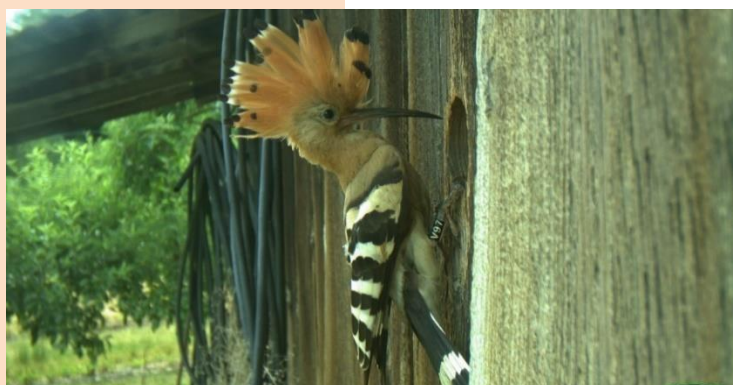


Population dynamics of Hoopoes *Upupa epops* and Wrynecks *Jynx torquilla* in the Valais

Annual report 2021

Michael Schaub
Irmgard Zwahlen



Internal report



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Authors

Michael Schaub, Irmgard Zwahlen

Fieldwork

Vincent Grognez, Alicia Mabillard, Louis Membrez and Irmgard Zwahlen

Cover pictures

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

Contact member

Michael Schaub, Schweizerische Vogelwarte, Seerose 1, 6204 Sempach

Tel.: 041 462 97 00, 041 462 97 66 (direct), michael.schaub@vogelwarte.ch

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1. Introduction

By the end of the 20th century, the breeding populations of the Eurasian Hoopoe *Upupa epops* and Eurasian Wryneck *Jynx torquilla* in Switzerland have strongly declined. To counter this negative trend, around 700 nest boxes have been installed in the Rhone valley between Martigny and Sierre 20 years ago. The populations of these two species breeding in these nest boxes are monitored every year since 2002.

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

The general survey consists of the control of all nest boxes every second week, the check of occupied nest boxes every fifth day to gather information about the broods, the capture or resighting of adult breeding birds and the ringing of all nestlings. Wrynecks are additionally captured prior to the breeding season by mean of tape luring. Standardized field protocols for each species have been developed and were updated for the last time in spring 2020.

As in the previous year 2020, we ringed all physically handled hoopoes and wrynecks with an alphanumeric colour ring in addition to the standard aluminium ring. The marking with the alphanumeric colour ring allows recognition of the individuals on photographs taken by camera traps at the entrance of the boxes and reduces the need for physical captures.

We continued to collect genetic samples from all physically handled birds (adult and nestlings) from which we did not already have a sample. Genetic samples were obtained by buccal swaps that are taken from the mouth. They allow sex determination and insights into the genetic structure of the population.

Louis Membrez (University Lausanne) conducted his Master thesis on the breeding dispersal in wrynecks. He helped in the field work and analysed the existing demographic data.

2. Fieldwork

In the first weeks of April all nest boxes were checked for a first time. Old nesting material of other species occupying the nest boxes (in particular tree sparrows, starlings and great tits) was removed and a layer of sawdust was put on the bottom of cleaned boxes to prevent eggs from rolling and breaking accidentally.

The first regular nest box check started on 19th April. All nest boxes were then inspected every second week until the end of July (last check ended on 27th July). Nest boxes occupied by hoopoes or wrynecks were checked about every fifth day to gather information on breeding output and phenology (clutch size, number of hatched eggs, number of fledglings, approximate laying and hatching dates). The nest box control was always conducted from the outside with a mirror or an endoscope camera through the entrance hole. We also documented the occupation of the nest boxes by other than the focal species.

Tape luring for wrynecks was preformed from 13th – 16th April.

We installed a RECONXY camera trap next to the entrance hole of nest boxes occupied by the target species. According to the updated field manuals, we installed cameras only after the clutch was full, and not as soon as the brood was discovered.

The capture of unmarked hoopoes started ten days after hatching of the oldest chick. Most hoopoe females that had to be captured were taken by hand directly from the box, while males were caught with a clap trap fixed at the nest box entrance.

The capture of unmarked wrynecks started the earliest five days after the chicks had hatched. Most individuals were taken directly from the nest, and some were caught with a mist net installed in front of the nest box.

We generally tried to avoid the capture of individuals that were identified on the photos as much as possible. We restricted the catching effort per brood to two hours a day, and to six hours in total (attempts every second day). Captured adults were ringed (standard ring plus an 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 length of tarsus, bill, third primary and weight were measured. Wryneck chicks were ringed (standard ring plus an alphanumeric colour ring) at the age of at least 10 days, and length of tarsus and weight were measured.

Unfortunately, the quality of the alphanumeric colour rings that we purchased from interrex (<https://colour-rings.eu>) had a poor quality. Particularly the inner diameter of the rings was smaller than ordered. The diameter of the hoopoe rings was so small that the rings could not be used because they were not turning on the leg. Therefore, we decided to use the still available rings from the previous purchase for unmarked adults and to leave some nestlings unringed (i.e., they did receive a standard aluminium ring, but no alphanumeric colour ring). The alphanumeric colour rings for the wrynecks could be used, although their quality was also worse than that from the previous purchase. We informed the company interrex about the bad quality, but never got feedback from them.

Field work was carried out by Vincent Grognez, Alicia Mabillard, Louis Membrez and Irmgard Zwahlen.

