

Population dynamics of Hoopoes *Upupa epops* and Wrynecks *Jynx torquilla* in the Valais

Annual report 2023

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Internal report



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Contribution

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Fieldwork

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Cover Pictures

Photos from the RECONYX camera traps used to identify already ringed birds

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Abstract

The fieldwork for the hoopoe and wryneck population ecology project continued, following the protocol of previous years, to monitor the population of the two species breeding in the more than 600 nest boxes installed in the Rhone Valley between Martigny and Sierre.

In 2023, 129 hoopoe broods were recorded, of which 88 were successful. From these 88 broods, 475 chicks fledged (average: 5.4 chicks / successful brood). After a temporary low in 2018 and 2019, the number of successful broods has increased steadily (except in 2022). 147 different breeding adults were identified, of which 87 had already been ringed with an alphanumeric colour ring and could therefore be identified on photos taken by a camera trap installed at the nest box entrance. A hoopoe that was ringed as a nestling near Frankfurt in 2022 successfully bred in our study area.

30 wryneck broods were recorded, of which 13 were successful. From these 13 broods, 87 chicks fledged (average: 6.7 chicks / successful brood). 2023 was the year with the lowest number of successful broods in our nest boxes since 2002. 27 different breeding adults were identified. Prior to the breeding season, 28 wrynecks were captured with playback equipment, of which 7 were already marked. 2 of these subsequently bred in our nest boxes.

1. Introduction

At the end of the 20th century, the breeding populations of the Eurasian Hoopoe *Upupa epops* and the Eurasian Wryneck *Jynx torquilla* declined sharply in Switzerland. In order to counteract this negative trend, around 700 nest boxes were installed in the Rhone Valley between Martigny and Sierre between 1998 and 2001, and the populations of these two breeding species have been monitored annually since 2002.

In addition to the local conservation goal of ensuring the long-term survival of these populations in the Valais, we also want to better understand the breeding ecology, demography and population dynamics of the two species.

The general survey consists of checking all nest boxes every two weeks, checking occupied nest boxes every five days to collect information on the broods, capturing or resighting adult breeding birds and ringing all nestlings. In addition, wrynecks are captured with tape luring prior to the breeding season. Standardised field protocols have been developed for each species and were last updated in spring 2020. A new tape luring protocol has been applied to standardise spatio-temporal effort.

As in previous years, all physically handled hoopoes and wrynecks were marked with an alphanumeric colour ring in addition to the standard aluminium ring. The alphanumeric ring makes it easier to identify individuals on photographs taken by camera traps at the entrance to the nestboxes and reduces the need for physical capture.

The collection of genetic samples from all physically handled birds (adults and nestlings) that had not previously been sampled was continued. Genetic samples were obtained by buccal swabs taken from the mouth. They allow sex determination and insight into the genetic structure of the population.

The University of Bern Division of Conservation Biology continued its project on post-fledging ecology of hoopoes, with a second year of fieldwork completed in summer 2023. The main goals of the project are (1) estimate the survival of fledgling hoopoes in relationship to environmental and biological covariates, (2) calculate movement rates in relation to behavioral development, and (3) determine habitat associations.

2. Fieldwork

Tape luring for wrynecks was carried out between 11 and 26 April, on a total of 7 different days. A new protocol was applied: at each of the 28 defined 500 x 500 m² sample sites within the study area (covering all zones except C) tape luring was performed twice with at least one week in between.

The first regular nest box check began on 17 April. All nest boxes were then checked every other week until the end of July (last check ended on 26 July). Nest boxes occupied by hoopoes or wrynecks were checked approximately every fifth day to collect information on breeding output and phenology (clutch size, number of eggs hatched, number of fledglings, approximate laying and hatching dates). Nest boxes were checked from the outside through the entrance hole using an endoscopic camera. Occupancy of the nest boxes by species other than the focal species was also documented.

At all nest boxes occupied by the target species, a camera trap was installed next to the entrance hole after the clutch was full in order to identify the breeding adults.

Capture of unmarked hoopoes began eight days after the oldest chick had hatched. Most female hoopoes were captured by hand directly from the nest box, while males were captured with a clap trap attached to the nest box entrance or with a mist net. Capture of unmarked wrynecks began no earlier than seven days after the chicks had hatched. Individuals were captured using a mist net placed in front of the nest box.

Attempts were made to avoid capturing individuals that had already been identified in photographs. Catching effort per brood was limited to two hours per day and a maximum of six hours in total (attempts every other day). Captured adults were ringed (standard ring plus alphanumeric colour ring) and several morphological measurements were taken (according to the field manuals).

Hoopoe chicks were ringed (standard ring plus an alphanumeric colour ring) at the age of at least 18 days, and the lengths of tarsus, bill, third primary and the weight were measured. Wryneck chicks were ringed (standard ring plus an alphanumeric colour ring) at an age of at least 10 days, and tarsus length and weight were measured.

The fieldwork was carried out by Anouck Brodard and Sidonie Nicole under the supervision of Irmi Zwahlen. Ian Ausprey, Rico Felder, Lisa Moser and Montaine Delmotte were the fieldworkers for the University of Bern's post-fledging ecology project.

3. Nest box availability

The development of the number of boxes since the start of the project in 2002 is shown in Figure 1. In 2023, 636 hoopoe nest boxes were available. The decline in the number of available nest boxes did not continue and there was even a slight increase (2022: 626; 2023: 636). As planned last year, more nest boxes were installed. The work was carried out by Valentin Debons, field technician from the University of Bern. At the same time, however, we have lost some this season because whole orchards have been cleared, generator huts have been demolished or because the owners have changed and no longer want the nest boxes. However, this has been recorded and we will ensure that nest boxes are replaced during the winter months.

