Open Nest	Ecological vulnerability to predation			
				Magpie	C. crow	Jackdaw	Jay
Shelduck	1	1	0	*	*	**	*
Short-eared owl	0.5	1	1	*	*	*	**
Shoveler	0.5	1	1	*	*	*	*
Skylark	1	1	1	2	4	3	2
Snipe	1	1	1	1	1	1	1
Song thrush	1	0	1	4	4	4	3
Spotted flycatcher	1	0	1	4	4	4	4
Starling	1	0	0	1	1	1	1
Storm petrel	1	0	0	*	*	**	*
Swift	1	0	0	1	1	1	1
Teal	1	1	1	*	*	*	*
Tree pipit	1	1	1	3	3	2	4
Tree sparrow	1	0	0	1	1	1	1
Turtle dove	0.25	0	1	4	4	3	3
Twite	1	1	1	*	*	*	*
Whinchat	1	1	0	1	1	1	1
Whitethroat	1	1	1	4	4	3	3
Willow tit	1	0	0	1	1	1	1
Willow warbler	1	1	0	1	1	1	1
Wood warbler	1	1	0	*	*	*	*
Woodcock	0.75	1	1	***	***	***	***
Yellow wagtail	0.5	1	1	1	3	1	1
Yellowhammer	1	1	1	4	4	3	3

App. IV Table 2. National trends (UK) and demographic drivers of change from BirdTrends and associated text, for high vulnerability species on the *BoCC3 W* list breeding in Wales.

Where information on trends is blank it is not currently produced due to small sample sizes. Information listed as “Text: nest predation” taken from further information provided in BirdTrends reviews or from JNCC’s Seabird population trends and causes of change report [SMP Report 1986–2019 | JNCC - Adviser to Government on Nature Conservation](#)

Species	BoCC3 W	Population Decline	Range Decline	Breeding failure trend (egg/chick data)	Productivity Trend	Breeding failure (text: nest predation)
Red grouse	Red	No	Yes			Predation from Corvids noted in some studies
Black grouse	Red	No	Yes			
Grey partridge	Red	Yes	Yes			Predation is a secondary driver
Corncrake	Red	Yes	Yes			
Golden plover	Red	Yes	Yes			
Lapwing	Red	Yes	Yes	Increasing (Egg)		Chick mortality is important in some studies
Curlew	Red	Yes	Yes	Decreasing (Egg)		Predation is a secondary driver, locally important
Dunlin	Red	Yes	No			
Common sandpiper	Red	Yes	No			
Redshank	Red	Yes	Yes	Decreasing (Egg)		Vulnerability to predators is suggested to increase due to habitat loss
Woodcock	Red	Yes	Yes			Drivers unknown
Little tern	Red	No	Yes			JNCC - predation (inc. corvid) driving low prod.
Roseate tern	Red	Yes	Yes			JNCC - predation may have played a role
Arctic tern	Red	No	Yes			JNCC - mink predation in West Scotland
Kittiwake	Red	Yes	No			JNCC - Crow predation noted in one location
Black-headed gull	Red	Yes	Yes			
Herring gull	Red	Yes	No			JNCC - ground predators at some colonies

Species	BoCC3 W	Population Decline	Range Decline	Breeding failure trend (egg/chick data)	Productivity Trend	Breeding failure (text: nest predation)
Great black-backed gull	Red	Yes	No			JNCC - some effects of mink on nests (low)
Turtle dove	Red	Yes	Yes			Predation not implicated
Cuckoo	Red	Yes	No			Predation not implicated
Short-eared owl	Red	Yes	Yes			
Lesser spotted woodpecker	Red	Yes	Yes			Predation but not by corvids one of several potential drivers
Kestrel	Red	Yes	No	Decreasing (Egg)	Increasing	Predation not implicated
Merlin	Red	Yes	Yes	Decreasing (Egg/Chicks)	Increasing	Predation not implicated
Willow tit	Red	Yes	Yes			Jays implicated in predation in one study
Marsh tit	Red	Yes	No	Decreasing (Egg)		Predation not implicated
Wood warbler	Red	Yes	No	Increasing (Chicks) Decreasing (Eggs)	Decreasing	Avian predators may be important
Willow warbler	Red	Yes	No	Increasing (Chicks)	Decreasing	Drivers uncertain
Whitethroat	Red	Yes	No			Predation not implicated
Grasshopper warbler	Red	Yes	No			Drivers uncertain
Starling	Red	Yes	No	Decreasing (Egg/Chicks)	Increasing	Predation not implicated
Ring ouzel	Red	No	Yes			Drivers uncertain
Spotted flycatcher	Red	Yes	No	Increasing (Chicks) Decreasing (Eggs)		Some evidence for importance from predator removal studies
Pied flycatcher	Red	Yes	No	Increasing (Chicks) Decreasing (Eggs)		Main drivers outside breeding season
Whinchat	Red	Yes	Yes	Increasing (Egg/Chicks)		Drivers of decline not understood
Tree sparrow	Red	Yes	Yes	Decreasing (Egg/Chicks)	Increasing	Factors operating during breeding season not main driver
Yellow wagtail	Red	Yes	Yes	Decreasing (Chicks)	Increasing	Predation not implicated as important driver
Bullfinch	Red	Yes	No			Possible role of predation, but by sparrowhawk

Species	BoCC3 W	Population Decline	Range Decline	Breeding failure trend (egg/chick data)	Productivity Trend	Breeding failure (text: nest predation)
Linnet	Red	Yes	No	Increasing (Egg/Chicks)	Decreasing	Predation not implicated
Yellowhammer	Red	Yes	Yes	Decreasing (Egg)	Increasing	Predation not implicated
Corn bunting	Red	Yes	No			Predation not implicated
Teal	Amber	No	Yes			
Red-breasted merganser	Amber	No	Yes			
Manx shearwater	Amber	No	Yes			Predation not implicated
Grey heron	Amber	No	Yes	Increasing (Egg)		Predation not implicated
Snipe	Amber	No	Yes	Decreasing (Egg)		Predator removal increased numbers in one study
Common tern	Amber	No	Yes			Predation but by rats and gulls may be important
Swift	Amber	Yes	No			Predation not implicated
Green woodpecker	Amber	Yes	Yes			Predation not implicated
Goldcrest	Amber	Yes	No			Predation not implicated
Long-tailed tit	Amber	Yes	No	Increasing (Chicks) Decreasing (Eggs)		Predation not implicated
Dipper	Amber	Yes	No	Decreasing (Egg)	Increasing	Predation not implicated
Grey wagtail	Amber	Yes	No	Decreasing (Egg/Chicks)	Increasing	Predation not implicated
Tree pipit	Amber	Yes	No	Decreasing (Egg)	Decreasing	High failure rate at chick stage implicates predation
Meadow pipit	Amber	Yes	No	Increasing (Egg) Decreasing (Chicks)	Decreasing	Predation not implicated
Hawfinch	Amber	Yes	No			
Greenfinch	Amber	Yes	No	Decreasing (Egg)		Predation not implicated
Twite	Amber	Yes	No			
Reed bunting	Amber	No	Yes	Increasing (Egg/Chicks)	Decreasing	Predation is secondary driver

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