3. Nest box availability

No new nest boxes were installed in 2021. The development of the number of boxes since the beginning of the project in 2002 is shown in Figure 1. The number of available hoopoe nest boxes slightly decreased from 689 in 2019 and 2020 to 666 in 2021 (Fig. 1).

As in 2019 and 2020, none of the nest boxes located in the 26 stone heaps (constructed in 2019) was occupied by a hoopoe nor by any other bird species.

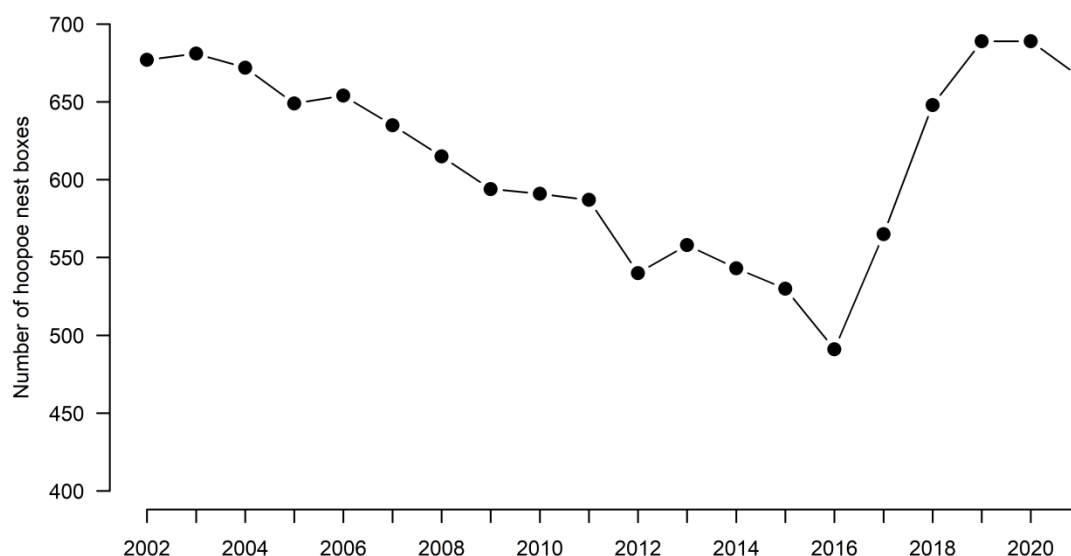


Fig. 1. Development of the number of available nest boxes in the study area (Schwegler wryneck boxes are excluded on the graph).

4. Hoopoe: results and discussion

4.1 Overview

In total, 106 broods were registered, of which 81 were successful, i.e., at least one chick fledged (Fig. 2). From these 81 broods, 398 chicks fledged (mean: 4.9 chicks / successful brood).

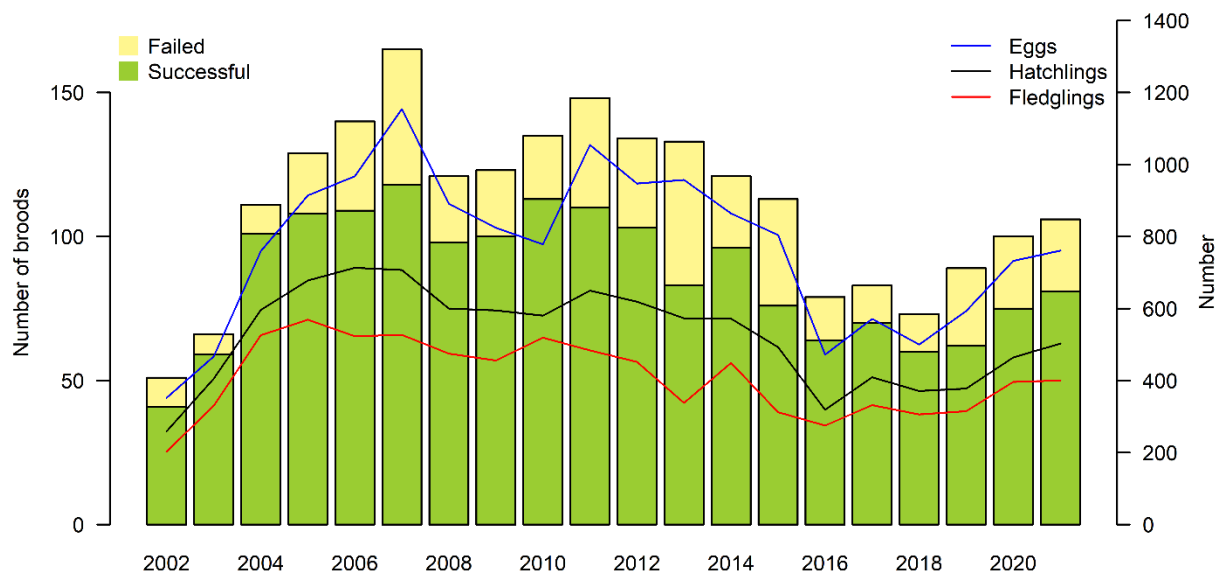


Fig. 2. Development of the hoopoe population. Bars represent the number of successful (green) and failed clutches (khaki) per year (left scale); lines represent the total number of laid eggs (blue), hatched eggs (black) and fledglings (red) per year since 2002 till now (right scale).

The number of successful broods increased compared to the previous year (2020: 75 successful broods; 2021: 81), but the number of fledglings was almost exactly the same as in 2020 (2020: 396 fledglings; 2021: 398).

