Scottish Raptor Monitoring Scheme Annual Report 2024

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Front cover image: Goshawk *Accipiter gentilis* (Malcolm Henderson, Lothian & Borders RSG).
Back cover image: Tawny Owl *Strix aluco* (Liz Cutting, BTO).

Foreword

Welcome to the 2024 report of the Scottish Raptor Monitoring Scheme.

It is heartening to see the Scheme continue to receive a large volume of records. The value of this long-term monitoring will be increasingly important to help understand changes in raptor populations as part of wider climate change impacts and positive changes that are likely to occur via landscape scale restoration and biodiversity enhancement projects. With that in mind the SRMS partners continue ongoing work to improve trends reporting and updated trends are being worked on currently.

SRMS partners continue to make regular use of the Scheme's data for a range of important purposes including statutory requirements, and we've yet to understand where raptors will fit into the statutory reporting targets being developed under the recently passed Natural Environment Bill. After an unfortunate delay NatureScot has recently published Research Report 1376, which is an analysis by BTO of avian influenza (HPAI) on breeding raptors using the 2023 SRMS data. It highlights partial recovery with both eagle species from 2022, but productivity was still below pre-HPAI levels. There was also evidence suggestive of local impacts on peregrine and given some of the impacts reported on peregrine internationally we should keep an eye on this species and remain vigilant as the disease does not seem to be going away.

This report also contains an article about an ongoing PhD on red kites and wind farms, again SRMS data is being used for part of this PhD which has funding support from two SRMS partners, NatureScot and RSPB. It aims to greatly increase our understanding of how our reintroduced and range recovering red kite population is interacting with wind farms and will be useful in informing wind farm development in relation to this species in future.

As ever, particular thanks to all those who have contributed records; to the partner organisations which provide funding and in-kind contributions; and the partner representatives who help oversee the Scheme. Special thanks once again to Gaby, Bjorn, 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.

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1 SUMMARY OF THE 2024 RAPTOR MONITORING SEASON

The Scottish Raptor Monitoring Scheme (SRMS) is able to provide raptor population data to support conservation, research and education thanks to the hard work and expertise of our SRMS contributors who collect the data, and thanks to the support of all partners in the Scheme which allows the data to be received and collated.

In 2024, thanks to the efforts of 361 SRMS contributors, the Scottish Raptor Monitoring Scheme received 5,975 records from raptor home ranges. Of these, a total of 5,759 records (96%) were available to be used for SRMS reporting, with most data contributors giving explicit permission for their data to be used in this way. This represents yet another tremendous effort from SRMS contributors, giving up thousands of days of their time to comb the Scottish landscape to monitor raptor populations.

In this section we provide an overview of the 2024 breeding season, starting with a look at two important factors that can affect raptor productivity: the weather and small mammal abundance. We also provide a summary of the records received from each region of Scotland and for each species in 2024, along with links to more detailed information on the SRMS website.

TERMINOLOGY

Throughout this report and in the SRMS newsletter and on the website, we use standardised monitoring and breeding terminology. To ensure clarity of the use of the terms, please refer to the glossary on page 16 of this report.

WEATHER AND FOOD AVAILABILITY

The effects of environmental factors such as weather and food availability on demographic parameters (such as breeding success or survival) of raptor populations are well documented. Furthermore, the timing of increases or decreases in these factors during the breeding season can affect different reproductive parameters (Kreiderits *et al.* 2016; Nägeli *et al.* 2022). Following a rather wet and warm year in 2023, 2024 continued with a warm streak and a prolonged stormy season that extended beyond the usual autumn and winter periods. Indeed, the 2023-24 storm season saw 12 storms - the highest number recorded since the British naming system for storms started in 2015 (where storms receive consecutive alphabetical names throughout each season from September to August of the following year), concluding with storm Lilian in late August. Some of these storms were particularly powerful, with the two storms flanking the turn of the year, Darragh and Éowyn, bringing winds strong enough to trigger red weather warnings. Then in the middle of May, the UK saw the wettest May day on record.

Much research has been carried out into the synchronicity of cyclic changes in the annual and seasonal abundance of voles and their implications for predator populations (Krebs *et al.* 2002; Torre *et al.* 2023). UK field vole abundance typically fluctuates over a 2–4-year cycle, with a up to a tenfold difference between peaks and troughs (Korpimäki 2003; Lambin *et al.* 2006). This can have profound effects on the numbers of breeding pairs and the breeding success of several raptor and owl species (e.g. Petty *et al.* 2000; Lambin *et al.* 2000). These vole fluctuations have particularly strong impacts on species that specialise in small mammals, such as Kestrel, Barn Owl and Short-eared Owl (Village 1990; Korpimäki & Norrdahl 1991, Taylor 1994). The breeding productivity of all these species is positively affected by vole abundance (Cheveau *et al.* 2004; Fay *et al.* 2020). However, the spatial scales over which these patterns in productivity are synchronised varies widely between places and species and can be driven by very different mechanisms.

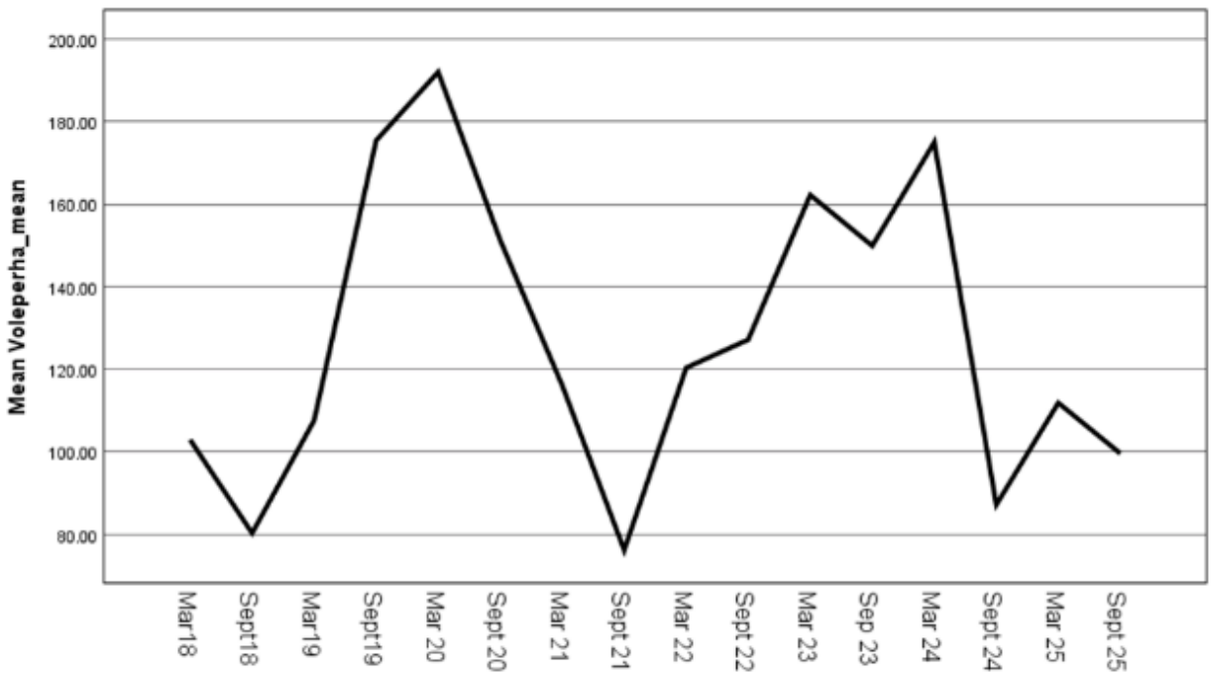

Figure 1: Estimated average numbers of voles per hectare at 19 sites across Eskdale, Ettrick and Craik Forests in the Scottish Borders (Andrew Village, Lothian and Borders RSG, based on vole signs index).