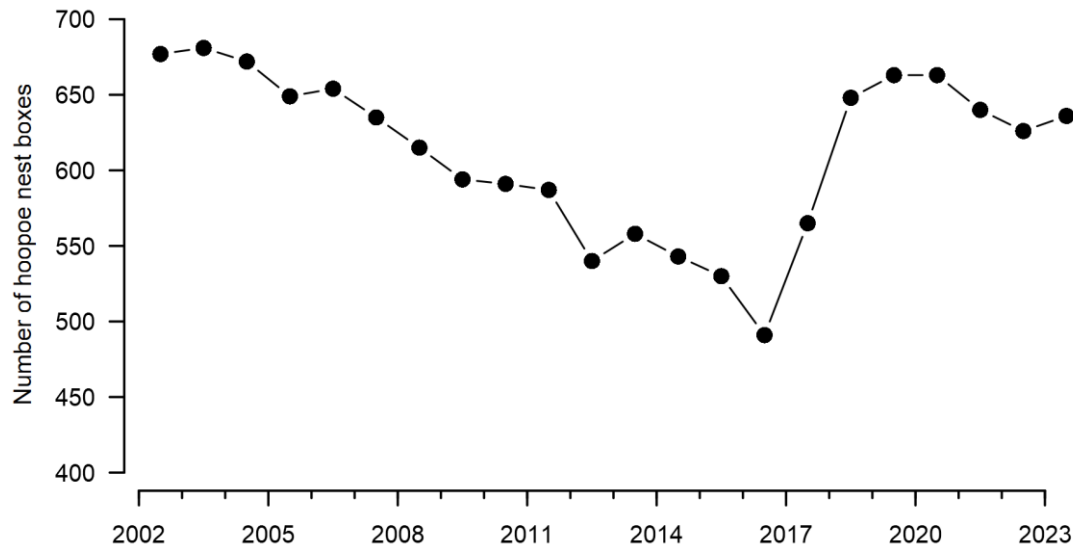


Fig. 1. Development of the number of available nest boxes in the study area (Schwegler wryneck boxes are not included in the graph).

4. Hoopoe: results and discussion

4.1. Overview

A total of 129 broods were recorded, of which 88 were successful, i.e., at least one chick fledged (Fig. 2). From these 88 broods, 475 chicks fledged (mean: 5.4 chicks / successful brood).

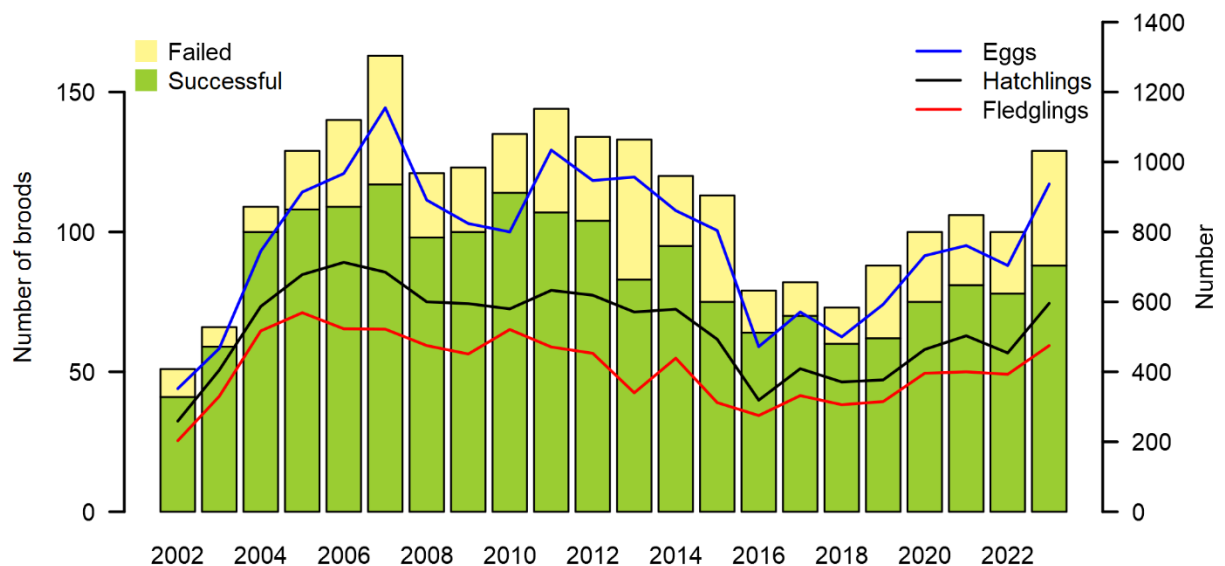


Fig. 2. Development of the hoopoe population. Bars represent the number of successful (green) and failed clutches (khaki) per year (left scale); lines represent the total number of eggs laid (blue), eggs hatched (black) and fledglings (red) per year since 2002 till now (right scale).

After a temporary low in 2018 and 2019, the number of successful broods has increased steadily (except in 2022). However, the number of fledglings has remained similar over the last three years, while this year has also seen an increase in the number of fledglings. With 475 fledglings in 2023 (the same number as in 2008), there have only been 6 years with a higher number of fledglings since 2002. Looking at the average number of fledglings per successful brood (5.40 in 2023), there was only one year with a higher average (5.59 in 2003).

41 unsuccessful broods in 2023 is proportionally high (32 %) compared to previous years. Over the years, the percentage of unsuccessful broods varied widely between 9 and 38 % (mean 22 %). Most unsuccessful broods in 2023 were abandoned clutches (26), of which 5 had only one egg. Other causes include predation or death of all nestlings, but the true cause of failure is very difficult to determine.

We identified 147 different adults (69 males, 78 females), 87 of which were already ringed, while 60 (26 males, 34 females) were unmarked. We ringed 520 nestlings, of which 475 finally fledged.