We identified 120 different adults (53 males, 65 females, 2 unknown sex), of which 72 were already ringed, while 48 (21 males, 25 females, 2 unknown sex) were unmarked. We ringed 411 nestlings, of which 398 finally fledged.

Genetic samples were collected from 51 adults and from 397 nestlings.

4.2 Capture of adults

A current goal of the study is to reduce the need to physically capture adults while still being able to monitor the population. In Table 1 we summarized by which method individuals have been identified and how this has evolved over time. Note that before 2011 all the adults could only be identified when they were physically captured. Since 2011, the encounter of the adults has been performed in four different ways: 1) use of the mist net in front of the nest box, 2) use of the clap trap, 3) bird taken by hand from the nest and 4) resighting by means of a camera. Individual birds might have been encountered several times during the season because they may have conducted several broods.

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
Mist net only (M)	18	10	6	4	6	0	1	0	4	1	0
Clap trap only (T)	69	56	55	48	29	57	51	36	31	24	29
By hand only (H)	65	78	47	54	78	14	19	6	8	18	14
Resighted only (R)	0	0	3	3	1	6	16	30	33	56	67
M & R	3	3	2	1	2	0	0	1	2	0	0
M & T	2	0	0	1	0	0	0	0	0	0	0
H & R	0	3	0	4	3	2	9	6	3	5	4
T & R	3	5	22	20	9	16	5	10	12	6	6
H & T	7	5	1	5	6	2	0	0	0	0	0
H & M	2	0	0	0	3	0	0	0	3	0	0
H & T & R	0	0	1	0	1	0	0	0	0	0	0
M & T & R	1	1	0	0	0	0	0	0	0	0	0
Total number identified	170	161	152	141	139	97	101	89	94	110	120
% physically captured	100	100	98	98	99	94	84	66	64	49	44
% taken by hand	48	40	32	45	65	19	28	13	12	20	15
Number of individuals physically captured twice in a year	37	20	13	32	46	9	1	0	0	0	0

The proportion of physically handled individuals was almost 100% until 2015 and declined thereafter to a minimal value of 44% in 2021. Moreover, the number of individuals that were physically captured twice during a breeding season was zero in the last four years.

Another way to look at the resulting change in the encounter technique after having started marking all individuals with alphanumeric colour rings is to consider the broods as units and only distinguish between physical capture (mist net, clap trap or taken 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 number of broods and encounter technique by which the parents were identified.

Number of broods	Year										
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Both captured	92	92	68	66	67	36	29	21	21	13	8
1 captured, 1 resighted	8	8	18	31	10	11	14	15	16	22	32
1 captured	18	12	8	10	17	13	14	2	5	5	5
Both resighted	0	1	14	1	3	4	10	21	28	34	40
1 resighted	0	1	2	2	0	6	5	5	4	13	10
None identified	29	22	26	11	16	9	11	9	16	13	11
Total number of broods	147	136	136	121	113	79	83	73	89	100	106
Percent of broods without capture	20%	18%	31%	12%	17%	24%	31%	48%	54%	60%	56%
Percent of broods whose parents were identified without capture	3%	2%	15%	3%	3%	14%	21%	41%	44%	54%	52%

Table 2 summarizes the results since 2011. The percentage of broods where no adult was physically captured increased from about 20% in 2011–2015 to 60% in 2020. In 2021 it was a bit lower with 56%, but still for more than half of the broods none of the adults was touched. It happens sometimes that none of the adults of a brood can be identified, either because the brood failed before identification started or because the identification was not successful. If we only consider broods in which at least one adult could be identified, we see that the percentage of broods without physical capture increased from close to zero to 52% in 2021.

All these results show that the systematic marking of nestlings and adults with alphanumeric colour rings and the subsequent resighting with cameras significantly reduced the handling pressure on the hoopoes. There is an increasing proportion of broods for which no physical capture is necessary anymore. However, the still strong immigration results in the presence of unmarked individuals. It is therefore likely that the proportion of birds that are not physically captured and the proportion of broods without physical capture will not decline significantly anymore. This can be seen also by comparing the last four years, where no larger changes occurred.

As already mentioned, the quality of a new series of ordered alphanumeric rings for the hoopoes was bad. By using up the rings from the previous purchase, we could still mark about half of the nestlings and almost all adults. But in the end, 192 of 398 fledglings and 2 of 48 adults received no alphanumeric colour ring.

We will probably have to physically catch a larger number of birds in the next year, even though they are already marked with a standard aluminium ring. But lacking an alphanumeric colour ring they will not be identifiable with the cameras.

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 (not on the immigration rate as previously). The estimates from the model are shown in Figures 3–5. For most parameters of the year 2021 there were no obvious changes compared to the previous years, except for productivity that was lower in 2021 compared to 2020 (Fig. 4). The reencounter probabilities remained at the same levels (Fig. 3), although the physical capture of hoopoes was much reduced (Tab.1 and 2).