Patterns in small mammal abundance may be driven by 'top-down' factors such as bird predation (Ims & Andreassen 2000), 'bottom-up' factors like food availability (Turchin & Batzli 2001), or by changes in land cover caused by activities such as forest clear-felling (Petty *et al.* 2000). Long-term studies provide valuable data that can be used to inform habitat and species conservation decisions. A very useful long-term vole population study in the Scottish Borders provides counts of voles twice per year across 19 sites covering the Eskdale, Ettrick and Craik Forests (Figure 1).

Wet and windy weather may benefit some rodents, such as the field vole *Microtus agrestis* and yellow-necked mouse *Apodemus flavicollis* (although the latter does not occur in Scotland). These species have been observed to forage more actively in stormy conditions, taking advantage of the fact that it is harder for predators to detect them (Wrobel & Bogdziewicz 2015; McCafferty *et al.* 2003).

If vole populations reach a peak during the spring, predator populations can respond with increases in the number of pairs settling to breed. Similarly, brood sizes, levels of breeding success and overall productivity tend to increase. Conversely, during vole cycle 'troughs' the numbers and output of raptor breeding pairs can decrease.

Data from the Scottish Borders study suggest that vole numbers in the area peaked for the current cycle in March 2024. This could have benefited breeding raptors during egg-laying and chick-provisioning, but a subsequent steep decline in vole numbers by autumn of the same year is likely to have negatively impacted the food availability for juveniles and adults, potentially reducing fledging success and survival to the following breeding season.

Highly Pathogenic Avian Influenza

Since October 2021, the UK has been experiencing unprecedented outbreaks of highly pathogenic avian influenza (HPAI) of the subtypes H5N1 and H5N5 in wild birds (Cunningham *et al* 2022; Günther 2024). Initial effects were apparent in wintering waterbirds and, subsequently, breeding seabirds, but testing of dead birds showed that the virus was affecting a wide range of other species, including several raptors.

An analysis of SRMS data compared the breeding performance of 12 raptor species in 2022 to that of previous years (Wilson *et al*. 2023). As reported in the 2023 SRMS Annual Report, the results showed declines in breeding success of Golden Eagle and White-tailed Eagle, consistent with impacts of avian influenza. For other raptor species, breeding success in most areas was similar to that of previous years.

NatureScot commissioned a follow-up analysis of SRMS data for the 2023 breeding season, which has just been published (Wilson *et al.* 2026). Overall, this provided less evidence for impacts of HPAI than in 2022, with breeding success of Golden and White-tailed Eagles much improved, although still significantly below pre-HPAI levels in several regions, and some apparent impacts on Peregrines in the south of Scotland. For further details, see chapter 3.

Further research on the effects of HPAI in Buzzard and Peregrine populations in Scotland, and an article on the use of ring recovery data to assess the impacts of HPAI on birds including Red Kites, can be found here:

https://www.tandfonline.com/journals/tbis20/collections/Highly_Pathogenic_Avian_Influenza.

Where publications are not openly accessible, articles are available on request from the authors.

Monitoring

Broadly, raptor monitoring in Scotland involves repeat visits to known home ranges and other areas of suitable habitat. These visits are timed to detect signs of home range occupancy and, in occupied home ranges, to determine the outcome of any breeding attempts (Hardey *et al.* 2013, https://raptormonitoring.org/need-advice-on-monitoring). SRMS data in 2024 were drawn from a total of 5,311 raptor home ranges in Scotland that were checked for occupancy (Table 1).

Figure 2 shows a summary of SRMS coverage in 2024, depicting 10-km squares where suitable habitat or known home ranges of one or more species were checked. Not all these 10-km squares were found to hold pairs. Some checked home ranges held single birds and others were recorded as vacant. Tables 1 and 2 provide regional breakdowns of home ranges checked in 2024.

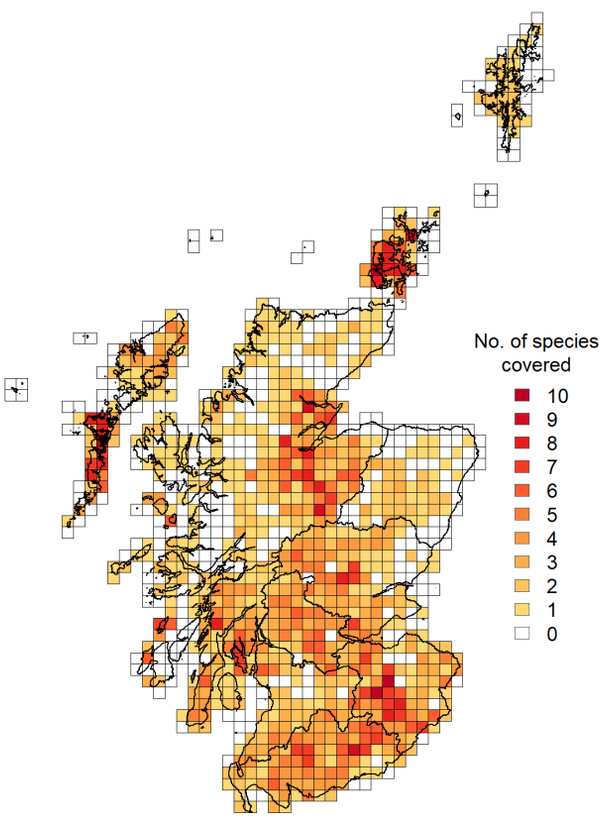

Figure 2: Raptor, owl and Raven monitoring coverage in Scotland in 2024. The map illustrates the number of SRMS species for which occupancy was checked in each 10-km square. The redder (darker) the square, the more species were covered. The maximum number of species checked for occupancy in a single square in 2024 was 10, from a total of 20 species. White squares indicate areas for which the Scheme received no monitoring records for 2024. Note that this figure masks variation in coverage at finer geographic scales, and work is ongoing to improve our knowledge of coverage.

Species-specific and regional breakdowns showing the results of monitored breeding attempts will appear on the SRMS website: https://raptormonitoring.org/.

DATA SUBMISSION & SRMS ONLINE

Since 2020 there has been a gradual rise in online reporting of Scottish Raptor Monitoring Scheme data: 3% of SRMS records in 2020, 27% in 2021, 38% in 2022 and 39% in 2023. The 2024 numbers remained the same as for 2023 with 39%.

If you would like to use or try the online submission system, we encourage you to contact the SRMS Coordinator who offers training and support for new and existing users of SRMS Online and is always available to help (srms@bto.org). We are very grateful to those using the system already and providing feedback to improve it further.

We are also very pleased 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). Records for which these permissions are not in place have not been used to inform the species accounts reported here, nor for any other reporting or analysis. Unless and until this permission is granted, these records cannot be used, in line with the SRMS Data Sharing & Use Policy. If you would like your records to be used and haven't yet signed the registration form, please send a completed form to the Scheme coordinator at srms@bto.org.

Table 1: The number of home ranges of raptors, owls and Raven checked in 2024 that were submitted to the SRMS. For a given region and species combination "-" indicates that the SRMS does not hold any previous records and "0" indicates that no records were provided for 2024 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 the UK.

