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Scottish Raptor Monitoring Scheme Annual Report 2021 & 2022

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Front cover image: Female Peregrine (Angus Hogg).
Back cover image: Ospreys in Perthshire (Keith Brockie).

Foreword

Welcome to a combined 2021 & 2022 report. Finalising and publishing our first trends report combined with our 20th anniversary event unfortunately resulted in a delay in publishing the 2021 report and it was agreed we catch up with this double issue reporting on the 2021 and 2022 breeding seasons. Notable amongst the species summaries for reintroduced Red Kites and White-tailed Eagles, is that over 150 territories of the latter are now being checked annually and that kites have crossed the Southern Uplands from Dumfries & Galloway and are establishing in Ayrshire and Lanarkshire.

This report includes articles on the trends following publication in November last year of the report to highlight this important work. There is an interactive page on our website that allows comparison of trends between species and areas which is worth checking out. The reporting period saw the rise of Highly Pathogenic Avian Influenza (HPAI) in our wild bird populations. Whilst initially geese, and then seabirds, made the headlines there were concerns about other species, especially raptors and scavenging species which were likely to feed on sick or dead birds. The number of HPAI cases in raptors reported was much higher than in previous years and NatureScot commissioned BTO to analyse the SRMS data to look for any evidence of an HPAI impact. An article on this is also in this report. Having the SRMS in being made such analysis possible for Scotland unlike other parts of the UK where no similar scheme exists.

Another area where the SRMS is likely to be important in future is in relation to the Wildlife Management and Muirburn (Scotland) Bill which is going through the Scottish Parliament currently. This will introduce grouse moor licensing and a baseline for the favourable status of Golden Eagle, Peregrine and Hen Harrier will need to be set so that changes in status post the legislation can be measured.

As ever thanks to all those who have contributed records; to the partner organisations which provide funding, NatureScot, BTO, FLS, RSPB and SOC; and the partner representatives that help oversee the Scheme. Special thanks to Amy and colleagues at BTO Scotland for their hard work collating and analysing the data.

Andrew Stevenson (Chair of the Scottish Raptor Monitoring Scheme)
on behalf of the Scottish Raptor Monitoring Group.

Contents

1 ROUND-UP OF RAPTOR MONITORING SEASON IN 2021 & 2022

The Scottish Raptor Monitoring Scheme received 5,896 records of raptor home ranges checked in 2021, with a total of 5,708 records available to be used for SRMS reporting, thanks to data contributors giving explicit permission for their data to be used in this way. In 2022, the equivalent figures were 5,512 records received of which 5,297 were available for reporting. This represents a tremendous effort from SRMS contributors and is a significant increase in data submission from 2020. This section provides an overview of the two breeding seasons, setting the scene on the weather conditions and prey situation that Scottish raptors experienced in 2021 and 2022. Here we also provide a summary of the records received from each region of Scotland in both years, along with some species highlights, and provide links to more detailed information on the SRMS website.

WEATHER

2021 Met Office data showed that the winter preceding the 2021 breeding season was colder and wetter than average. January was the UK's coldest month since March 2013 and the lowest temperature of the year (-23.0 °C at Braemar, Aberdeenshire on February 11th), was the lowest recorded anywhere in the UK since 1995.

Rainfall was broadly close to average, though the western half of Scotland had a rather dry year with less than 80% of average rainfall.

Spring was colder than average which is likely to have been unfavourable for many breeding raptors.

2022 The November of 2021 that preceded the 2022 breeding season brought Storm Arwen, one of the most powerful and damaging storms of the last decade. Scottish Forestry reported windblow (falling trees) in at least 4,000 hectares of woodland. Such extensive damage is likely to have destroyed many former raptor breeding sites, particularly in eastern Scotland.

Spring was warmer than average, by up to 1.0 °C in most areas.

VOLE ABUNDANCE

Cyclic changes in the annual and seasonal abundance of voles can have a profound effect on the number of pairs and breeding success of a number of raptor and owl species (e.g. Petty *et al.* 2000; Lambin *et al.* 2000), particularly affecting Kestrel, Barn Owl and Short-eared Owl (Figure 1) (Village 1990; Korpimäki & Norrdahl 1991, Taylor 1994). If vole populations reach a peak during the spring, predator populations can respond with increases in the number of pairs settling to breed and corresponding increases in brood size, nesting success and productivity. Conversely, when vole numbers are low, the reverse can occur.

Figure 1: Kestrel in Ayrshire (Photo: Angus Hogg, South Strathclyde RSG).

There is a dearth of systematically collected information on variation in small mammal abundance across Scotland. Exceptions include monitoring carried out by Andrew Village at sites in the Scottish Borders. Andrew's results, and anecdotal information from many contributors to the SRMS suggested that 2021 was a particularly poor year for voles in many parts of Scotland, with vole abundance in 2022 being higher. This was based on observations of

breeding raptor behaviour as well as on sightings of small mammals or their signs. More data on small mammal abundance in Scotland would be useful to better understand the drivers of demographic rates in raptors.

Highly Pathogenic Avian Influenza

October 2021 marked the beginning of an outbreak of highly pathogenic avian influenza (HPAI) of the subtype H5N1 in wild birds, initially in wintering waterbirds and then in breeding seabirds and other species, including raptors. In Chapter 3 you can read more of how an analysis of SRMS data found declines in breeding success of two SRMS species consistent with impacts of avian influenza (Wilson *et al*., 2023).

Monitoring

In general, raptor workers try to visit known home ranges and other areas of suitable habitat several times before and during the breeding season, with the aim of establishing whether or not ranges are occupied. In 2021 a total of 5,708 raptor home ranges in Scotland were visited at least once to check for occupancy (Table 1), with the equivalent number in 2022 being 5,297 (Table 2). Figure 2 shows a summary of raptor monitoring coverage in 2021 and 2022, depicting 10-km squares where home ranges of one or more species were checked. Not all of these 10-km squares were found to hold pairs: some checked home ranges held single birds and others were apparently vacant. Tables 1 and 2 provide regional breakdowns of home ranges checked in 2021 and 2022.

Following occupancy checks, subsequent visits are made to confirm the findings of the first visit and to monitor the breeding status and outcome of birds present. Breeding success, normally expressed as the percentage of monitored breeding pairs rearing at least one offspring to independence, together with the mean fledged