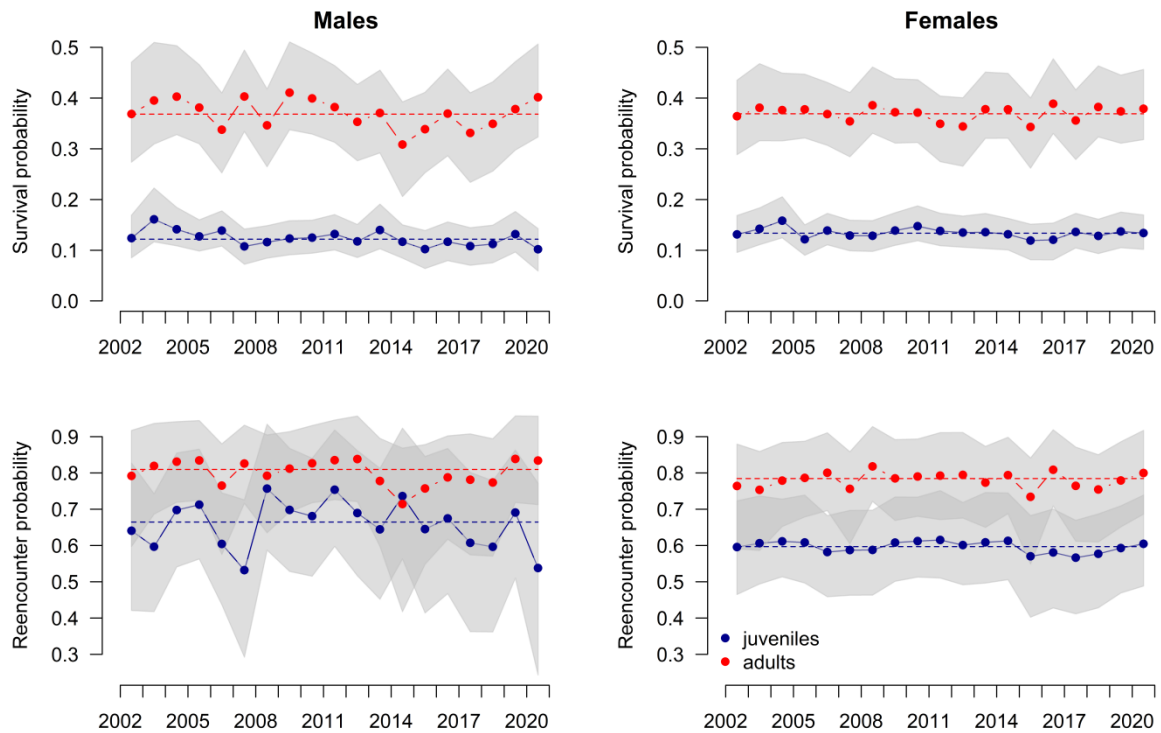


Fig. 3. Estimated annual apparent survival probabilities of juvenile (blue line) and adult hoopoes (red line) (top panels) and estimated reencounter (recapture or resighting) probabilities (bottom panels). Estimates of males are in the left panels, estimates of females in the right panels. Dots are posterior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

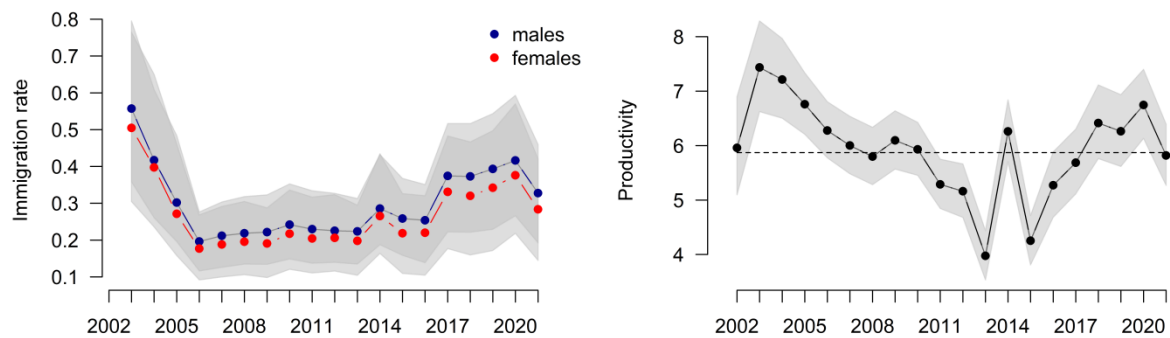


Fig. 4. Estimated immigration rates of hoopoes by sex and the estimated number of fledglings per female (productivity). Dots are posterior means, the polygons show the 95% credible intervals and the broken lines show the mean over time.