Genetic samples were collected from all first captured adults and from all ringed nestlings.

4.2. Capture of adults

A current aim of the study is to reduce the need for physical capture of adults while still being able to monitor the population. Table 1 summarises the methods used to identify individuals and how this has changed over time. Note that prior to 2011, all adults could only be identified if they were physically captured. Since 2011, there have been four different ways of encountering adults: 1) using the mist net in front of the nest box, 2) using the clap trap, 3) removing the bird from the nest by hand, and 4) resighting with a camera. Individual birds may have been seen more than once during the season, as they may have had more than one brood.

Table 1. Summary of the identified adult hoopoes in relation to the encounter technique.

Capture technique	Year												
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Mist net only (M)	18	10	6	4	6	0	1	0	4	1	0	0	2
Clap trap only (T)	69	56	55	48	29	57	51	36	31	24	29	28	37
By hand only (H)	65	78	47	54	78	14	19	6	8	18	14	23	15
Resighted only (R)	0	0	3	3	1	6	16	30	33	56	67	51	73
M + R	3	3	2	1	2	0	0	1	2	0	0	0	0
M + T	2	0	0	1	0	0	0	0	0	0	0	0	0
H + R	0	3	0	4	3	2	9	6	3	5	4	5	7
T + R	3	5	22	20	9	16	5	10	12	6	6	7	7
H + T	7	5	1	5	6	2	0	0	0	0	0	0	1
H + M	2	0	0	0	3	0	0	0	3	0	0	0	0
H + T + R	0	0	1	0	1	0	0	0	0	0	0	0	1
M + T + R	1	1	0	0	0	0	0	0	0	0	0	0	0
Total number identified	170	161	152	141	139	97	101	89	94	110	120	114	147
% physically captured	100	100	98	98	99	94	84	66	64	49	44	55	50
No. captured physically twice in a year	37	20	13	32	46	9	1	0	0	0	0	0	3

The proportion of physically handled individuals was almost 100 % until 2015 and declined thereafter to a minimum of 44 % in 2021. In recent years it has stabilized at around 50 %.

The number of individuals physically captured twice during a breeding season has been zero in the last four years. This year 3 individuals were captured twice. This occurred when only one of the two parents was captured on the first attempt, and on the second attempt to capture the unmarked individual, the individual already captured on the first attempt was accidentally recaptured.

Another way of looking at the resulting change in encounter technique after we started to mark all individuals with alphanumeric colour rings is to consider the broods as units and only distinguish between physical capture (mist net, clap trap or by hand) and resighting with the cameras. At the brood level it is possible that none, only one or both parents have been identified by the two possibilities.

Table 2. Summary of the identified adult hoopoes in relation to the encounter technique.

Number of broods	Year												
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Both captured	92	92	68	66	67	36	29	21	21	13	8	15	21
1 captured, 1 resighted	8	8	18	31	10	11	14	15	16	22	32	31	32
1 captured	18	12	8	10	17	13	14	2	5	5	5	2	3
Both resighted	0	1	14	1	3	4	10	21	28	34	40	27	47
1 resighted	0	1	2	2	0	6	5	5	4	13	10	13	5
None identified	29	22	26	11	16	9	11	9	16	13	11	12	21
Total number of broods	147	136	136	121	113	79	83	73	90	100	106	100	129
% of broods without capture	20	18	31	12	17	24	31	48	53	60	58	52	57
% of broods whose parents were identified without capture	0	2	15	3	3	14	21	41	43	54	53	45	48

Table 2 summarizes the results since 2011. The percentage of broods where no adult was physically captured has increased from between 12–31 % in 2011–2017 to between 48–60 % since 2018.

In 2023, in more than half of the broods, none of the adults were touched. It sometimes happens that none of the adults in a brood can be identified, either because the brood died before identification began or because identification was unsuccessful. If we only consider broods where at least one adult could be identified, we see that the percentage of broods without physical capture has increased from almost zero to around 50 % since 2018/19.

All these results show that the systematic marking of nestlings and adults with alphanumeric colour rings and subsequent camera monitoring has significantly reduced handling pressure on hoopoes. There is an increasing proportion of broods that no longer require physical capture. However, immigration is still high, resulting in the presence of unmarked individuals. It is therefore likely that the proportion of birds not physically captured will not decrease significantly anymore. This can also be seen by comparing the last five years, where no major changes have occurred.

4.3. Demographic performance

Using a Bayesian integrated population model, we analysed all demographic data sets jointly to get hints about demographic changes in the population. The model is constructed in such a way that temporal random effects in all demographic parameters are imposed. For the immigration the temporal random effect was applied on the number of immigrants. The estimates from the model are shown in Figures 3–5. For most of the parameters, there were no obvious changes in 2023 compared to previous years.

