**Electronic Supplementary Material ESM**

**Study system**

Alpine swifts are colonial birds that can live up to 26 years of age [1]. They sexually mature at the age of 2 or 3 years. Usually, after having initiated reproduction, most individuals will produce one clutch of 1–4 eggs/yr. every year until the year of their disappearance, which in most cases coincides with the year of their death [1]. Alpine swifts are socially monogamous with males and females sharing equally their investment in parental care from incubation onwards [2]. Alpine swifts build open nests on the ground that can be predated by terrestrial predators such as rats and stone martens and aerial predators such as corvids [3].

This study was performed between 1999 and 2014 in two Alpine swift colonies located 21 km apart, in the clock towers of Bienne (*ca.* 100 breeding pairs; 47°10’N, 7°12’E) and Solothurn (*ca.* 50 breeding pairs; 47°12’N, 7°32’E), Switzerland (Figure S1). The Swiss Alpine swift population counts ca. 2,300 breeding pairs that are distributed in more than 100 colonies ranging in size from 1-4 breeding pairs up to 150 breeding pairs (Figure S1).

Each year, nests in the two study colonies were visited regularly to record breeding data, capture parents (during incubation or while brooding young nestlings) for identification and measurements, as well as ring nestlings (when 10 days old) and measure their growth. Feathers or blood were sampled to sex individuals from DNA [4].

Each year, adults were captured in the two study colonies for identification and behavioural and biometric measurements [5]. Natal dispersal status was defined for 522 individuals ringed as nestlings by a change of colony between birth and first breeding (i.e. change / no change) (Table S1). Because Alpine swift nestlings are regularly ringed by amateur ornithologists in several Swiss colonies besides Biel and Solothurn, it allowed us to gather information on natal colony of dispersing birds ringed as nestlings for 74 individuals (Table S1, Figure S1). Furthermore, because adult Alpine swifts do not disperse once settled (no breeding dispersal event observed out of 2,064 breeding events in those two close-by colonies since 1999 despite almost perfect individual detection) and because all the nestlings are ringed each year in the two study colonies, we assumed that all the individuals ringed as adults (N = 237) in the two study colonies (i.e. Biel and Solothurn) were immigrants coming from unmonitored colonies (Table S1; Figure S1). They were thus included as natal dispersers into the analyses. There was a small but significant difference in sex-ratios between dispersing and locally-born individuals (chi-square test: = 4.18, P = 0.041). 241 of the 448 (53.8%) locally born individuals were females and 143 of the 311 (46.0%) dispersing individuals were females. This suggests that in the Alpine swift, males are more likely to disperse than females. There was no difference between the two study sites in the proportion of females that were locally born (chi-square test: = 0.00, P = 1.00). In Biel 173 of the 321 (53.9%) locally-born individuals were females, and in Solothurn 68 of the 127 (53.5%) locally-born individuals were females. There was also no difference between the two study sites in the proportion of females that were dispersants ( = 0.04, P = 0.836). In Biel 74 of the 164 (45.1%) dispersing individuals were females, and in Solothurn 69 of the 147 (46.9%) dispersing individuals were females. Because males are more likely to disperse than females and they are also more likely flush from their nest than females (see Table S3), a phenotypic and genetic correlation between dispersal behaviour and nest-defence behaviour may be driven by skewed sex ratios. However, such effects are expected under highly skewed sex ratios, which is not the case in this study (see results above). Finally, time spent before reproduction may influence the integration process and affect the correlation between dispersal status and nest defence behaviour. However, we found no difference in age at first reproduction [1] between locally-born individuals and dispersing individuals (*F*1,443 = 0.42, *P* = 0.371), after controlling for the effects of sex (*F*1,443 = 5.77, *P* = 0.001) and breeding colony (*F*1,443 = 1.11, *P* = 0.145).

Bird capture and ringing were performed under the legal authorisation of Swiss Federal Agency for Environment, Forests and Landscapes. Blood sampling was performed under the legal authorisation of the veterinary services from the Cantons Berne and Solothurn.

**Animal mixed model analysis**

Effects and variances were estimated with a Bayesian approach using ‘MCMCglmm’ R package [6]. Nest defence behaviour had repeated measurement at the individual level and dispersal status only had one observation per individual. In addition, nest defence behaviour was fitted with an ordinal distribution but dispersal status had a binary distribution. Given the structure of the data, repeated measured only for nest defence behaviour, and the distribution of the response variables, it was not possible to estimate a phenotypic correlation within the bivariate model. We thus fixed the residual covariance to zero. Since dispersal status was fitted as a binary trait with a logit link function, we fixed its residual variance (*VR*) to one and thus estimated the additive genetic variance on the latent scale [7]. The nest-defence score was fitted as an ordinal trait with 5 categories using a probit link and 4 cut points to be estimated. The first cut point was fixed to zero. We also fixed the residual variance to one and estimated the variance components on the latent scale [7]. For year and permanent environment effects on nest defence behaviours, we used non-informative priors (V = 1, nu = 0.02). For the additive genetic (co)variance, we could not use a flat prior on the correlation scale since it was too weak to allow proper model mixing and convergence of parameters related to dispersal. We instead used a prior that was relatively flat on the correlation level but provided more weight to an absence of correlation (i.e. bell shaped centred on zero). Such prior could lead potentially to a higher rate of type II error for the genetic correlation (i.e. rejecting the correlation when it exist). We used the following expanded priors (V = diag(2)\*0.02, nu = 8, alpha.mu = c(0, 0), alpha.V = diag(2) \* c(1000,10)). To compute the posterior distribution, the model was run over 5.05 × 106 iterations, with a burn-in of 50,000 and a thinning interval of 5,000, to obtain an effective sample size between 901 and 1,000 with an autocorrelation level between retained iterations lower than 0.1. Parameter convergence and appropriate mixing of the chain was assessed visually for each parameter. The narrow-sense heritability of each trait was calculated as *VA/VP*, with *VP = VA + VPE + VYear + VR* + 1 for nest-defence and *VP = VA + 1+ π2/3* for dispersal [8]. The genetic correlation between natal dispersal status and nest-defence behaviour was calculated as *COVA / (sqrt(VA defence\*VA dispersal))* [9]*.*