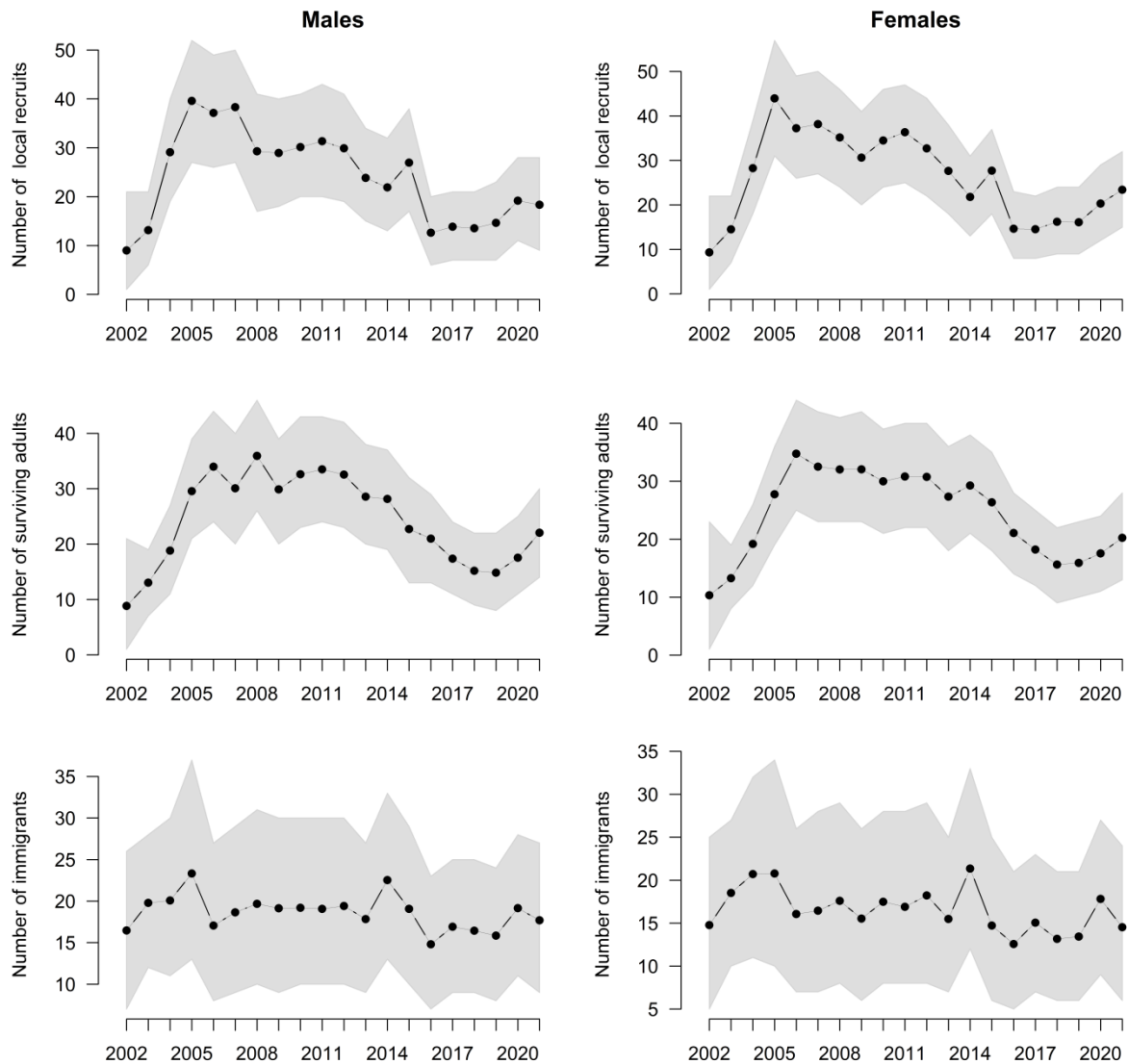


Fig. 5. Hoopoe population composition: estimated number of local recruits, surviving adults and immigrants for each sex. Dots are posterior means, the polygons show the 95% credible intervals and the broken lines show the mean over time.

The overall production of fledglings was almost exactly the same in 2021 as in 2020, although there were more broods in 2021 than in the previous year. To get further insights into productivity, we analyzed the development of different components of productivity across time. These different components were in 2021 not very different from 2020 (Fig. 6). The fledging success (i.e., the probability that a hatchling fledges) was slightly lower than in 2020, which may be due to the wet weather in May and June. As a result, both the number of fledglings per successful brood and the number of fledglings per brood were slightly lower compared to 2020.