Species	Argyll	Central Scotland	Dumfries & Galloway	Highland	Lewis & Harris	Lothian & Borders	North-east Scotland	Orkney	Shetland	South Strath-clyde	Tayside & Fife	Uist	**TOTAL**	Estimated population size (pairs)	Region estimate relates to	Year estimate relates to
Osprey	44	62	24	88	-	17	25	-	-	16	36	-	**312**	266	Scotland	2022[1]
Honey-buzzard	-	0	2	14	-	-	1	-	-	-	0	-	**17**	48-49	Scotland	2020-21[2]
Golden Eagle	55	13	5	158	36	7	0	1	-	1	41	23	**340**	508	Scotland	2015[3]
Sparrowhawk	17	31	1	22	0	10	0	38	34	0	16	7	**176**	30,500	UK	2016[4]
Goshawk	0	23	34	18	-	44	0	-	-	17	3	-	**139**	315	Scotland	2022[1]
Marsh Harrier	0	5	1	1	-	2	1	1	-	-	17	-	**28**	13	Scotland	2022[1]
Hen Harrier	41	12	10	45	35	14	27	257	-	71	10	24	**546**	529	Scotland	2023[5]
Red Kite	0	46	133	52	-	5	30	-	-	12	67	-	**345**	≥ 254	Scotland	2023[6]
White-tailed Eagle	36	3	-	72	36	-	0	2	-	-	6	19	**174**	148	Scotland	2022[1]
Buzzard	93	34	56	168	4	96	0	28	-	2	56	37	**574**	63,000-87,500	UK	2016[4]
Barn Owl	94	136	109	92	-	67	0	-	-	14	5	-	**517**	500-1000	Scotland	post 2004[7]
Tawny Owl	48	116	77	61	-	27	0	-	-	3	11	-	**343**	50,000	UK	2015[4]
Little Owl	-	-	-	-	-	3	-	-	-	-	-	-	**3**	<10	Scotland	2023[6]
Long-eared Owl	9	0	0	3	-	4	0	7	0	6	1	5	**35**	1,800-6,000	UK	2007-11[4]
Short-eared Owl	9	0	0	4	2	17	0	134	0	0	3	11	**180**	620-2,200	UK	2007-11[4]
Kestrel	40	3	17	42	3	55	0	59	-	9	50	20	**263**	2,750-5,500	Scotland	2013[8]
Merlin	3	1	13	20	12	32	69	77	61	1	16	8	**311**	733	Scotland	2008[9]
Hobby	-	-	0	0	-	0	-	-	-	-	0	-	**0**	2,050	UK	2016[4]
Peregrine	34	25	105	63	1	151	2	24	0	71	71	5	**520**	523 (479-592)	Scotland	2014[10]
Raven	89	6	58	40	8	46	0	63	0	55	84	39	**488**	3241 (1035-5447)	Scotland	2007-11[11]
TOTAL	**612**	**516**	**645**	**963**	**137**	**597**	**155**	**691**	**95**	**278**	**493**	**198**	**5380**			

Sources of estimated population sizes: [1]Eaton *et al*. 2024; [2]Clements *et al.* 2022; [3]Hayhow *et al*. 2017; [4]Woodward *et al*. 2020; [5]Kelly *et al*. 2025; [6]Peniche *et al*. 2025; [7]Shaw 2007; [8]Wilson *et al*. 2015; [9]Ewing *et al*. 2011; [10]Wilson *et al*. 2018; [11]Wilson *et al.* 2019.

Table 2: Number of raptor, owl and Raven breeding attempts monitored (i.e. with known outcome) under the Scottish Raptor Monitoring Scheme in 2024.

Species	Argyll	Central Scotland	Dumfries & Galloway	Highland	Lewis & Harris	Lothian & Borders	North-east Scotland	Orkney	Shetland	South Strath-clyde	Tayside & Fife	Uist	**TOTAL**
Osprey	18	38	15	67	-	15	19	-	-	9	30	-	**211**
Honey-buzzard	-	0	1	1	-	-	0	-	-	-	0	-	**2**
Golden Eagle	44	8	1	112	25	2	0	1	-	1	24	11	**229**
Sparrowhawk	5	11	0	15	0	4	0	20	21	0	13	4	**93**
Goshawk	0	17	21	13	-	29	0	-	-	11	2	-	**93**
Marsh Harrier	0	2	1	1	-	0	1	0	-	-	11	-	**16**
Hen Harrier	15	0	9	24	20	10	12	100	-	14	3	12	**219**
Red Kite	0	19	82	34	-	4	8	-	-	11	33	-	**191**
White-tailed Eagle	34	1	-	59	32	-	0	1	-	-	5	14	**146**
Buzzard	22	28	32	92	1	69	0	13	-	1	32	17	**307**
Barn Owl	32	70	58	69	-	53	0	-	-	6	3	-	**291**
Tawny Owl	10	41	15	32	-	19	0	-	-	1	9	-	**127**
Little Owl	-	-	-	-	-	0	-	-	-	-	-	-	**0**
Long-eared Owl	1	0	0	2	-	2	0	0	0	0	1	2	**8**
Short-eared Owl	2	0	0	1	1	2	0	26	0	0	1	0	**33**
Kestrel	15	3	7	16	2	31	0	14	-	4	18	6	**105**
Merlin	2	0	4	8	3	13	17	13	20	0	3	4	**86**
Hobby	-	-	0	0	-	0	-	-	-	-	0	-	**0**
Peregrine	16	13	34	12	0	47	1	8	0	28	29	4	**176**
Raven	46	6	27	29	4	35	0	33	0	32	56	18	**286**
TOTAL	**262**	**257**	**307**	**587**	**88**	**335**	**58**	**229**	**41**	**118**	**273**	**92**	**2647**

2 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 the SRMS summary tables which can be accessed on the SRMS website:

https://raptormonitoring.org/annual-report.

If you need a printed copy of the tables but do not have access to a printer, as a data contributor, you can request a copy from the Scheme coordinator – srms@bto.org

The tables presented in this report summarise the records that the SRMS has received and collated as set out in the SRMS Data Sharing & Use Policy (https://raptormonitoring.org/srms-data/data-sharing-use-policy).

It is important to recognise that, for nearly all species, **monitoring was not carried out for all breeding pairs. This means that the numbers presented do not represent absolute population sizes or provide a complete picture of breeding productivity, at either regional or national scales**. Table 1 provides 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 (Table 1). This allows the calculation of several national and regional trends for the species (https://raptormonitoring.org/trends). It is likely that additional monitoring effort will be useful across the species' range in future as it continues to expand its population successfully.

2024 232 of 312 checked home ranges were occupied by pairs. A further 14 home ranges were occupied by single birds. Of 211 pairs that were monitored, 198 were confirmed as having laid eggs. 153 of these went on to fledge a minimum total of 270 young.

In Ireland, a pair of Ospreys in County Fermanagh were the first to breed on the island of Ireland for more than 200 years (Eaton *et al.* 2025).

Honey-buzzard

Honey-buzzard is an extremely secretive species and likely to be a under-recorded in Scotland. However, since the 2020 national survey, organised by Honey-buzzard experts on behalf of the RBBP, we have a better understanding of the species' presence around the country and the various SRSG Honey Buzzard species coordinators continue to work hard, together with their branches, to improve monitoring of this species. While a couple of studies have been established in Tayside & Fife and in Central Scotland since 2017 (McInerny *et al*. 2017; Shaw *et al*. 2017 and McInerny *et al*. 2021), the data from these are not shared fully with the SRMS (and so do not appear in our summary tables).

Figure 3: Honey Buzzard nestling with a full crop (Photo: Carol Miller, Highland RSG).

2024 From records reported to the SRMS from Dumfries and Galloway, Highlands, and North-east Scotland we know that 8 of 17 home ranges checked were occupied in 2024. A further eight ranges were occupied by single birds. Two pairs were monitored to completion. Both were known to lay eggs, fledging one young each.

Figure 4: Sparrowhawk (Photo: Tom Streeter, BTO)

Golden Eagle

Golden Eagles are monitored very widely across Scotland, and home ranges of a substantial proportion of the estimated total breeding population are checked annually by SRMS contributors (Table 1). This monitoring enables the Scheme to calculate national and regional trends in Golden Eagle productivity as well as trends in numbers of breeding pairs for several regions. There are some knowledge gaps that remain across the country, in part due to limited coverage in some remote areas, and in a few areas data not currently being shared with the SRMS.