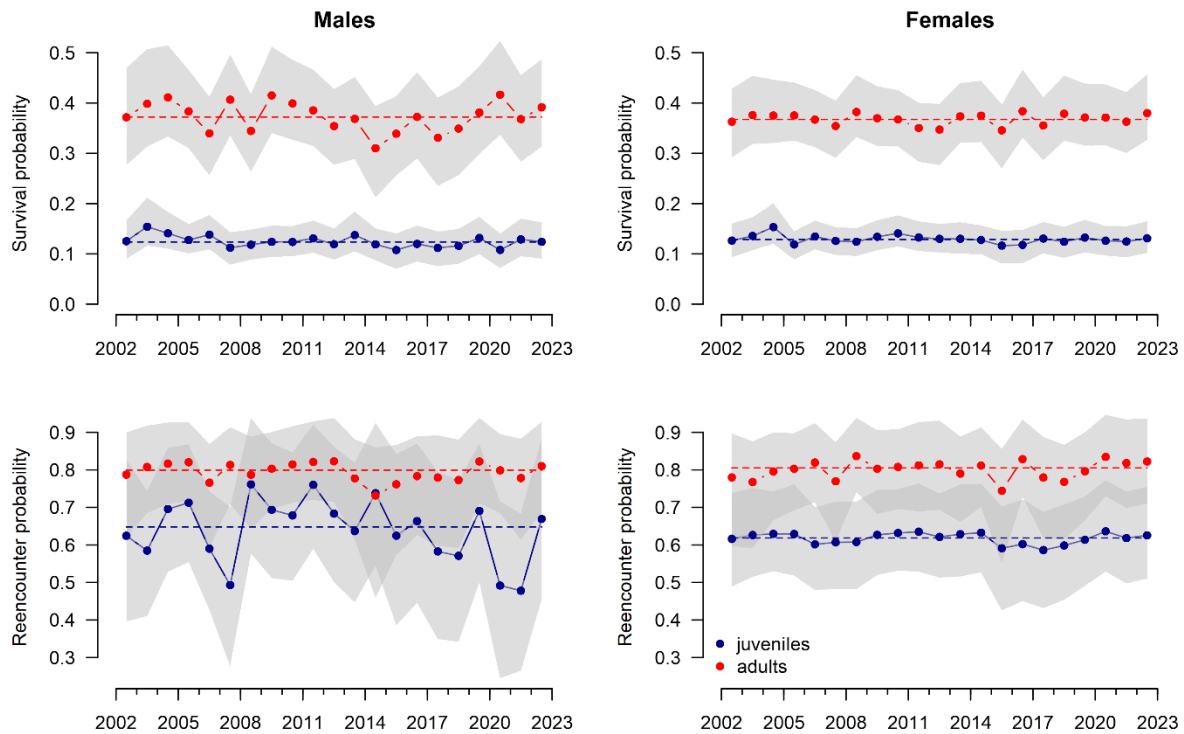


Fig. 3. Estimated annual apparent survival probabilities of juvenile (blue line) and adult (red line) hoopoes (top panels) and estimated reencounter (recapture or resighting) probabilities (bottom panels). Estimates for males are in the left panels and estimates for females are in the right panels. Points are posterior means, the polygons show the 95% credible intervals, and dashed lines show the mean over time.

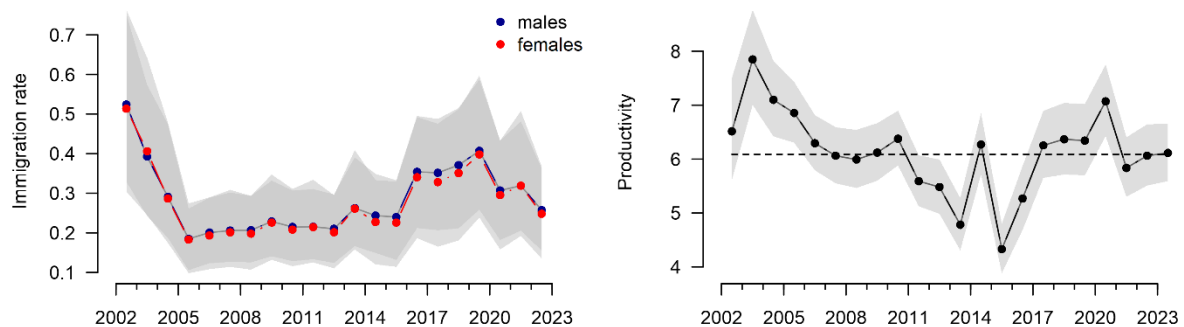


Fig. 4. Estimated immigration rates of hoopoes by sex and the estimated number of fledglings per female (productivity). Points are posterior means, the polygons show the 95 % credible intervals and dashed lines show the mean over time.