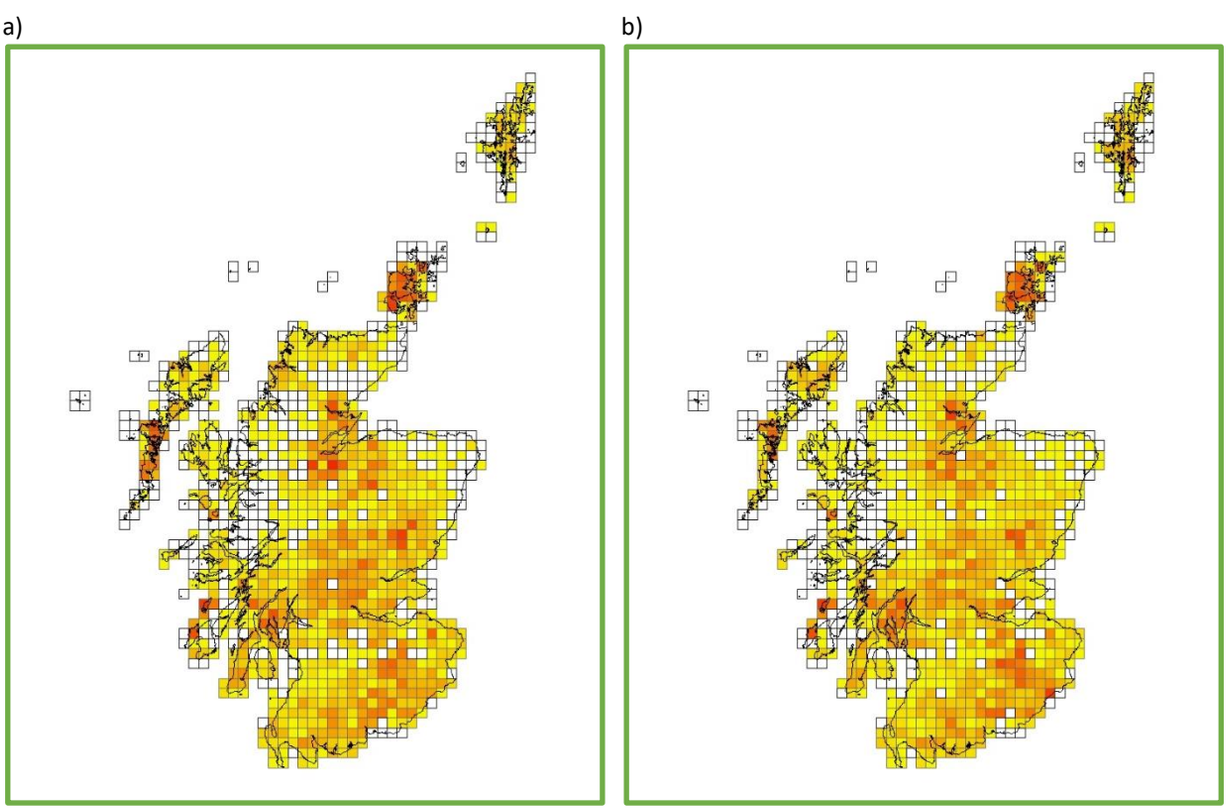

Figure 2: Raptor, owl and Raven monitoring coverage in Scotland in (a) 2021 and (b) 2022. These maps illustrate the number of SRMS species for which occupancy (or absence) was recorded for each 10-km square. The redder the square, the more species were covered. The maximum number of species checked for occupancy in a single square in 2021 was 11 and in 2022 was 10, from a total of 20 species. White squares received no monitoring records for that year. Note that this figure masks variation in coverage at finer geographic scales, and work is ongoing to improve our knowledge of coverage.

brood size, provides a measure of a population's breeding productivity. In 2021, 2,587 potential breeding pairs received further visits that enabled their nest success to be determined (Table 3), and in 2022, the equivalent figure was 2,707 (Table 4).

Species-specific and regional breakdowns showing the results of monitored breeding attempts can be found on the SRMS website, https://raptormonitoring.org/.

Data Submission

We are very pleased to report significant growth in submissions via SRMS Online and thank all recorders who are using the system and are helping to further improve it. SRMS Online is the preferred data entry system as it supports visit-by-visit recording, and direct data entry by recorders into the central database increases accuracy and significantly reduces the need for processing and the potential for errors. In 2020 only 3% of submissions contributing to SRMS reporting were made via SRMS Online. In 2021 27% of submissions contributing to SRMS reporting were made via SRMS Online and this increased to 38% in 2022. SRMS Online use increased across all SRMS regions that had used SRMS Online in 2021. Unfortunately, there has been no uptake of SRMS Online yet within a couple of SRMS regions where contributors continue to supply data via the standard Excel spreadsheet. It is positive to see that a proportion of records for every SRMS species is now reaching the Scheme via SRMS Online.

We are also very pleased to report that most contributors have now given express permission for their records to be used via the SRMS Registration Form (which became necessary following changes in privacy laws). Of the records received in 2021 and 2022, a small proportion (3% and 4%, respectively) came from contributors who had not given explicit permission for their records to be used for standard SRMS purposes. Unfortunately, we cannot use these records to inform the following species accounts, or for any other reporting, analysis or sharing with SRMS partners in line with our SRMS Data Sharing & Use Policy, unless and until this permission is given.

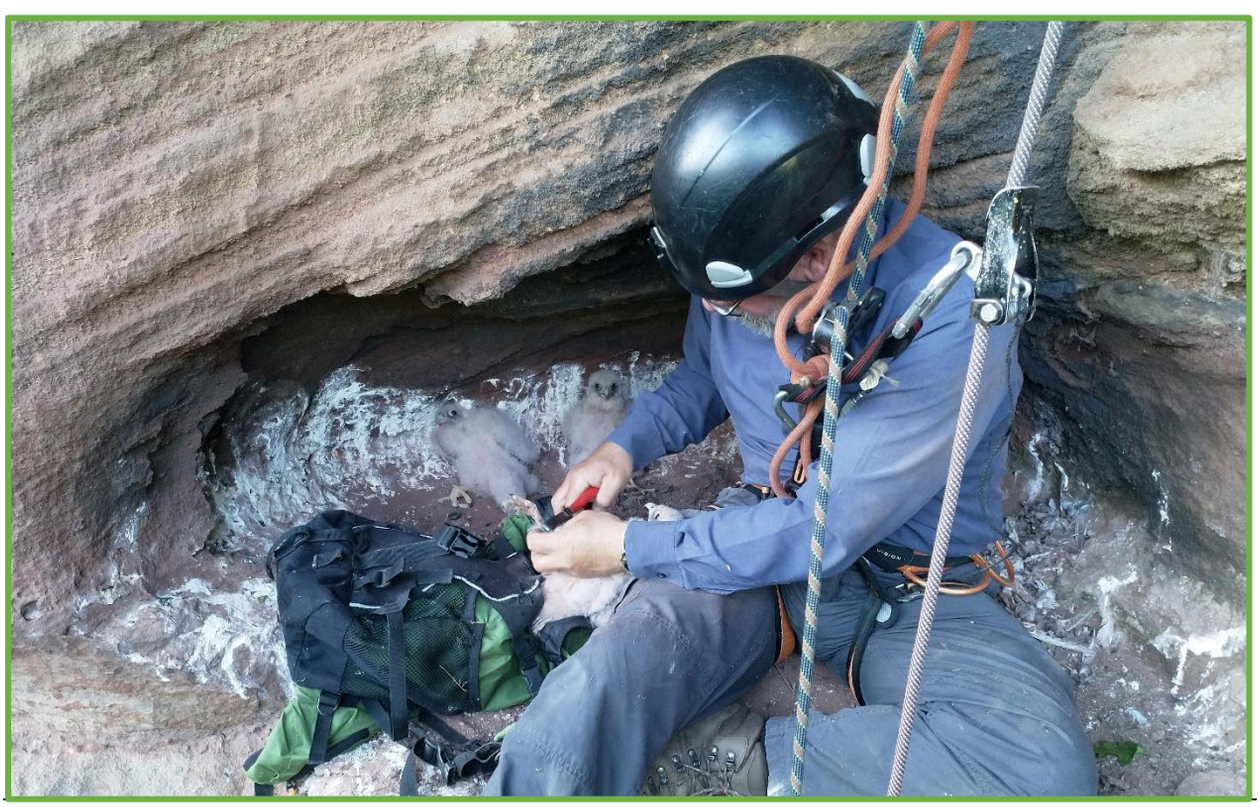

Figure 3: George Smith ringing and swabbing Peregrine chicks (Photo: Björn Beckmann, Lothian & Borders RSG).

Table 1: The number of home ranges of raptors, owls and Raven checked in 2021 that were submitted to the SRMS. For a given region and species combination a "-" indicates that the SRMS does not hold any previous records and "0" indicates that no records were provided for 2021 (but that SRMS does hold records from previous years). The most recent population estimates available for each species are also presented for context, where possible for Scotland, otherwise for a broader geographic region.