The South of Scotland Golden Eagle Project (www.goldeneaglessouthofscotland.co.uk) is bolstering the population in the region significantly, with over 50 birds now flying around the skies of southern Scotland. Some of the released birds are beginning to pair up, settle down on territories and show signs of breeding. In 2014, during the SSGEP feasibility assessment, Fielding & Haworth (2014) suggested that southern Scotland could support a population of 11-16 pairs. So far, the current movements and behaviour of released birds seem to support this assessment and from current observations, individuals appear to be settling in areas that resemble the expected distribution.

2024 278 of 340 checked home ranges were occupied by pairs, with single birds or fresh signs reported from a further 30 home ranges.

Of 229 pairs that were monitored, 46 failed early or did not breed but 159 pairs were confirmed to lay eggs, of which 87 went on to fledge a minimum total of 102 young.

Sparrowhawk

Sparrowhawks are common and widespread but secretive. As such, the species is challenging to monitor. In relation to its estimated total population size, the species receives limited attention, constraining our ability to report on regional and national trends in breeding numbers and productivity. Wider monitoring of the species across the country would allow production of regional and national trends. This

is one of the key species for which the SRMS is trying to improve coverage through the *Raptor Patch* initiative.

2024 106 of 176 checked home ranges were occupied by pairs. Of these, 93 pairs were monitored, 82 of which were confirmed to lay eggs. A total of 67 pairs went on to fledge a minimum total of 157 young. The species has been breeding successfully in Shetland since 2018 and the number of pairs monitored has been increasing since then. In 2024, 22 monitored pairs fledged 34 young.

Goshawk

The coverage of Goshawk by SRMS contributors, relative to the total estimated population, is much greater than that of its smaller cousin the Sparrowhawk (Tables 1 and 2). With their famously elusive nature and a gradually expanding population, Goshawks are very challenging to monitor comprehensively. Goshawks favour woodland with sufficient space between trees for their nest sites, and breeding sites include mature plantations as well as windblow, meaning that nest sites may be felled and therefore move from year to year, adding to the difficulty of monitoring. Additional study areas in the Goshawk's range are always welcome and would further increase the SRMS' ability to produce regional and national trends for breeding numbers and productivity.

2024 104 of 139 checked home ranges were occupied by pairs, with single birds or fresh signs reported from a further 17 home ranges. Of 93 pairs that were monitored, 87 were confirmed to lay eggs and 69 of these went on to fledge a minimum total of 123 young.

Marsh Harrier

Marsh Harrier continues to be a scarce breeder and passage migrant in Scotland. However, ongoing monitoring has shown that occupation of known home ranges has been maintained for the past three years, and the number of breeding pairs continues to increase slowly.

Figure 5: Marsh Harrier, Benbecula (Photo: Angus Hogg D&G RSG and SSC RSG).

2024 16 of 28 checked home ranges were occupied by pairs. Of 16 pairs that were monitored, 15 pairs were known to lay eggs, 14 of which went on to successfully fledge a minimum total of 37 fledglings.

Hen Harrier

Hen Harrier is monitored very widely across Scotland thanks to the efforts of SRMS contributors. Some geographical gaps in annual monitoring are present in Caithness, East Sutherland and some other areas, where additional study areas would improve the Scheme's ability to produce regional and national trends in breeding numbers and productivity.

The 2023 national survey for Hen Harrier organised under the Statutory Conservation Agency/RSPB Annual Breeding Bird Scheme (SCARABBS) estimated that Scotland held 529 territorial pairs (95% confidence limits: 431-640). This number is equivalent to 81% of the estimated UK Hen Harrier population, and marks a (non-significant) 15% increase from the estimated 460 pairs in Scotland at the time of the last national survey in 2016. For further details see Kelly *et al.* 2025.

2024 281 of 546 home ranges were occupied by pairs with a further 49 ranges occupied by

single birds. Of 219 pairs that were monitored, 138 were confirmed to lay eggs, 107 of which went on to fledge a minimum total of 260 young.

Red Kite

Red Kites were reintroduced to Scotland from 1989 with populations initially establishing near release areas in Ross-shire, Perthshire / Stirlingshire, Dumfries & Galloway, and Aberdeenshire. The species is widely and effectively monitored by SRMS contributors in much of its current core Scottish range. A growing challenge is to ensure that breeding pairs are monitored within these core areas, where population densities continue to increase, as well as in newly occupied areas in the Red Kite's steadily expanding Scottish range.

Figure 6: Red Kite (Photo: Tom Victory)

2024 271 of 345 checked home ranges were occupied by pairs. Home ranges were checked in a total of 114 separate 10x10 km squares. Twelve of these squares (four more than in 2023) were checked for the first time in 2024, reflecting both the continuing range expansion of the species and the ongoing monitoring efforts to keep up with this expansion. Of 191 pairs that were monitored across Scotland, 187 were confirmed to lay eggs and 158 pairs went on to fledge a minimum total of 242 young.

The species is well known to form loose colonies or clusters of breeding pairs (Hardey *et al*. 2013). In some areas pairs have been known to successfully fledge clutches when their nests have been as close as 30m from each other.

White-tailed Eagle

White-tailed Eagles were reintroduced to Scotland from 1975, with a self-sustaining population reestablished by the early 2000s. 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. As for Red Kites, a growing challenge is to ensure that monitoring keeps up with the continued increase in this species' breeding range.

2024 164 of 174 checked home ranges were occupied by pairs. Home ranges were checked in a total of 123 separate 10x10 km squares. Ten of these squares were checked for the first time in 2024, reflecting the continuing successful range expansion of the species and the monitoring efforts of recorders to track this expansion.

Of 146 pairs that were monitored, 128 were confirmed to lay eggs, 91 of which fledged a minimum total of 112 young.

There was some very positive news in England, with a pair of White-tailed Eagles in Sussex being the first English breeding record in 240 years (Eaton *et al.* 2025). These were birds translocated from Scotland to the Isle of Wight as part of the reintroduction project (https://roydennis.org/isle-of-wight-see-eagle-reintroduction).

Figure 7: Buzzard (Photo: Harry Bell, Tayside & Fife RSG)

Buzzard

Buzzard has not always been the most common raptor in Scotland, but this is now very much the case. Its abundance and ubiquity make effective monitoring of this species challenging. Despite having some of the highest numbers of records submitted annually, the number reported reflects a small fraction of the national population (Tables 1 and 2). As for other common and widespread species, our ability to report on regional and national trends in breeding numbers and productivity would be improved by a greater emphasis on area-based monitoring, with the focus on monitoring all pairs breeding within discrete study areas. Buzzard is one of the key species for which the SRMS will be trying to improve coverage through the *Raptor Patch* initiative.

2024 371 of 574 checked home ranges were occupied by pairs, with a further 45 ranges occupied by single birds. Of 307 monitored pairs, 271 were confirmed to lay eggs. 232 of these went on to fledge a minimum total of 354 young.

Barn Owl

SRMS contributors are monitoring a significant proportion of the estimated breeding population of Barn Owls in Scotland, mostly through 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 could improve further with additional study areas across many parts of its Scottish range, as well as better understanding of the number of pairs breeding outwith nestbox schemes.

2024 337 of 517 checked home ranges were occupied by pairs, with a further 46 sites occupied by single birds. Of 291 pairs that were monitored, 278 were confirmed to lay eggs, 229 of which went on to fledge a minimum total of 497 young.