**References**

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**Table S1: Number of locally-born individuals and dispersing individuals in the two study colonies.** Locally-born individuals are individuals that were ringed as nestlings in the study colony and later observed reproducing in the same colony. Dispersing individuals are individuals that either were ringed as nestlings in a colony different from the one in which they were breeding (natal colony known), or were ringed as adults in the study colony and presumed to be born in a different colony (natal colony unknown). See the Figure S1 for the distribution of the different Alpine swift colonies in Switzerland.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
| **Study colony** | **Dispersing status** | **Number of individuals** | | |
|  |  |  |  |  |
| Biel | Locally born | 321 |  |  |
|  |  |  |  |
| Dispersing, ringed as nestling | 35 |  | 4x Baden |
|  |  | 2x Basel |
|  |  | 1x Burgdorf |
|  |  | 5x Fribourg |
|  |  | 1x Lenzburg |
|  |  | 1x Schaffhausen |
|  |  | 21x Solothurn |
|  |  |  |  |
| Dispersing, ringed as adult | 128 |  | Unknown natal colony |
|  |  |  |  |  |
| Solothurn | Locally-born | 127 |  |  |
|  |  |  |  |
| Dispersing, ringed as nestling | 39 |  | 3x Solothurn centrum |
|  |  | 2x Baden |
|  |  | 29x Biel |
|  |  | 1x Burgdorf |
|  |  | 2x Fribourg |
|  |  | 2x Winterthur |
|  |  |  |  |
| Dispersing, ringed as adult | 107 |  | Unknown natal colony |
|  |  |  |  |  |
|  |  |  |  |  |

**Table S2: Statistics for the pedigree of the Alpine swift study populations.** This table summarizes the statistics (N: number of individuals / links) for the pedigree including only individuals that are informative with respect to our estimation of the genetic covariance between natal dispersal status and nest defence behaviour. Maximum depth is the maximum number of generations that separate two related individuals. These statistics were computed in R with pedantics package [9].

|  |  |
| --- | --- |
|  |  |
| **Pedigree statistics** | **Count** |
| N individuals | 829 |
| N maternal links | 321 |
| N paternal links | 318 |
| N full sibs | 118 |
| N maternal sibs | 226 |
| N maternal half sibs | 108 |
| N paternal sibs | 222 |
| N paternal half sibs | 104 |
| N maternal grandmothers | 93 |
| N maternal grandfathers | 92 |
| N paternal grandmothers | 56 |
| N paternal grandfathers | 56 |
| Maximum depth (N generations) | 4 |
|  |  |

**Table S3: Results of a mixed model testing whether nest-defence score (ordinal trait; 3092 observations) differed between natal dispersers and locally born individuals (759 individuals).** In addition to natal dispersal status, the model included breeding colony and sex as factors and bird identity and year of observation as a random effects. The interaction between sex and dispersal status was not significant (*P* =0.374), and thus removed from the final model presented here.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
| **Variable** | **Estimate** | **SE** | ***P*-value** | **Comment** |
|  |  |  |  |  |
| *Fixed* |  |  |  |  |
| Dispersal status | 0.61 | 0.16 | <0.001 | Dispersers are more likely to flush from their nest than locally-born individuals |
| Sex | 0.35 | 0.15 | 0.018 | Males are more likely to flush from their nest than females |
| Colony | 0.88 | 0.16 | <0.001 | Individuals are more likely to flush from their nest in Solothurn than Biel |
|  |  |  |  |  |
| *Random* |  |  |  |  |
| ID | 2.718 | 1.649 |  |  |
| Year | 0.055 | 0.234 |  |  |
|  |  |  |  |  |
| *Ordinal cut points* |  |  |  |  |
| 0 | 0.5 | -2.52 | 0.16 |  |  |
| 0.5 | 1 | -0.71 | 0.15 |  |  |
| 1 | 1.5 | 2.77 | 0.16 |  |  |
| 1.5 | 2 | 3.48 | 0.18 |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

**Figure S1. Distribution of the Alpine swift colonies in Switzerland.** This figure shows the distribution and size of Alpine swift colonies in Switzerland. The two study colonies, Biel and Solothurn, are reported in blue. Colonies reported in green are sites were nestlings are regularly ringed by amateur ornithologists and from where some of the dispersants included in our analyses are coming. See the Table S1 for information on number of dispersing individuals.