Species	Argyll	Central Scotland	Dumfries & Galloway	Highland	Lewis & Harris	Lothian & Borders	North-east Scotland	Orkney	Shetland	South Strathclyde	Tayside & Fife	Uist	TOTAL	Estimated population size (pairs)	Region estimate relates to	Year estimate relates to
Osprey	20	52	18	70	-	14	27	-	-	4	32	-	**237**	229	Scotland	2021[2]
Honey-buzzard	-	0	0	43	-	-	1	-	-	-	3	-	**47**	58	Scotland	2021[2]
Golden Eagle	52	13	1	116	19	3	0	2	-	1	29	14	**250**	508	Scotland	2015[4]
Sparrowhawk	10	27	3	24	0	29	0	36	19	9	15	8	**180**	30,500	UK	2016[9]
Goshawk	0	0	29	18	-	42	2	-	-	7	25	-	**123**	283	Scotland	2021[2]
Marsh Harrier	0	1	-	0	-	2	1	5	-	-	17	-	**26**	21	Scotland	2021[2]
Hen Harrier	53	10	21	58	12	8	12	250	-	12	53	18	**507**	460	Scotland	2016[10]
Red Kite	-	47	156	56	-	2	29	-	-	3	99	-	**392**	≥ 273	Scotland	2015[1]
White-tailed Eagle	41	2	-	67	28	-	2	2	-	-	3	14	**159**	150	Scotland	2021[2]
Buzzard	153	13	60	173	3	81	2	24	-	7	225	25	**766**	63,000–87,500	UK	2016[9]
Barn Owl	91	128	171	63	-	66	0	-	-	31	24	-	**574**	500–1000	Scotland	post 2004[5]
Tawny Owl	41	101	66	51	-	36	0	-	-	0	11	-	**306**	50,000	UK	2015[9]
Little Owl	-	-	-	-	-	1	-	-	-	-	-	-	**1**	<10	Scotland	2015[1]
Long-eared Owl	10	2	0	8	-	6	0	4	2	0	13	2	**47**	1,800–6,000	UK	2007-2011[9]
Short-eared Owl	12	0	0	9	1	15	0	139	1	2	41	8	**228**	620–2,200	UK	2007-2011[9]
Kestrel	43	21	21	35	0	16	2	61	-	0	53	14	**266**	2,750–5,500	Scotland	2013[6]
Merlin	3	8	14	68	2	43	76	82	49	6	43	4	**398**	733	Scotland	2008[3]
Hobby	-	-	0	0	-	3	-	-	-	-	3	-	**6**	2,050	UK	2016[9]
Peregrine	41	18	111	46	4	144	39	25	7	77	80	3	**595**	523 (479-592)	Scotland	2014[7]
Raven	110	50	58	60	12	35	1	50	55	47	90	32	**600**	3241 (1035–5447)	Scotland	2007-2011[8]
TOTAL:	**680**	**493**	**729**	**965**	**81**	**546**	**194**	**680**	**133**	**206**	**859**	**142**	**5708**			

Sources of estimated population sizes: [1]Challis *et al*. 2016; [2]Eaton *et al*. 2021; [3]Ewing *et al*. 2011; [4]Hayhow *et al*. 2017; [5]Shaw 2007; [6]Wilson *et al*. 2015; [7]Wilson *et al*. 2018; [8]Wilson *et al*. 2019; [9]Woodward *et al*. 2020; [10]Wotton *et al*. 2018.

Table 2: The number of home ranges of raptors, owls and Raven checked in 2022 that were submitted to the SRMS. For a given region and species combination a "-" indicates that the SRMS does not hold any previous records and "0" indicates that no records were provided for 2022 (but that SRMS does hold records from previous years). The most recent population estimates available for each species are also presented for context, where possible for Scotland, otherwise for a broader geographic region.

Species	Argyll	Central Scotland	Dumfries & Galloway	Highland	Lewis & Harris	Lothian & Borders	North-east Scotland	Orkney	Shetland	South Strathclyde	Tayside & Fife	Uist	TOTAL	Estimated population size (pairs)	Region estimate relates to	Year estimate relates to
Osprey	18	50	19	85	-	17	26	-	-	7	50	-	**272**	229	Scotland	2021[2]
Honey-buzzard	-	0	2	10	-	-	1	-	-	-	0	-	**13**	58	Scotland	2021[2]
Golden Eagle	51	13	2	129	32	4	0	2	-	0	31	9	**273**	508	Scotland	2015[4]
Sparrowhawk	27	27	2	22	3	9	8	39	26	8	15	2	**188**	30,500	UK	2016[9]
Goshawk	0	13	32	14	-	51	0	-	-	9	16	-	**135**	283	Scotland	2021[2]
Marsh Harrier	0	2	-	0	-	1	0	5	-	-	10	-	**18**	21	Scotland	2021[2]
Hen Harrier	42	3	12	40	24	8	13	247	-	37	36	25	**487**	460	Scotland	2016[10]
Red Kite	-	40	168	55	-	5	28	-	-	6	94	-	**396**	≥ 273	Scotland	2015[1]
White-tailed Eagle	37	2	-	67	26	-	1	1	-	-	2	9	**145**	150	Scotland	2021[2]
Buzzard	106	5	46	141	4	102	8	24	-	3	112	23	**574**	63,000–87,500	UK	2016[9]
Barn Owl	89	97	159	61	-	63	0	-	-	19	22	-	**510**	500–1000	Scotland	post 2004[5]
Tawny Owl	51	36	44	56	-	20	0	-	-	3	10	-	**220**	50,000	UK	2015[9]
Little Owl	-	-	-	-	-	0	-	-	-	-	-	-	**0**	<10	Scotland	2015[1]
Long-eared Owl	11	1	0	3	-	11	0	4	7	3	2	8	**50**	1,800–6,000	UK	2007-2011[9]
Short-eared Owl	11	0	0	4	4	3	0	177	6	0	32	9	**246**	620–2,200	UK	2007-2011[9]
Kestrel	17	51	15	31	2	43	0	56	-	9	41	5	**270**	2,750–5,500	Scotland	2013[6]
Merlin	1	6	12	44	15	29	72	75	52	3	31	2	**342**	733	Scotland	2008[3]
Hobby	-	-	0	0	-	0	-	-	-	-	5	-	**5**	2,050	UK	2016[9]
Peregrine	25	24	105	82	2	143	43	25	10	81	67	3	**610**	523 (479-592)	Scotland	2014[7]
Raven	119	42	49	38	3	48	1	40	64	40	70	29	**543**	3241 (1035–5447)	Scotland	2007-2011[8]
TOTAL:	**605**	**412**	**667**	**882**	**115**	**557**	**201**	**695**	**165**	**228**	**646**	**124**	**5297**			

Sources of estimated population sizes: [1]Challis *et al*. 2016; [2]Eaton *et al*. 2021; [3]Ewing *et al*. 2011; [4]Hayhow *et al*. 2017; [5]Shaw 2007; [6]Wilson *et al*. 2015; [7]Wilson *et al*. 2018; [8]Wilson *et al*. 2019; [9]Woodward *et al*. 2020; [10]Wotton *et al*. 2018.

Table 3: Raptor, Owl and Raven breeding attempts monitored under the Scottish Raptor Monitoring Scheme in 2021.

Species	Argyll	Central Scotland	Dumfries & Galloway	Highland	Lewis & Harris	Lothian & Borders	North-east Scotland	Orkney	Shetland	South Strathclyde	Tayside & Fife	Uist	TOTAL
Osprey	12	35	10	47	-	12	18	-	-	4	15	-	**153**
Honey-buzzard	-	0	0	7	-	-	1	-	-	-	0	-	**8**
Golden Eagle	44	7	1	86	15	1	0	1	-	1	17	9	**182**
Sparrowhawk	0	9	2	11	0	23	0	15	16	2	9	1	**88**
Goshawk	0	0	16	16	-	30	2	-	-	3	7	-	**74**
Marsh Harrier	0	0	-	0	-	0	1	2	-	-	13	-	**16**
Hen Harrier	17	4	7	21	9	3	7	81	-	6	17	9	**181**
Red Kite	-	24	70	43	-	2	14	-	-	3	44	-	**200**
White-tailed Eagle	40	1	-	54	19	-	2	0	-	-	2	12	**130**
Buzzard	35	2	28	114	0	58	0	15	-	6	104	15	**377**
Barn Owl	10	40	52	48	-	36	0	-	-	15	15	-	**216**
Tawny Owl	8	10	7	31	-	7	0	-	-	0	9	-	**72**
Little Owl	-	-	-	-	-	0	-	-	-	-	-	-	**0**
Long-eared Owl	4	1	0	6	-	4	0	0	1	0	3	0	**19**
Short-eared Owl	0	0	0	5	1	4	0	20	1	1	8	0	**40**
Kestrel	12	16	8	23	0	12	1	9	-	0	12	5	**98**
Merlin	1	0	6	31	0	18	28	12	27	3	7	2	**135**
Hobby	-	-	0	0	-	0	-	-	-	-	2	-	**2**
Peregrine	19	5	56	10	1	46	12	9	1	33	36	2	**230**
Raven	55	32	30	42	5	19	1	42	35	28	57	20	**366**
TOTAL:	**257**	**186**	**293**	**595**	**50**	**275**	**87**	**206**	**81**	**105**	**377**	**75**	**2587**

Table 4: Raptor, Owl and Raven breeding attempts monitored under the Scottish Raptor Monitoring Scheme in 2022.