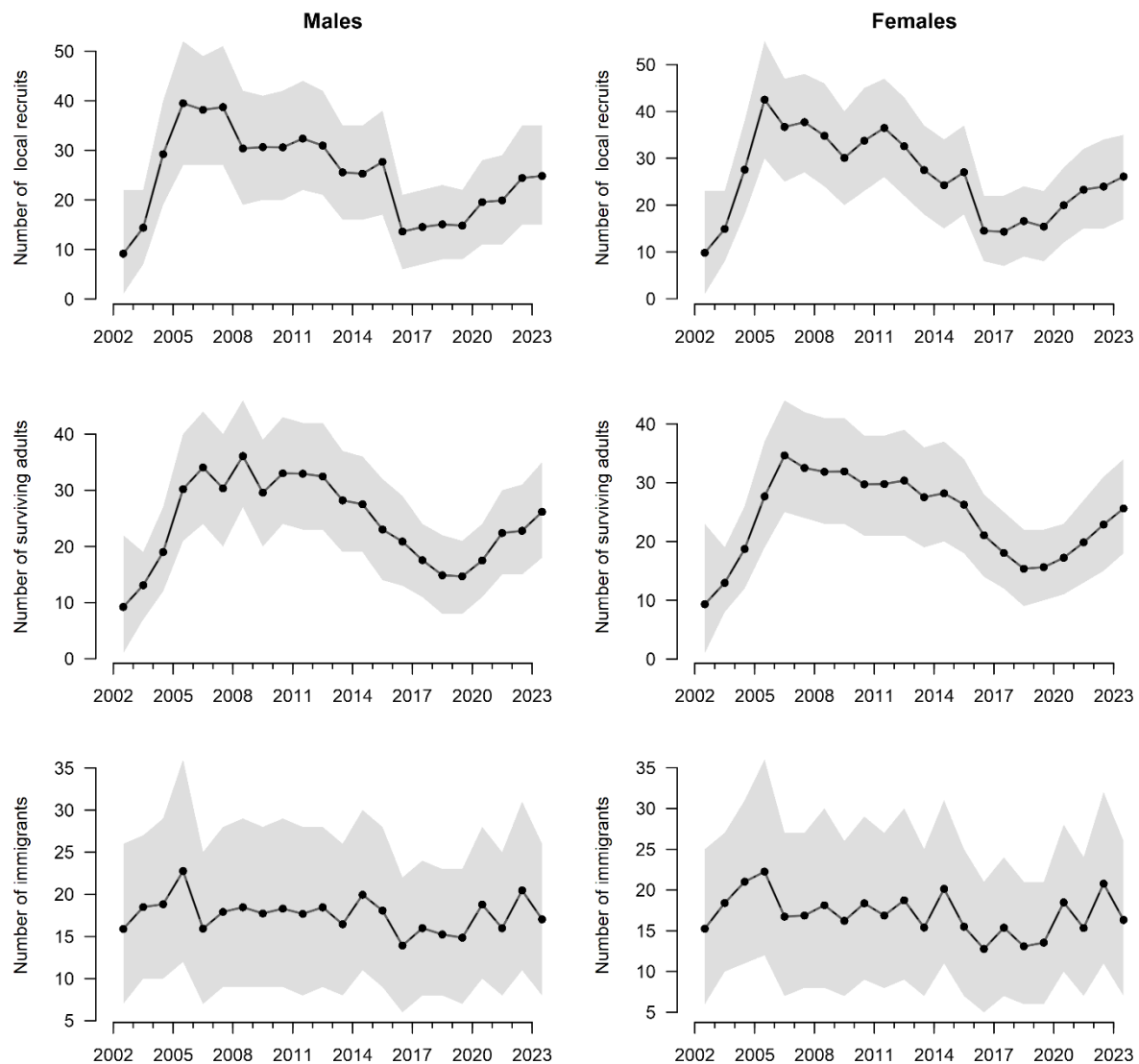


Fig. 5. Hoopoe population composition: estimated number of local recruits, surviving adults and immigrants for each sex. Points are posterior means, the polygons show the 95% credible intervals and dashed lines show the mean over time.

The total production of fledglings was higher in 2023 than in 2022, but there were also more broods. To gain further insight into productivity, we analysed the development of different components of productivity over time. These different components were not very different in 2023 compared to 2022 (Fig. 6). Fledging success (i.e. the probability that a hatchling fledged) was slightly lower than in 2022, but clutch size was slightly higher. As a result, the number of fledglings per successful brood was slightly higher and the number of fledglings per brood was slightly lower than in 2022.