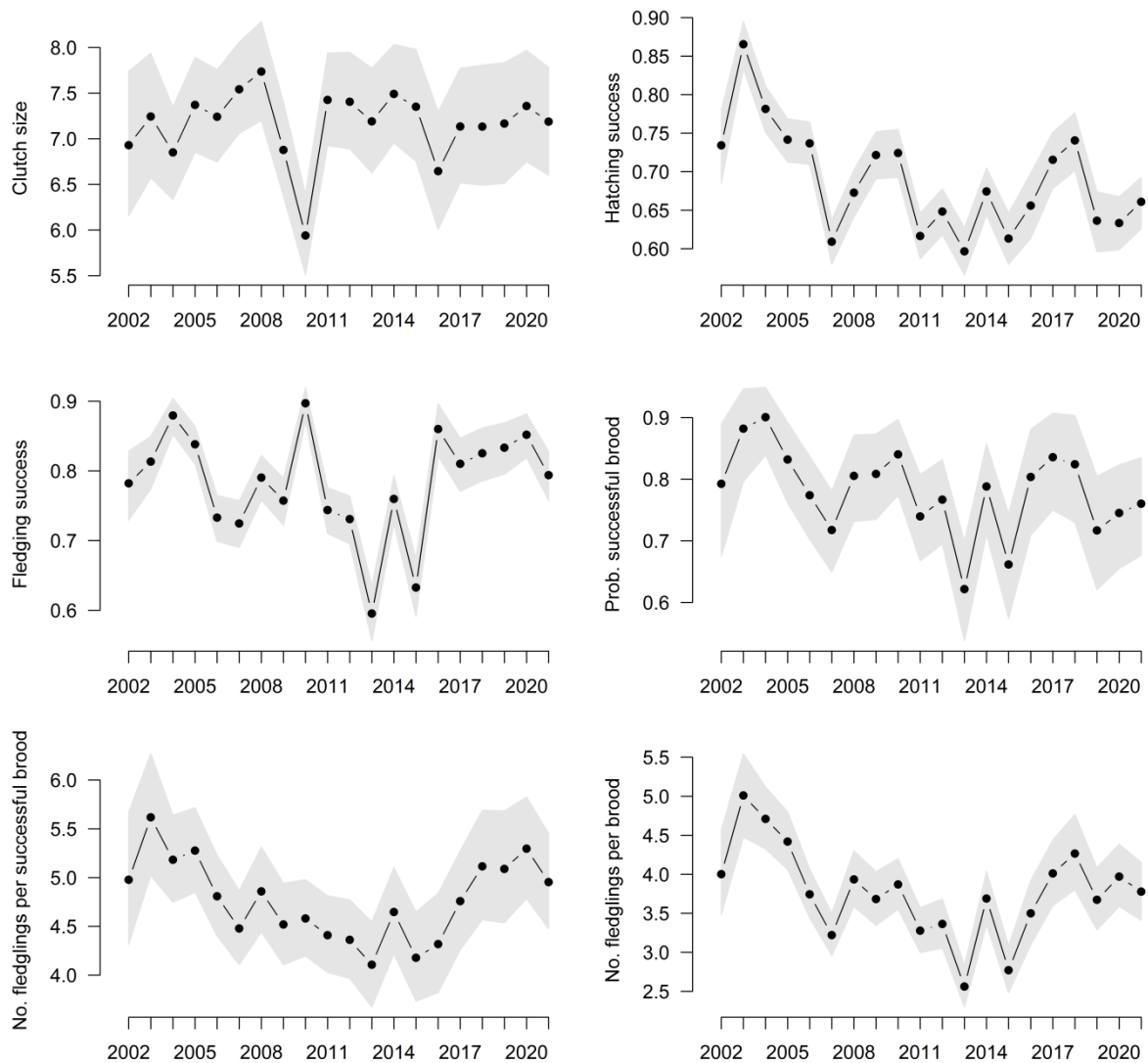


Fig. 6. Development of different components of hoopoe productivity over time: clutch size, hatching success (probability that an egg hatches), fledging success (probability that a hatchling fledges), the probability that an initiated brood was successful (i.e. at least 1 fledgling), the mean number of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

5. Wryneck: results and discussion

5.1 Overview

In total, 26 broods were registered, of which 16 were successful, i.e. at least one chick fledged (Fig. 7). From these 16 broods, 104 chicks fledged (mean: 6.5 chicks / successful brood).

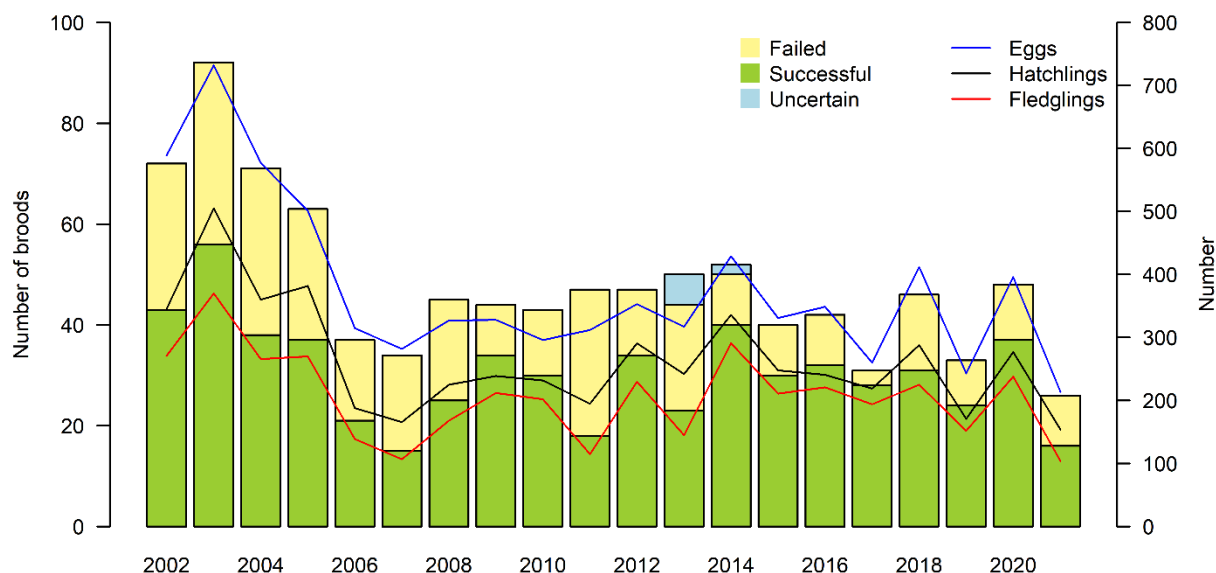


Fig. 7. Development of the wryneck population. Bars represent the number of successful (green) and failed clutches (khaki) per year (left scale); lines represent the total number of laid eggs (blue), hatched eggs (black) and fledged chicks (red) per year since 2002 till now (right scale).

With only 16 successful broods, 2021 was the second worst year since beginning of the study. In 2007 there were only 15 successful broods, in 2011 18. Only 104 fledglings were recorded in 2021, which was even lower than in 2007 (107) and 2011 (115).

We identified 35 adult individuals, of which 11 were already ringed while 24 were unmarked. 13 adults were captured prior to egg laying using tape luring, of which four were recaptures from previous years. Two of the adults captured during tape luring were later resighted by camera as breeding birds at a nest box. The ringing of the wrynecks with an alphanumeric colour ring allowed the identification of 15 individuals by the mean of the camera trap.