Species	Argyll	Central Scotland	Dumfries & Galloway	Highland	Lewis & Harris	Lothian & Borders	North-east Scotland	Orkney	Shetland	South Strathclyde	Tayside & Fife	Uist	TOTAL
Osprey	10	31	11	65	-	13	20	-	-	5	32	-	**187**
Honey-buzzard	-	0	0	3	-	-	1	-	-	-	0	-	**4**
Golden Eagle	45	9	2	95	31	2	0	1	-	0	22	4	**211**
Sparrowhawk	6	12	1	17	0	8	6	19	20	5	4	1	**99**
Goshawk	0	11	21	11	-	35	0	-	-	6	7	-	**91**
Marsh Harrier	0	2	-	0	-	0	0	2	-	-	8	-	**12**
Hen Harrier	18	2	6	21	15	4	9	89	-	3	11	15	**193**
Red Kite	-	22	124	39	-	4	20	-	-	4	41	-	**254**
White-tailed Eagle	33	2	-	58	25	-	1	1	-	-	2	6	**128**
Buzzard	30	2	22	84	1	85	2	12	-	2	66	9	**315**
Barn Owl	40	58	57	41	-	49	0	-	-	8	16	-	**269**
Tawny Owl	13	22	18	31	-	15	0	-	-	2	7	-	**108**
Little Owl	-	-	-	-	-	0	-	-	-	-	-	-	**0**
Long-eared Owl	2	1	0	3	-	9	0	2	0	3	0	1	**21**
Short-eared Owl	1	0	0	1	1	0	0	38	2	0	0	1	**44**
Kestrel	5	42	9	17	1	26	0	14	-	6	10	0	**130**
Merlin	0	0	2	16	9	9	28	10	31	0	6	1	**112**
Hobby	-	-	0	0	-	0	-	-	-	-	2	-	**2**
Peregrine	9	11	44	23	0	47	20	10	1	28	32	2	**227**
Raven	54	20	23	26	1	34	1	29	29	23	41	19	**300**
TOTAL:	**266**	**247**	**340**	**551**	**84**	**340**	**108**	**227**	**83**	**95**	**307**	**59**	**2707**

SPECIES SUMMARIES

Throughout this report the names of birds follow the SOC list of English vernacular names (http://www.the-soc.org.uk/bird-recording/the-scottish-list/).

The following species accounts draw principally on the information presented in our SRMS summary tables which can be accessed on the SRMS website (https://raptormonitoring.org/annual-report).

If you have a genuine need for a printed copy of the tables and do not have access to a printer, then you can request a copy from the SRMC – srmc@bto.org

These tables summarise the records which the SRMS has received in the standard SRMS format and have therefore passed through our quality assurance processes as set out in the SRMS Data Sharing & Use Policy (see https://raptormonitoring.org/srms-data/data-sharing-use-policy).

It is important to recognise that, for the majority of species, **not all breeding pairs were monitored. This means that the numbers presented do not represent absolute population size or provide a complete picture of breeding productivity, at either regional or national scales**. Tables 1 and 2 provide the most recent population estimates available for each species to help contextualise the SRMS data.

Osprey

Thanks to the efforts of SRMS contributors, a large proportion of the estimated total breeding population of Ospreys in Scotland is monitored annually (Tables 1 and 2). This is allowing the Scheme to calculate several national and regional trends for the species (see Chapter 2). Nevertheless, our ability to report on trends for Osprey would benefit further from additional study areas across its range as the species continues to expand successfully. Some important monitoring datasets are not currently shared with the Scheme.

Figure 4: Osprey in Perthshire in 2022 (Photo: Robin Manson, Tayside & Fife RSG).

2021 167 of 237 checked home ranges were occupied by pairs. A further 17 home ranges were occupied by single birds. Of 153 pairs that were monitored, 144 were confirmed as having laid eggs. 112 of these went on to fledge a minimum total of 223 young.

2022 202 of 272 checked home ranges were occupied by pairs. A further 10 home ranges were occupied by single birds. Of 187 pairs that were monitored, 172 were confirmed as having laid eggs. 151 of these went on to fledge a minimum total of 310 young.

Honey-buzzard

Honey-buzzard continues to be a very under-recorded species in Scotland, though over recent years the species has received increasing attention through a national survey organised by Honey-buzzard experts on behalf of the RBBP. While a couple of studies for this species have been established in Tayside & Fife and in Central Scotland since 2017 (McInerny *et al*. 2017; Shaw *et al*. 2017 and McInerny *et al*. 2018) the data from these are not fully shared with the SRMS (and so do not appear in our summary tables).

2021 We saw a further increase in Honey-buzzard records reported to the SRMS in 2021 as the national survey started in 2020 was extended. 11 of 47 checked home ranges were occupied by pairs with a further 11 occupied by single birds. Of the 8 pairs that were monitored, six were known to lay eggs, fledging a minimum of eight young between them.

2022 Following the peak of 47 home ranges checked in 2021, we received records of only 13 checked home ranges in 2022. Five of these were occupied by pairs and a further seven occupied were by single birds. The four pairs that were monitored went on to successfully fledge at least one chick each.

Golden Eagle

Golden Eagle is monitored widely across Scotland, and home ranges of a substantial proportion of the estimated total breeding population are checked annually by SRMS contributors (Tables 1 and 2). This enables the Scheme to calculate trends in Golden Eagle productivity nationally and in several regions, and trends in numbers of breeding pairs in some regions (Chapter 2). Nevertheless, some important monitoring data are not currently shared with the SRMS and some large areas of mainland Scotland have inconsistent coverage, limiting the Scheme's ability to produce comprehensive regional and national trends in breeding numbers and productivity.

The South of Scotland Golden Eagle Project continues to bolster the population in Southern Scotland. Released birds are beginning to settle even if they do not as yet appear in the SRMS data to show the positive signs for the project. A study suggested that Southern Scotland could support a minimum of 11-16 pairs (Fielding & Haworth 2014).

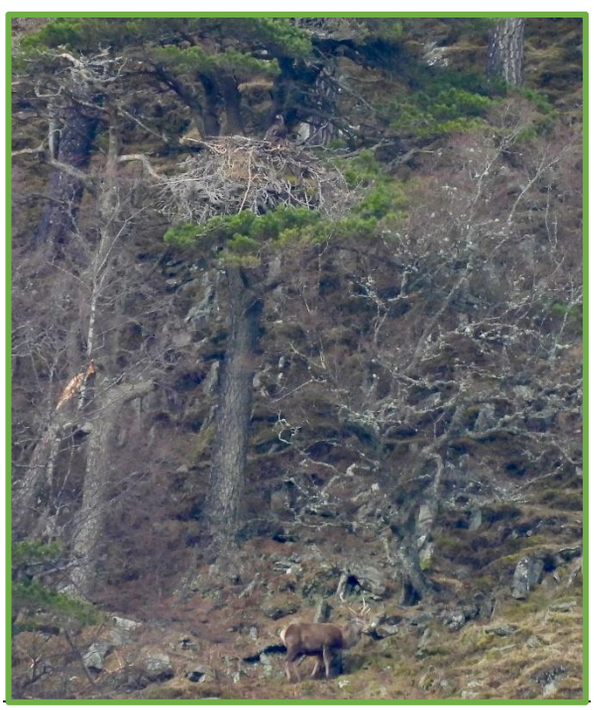

Figure 5: Golden Eagle eyrie in 2021 (Photo: Keith Brockie, Tayside & Fife RSG).

