Supplementary information S1

Daily estimates of population size within each annual sampling period, was calculated by simulations based on different survival functions for each age group. During summer, fledglings leave the nest and may be captured and sampled for determination of infection status (i.e. feces sampling). However, many fledglings die soon after leaving the nest and are therefore never sampled. These individuals still contributed to increased population size while they were alive. We therefore assumed that their daily survival rate had a Weibull distribution, i.e. survival rate was relatively low right after they left the nest, but increased with time. We therefore used a Cox’s proportional hazard model (Survival package, survreg, R Core Team 2018) to estimate the change in survival rate per day for newly fledged individuals. The number of fledglings and time of fledging were taken from nest data where all available nests on each of the four study islands had been visited at least once a week (Ringsby et al. 2002, Billing et al. 2012, Holand et al. 2015). Individual nestlings were marked with color rings along with a uniquely numbered metal ring at age 11 (range 8-13) days. We assumed perfect survival from marking until the nestlings left the nest (age ca. 14 days). The model of daily survival rate outside the nest was based on data from observations (using a telescope to observe the unique combination of rings) and captures (using mist nets). We pooled data from all years in the long-term study for each island (1993 – 2017). Hence we estimated the mean survival function across all years for each island (Aldra, Gjerøy, Hestmannøy and Indre Kvarøy) separately. We then used the survival function estimated for each island along with nest data for each year and island to estimate the number of fledglings that were alive outside the nest on each island each year at any given time during the field season using simulations (see below).

The number of adults present at the start of the field season each year (1 May) was estimated by counting the number of adults captured or observed during the entire field season each year on each island (Baalsrud et al. 2014). The number of adults present at the end of the field season was determined based on the number of adults observed or captured during the autumn field season. During the autumn field season almost the entire population was captured or observed. We assumed a simple, linear daily survival function for adults each year on each island based on the number of adults that must have been alive at May 1st and the number that must have been alive at the start of the autumn field season. The length of the survival interval was based on number of days between May 1st and the start of the autumn field season on each island each year. Juvenile individuals captured for the first time outside the nest were assumed to have the same daily survival probability and survival function as adults on the same island the same year. These juveniles were assumed to enter the population on the same day they were caught for the first time.

The number of individuals present at any given time during the field season on a given island and year was then estimated based on the mean values from 1000 simulations of individual survival histories that accounted for when an individual entered the population and the respective survival probability and function described above. Relative population size on each island was calculated by subtracting the mean population size across all years 2007-2013 and dividing by the standard deviation (i.e. a z-score transformation). Assuming that the size of the suitable habitat on each island did not change in the period, this estimate would correspond to population density on a given date, year and island.

References

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