We ringed 131 chicks of which 104 finally fledged.

Genetic samples were collected from 23 adults and from 130 nestlings.

5.2 Demographic performance

We analysed the capture-recapture data to estimate annual apparent survival and reencounter probabilities, and the productivity data to estimate different components of the reproductive performance.

The annual apparent survival probabilities and the recapture rates are shown in Figure 8. Apparent survival of the adults was fairly low (0.32 on average) and showed quite extensive annual fluctuations. Juvenile apparent survival was 0.10 on average and showed less pronounced annual variation. As in the hoopoes, the recapture rates of juveniles were lower than that of the adults, suggesting less successful breeding in first year birds compared to older birds.

Apparent survival of the adults was slightly higher in 2021 compared to the last three years, while apparent juvenile survival did not show big changes. The recapture probability of adults was still low, but we hope to be able to improve it by the novel use of alphanumeric colour rings. Recapture probability of juveniles dropped in 2021 to the lowest value since 2002. This may indicate that younger individuals were less likely to reproduce in 2021 than in previous years.

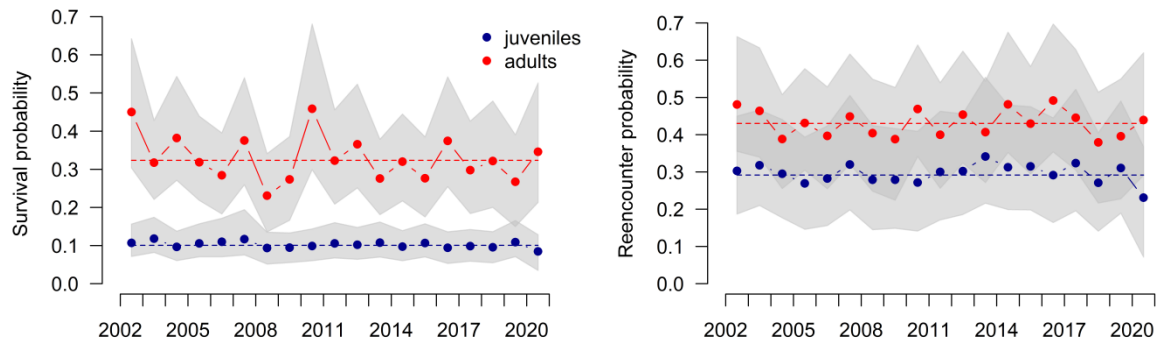


Fig. 8. Development of age-specific apparent survival and recapture rates of wrynecks, based on all captures (including tape lured birds). Dots are posterior means, the polygons show the 95% credible intervals and the broken lines show the mean over time.

The performances of the different components of productivity over time are shown in Figure 9. While clutch size and hatching success did not show large changes in 2021 compared to the previous years, the fledging success was strikingly lower in 2021 compared to most other years. Thus, a larger proportion of hatchlings did not manage to fledge. The probability that the complete brood failed was only slightly lower in 2021 compared to 2020. The number of fledglings per successful brood and overall was also slightly lower in 2021 compared to 2020. Thus, the overall low number of fledglings observed in 2021 was mostly due to the low number of wrynecks that initiated a brood and only to a lesser degree due to lower performance of the started broods. Interestingly we did not see a reduction in survival in 2021 compared to previous years, suggesting that potential breeding birds were present. This is also corroborated by the impression of the field workers who heard many singing wrynecks in spring. This again suggests that a substantial fraction of wrynecks was not reproducing in 2021, probably due to the wet environmental conditions.