Tawny Owl

Tawny Owl is well monitored in several study areas, including through active nest box schemes. As a widespread and common species, our ability to report on regional and national trends in breeding numbers and productivity is limited and could be improved further with additional study areas for this species. Monitoring of pairs breeding in natural sites is challenging. Acoustic monitoring may be a promising method to help with this and increase monitoring coverage in the future (Vrezec & Bertoncelj 2017).

2024 146 of 343 checked home ranges were occupied by pairs. Of 127 pairs that were monitored, 126 were confirmed to lay eggs. 93 of these went on to fledge a minimum total of 159 young.

Figure 8: Tawny Owl (Photo: Katy Anderson, Central Scotland RSG)

Little Owl

Little Owl reaches the northern edge of its UK range in southern Scotland and combined with an ongoing decline across its predominantly English and Welsh range, is a very scarce breeding bird here.

2024 Three sites were checked in the Scottish Borders, with a pair present at one site and a single bird at another site. No breeding attempt was found.

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 Scotland.

2024 12 of 35 checked home ranges were occupied by pairs. Of the eight pairs that were monitored, all laid clutches and seven of these were successful, fledging a minimum total of 15 young.

Short-eared Owl

Figure 9: Short-eared Owl (Photo: Chris Baker, Tayside and Fife RSG)

Short-eared Owl is a very challenging species to survey systematically. Yearly variation in the distribution and local abundance of this highly nomadic 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 to breed in areas where voles are more abundant.

A recent tracking study observed an average distance of 1,723km between consecutive breeding sites of the same individuals, and an average natal dispersal distance from hatching locations to first nest-sites of 1,931km (Calladine *et al*. 2024, Fig. 10)!

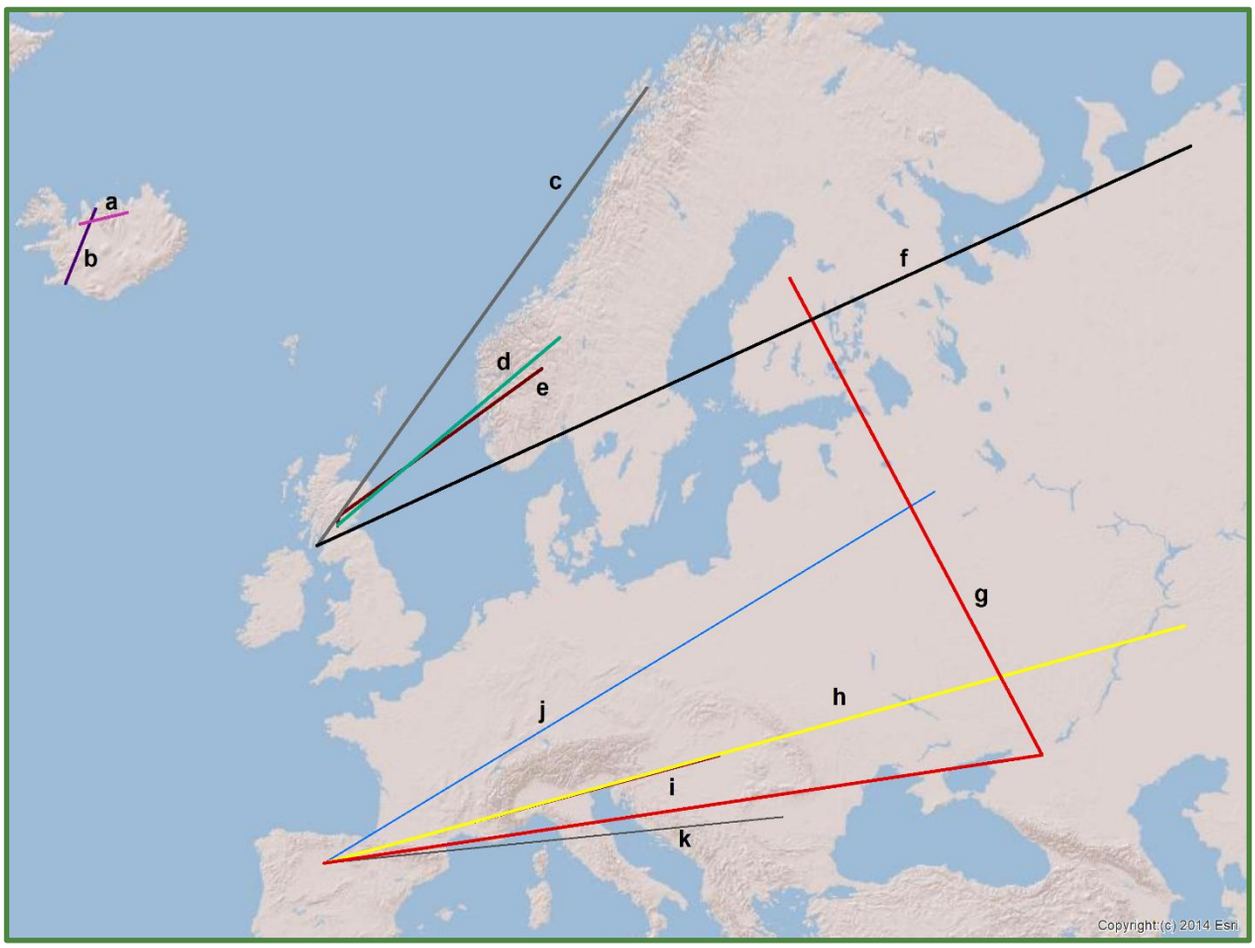

Figure 10: Lines joining the sequential nest-sites used by tagged Short-eared Owls in a recent study by Calladine *et al.* (2024). Distances between sites were: (a) 145km; (b) 244km; (c) 1838km; (d) 922km; (e) 41km and 922km; (f) 3131km; (g) 3640km and 2133km; and (h) 4216km. Also shown are three lines showing natal dispersal from hatching locations to first nest-sites: (i) 2075km; (j) 3226km; and (k) 2389km. In addition, one natal dispersal distance of 35km was recorded within Scotland. Figure reproduced with permission.

Overall, it is likely that Short-eared Owls are under-recorded. However, a steady increase in breeding attempts has been detected in Orkney for the last three years. Alongside this, the activity signs of Orkney Vole *Microtus arvalis* have been increasing (Perkins 2024), potentially providing more food for this species. This may be related to non-native stoat eradication under the Orkney Native Wildlife Project beginning to bear fruit (Auld 2019; Perkins 2024).

2024 57 of 180 checked home ranges were occupied by pairs, with a further 48 home ranges occupied by single birds. Of 33 pairs that were monitored, nine were confirmed to lay eggs. Seven of these pairs went on to fledge a minimum total of eight young. The low productivity observed may be a reflection of lower vole numbers recorded this year.

Figure 11: Kestrel male (Photo: Harry Bell, Tayside & Fife RSG)

Kestrel

Like several other widespread and common raptor species, Kestrel is challenging to monitor at national or regional scales. Thanks to the efforts of SRMS contributors, the species is monitored comprehensively in a few 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 for this species and Kestrel is one of the key species for which the SRMS will be trying to improve coverage through the *Raptor Patch* initiative.

2024 170 of 298 checked home ranges were occupied by pairs. Of 116 pairs that were monitored, 97 were confirmed to lay eggs. 84 of these went on to fledge a minimum total of 260 young, about half the number recorded in 2023.

Merlin

Merlin is monitored 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.

2024 Saw a reduction in the number of Merlin sites being monitored. 113 of 313 checked home ranges were occupied by pairs. Of 87 pairs that were monitored, 74 were confirmed to lay eggs, of which 58 went on to fledge a minimum of 152 young. The 2026 Merlin national survey will provide a very welcome update on the status of the Merlin population, which was last the subject of a national survey in 2008 (Ewing *et al*. 2011).