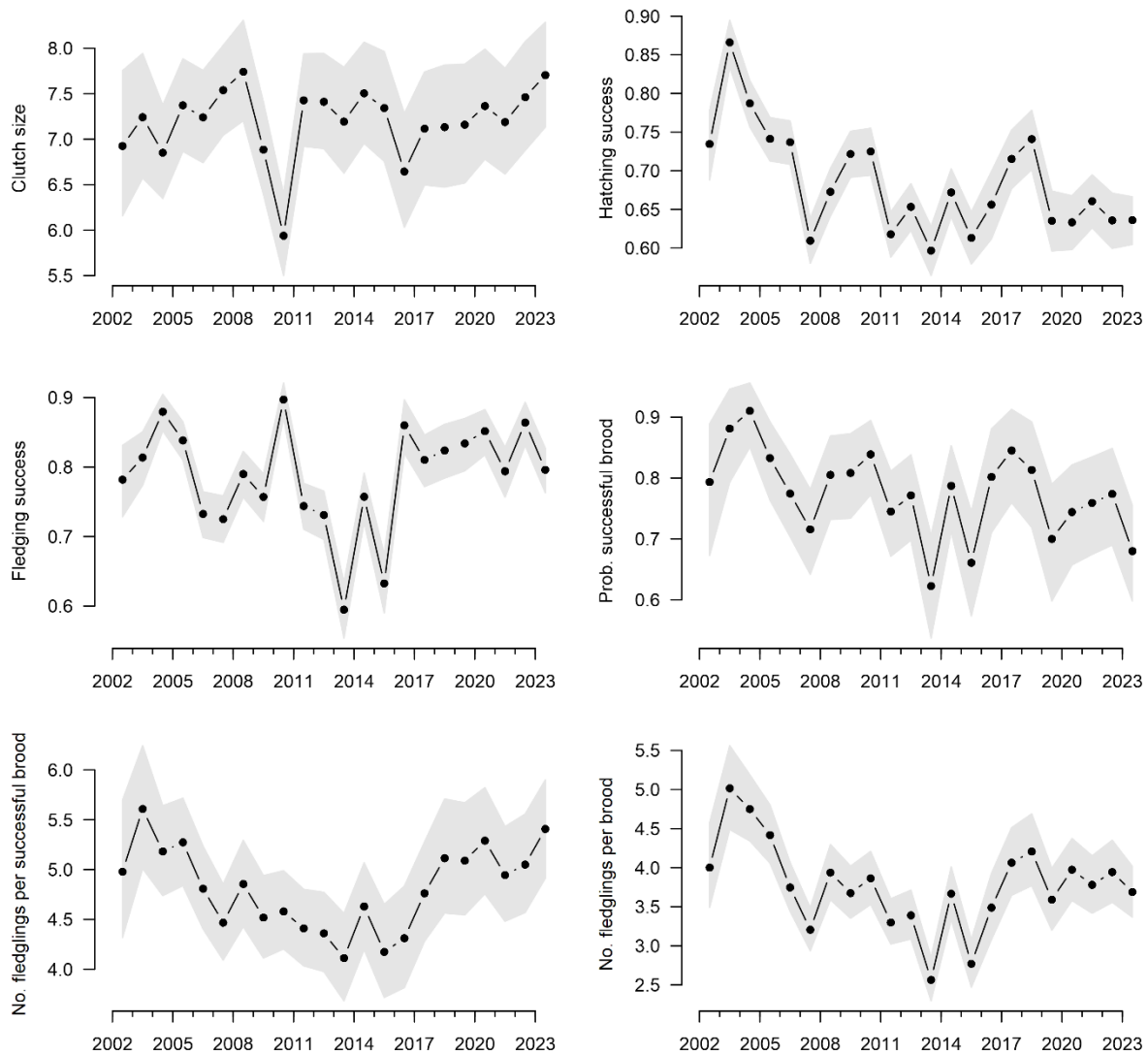


Fig. 6. Development of different components of hoopoe productivity over time: clutch size, hatching success (probability that an egg hatched), fledging success (probability that a hatchling fledged), the probability that an initiated brood was successful (i.e. at least 1 fledgling), the mean number of fledglings per successful brood, and the mean number of fledglings per brood. The points are posterior means, the polygons show the 95 % credible intervals and the dashed lines show the mean over time.

4.4. Post-fledging ecology

The post-fledging ecology of hoopoes is studied by a team of the university of Bern division of Conservation Biology led by Ian Ausprey and Rico Felder. They were also joined for fieldwork by Lisa Moser who is completing her BSc thesis on the behavioral development of fledgling Hoopoes and Montaine Delmotte, a visiting student from France completing a research internship as part of her MSc degree in Paris.

In 2023 the team placed radio transmitters on 37 nestlings within 5 days of fledging. Of these birds, four died in the nest before fledgling, leaving a final sample size of $n = 33$ birds that were radio-tracked. Nestling tagging began in mid May and fieldwork was concluded by mid early August, with approximately half the fledglings tagged in May and the remainder in early July.

Preliminary results of a survival analysis using the Mayfield method show that daily survival rate was lower during the first week (0.937 ± 0.014 SE) compared to the second (0.996 ± 0.004 SE) and third (0.995 ± 0.005 SE) week post-fledging. The number of foraging attempts increased with fledgling age and the number

of parental provisioning attempts decreased with fledgling age. No correlation was found between distance moved during the first week and body condition indices.

The project plans to continue in 2024 with a MSc student already identified to conduct the summer field-work and plans to find a BSc student in February. The thesis of the MSc student will focus on studying the movement ecology of fledgling hoopoes, using data from 2022–2024.

5. Wryneck: results and discussion

5.1. Overview

A total of 30 broods were recorded, of which 13 were successful, i.e. at least one chick fledged (Fig. 7). From these 13 broods, 87 chicks fledged (mean: 6.7 chicks / successful brood).

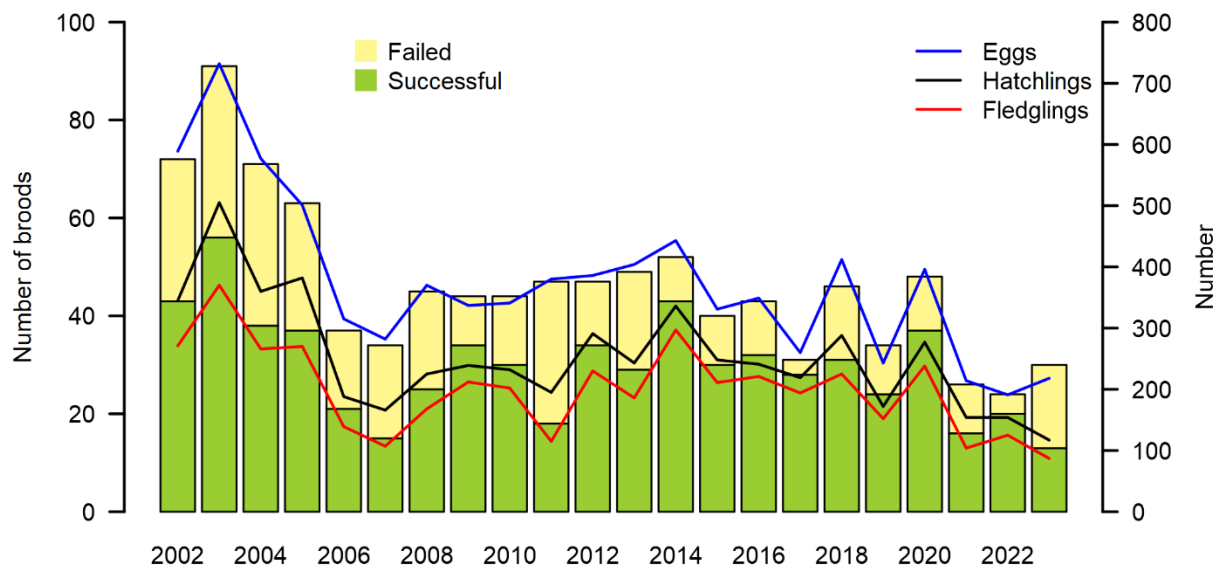


Fig. 7. Development of the wryneck population. Bars represent the number of successful (green) and failed clutches (khaki) per year (left scale); lines represent the total number of eggs laid (blue), eggs hatched (black) and chicks fledged (red) per year since 2002 to date (right scale).

With only 13 successful broods, 2023 was the year with the lowest number of successful broods since 2002. Of these 13 successful broods, only one was a second brood and 3 were replacements of failed first attempts. The 13 successful broods occurred in 12 different nest boxes, of which 4 were Schwegler and 8 were hoopoe nest boxes.

We identified 27 different breeding adults during the breeding season, of which 8 were already ringed and 19 were unmarked. Of the 13 successful broods, 24 out of 26 breeding adults were successfully identified.