2021 208 of 250 checked home ranges were occupied by pairs, with single birds or fresh signs reported from a further 24 home ranges. Of 182 pairs that were monitored, 30 failed early or did not breed. 139 pairs were confirmed to lay eggs, of which 99 went on to fledge a minimum total of 115 young.

2022 238 of 273 checked home ranges were occupied by pairs, with single birds or fresh signs reported from a further 19 home ranges. Of 211 pairs that were monitored, 76 failed early or did not breed. 117 pairs were confirmed to lay eggs, of which 60 went on to fledge a minimum total of 64 young.

Sparrowhawk

As a common and widespread but secretive species, Sparrowhawk is challenging to monitor. In relation to its estimated total population size, Sparrowhawk still receives limited attention and our ability to report on regional and national trends in breeding numbers and productivity would benefit from more study areas across its range. This is one of the key species for which the SRMS is trying to improve coverage through our *Raptor Patch* initiative.

2021 103 of 180 checked home ranges were occupied by pairs. Of these, 88 pairs were monitored, 84 of which were confirmed to lay eggs. A total of 74 pairs went on to fledge a minimum total of 166 young. Three years after Sparrowhawks were first recorded breeding successfully on Shetland in 2018 it is heartening to see that as many as 16 pairs are now being monitored, with 11 pairs fledging 30 young.

2022 107 of 188 checked home ranges were occupied by pairs. Of these, 99 pairs were monitored, 92 of which were confirmed to lay eggs. A total of 77 pairs went on to fledge a minimum total of 197 young.

Goshawk

Relative to the estimated population total, coverage of Goshawk by SRMS contributors is much greater than for its smaller cousin the Sparrowhawk (Tables 1 and 2). Nevertheless, our ability to report on regional and national trends in breeding numbers and productivity of Goshawk would benefit from additional study areas across its range. Some important monitoring data for this species are not currently shared with the Scheme.

2021 82 of 123 checked home ranges were occupied by pairs, with single birds or fresh signs reported from a further 22 home ranges. Of 74 pairs that were monitored, 69 were confirmed to lay eggs. 48 of these went on to fledge a minimum total of 72 young.

2022 98 of 135 checked home ranges were occupied by pairs, with single birds or fresh signs reported from a further 18 home ranges. Of 91 pairs that were monitored, 85 were confirmed to lay eggs. 67 of these went on to fledge a minimum total of 116 young.

Figure 6: Goshawk chick in 2021 (Photo: Robin Manson, Tayside & Fife RSG).

Marsh Harrier

Marsh Harrier continues to be a scarce breeder and passage migrant in Scotland.

2021 18 of 26 checked home ranges were occupied by pairs. Of 16 pairs monitored across Scotland, ten pairs were known to lay eggs, all of which went on to successfully fledge, with a minimum total of 23 fledglings.

2022 13 of 18 checked home ranges were occupied by pairs. Of 12 pairs monitored across Scotland, ten pairs were known to lay eggs and 8 went on to successfully fledge a minimum total of 23 young.

Figure 7: Female Hen Harrier in the Scottish Borders (Photo: Ian Poxton, Lothian & Borders RSG).

Hen Harrier

Hen Harrier is monitored very widely across Scotland thanks to the efforts of SRMS contributors, and additionally, several recent national surveys. There remain some important geographical gaps in annual monitoring (e.g. in Caithness, East Sutherland and NE Scotland) where additional study areas would improve the Scheme's ability to produce regional and national trends in breeding numbers and productivity.

The latest national survey for Hen Harrier took place in 2023. This was coordinated by RSPB as part of the Statutory Conservation Agency and RSPB Annual Breeding Bird Scheme (SCARABBS) programme. The previous national survey in 2016 found that Scotland held the majority of the UK population of 460 (95% confidence intervals 359-573) territorial pairs, which constituted a statistically non-significant decline of 9% since the previous survey in 2010.

2021 201 of 507 checked home ranges were occupied by pairs with a further 47 ranges occupied by single birds. Of 181 pairs that were monitored, 136 were confirmed to lay eggs, 85 of which went on to fledge a minimum total of 203 young.

2022 212 of 487 checked home ranges were occupied by pairs with a further 37 ranges occupied by single birds. Of 193 pairs that were monitored, 151 were confirmed to lay eggs, 97 of which went on to fledge a minimum total of 268 young.

Red Kite

Red Kite was reintroduced to Scotland in 1989. The species is widely and effectively monitored in much of its core current Scottish range by SRMS contributors. A challenge for the future will be to ensure that appropriate monitoring is carried out as densities increase further in the current range and in areas where the breeding range is expanding.

2021 285 of 392 checked home ranges were occupied by pairs. Home ranges were checked in a total of 110 separate 10x10 km squares. 13 of these squares were checked for the first time in 2021, reflecting the continuing successful range expansion of the species - and reflecting the monitoring efforts in tracking this expansion,

which continue to expand thanks to the efforts of recorders. Of 200 pairs that were monitored across Scotland, 195 were confirmed to lay eggs. 166 pairs went on to fledge a minimum total of 260 young.

2022 298 of 396 checked home ranges were occupied by pairs. Home ranges were checked in nine further 10x10 km squares compared to 2021, reflecting the continued expansion of this species. Among these were the first breeding Red Kites recorded in Ayrshire since the 19th century, where three pairs were monitored and a minimum of four young successfully fledged. Of 254 pairs that were monitored across Scotland, 235 were confirmed to lay eggs. 206 of these went on to fledge a minimum total of 305 young.

It is interesting to note the close proximity within which some pairs of Red Kite are successfully breeding, for example, in 2021 two pairs each fledged chicks within 30m of each other in D&G. The species is well known to form loose colonies or clusters of breeding pairs (Hardey et al. 2013). This is an aspect of the records which could be explored more generally as the increasing capture of higher precision grid references (which are readily accommodated via our online data entry system, SRMS Online) makes this possible.

White-tailed Eagle

White-tailed Eagle was reintroduced to Scotland in 1975. SRMS contributors currently achieve very good coverage of much of the population, allowing the calculation of national and several regional trends in both breeding numbers and productivity (Chapter 2). A challenge for the future will be to ensure appropriate monitoring can be maintained and expanded as the species further successfully increases its breeding range.

2021 143 of 159 checked home ranges were occupied by pairs. Home ranges were checked in a total of 121 separate 10x10 km squares. 12 of these squares were checked for the first time in 2021, reflecting the continuing successful range expansion of the species - and reflecting the monitoring efforts in tracking this expansion, which continue to expand thanks to the efforts of recorders. Of 130 pairs that were monitored, 123 were confirmed to lay eggs, 89 of which fledged a minimum total of 112 young.

2022 140 of 151 checked home ranges were occupied by pairs. Home ranges were checked in five further 10x10 km squares compared to 2021. Of 132 pairs that were monitored, 114 were confirmed to lay eggs, 60 of which fledged a minimum total of 72 young.

Buzzard

As the most common raptor in Scotland, Buzzard is inherently challenging to monitor adequately, and even though it often receives the highest number of annual records of any SRMS species, this represents only a small fraction of the estimated total population (Tables 1 and 2). Like for other common and widespread species in particular, our ability to report on regional and national trends in breeding numbers and productivity of Buzzard would benefit from additional focused study areas, particularly south of the Central Belt and in Angus and the North-East, where Buzzard abundance is high. Large parts of the Highlands and islands are also not adequately represented. Buzzard is one of the key species for which the SRMS is trying to improve coverage through our *Raptor Patch* initiative.