Hobby

Hobby is a scarce breeder and summer visitor to Scotland, with very 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 become a more widespread breeder in Scotland. However, breeding records of the species are still scarce.

2024 We received no records of breeding Hobby, however, we are aware of increasing efforts being invested in scouring areas of central Scotland following reports of historical and recent sightings for the species.

Peregrine

Figure 12: Peregrine brood (Photo: Robin Manson, Tayside & Fife RSG)

Peregrine is one of the most comprehensively monitored raptor species in Scotland thanks to the efforts of SRMS contributors. Good coverage and monitoring of the species permit the calculation of several regional and national trends in breeding productivity and numbers. Additional coverage of remote western and northern areas as well as new lowland sites including urban areas would further increase the capacity to calculate trends.

2024 226 of 552 checked home ranges were occupied by pairs, with single birds or fresh signs reported from a further 38 home ranges. Of 192 pairs monitored, 155 were confirmed to lay eggs and 126 went on to fledge a minimum total of 286 young.

Raven

Raven is the Scheme's honorary raptor. As a predator and scavenger, it is ecologically similar to some raptors and monitoring Raven populations can tell us about some aspects of ecosystem health. SRMS contributors check many territories annually, but these represent only a small proportion of the overall estimated population which is continuing to expand its range (Tables 1 and 2).

Our ability to report on regional and national trends in breeding numbers and productivity would benefit from better coverage in many areas, particularly in the northern half of Scotland and in eastern areas where the species is recolonising its former range. Along with Buzzard, Kestrel and Sparrowhawk, Raven is one of the species for which the SRMS will be trying to improve coverage through the *Raptor Patch* initiative.

2024 363 of 488 checked home ranges were occupied by pairs. Of 286 monitored pairs, 261 were confirmed to lay eggs. 237 of these went on to fledge a minimum total of 620 young.

Scarcer species

No records were submitted in 2024 of other raptor or owl species.

3 HOW HAVE SRMS DATA BEEN USED OVER THE LAST YEAR?

One of the main functions of the Scottish Raptor Monitoring Scheme is to curate raptor monitoring data to make them available for the benefit of raptor conservation, whether by non-governmental organisations, statutory agencies or ultimately the Scottish Government.

SRMS partner organisations make regular use of the Scheme's data for a range of important purposes including statutory requirements.

SRMS data are also made available to others on a case-by-case basis. In 2024 NatureScot contracted BTO to undertake an analysis of SRMS data of the 2023 breeding season to improve understanding of the impact of the continuing Highly Pathogenic Avian Influenza (HPAI) outbreak on raptor populations in Scotland – a follow-up on a similar analysis of the 2022 breeding season data. The analysis found overall reduced evidence for impacts with breeding success of Golden and White-tailed Eagles recovering, albeit still below pre-HPAI levels in several regions, including inland regions which had not been affected in 2022. In addition, there was some evidence for impacts on the numbers of Peregrine breeding pairs in southern Scotland, and a very unusual number of immature birds holding territories, consistent with impacts of HPAI on adult Peregrines prior to the 2023 breeding season.

SRMS partners granted access to a PhD researcher at Stirling University to investigate effects of wind energy infrastructure on Red Kite and Buzzard populations.

SRMS volunteers regularly author or contribute to raptor research publications. The scheme newsletter "Scottish Raptor" available on the scheme website www.raptormonitoring.org lists recent publications which SRMS has been made aware of.

USE OF SRMS DATA BY THE SCHEME'S PARTNER ORGANISATIONS

SRMS partner organisations make frequent use of the Scheme's data for a range of important purposes including statutory requirements.

For NatureScot, use of SRMS data includes ongoing statutory requirements such as reporting on protected area status, providing context information for assessments of development proposals, and informing the current review of bird monitoring priorities including planning of future national surveys.

For Scottish Forestry and Forest & Land Scotland, SRMS data provide important background and context information, for example for assessing planting schemes and for planning harvesting operations.

For RSPB, SRMS data provide context for monitoring raptors on reserves, inform research, and provide context for wildlife crime investigations. SRMS data played an important role in planning the 2023 National Hen Harrier Survey in Scotland, and SRMS contributors carried out a large proportion of the fieldwork.

For the Rare Breeding Birds Panel, SRMS data are an important source of information, including for the RBBP's latest report "Rare Breeding Birds in the UK in 2023" published in November 2025 in the journal British Birds (Eaton *et al.* 2025). This, in turn, is an important source of information for conservation decisions (see RBBP website).

SRSG members provide the large majority of SRMS data and also regularly author or contribute to raptor research publications, including three on the effects of HPAI on raptors in Scotland (see below). The scheme newsletter "Scottish Raptor", available on the scheme website www.raptormonitoring.org, lists further recent publications which SRMS has been made aware of. SRSG branches also make raptor data available for Environmental Impact Assessments on a case-by-case basis.

For SOC, SRMS data are an important source of information for county bird reports (https://www.the-soc.org.uk/pages/bird-reports-atlases).

For BTO, SRMS data frequently provide important contributions to research projects – a recent example is described in the following.

Research into the effects of Highly Pathogenic Avian Influenza on raptors in 2023

An outbreak of Highly Pathogenic Avian Influenza (HPAI) in Scotland, as well as the wider UK, has negatively impacted many species of wild birds (Pearce-Higgins *et al.* 2023). While seabirds and wildfowl have been the most visibly affected groups, impacts on raptors have been less obvious due to their solitary and secretive habits, and raptor monitoring data are critical in showing that raptors, particularly scavengers and those preying on birds, can also be significantly impacted.

NatureScot commissioned an analysis of Scottish Raptor Monitoring Scheme data for the 2023 breeding season – a follow-up on a similar analysis of the 2022 season data (Wilson *et al.* 2023).

The results of the 2023 season analysis have just been published (Wilson *et al.* 2026). The analysis compared raptor breeding data from 2023 with equivalent data from previous years to identify apparent effects of HPAI on breeding raptor populations.

Overall, the evidence for apparent impacts of HPAI on breeding populations and performance of raptors in Scotland was weaker for 2023 than it was for 2022. Breeding success of Golden Eagle and White-tailed Eagle, the two species for which impacts of HPAI in 2022 seemed likely to be most severe, appeared much improved in 2023. There was still evidence for reduced breeding success consistent with impacts of avian influenza on the breeding output, particularly of White-tailed Eagles, in some areas. However, in most areas, reduced breeding success was not as pronounced as it was in 2022.

The most severe impacts on eagles in 2023 appeared to be in some inland areas. This contrasts with the situation in 2022, when the lowest levels of breeding success were reported in areas adjacent to the coast, suggesting a link between HPAI risk and predation of coastal birds (or scavenging on their remains).

The breeding performance of other raptor species in 2023 suggested fewer apparent or possible impacts of HPAI than were found in 2022.

The most notable indications of possible impacts were for Peregrines in southern Scotland, where one local study showed a substantial decrease in the number of breeding pairs (although this was not quite statistically significant), and another local study reported similar concerns.

In the south-east of Scotland, there appeared to be localised impacts on Peregrine breeding success. An unusually high number of immature birds (mostly females) were recorded holding territories in 2023 suggesting high mortality among territorial adults since the previous breeding season.

Although this analysis of 2023 data brings mostly good news in terms of decreases in the severity of apparent impacts for most species, this does not necessarily mean that the risks posed by HPAI have gone away. Moreover, the differences in apparent impacts between 2023 and 2022 emphasise how quickly these risks can change and that continued monitoring of breeding raptors in Scotland will be critical to understand this evolving threat to raptor populations.