Of the 17 unsuccessful broods, only 9 out of 34 adults were identified. Failure to identify was mainly due to the brood failing before identification was successful or before an encounter attempt had even begun.

We ringed 97 chicks, of which 87 finally fledged.

Genetic samples were collected from all first captured adults and from all ringed nestlings.

Of the 17 failed broods, 5 were in Schwegler nest boxes and 12 were in hoopoe nest boxes. Of the 103 available Schwegler boxes, 76 were occupied by sparrows or great tits. The occupancy rate of these boxes

was therefore very high. Many of the tree sparrows and great tits already start breeding in April, that's before the wrynecks start breeding.

5.2. Tape luring

With the decline of wryneck broods in the monitored nest boxes, we are gradually losing the ability to monitor survival. Tape luring offers the possibility of catching wrynecks that are not associated with a brood in our nest boxes, and we have therefore decided to use it more systematically. This requires a more defined and systematic design. We therefore defined 28 sampling sites of 500 x 500 m², located in all zones except C. At each site, tape-luring was carried out twice in April, with at least one week in between.

We captured 28 wrynecks using tape luring, of which 21 were unmarked and 7 were recaptures from previous years. The recaptures are shown in Table 3.

Two wrynecks captured during tape luring were later breeding in our nest boxes (one newly ringed and the recapture Y42132).

Table 3: Recaptures during tape luring 2023 with information on ringing and resight/recapture history.

Ring number	Recapture date	Ringing date	Circumstances ringing	Encountered since marking
Y47539	18.04.2023	15.06.2020	Nestling	No
Y53657	26.04.2023	03.07.2021	Nestling	No
Y53679	13.04.2023	19.07.2021	Nestling	No
Y53752	13.04.2023	22.04.2022	Tape luring	No
Y53704	12.04.2023	11.04.2022	Tape luring	No
Y53905	12.04.2023	20.07.2022	Breeding adult	No
Y42132	12.04.2023	03.06.2018	Breeding adult	In 2020, 2022 + 2023

5.3. Demographic performance

We analysed the capture-recapture data with Bayesian Cormack-Jolly-Seber models and the productivity data with Bayesian generalised linear models to gain insight into the temporal dynamics of survival probabilities and components of reproductive success. In contrast to the hoopoe data, we did not run an integrated population model because we cannot use nest box occupancy as an index of population trends.

Annual survival probabilities are shown in Figure 8. They show no long-term trends and, interestingly, adult survival shows stronger temporal patterns than juvenile survival. The recapture probability of adults is much higher than that of juveniles (in fact, this is the probability of catching an individual marked as a nestling when it is 1 year old), which may indicate that the breeding propensity of first year birds is lower than that of older birds.

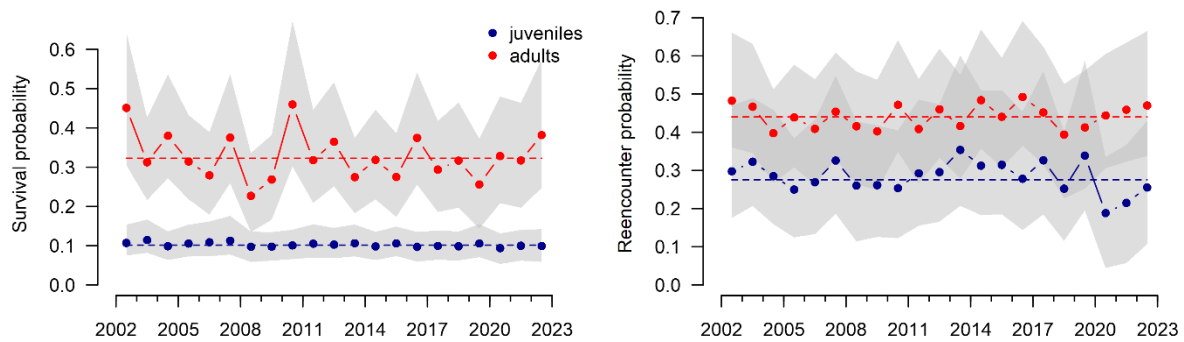


Fig. 8: Development of age-specific apparent survival and recapture rates of wrynecks, based on all captures (including tape lured birds).

The components of reproductive success are shown in Figure 9, all of which are quite variable over time. The number of fledglings per brood in 2023 was very similar to that of the previous year, although hatching success was significantly lower in 2023 than in 2022. This appears to have been compensated for by the higher clutch size.