2021 472 of 766 checked home ranges were occupied by pairs, with a further 53 ranges occupied by single birds. Of 377 monitored pairs, 338 were confirmed to lay eggs. 291 of these went on to fledge a minimum total of 439 young.

2022 373 of 574 checked home ranges were occupied by pairs, with a further 27 ranges occupied by single birds. Of 315 pairs that were monitored, 290 were confirmed to lay eggs. 237 of these fledged a minimum total of 357 young.

Figure 8: Buzzard in Ayrshire (Photo: Angus Hogg, South Strathclyde RSG).

Barn Owl

SRMS contributors are monitoring a significant proportion of the estimated breeding population of Barn Owls in Scotland, including through active nest box schemes in several regions (Tables 1 and 2). Nevertheless, our ability to report on regional and national trends in breeding numbers and productivity of Barn Owl would benefit from additional study areas across many parts of its Scottish range (with the exception of parts of southern and central Scotland).

2021 233 of 574 checked home ranges were occupied by pairs, with a further 77 sites occupied by single birds. Of 216 pairs that were monitored, 184 were confirmed to lay eggs, 142 of which went on to fledge a minimum total of 286 young.

2022 290 of 510 checked home ranges were occupied by pairs, with a further 39 sites occupied by single birds. Of 269 pairs that were monitored, 257 were confirmed to lay eggs, 227 of which went on to fledge a minimum total of 654 young.

Tawny Owl

Tawny Owl is well monitored in several local study areas, including through active nest box schemes. As a widespread and common species, however, our ability to report on regional and national trends in breeding numbers and productivity of Tawny Owl would benefit from more study areas across many parts of Scotland.

2021 79 of 306 checked home ranges were occupied by pairs. Of 72 pairs that were monitored, 69 were confirmed to lay eggs. 45 of these went on to fledge a minimum total of 74 young.

2022 121 of 220 checked home ranges were occupied by pairs. Of 108 pairs that were monitored, all were confirmed to lay eggs. 95 of these went on to fledge a minimum total of 156 young.

Little Owl

Little Owl is a scarce breeding bird in Scotland.

2021 A single record was received for a nest site checked in the Scottish Borders which was found to be vacant.

2022 No records were received.

Long-eared Owl

Long-eared Owl is a widespread but scarce and challengingly secretive species to monitor and is therefore thought to be severely under-recorded throughout its range, which includes all regions of Scotland.

2021 25 of 47 checked home ranges were occupied by pairs. Of 19 pairs that were monitored, all laid eggs and 18 went on to fledge a minimum total of 36 young. 2021 saw a successful breeding attempt in Shetland, the first reported to the SRMS (the only other successful breeding attempt in the Northern Isles reported to SRMS having been in 2016 in Orkney).

2022 31 of 50 home ranges checked were occupied by pairs. Of 21 pairs that were monitored, 20 laid eggs and 19 went on to fledge a minimum total of 32 young.

Short-eared Owl

Short-eared Owl is a challenging species to survey systematically. Yearly variation in the distribution and local abundance of this nomadic owl species is closely tied to patterns in the abundance of its small mammal prey. Breeding Short-eared Owls are quick to move away from

areas where voles are scarce and to colonise areas where voles are more abundant.

2021 51 of 228 checked home ranges were occupied by pairs, with a further 61 home ranges occupied by single birds. Of 40 pairs that were monitored, 20 were confirmed to lay eggs. 18 of these went on to fledge a minimum total of 29 young.

2022 52 of 246 checked home ranges were occupied by pairs, with a further 76 home ranges occupied by single birds. Of 44 pairs that were monitored, 24 were confirmed to lay eggs. 19 of these went on to fledge a minimum total of 29 young.

Kestrel

Like several other widespread and common raptor species, Kestrel is challenging to monitor adequately. Thanks to the efforts of SRMS contributors, the species is monitored well in a number of local study areas, but these represent a small proportion of the estimated total breeding population (Tables 1 and 2). Our ability to report on regional and national trends in breeding numbers and productivity of Kestrel would benefit from more study areas, particularly in much of the Highlands, North East Scotland and also much of central and southern Scotland. Kestrel is one of the key species for which the SRMS is trying to improve coverage through our *Raptor Patch* initiative.

2021 150 of 266 checked home ranges were occupied by pairs. Of 98 pairs that were monitored, 93 were confirmed to lay eggs. 81 of these went on to fledge a minimum total of 208 young.

2022 157 of 270 checked home ranges were occupied by pairs. Of 130 pairs that were monitored, 111 were confirmed to lay eggs. 101 of these went on to fledge a minimum total of 361 young.

Merlin

Merlin is monitored very widely across Scotland thanks to the efforts of SRMS contributors. Nevertheless, additional geographic coverage, particularly of some northern and western areas would further improve the regional and national trends in breeding numbers and productivity that the Scheme can produce.

2021 157 of 398 checked home ranges were occupied by pairs. Of 135 pairs that were monitored, 116 were confirmed to lay eggs. 86 of these went on to fledge a minimum total of 223 young.

2022 129 of 342 checked home ranges were occupied by pairs. Of 112 pairs that were monitored, 108 were confirmed to lay eggs. 86 of these went on to fledge a minimum of 225 young.

Hobby

Hobby is a scarce summer visitor to Scotland, with small numbers of records reaching the SRMS each year. This migrant breeder has significantly increased its range in the UK in recent decades and may well become a more widespread breeder in Scotland.

2021 We received records of six checked home ranges; three in Lothian & Borders and three in Angus. Two pairs were monitored in Angus, each of them successfully fledging 2 young each.

2022 We received records of five checked home ranges, all in Angus. Two pairs were monitored in Angus, each of them successfully fledging 3 young.

Peregrine

Peregrine is one of the most comprehensively monitored raptor species in Scotland thanks to the efforts of SRMS contributors. Nevertheless, additional geographic coverage of the Highland region and some other areas (including urban areas) would further improve the regional and national trends in breeding numbers and productivity that the Scheme can produce.

2021 264 of 595 checked home ranges were occupied by pairs, with single birds or fresh signs reported from a further 49 home ranges. Of 230 pairs monitored, 189 were confirmed to lay eggs

and 157 went on to fledge a minimum total of 336 young.

2022 265 of 610 checked home ranges were occupied by pairs, with single birds or fresh signs reported from a further 72 home ranges. Of 227 pairs monitored, 181 were confirmed to lay eggs and 151 went on to fledge a minimum total of 330 young.

Raven

Raven is the Scheme's honorary raptor - it is actually a songbird!

Figure 9: Raven in Fife (Photo: Harry Bell, Tayside & Fife RSG).

SRMS contributors check a large number of territories annually, but these nevertheless represent only a small proportion of the overall estimated population, which is continuing to successfully expand further (Tables 1 and 2). Our ability to report on regional and national trends in breeding numbers and productivity would benefit from further coverage, particularly in the northern half of Scotland and in eastern areas which the species is recolonising. Along with Buzzard, Kestrel and Sparrowhawk, Raven is a species for which the SRMS is trying to improve coverage through the *Raptor Patch* initiative.

2021 466 of 600 checked home ranges were occupied by pairs. Of 366 monitored pairs, 296 were confirmed to lay eggs. 285 of these went on to fledge a minimum total of 709 young.

2022 391 of 543 checked home ranges were occupied by pairs. Of 300 monitored pairs, 255 were confirmed to lay eggs. 231 of these went on to fledge a minimum total of 598 young.

Scarcer species

No records of breeding attempts by irregular breeders such as Snowy Owl, Pallid Harrier and Montagu's Harrier were reported to the SRMS for the 2021 or 2022 breeding seasons.