Effects of wind energy infrastructure on red kite and buzzard populations

Anna Costley-Wood
PhD researcher, University of Stirling

Scotland's uplands are changing: the ongoing and rapid expansion of onshore wind is transforming a landscape that is both ecologically valuable and sensitive, and we don't yet fully understand how this will continue to affect our vulnerable soaring raptor species. Fielding, Whitfield and colleagues have done excellent work on Golden Eagles—movement, habitat use and the development of the Golden Eagle Topographical model (GET) used to calculate landscape use by Golden Eagles (Fielding *et al*. 2019). The GET model uses three key topographical variables (slope, altitude and

distance from ridge) to predict space use by Golden Eagles. The model achieves high correlations with telemetry data of GPS-tracked birds and found that young Golden Eagles preferred space above slopes greater than 10°, at an altitude of ≥ 300m, and within 300m of a ridge.

However, Red Kites may respond quite differently, being more obligate soarers with a scavenging strategy, and utilising different home ranges and habitat preferences. Their ongoing recolonisation over the past few decades may make them more vulnerable to additional mortality, especially in the northernmost populations. Understanding these species-specific responses across multiple spatial and temporal scales—from fine-scale turbine avoidance to population-level demographic consequences of wind farm density—is necessary for effective conservation and impact mitigation.

Figure 13: Moy (Photo: Anna Costley-Wood)

This is where my PhD work comes in. Supported by the RSPB and NatureScot at the University of Stirling, I am using the Black Isle Red Kite population as a case study, compiling movement datasets from vantage point surveys at Moy wind farm and GPS telemetry from tagged individuals across two time periods.

The two time periods encompass two sets of the GPS tagging data we have, one for 2009-2014 and another set from 2016-2025. For some birds we have up to seven years of tracking data.

Common Buzzards will also provide valuable comparative insights throughout, given their contrasting population status, foraging ecology and flight behaviour.

My first chapter, currently in manuscript preparation, addresses fine-scale flight behaviour within a wind farm by applying novel statistical techniques to vantage point survey data. Chapters 2 and 3 will focus on broader-scale ranging behaviour across the birds' lifetimes from the GPS data (I'm currently knee-deep in processing this now).

My fourth and final chapter will examine how wind farm infrastructure affects breeding site selection and reproductive success. This is where the SRMS nest-level data will be crucial. By combining breeding records with movement data, we can understand how turbine density affects site selection and breeding outcomes, then predict dispersal and population success under different scenarios. This should provide baseline understanding to promote strategic planning that balances renewable expansion with conservation priorities in Scotland's uplands. I'm grateful for the SRMG's decades of dedication, making long-term analyses like this possible. I'm excited to get started with this fantastic dataset and to share my progress and findings as the work develops.

Figure 14: Red Kite chick (Photo: Anna Costley-Wood)

4 GLOSSARY

Terms used by the Scottish Raptor Monitoring Scheme, adapted from Hardy *et al*. 2013.

Breeding attempt	Breeding is established if it can be ascertained that eggs have been laid (RBBP and Hardy *et al*. 2013). Subsequent behaviour between the pair such as food being passed between individuals of a pair can indicate that breeding is ongoing.
Successful breeding	If at least one of the young in the nest has fledged.
Sites monitored	Nest sites that are checked on repeated occasions in a systematic way during the breeding season in order to ascertain if 1) site occupation, 2) nesting, 3) breeding or 4) fledging occurs.
Home Range	Is the area over which an individual or group travels in search of food, nest sites or mates. This space can overlap with that of a neighbouring individual or group so it can be a difficult to delineate.
Occupancy	When a single bird, pair of birds, or presence of signs is observed during the breeding season in a home range, territory or nesting range, we consider the area occupied. Strong evidence of presence includes a new nest being built, fresh material on old nests, presence of droppings, feathers, fresh pellets, and prey remains.
Checked	Examination to detect the presence of something. For the purposes of the SRMS this includes a visit to a site, nest, home range or territory.
Cold searching	Surveying an area where no prior knowledge of the target bird occupancy exists. Surveying with no knowledge whether breeding exists or of the presence of roosts, nests or other signs of occupation.
Fledging	Time when chicks acquire the ability to fly.
Fledging success	For survey and monitoring purposes a fledgling raptor should have left the nest (even if it is still dependent on its parents for food), be capable of flight and be fully feathered. When at least one young acquires the ability to fly from the nest, the nest can be considered to have had a fledging success. In the absence of the observation of fledglings, supporting evidence for successful fledging can include large accumulations of droppings and the remains of kills in or close to the nest.
Plucks	Sites where a prey has been killed and / or partially consumed and prey remains have been left behind.
Population	A group of individuals of the same species occupying a particular geographical area.
Raptor	Traditional term used for a bird of prey, derived from the verb rapere, 'to take by force'
Surveillance	Conducting surveys at defined time intervals, using comparable methods in order to identify changes.
Survey	The systematic observation of the number or distribution of a species or assemblage in an area.

5 REFERENCES

Auld, M., Ayling, B., Bambini, L., Harper, G., Neville, G., Sankey, S., Thompson, D.B.A. and Walton, P. 2019. Safeguarding Orkney's native wildlife from non-native invasive stoats. *Island invasives: scaling up to meet the challenge*, (62), p.244.

Calladine, J., Hallgrimsson, J.T., Morrison, N., Southall, C., Gunnarsson, H., Jubete, F., Sergio, F. & Mougeot, F. 2024. Remote tracking unveils intercontinental movements of nomadic Short-eared Owls (*Asio flammeus*) with implications for resource tracking by irruptive specialist predators. *Ibis*. https://doi.org/10.1111/ibi.13304.

Cheveau, M., Drapeau, P., Imbeau, L. and Bergeron, Y. 2004. Owl winter irruptions as an indicator of small mammal population cycles in the boreal forest of eastern North America. *Oikos*, 107(1), pp.190-198.

Clements, R., Shaw, K.D., McInerny, C.J., Miller, C., & Roberts, S. 2022. British Honey-buzzard survey 2020–21. *British Birds*, 115: 190–197.

Cunningham, E. J., Gamble, A., Hart, T., Humphreys, E. M., Philip, E., Tyler, G., & Wood, M. J. 2022. The incursion of Highly Pathogenic Avian Influenza (HPAI) into North Atlantic seabird populations: an interim report from the 15th International Seabird Group conference. *Seabird*, *34*: 67-73.

Eaton, M. and the Rare Breeding Birds Panel 2024. Rare breeding birds in the UK in 2022. *British Birds* 117: 591-656. https://rbbp.org.uk/wp-content/uploads/2025/09/rbbp-report-2022.pdf.

Eaton, M. and the Rare Breeding Birds Panel 2025. Rare breeding birds in the UK in 2023. *British Birds* 118: 561-636. https://rbbp.org.uk.

Ewing, S.R., Rebecca, G.W., Heavisides, A., Court, I., Lindley, P., Ruddock, M., Cohen, S. & Eaton, M.A. 2011. Breeding status of Merlins *Falco columbarius* in the UK in 2008. *Bird Study* 58: 379–389.

Fay, R., Michler, S., Laesser, J., Jeanmonod, J. and Schaub, M. 2020. Large-Scale vole population synchrony in Central Europe revealed by kestrel breeding performance. *Frontiers in Ecology and Evolution*, 7, p.512.

Fielding, A.H. and Haworth, P.F. 2014. Golden eagles in the south of Scotland: an overview. Scottish Natural Heritage Commissioned Report No. 626. Available for download at: https://www.goldeneaglessouthofscotland.co.uk/media/uploads/cat-10/need-and-demand-626-golden-eagles-south-of-scotland-haworth-and-fielding.pdf.

Fielding, A.H., Haworth, P.F., Anderson, D., Benn, S., Dennis, R., Weston, E. & Whitfield, D.P. 2019. A simple topographical model to predict Golden Eagle *Aquila chrysaetos* space use during dispersal. *Ibis* 162: 400-415, https://doi.org/10.1111/ibi.12718.