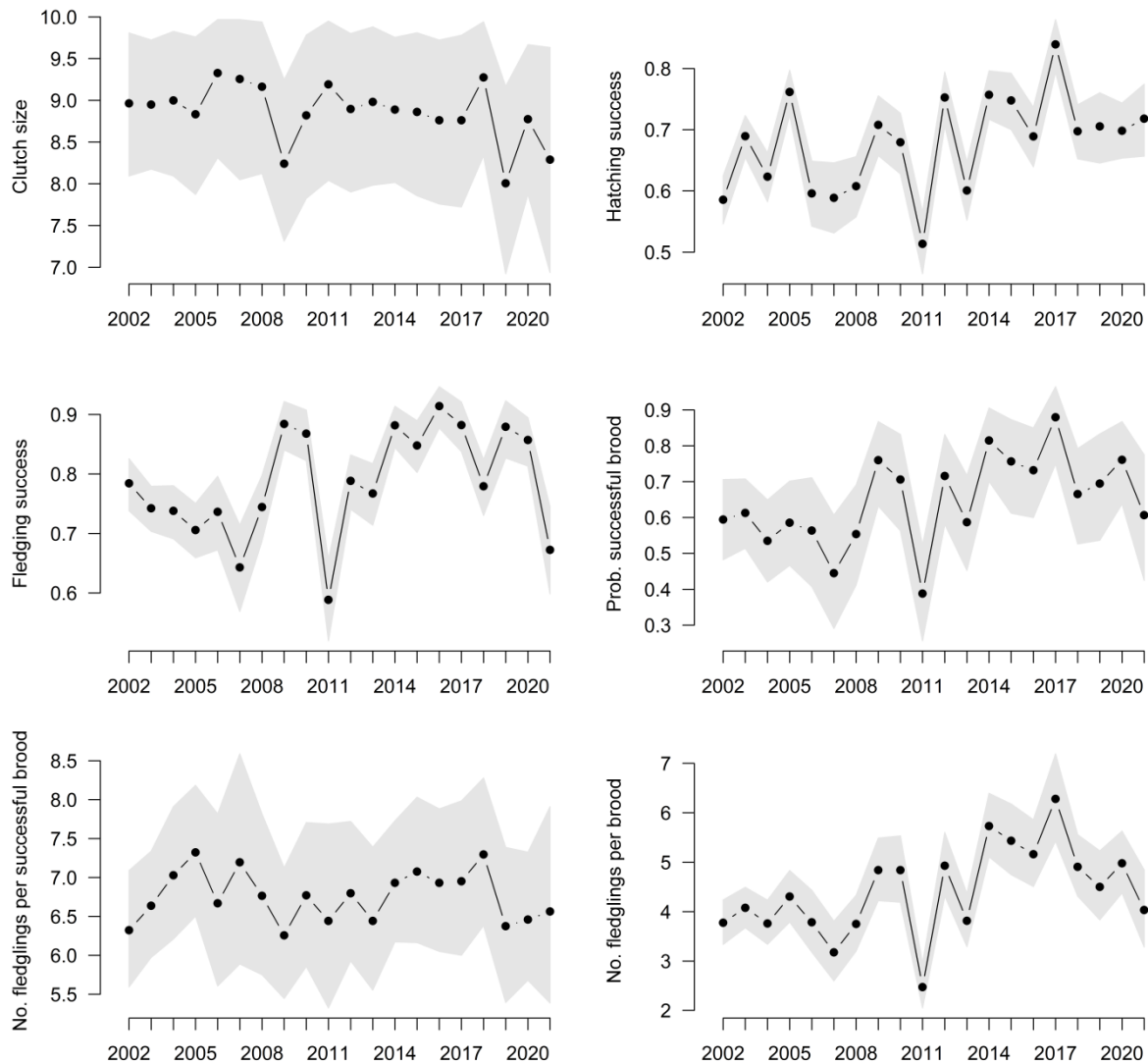


Fig. 9. Development of different components of wryneck productivity over time: clutch size, hatching success (probability that an egg hatches), fledging success (probability that a hatchling fledges), the probability that an initiated brood was successful (i.e. at least 1 fledgling), the mean number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

6. Nest boxes occupied by other species

We continued to record the occupancy of the nest boxes by other than the two target species. The most frequently observed other species in the boxes were starlings, followed by tree sparrows and great tits. The proportion of territories in which a starling was breeding was particularly high in zones C and D (Tab. 3). Compared to last year, the proportion of territories and of nest boxes occupied by starlings nearly doubled in zone A. By contrast, the proportion of territories occupied by starlings declined by one third in zone D. The overall proportion of territories occupied by starlings did not change.

Table 3. Summary of the number of available territories (nest box sites) and nest boxes, and how many of them were occupied by starlings in 2021. In parentheses are the proportions of occupancy from year 2020 in %. * The specific nest box occupied by a starling within a territory was not recorded and therefore absolute numbers cannot be reported.

Zone	Territories	Boxes	Number of territories with starlings		Number of boxes with starlings	
			Absolut	%	Absolut	%
A	155	266	19	12% (7)	29	11% (5)
B	85	150	20	23% (19)	21	14% (17)
C	71	107	45	63% (61)	.*	.*
D	87	131	35	40% (59)	.*	.*
G	7	12	1	14% (0)	1	8% (0)
Overall	405	666	120	30% (30)	.*	.*

7. Ring recoveries and resightings outside the study area

Here we report dead recoveries and resightings of hoopoes and wrynecks marked in the study area from locations outside the study area. Most of these data were transmitted via the ringing central of the Swiss Ornithological Institute.

7.1 Hoopoe

Hoopoe **H148414** was ringed as a nestling on 06.07.2021 in Ardon (territory B17). It was found dead (glass collision) on 19.08.2021 in Les Houches, Bonneville, France (Dep. Haute Savoie; distance 50 km; M. Séverine)

Hoopoe **H132631** was ringed as a nestling on 06.07.2019 in Riddes (territory B39). It was found dead (car collision) on 19.07.2021 in Alixan, France (Dep. Drôme; distance 215 km). There was no resighting of this individual between ringing and its death two years later.

Hoopoe **H138916** with alphanumeric colour ring J40 was ringed as a nestling on 30.05.2018 in Saint-Léonard (territory D6). In 2020 he was resighted by camera on a nest box in Bramois (territory C38) and sexed as male that successfully raised a brood with six fledglings. He was resighted alive on 04.04.2021 in Zillis, Switzerland (Canton GR; distance 159 km; A. Brunner)

Hoopoe **H132429** with alphanumeric colour ring N87 was ringed as a nestling on 09.07.2019 in Saxon (territory A108). It was resighted alive on 13.04.2021 in Maienfeld, Switzerland (Kanton GR; distance 205 km; H. Rüedi). Interestingly, this individual is one out of the seven siblings of H132427, which was seen alive in Killeberg, Sweden (23.5.2020; distance 1244 km) and died in a rescue centre in Luxemburg (11.6.2020 in Dunelange).

7.2 Wryneck

Wryneck **Y44606** was ringed as a nestling on 17.06.2018 in Riddes (territory B39). It was resighted alive on 20.06.2021 breeding in Grandson, Switzerland (Kanton VD; distance 85 km). It was again resighted while raising a second brood at the same location on 02.08.2021. (JL. Zimmermann)