2 TRENDS IN BREEDING NUMBERS & PRODUCTIVITY

A key objective for the Scottish Raptor Monitoring Scheme is to provide robust information on Scottish raptor populations, in order to report on trends in numbers, range and productivity and also to understand the causes of population changes and constraints on raptor populations. Such trends are important, as they allow us to monitor the health of our raptor populations, understand the causes of population change, and identify problems that conservation NGOs, statutory agencies and ultimately Scottish Government can act on to protect these raptors. This section of the report aims to provide a concise summary of all current trend information available for Scottish raptors as a one-stop shop for stakeholders. The ability of the Scheme to produce robust trends is likely to gain added importance with the introduction of grouse moor licensing (see Foreword).

BACKGROUND

The SRMS aims *"to provide robust information on Scottish raptor populations to determine trends in numbers, range, survival and productivity, and to understand the causes of population change"*. Of these, survival is the hardest to monitor, so the SRMS has concentrated on developing trends in breeding numbers and productivity using the annual monitoring contributions of more than 800 observers across Scotland.

In 2022, to coincide with the SRMS's 20th anniversary, we were delighted to be able to publish a first definitive set of national (Scottish) and regional (SRMS Regions and Natural Heritage Zones) trends in breeding numbers and productivity, making the best possible use of breeding records collected by the SRMS since its inception. The trends cover the period 2009-2018 and are summarised in a standalone report (Challis *et al*., 2022).

Detailed trend information is published on the SRMS website (https://raptormonitoring.org/trends) where you can access trends summarised by species, by region or by parameter, and can explore and compare trends using an interactive tool (https://raptormonitoring.org/trends/explore-trends-interactively).

In this chapter we outline the national and regional (SRMS regions) trends that are available for the SRMS for the period 2009-2018 and discuss how we are going to take forward work on trends over the next few years.

NATIONAL TRENDS

National trends in breeding numbers are available only for White-tailed Eagle (Table 5). National trends in breeding success, clutch size, brood size and the number of fledglings are available for only Osprey, Golden Eagle and White-tailed Eagle (Table 6).

REGIONAL TRENDS

While it was not possible to produce SRMS regional trends for every combination of species and the regions in which they are known to occur, trends are available for a broad suite of species-region combinations. Trends for all species except Sparrowhawk are available in at least one region, including all 12 SRMS Regions apart from Shetland (Tables 5-6). Regional trends for Natural Heritage Zones (NHZs) can be viewed on the SRMS website.

NEXT STEPS

From April 2024 the SRMS will be starting the first year of a new three-year work plan, comprising projects and tasks agreed by all Scheme partners. These will include a repeat of the trends analysis to bring it up to date, taking

in suitable data that have been collected from 2019 onwards. In addition to looking at national and regional trends we are also keen to assess the suitability of SRMS data for producing trends in breeding numbers and productivity of raptors in designated sites (e.g. Special Protection Areas and Sites of Special Scientific Interest) where raptors are qualifying features.

Our report also points to the fact that, for many raptor species that breed in Scotland, representative national trends would require existing monitoring to be expanded or otherwise optimised.

The SRMS partnership is keen to take forward work to enhance data collection to better support the production of a more comprehensive set of trends in the future.

We will be establishing a group to facilitate sharing of ideas and discussions between existing data contributors and all SRMS partners about ways in which we can optimise and improve raptor monitoring coverage. To help with this, we are preparing a series of maps showing SRMS data (mean home ranges checked per year) together with Bird Atlas abundance. These maps will show where survey intensity was considered high enough to contribute to the drawing of regional and national trends. We hope that these maps may (i) help to explain why some SRMS data did not contribute to the trends analysis, (ii) stimulate conversations about the extent and intensity of monitoring in the areas that have contributed to trends analysis and (iii) inform thinking about ways to optimise monitoring coverage. We are particularly keen to identify ways of making monitoring more effective and valuable (without increasing surveyor effort, as we know that many SRMS contributors are working flat out to cover sites in many areas as it is).

We will also consider a range of options for increasing the information coming to the SRMS from areas where we currently have little or no data being reported. For the more widespread species (such as Buzzard, Kestrel, Sparrowhawk and Raven) this will include promotion of our *RaptorPatch* initiative. Resources permitting, we are planning to formally launch *RaptorPatch* for the 2025 breeding season once a finalised sampling and survey methodology has been agreed.

We are also keen to continue to support the increasing number of data contributors supplying their data via SRMS Online, our online data entry system. The increasing proportion of records reaching us via SRMS Online will over time, increase the value of SRMS data for understanding changes in raptor populations.

One aspect of SRMS Online that can enhance data is that it allows users to set up Study Areas and to record their survey effort within these. This allows us to understand more about the areas being monitored and any changes in coverage between years. Over time, this information will enable us to draw on a greater proportion of SRMS records when calculating trends and make them more representative and robust.

If you are an SRMS Online user, please capture your Study Area in SRMS Online and record your monitoring effort against it. If you are comprehensively surveying a relatively large area, which has perhaps a relatively low density of territories within it, it may have been excluded from our previous analysis due to it not meeting threshold criteria, however, having the effort information captured might mean that it is suitable for future trends analysis.

Another feature of SRMS Online that can enhance trends production is visit-by-visit data recording. Trend robustness can be undermined by variation in the number, duration, and timing of visits as well as the effort spent searching for new nest sites. Knowing when visits took place and what was observed on each occasion allows us to take account of this variation during trend production and can also improve our estimates

of breeding success and other relevant parameters. For example, this information can be used to work out the length of time between breeding attempts being detected and outcomes being recorded, which in turn can be used to calculate daily nest survival rate. This is widely recognised as a more robust measure of breeding success (when comparing this between different groups of territories, or over time) than simply using the proportion of nests that successfully fledge young.

Table 5: Summary of SRMS regional trends for the number of breeding pairs during 2009-2018. Figures in parentheses indicate the annual change, with significant increases (Inc) highlighted in green, significant decreases (Dec) highlighted in blue and non-significant (NS) changes highlighted in grey. 'NL' indicates non-linear trends. '—' indicates where the species occurs but no trend is available. 'ND' indicates where the SRMS does not hold any records for the region of interest. 'Abs' indicates where the species is not known to breed.

	Osprey	Golden Eagle	Sparrowhawk	Goshawk	Hen Harrier	Red Kite	White-tailed Eagle	Buzzard	Barn Owl	Tawny Owl	Kestrel	Merlin	Peregrine	Raven
Scotland	—	—	—	—	—	—	**Inc [ax] (5.4%)**	—	—	—	—	—	—	—
SRMS Region:														
Argyll	NS [s]	—	—	—	NS	ND	**Inc [ax] (5.8%)**	**Dec (-4.2%)**	—	—	—	—	**Dec [s] (-11%)**	NS
Central	NS	NS [s]	—	—	—	NS [x]	Abs	—	**Dec [ns] (-42.5%)**	—	—	—	NS [s]	—
Dumfries & Galloway	—	—	—	NS [s]	NS [s]	**Inc [x] (4%)**	Abs	—	**Dec [n] (-5.9%)**	NS	—	—	NS	**Inc (5.4%)**
Highland	**Inc (4.9%)**	NS	—	—	**Dec (-9.4%)**	**Dec (-10.8%)**	NS [ax]	NS	—	NS [ns]	—	NS	—	—
Lewis & Harris	Abs	—	—	Abs	—	Abs	NS [asx]	—	Abs	Abs	—	—	—	—
Lothian & Borders	—	—	—	—	—	—	Abs	—	—	—	—	NS	NS	NS [s]
North East Scotland	NS [s]	—	—	—	—	NS [sx]	—	—	—	—	—	NS	NS	—
Orkney	Abs	Abs	—	Abs	NL	Abs	—	—	Abs	Abs	NL	NS	NS [s]	—
Shetland	Abs	Abs	—	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs	—	—	—
South Strathclyde	—	—	—	—	**Dec (-27%)**	—	Abs	—	NS [ns]	—	—	—	NS	NS
Tayside & Fife	NS [s]	NS [s]	—	—	NS	NL	—	**Dec (-4.5%)**	—	—	—	NS [sv]	**Dec (-4.1%)**	NS
Uist	Abs	NS [s]	—	Abs	—	Abs	NS	—	Abs	Abs	—	—	—	NS [sv]

[a] All data used, [n] Nestbox based, [r] No home range random effect, [s] Sample sizes small, [v] Variable effort, [x] Expanding population.