Günther, A. 2024. Avian raptor surveillance – expert screening for highly pathogenic avian influenza viruses *(clade 2.3. 4.4 b)* (Doctoral dissertation, LMU). Available at: https://edoc.ub.uni-muenchen.de/34500/6/Guenther_Anne.pdf

Hardey, J., Crick, H., Wernham, C., Riley, H., Etheridge, B. & Thompson, D. 2013. Raptors: a field guide to survey and monitoring (3rd Edition). The Stationery Office, Edinburgh. Available for download at https://raptormonitoring.org/need-advice-on-monitoring.

Hayhow, D.B., Benn, S., Stevenson, A., Stirling Aird, P.K. & Eaton, M.A. 2017. Status of Golden Eagle *Aquila chrysaetos* in Britain in 2015. *Bird Study* 64: 281-294.

Ims, R.A. and Andreassen, H.P. 2000. Spatial synchronization of vole population dynamics by predatory birds. *Nature*, 408(6809), pp.194-196.

Kelly, L.A., Tománková, I., Downing, S., Lindley, P., Mattingley, W., Morris, N.G., Murphy, S., Orr-Ewing, D., Owens, R., Rooney, E. and Ruddock, M. 2025. The status of breeding Hen Harriers *Circus cyaneus* in the UK and Isle of Man in 2023. *Bird Study*, 31: 1-18. https://doi.org/10.1080/00063657.2024.2446373.

Korpimäki, E., & Norrdahl, K. 1991. Numerical and Functional Responses of Kestrels, Short-eared Owls, and Long-eared Owls to Vole Densities. *Ecology* 72: 814-826.

Korpimäki, E., Klemola, T., Norrdahl, K., Oksanen, L., Oksanen, T., Banks, P.B, Batzli, G.O. & Henttonen, H. 2003. Vole cycles and predation. *Trends in Ecology and Evolution*, 18(10): 494-494.

Krebs, C.J., Kenney, A.J., Gilbert, S., Danell, K., Angerbjörn, A., Erlinge, S., Bromley, R.G., Shank, C. and Carriere, S. 2002. Synchrony in lemming and vole populations in the Canadian Arctic. *Canadian Journal of Zoology*, *80*(8), pp.1323-1333.

Kreiderits, A., Gamauf, A., Krenn, H.W. and Sumasgutner, P. 2016. Investigating the influence of local weather conditions and alternative prey composition on the breeding performance of urban Eurasian Kestrels Falco tinnunculus. *Bird Study*, 63(3), pp.369-379.

Lambin, X., Petty, S. J. & Mackinnon, J. L. 2000. Cyclic dynamics in field vole populations and generalist predation. *Journal of Animal Ecology* 69: 106-118.

Lambin, X., Bretagnolle, V., & Yoccoz, N. G. 2006. Vole population cycles in northern and southern Europe: is there a need for different explanations for single pattern? *Journal of Animal Ecology*, 75(2): 340-349.

McCafferty, D.J., Moncrieff, J.B. and Taylor, I.R. 2003. Winter microclimate of field voles (Microtus agrestis) in SW Scotland. *Journal of Thermal Biology*, 28(5), pp.397-401.

Nägeli, M., Scherler, P., Witczak, S., Catitti, B., Aebischer, A., van Bergen, V., Kormann, U. and Grüebler, M.U. 2022. Weather and food availability additively affect reproductive output in an expanding raptor population. *Oecologia*, 198(1), pp.125-138.

Peniche, G., Challis, A., Beckmann, B., Wilson, M., Eaton, M., Stevenson, A., Stirling-Aird, P., Thornton, M. and Wilkinson, N. 2024. Scottish Raptor Monitoring Scheme Annual Report 2023. BTO Scotland, Stirling.

Perkins, A. 2024. Orkney Native Wildlife Project – Wildlife Monitoring Programme Year 5 report 2023. Orkney Native Wildlife Project, Orkney (unpublished report).

Petty, S.J., Lambin, X., Sherratt, T.N., Thomas, C.J., Mackinnon, J.L., Coles, C.F., Davison, M. and Little, B. 2000. Spatial synchrony in field vole *Microtus agrestis* abundance in a coniferous forest in northern England: the role of vole-eating raptors. *Journal of Applied Ecology*, 37, pp.136-147.

Shaw, G. 2007. *Barn Owl.* In The Birds of Scotland, ed. by R.W. Forrester, I.J. Andrews, C.J. McInerny, R.D. Murray, R.Y. McGowan, B. Zonfrillo, M.W. Betts, D.C. Jardine & D.S. Grundy. The Scottish Ornithologists' Club, Aberlady. pp. 902-906.

Shaw, K.D., McInerny, C.J., Little, A., Little, K., Nadin, J.S. and Goater, R. 2017. An exceptional season at a central Scotland honey-buzzard study area. *Scottish Birds*, *37*, pp.3-13.

Taylor, I. R. 1994. *Barn Owls: Predator-Prey Relationships and Conservation*. Cambridge University Press, Cambridge.

Torre, I. and Balčiauskas, L. 2023. The abundance and dynamics of small mammals and their predators: an editorial. *Life*, 14(1), p.41.

Turchin, P. and Batzli, G.O. 2001. Availability of food and the population dynamics of arvicoline rodents. *Ecology*, *82*(6), pp.1521-1534.

Village, A. 1990. *The Kestrel*. T. & A.D. Poyser, London.

Vrezec, A., & Bertoncelj, I. 2018. Territory monitoring of Tawny Owls *Strix aluco* using playback calls is a reliable population monitoring method. *Bird Study*, *65*(sup1), S52–S62. doi.org/10.1080/00063657.2018.1522527

Wilson, M.W., Austin, G.E., Gillings S. & Wernham, C.V. 2015. Natural Heritage Zone Bird Population Estimates. SWBSG Commissioned report number SWBSG_1504. pp72. Available from: www.swbsg.org

Wilson, M.W., Balmer, D.E., Jones, K., King, V.A., Raw, D., Rollie, C.J., Rooney, E., Ruddock, M., Smith, G.D., Stevenson, A. and Stirling-Aird, P.K. 2018. The breeding population of peregrine falcon *Falco peregrinus* in the United Kingdom, Isle of Man and Channel Islands in 2014. *Bird Study*, 65(1), pp.1-19.

Wilson, M.W., Beckmann, B.C., Challis, A. and Wernham, C.V. 2026. An analysis of Scottish Raptor Monitoring Scheme data to improve understanding of the impact of Avian Influenza in 2023 on raptors and raptor populations in Scotland. NatureScot Research Report 1376.

Wilson, M.W., Cook, A.S.C.P., Horswill, C., Robinson, R.A. & Wernham, C.V. 2019. Population modelling for the Scottish Northern raven population. Scottish Natural Heritage Research Report No. 1012.

Wilson, M.W., Wetherhill, A.S., and Wernham, C.V. 2023. An analysis of Scottish Raptor Monitoring Scheme data to improve understanding of the impact of the 2022 Avian Influenza outbreak on raptors and raptor populations in Scotland. NatureScot Research Report 1331.

Woodward, I., Aebischer, N., Burnell, D., Eaton, M., Frost, T., Hall, C., Stroud, D.A. & Noble, D. 2020. Population estimates of birds in Great Britain and the United Kingdom. *British Birds* 113: 69–104.

Wróbel, A. and Bogdziewicz, M. 2015. It is raining mice and voles: which weather conditions influence the activity of *Apodemus flavicollis* and *Myodes glareolus*?. *European Journal of Wildlife Research*, 61(3), pp.475-478.

https://www.metoffice.gov.uk/research/climate/maps-and-data/summaries/index

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