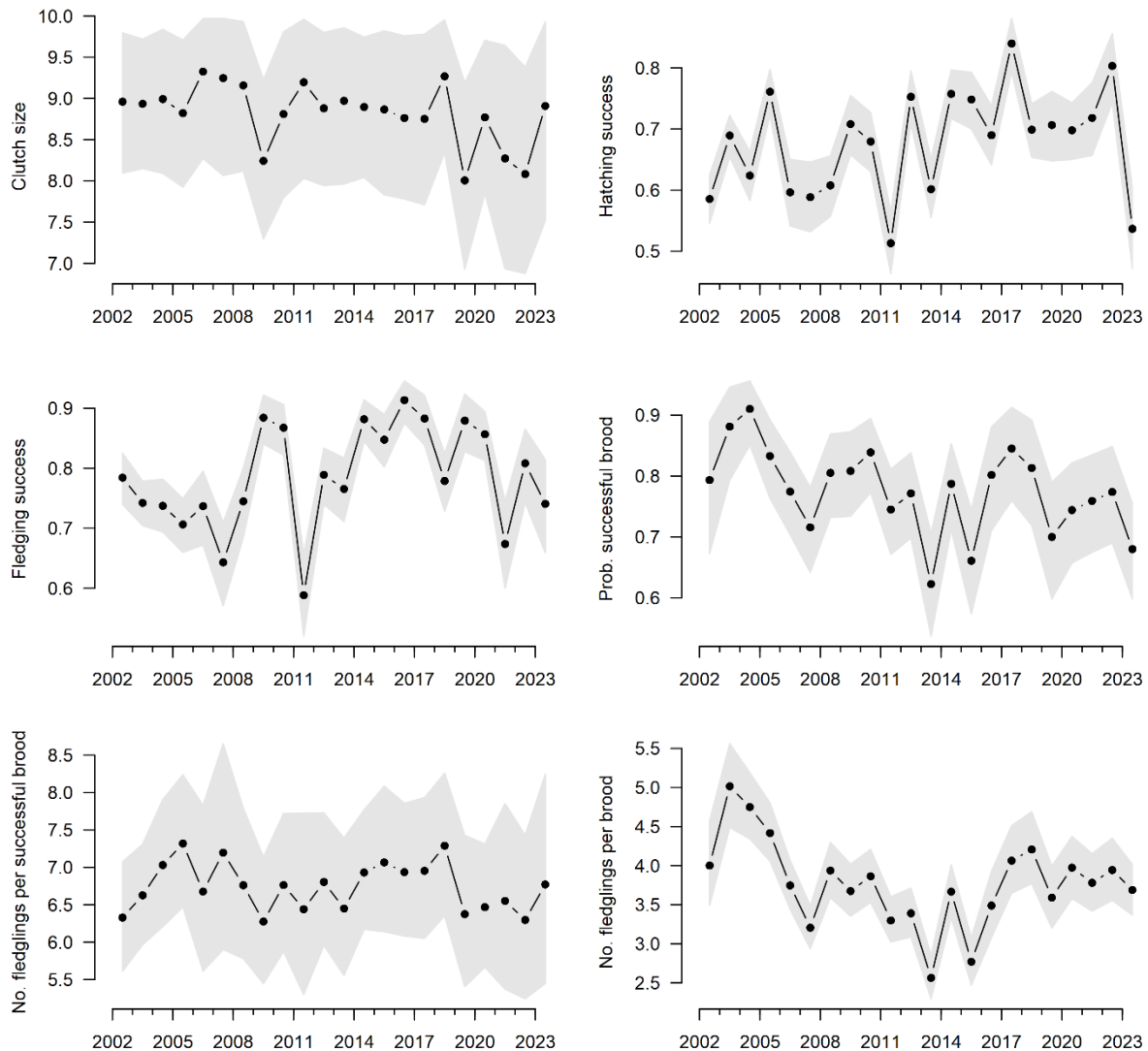


Fig. 9. Development of different components of wryneck productivity over time: clutch size, hatching success (probability that an egg hatched), fledging success (probability that a hatchling fledged), the probability that an initiated brood was successful (i.e. at least 1 fledgling), the mean number of fledglings per successful brood, and the mean number of fledglings per brood. The points are posterior means, the polygons show the 95 % credible intervals and the dashed lines show the mean over time.

6. Nest boxes occupied by other species

We continued to record nest box occupancy by species other than the two target species. In 266 out of 389 sites and in a total of 381 nest boxes we recorded species other than the two target species. Of the 636 hoopoe nest boxes, 169 were occupied by starlings, 76 by great tits and 25 by sparrows. Of the 103 Schwegler nest boxes, 76 were occupied by sparrows or great tits.

Further users of our boxes other than birds were two snakes (probably Aesculapian snake *Zamenis longissimus*), 4 boxes were occupied by the edible dormice *Glis glis*. In one box they were even breeding and were seen with young, in another box there were three dormice at the same time. One nest box was occupied by a family of mice *Microtus arvalis*.

7. Resightings and ring recoveries

Here we report on resightings and ring recoveries of hoopoes and wrynecks ringed in our study area from elsewhere, as well as hoopoes and wrynecks resighted in our study area but ringed elsewhere. Most of these data were submitted via the ringing central of the Swiss Ornithological Institute.

7.1. Hoopoe

Ringed elsewhere, breeding in our study area:

Hoopoe with a Helgoland ring **71032942** was ringed as a nestling on 18 June 2022 in Flörsheim-Wicker (near Frankfurt am Main), Germany. On 5 June 2023 he was recaptured as a male parent in a nest box in Saint-Leonard VS (distance 425 km).

Hoopoe **H 101000** was ringed as a nestling on 31 May 2022 in Begnins VD. On the 22 May 2023 he was recaptured as a male parent in a nest box in Saxon VS (distance 79 km).

Ringed in our study area, resighted elsewhere:

Hoopoe **H 154857** was ringed as a nestling on 4 June 2022 in Fully VS and was resighted alive on 25 April 2023 in 't Zand, Netherlands (distance 764 km, T. Zutt).

Hoopoe **H 146080** was ringed as a nestling on 27 May 2020 in Fully and was resighted alive on 30. April 2023 in Feldthurns, Italy (distance 348 km, T.Gantioler). It was most probably breeding there, as we have received a photo of a copulation. This bird had not been seen since fledging in 2020 until this resighting.

7.2. Wryneck

We are not aware of any resightings of 'our' wrynecks from outside the study area, nor have we encountered any breeding ringed wrynecks in our study area from elsewhere. However, there is something else to mention:

Wryneck **Y 42132** was ringed as a breeding adult (2nd calendar year) on 3. June 2018 at one of our nest boxes in Saxon. Since then it has been recaptured or resighted within our study in 2020, 2022 and 2023. On 27 July 2023 the bird was found dead after having a collision with a window in Saxon. This was just after its chicks had fledged. It produced at least 41 fledglings during its lifetime. It died at the age of 6.