Table 6: Summary of SRMS regional trends for breeding success during 2009-2018. Figures in parentheses indicate the annual change, with significant increases (Inc) highlighted in green, significant decreases (Dec) highlighted in blue and non-significant (NS) changes highlighted in grey. 'NL' indicates non-linear trends. '—' indicates where the species occurs but no trend is available. 'ND' indicates where the SRMS does not hold any records for the region of interest. 'Abs' indicates where the species is not known to breed.

	Osprey	Golden Eagle	Sparrowhawk	Goshawk	Hen Harrier	Red Kite	White-tailed Eagle	Buzzard	Barn Owl	Tawny Owl	Kestrel	Merlin	Peregrine	Raven
Scotland	Non-linear	NS	—	—	—	—	NS [x]	—	—	—	—	—	—	—
SRMS Region:														
Argyll	NS [s]	NS [v]	—	—	NS	ND	NS [x]	NL	NS [n]	—	—	—	NS [s]	NS [r]
Central	NS	—	—	—	—	NS [x]	Abs	NS [v]	**Dec [n] (-0.7%)**	**Inc [n] (5.3%)**	—	—	NS [s]	NS [r]
Dumfries & Galloway	—	—	—	**Dec (-1.4%)**	—	NS [x]	Abs	NS [rs]	**Dec [n] (-0.8%)**	NS [ns]	—	—	NS	NS [r]
Highland	NS	NS	—	—	NS [s]	NS [x]	NS [x]	NS [r]	—	NS [n]	—	—	—	NS [s]
Lewis & Harris	Abs	NS	—	Abs	—	Abs	NS [sx]	—	Abs	Abs	—	—	—	—
Lothian & Borders	**Dec [s] (-1.7%)**	—	—	NS	—	—	Abs	NS [r]	NS [n]	**Inc [ns] (6.2%)**	—	—	**Dec (-2.1%)**	NS [r]
North East Scotland	NS	—	—	—	—	NS [sx]	—	—	—	—	—	NL	**Inc (8.3%)**	—
Orkney	Abs	Abs	—	Abs	NL	Abs	—	—	Abs	Abs	NS	—	**Dec [s] (-2.4%)**	—
Shetland	Abs	Abs	—	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs	—	—	—
South Strathclyde	—	—	—	—	—	—	Abs	—	NS [nrs]	—	NS [ns]	—	NL	**Dec [r] (-1%)**
Tayside & Fife	NS	NS	—	—	**Dec (-3.9%)**	NS [x]	—	NS	—	—	—	NS [rs]	NS	NS
Uist	Abs	NS [sv]	—	Abs	—	Abs	—	NS	Abs	Abs	—	—	—	NS [s]

[a] All data used, [n] Nestbox based, [r] No home range random effect, [s] Sample sizes small, [v] Variable effort, [x] Expanding population.

3 How have SRMS data been used over the last year?

One of the main functions of the Scottish Raptor Monitoring Scheme is to help get raptor data to people that can use these data to benefit raptor conservation, whether in statutory agencies, non-governmental organisations, or anywhere else. In 2022 NatureScot contracted BTO to undertake an analysis of SRMS data to improve understanding of the impact of the recent Highly Pathogenic Avian Influenza (HPAI) outbreak on raptors and raptor populations in Scotland. Read on to find out more about this useful piece of work!

Using SRMS data to improve understanding of the impact of the 2022 Avian Influenza outbreak on raptors

By Mark Wilson (Acting Head of Science, BTO Scotland)

INTRODUCTION

The SRMS is keen to ensure that Scottish Raptor Monitoring Scheme data are used to improve our understanding of the impact of the Highly Pathogenic Avian Influenza (HPAI) outbreak on raptor populations in Scotland.

To this end, NatureScot contracted BTO to evaluate quantitatively whether occupancy and breeding success information from 2022 showed any unexpected patterns (relative to the recent trends published using data up to 2018) and to consider any further evidence for impacts of HPAI reported by SRMS data contributors.

To support this work the SRMS appealed via its December 2022 Scottish Raptor newsletter for data contributors to describe any observations from their own monitoring during the 2022 breeding season that might be related to impacts of HPAI. Such observations could be of dead adults close to the nest, late loss of large young, atypically low occupancy at the start of the breeding season or loss of pairs/active nests during the breeding season. Because we were keen to link these observations to the relevant monitoring data submitted to the Scheme in 2022, data contributors were asked to provide any information that could allow the relevant nest sites and home ranges to be identified (e.g. SRMS Home Range code, site name, site code and grid reference). A big thank you to everyone who responded to this appeal for information!

To read the full report of this analysis (Wilson *et al.*, 2023) please visit: - https://www.nature.scot/doc/naturescot-research-report-1331-analysis-scottish-raptor-monitoring-scheme-data-improve

MAIN FINDINGS

The analysis found strong evidence for declines in breeding success, consistent with impacts of HPAI on the breeding productivity of Golden Eagle and White-tailed Eagle in 2022. Across the whole SRMS dataset, we compared breeding data from 2022 with data from the previous four years. These comparisons show that in 2022 Golden Eagle breeding success (the percentage of territorial pairs that successfully reared young) declined from a previous average of 48% to 28% while that of White-tailed Eagle declined from 67% to 45%. The largest declines recorded for both species were in Lewis & Harris, where breeding success of Golden Eagles fell from 55% to 16%, and breeding success of White-tailed Eagle declined from 66% to 24%.

These impacts are evident in most of the regions where these species breed but, for both species, they appear to be greatest in areas where breeding pairs had access to coastal and marine

habitats. This suggests a possible link to predation and scavenging of infected seabirds and waterfowl. White-tailed Eagle breeding success in three coastal study areas experienced statistically significant declines from between 60% to 67% before 2022 to between 16% and 50% in 2022. By contrast, breeding success of inland breeding pairs during the same period rose (non-significantly) from 67% to 77%.

Impacts on the breeding success of other raptor species seem to have been more restricted. However, reduced levels of breeding success in 2022 suggest that some species were locally impacted. There were statistically significant declines in breeding success of Ravens in Shetland and Orkney, Peregrines in Tayside & Fife, and Red Kites in Highland and North-east Scotland.

There is more limited evidence for impacts on the number of pairs attempting to breed in 2022. Among studies for which the number of home ranges checked in 2022 was similar to that in previous years, fewer pairs were recorded in 2022 for Buzzards in Tain (Easter Ross) and for Hen Harriers on Rousay (Orkney).

For most species and in most areas, the numbers of offspring fledged by successfully breeding pairs in 2022 were broadly similar to those recorded in previous years. The fact that breeding success appears to have been more severely affected than fledged brood size suggests that, where HPAI results in nestling mortality, it is relatively uncommon for any chicks from affected broods to survive.

There are other factors that could explain, or at least contribute to, the differences observed between 2022 and other years. These include variation in weather, prey availability and survey effort. Of these, weather at the start of the 2022 breeding season seems most likely to have contributed to low breeding success in that year but is unlikely to entirely account for the observed differences.

Additional observations by SRMS contributors included many instances where breeding failure was suspected to have been caused by HPAI. In general, these observations fit well with the patterns described above, and include breeding failures of Golden Eagle, White-tailed Eagle, Buzzard, Red Kite and Raven pairs.

Figure 21: Dead Golden Eagle chick found under its eyrie in Sutherland. It tested positive for HPAI (Photo: Derek Spencer, Highland RSG).

HOW YOU CAN HELP

Simply by contributing your raptor monitoring data to the SRMS in 2023 you will be improving our ability to detect and attribute any further impacts of HPAI on breeding raptors in Scotland. Your data will be even more useful if you submit them via our online data entry system – SRMS Online. In autumn 2023 there will be improvements to the way that causes and supporting evidence for failure are captured, which will help you to document the effects of and evidence for HPAI for future years.

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