Structure of the capture-recapture model

At a given sampling occasion, an individual may be prebreeder (PB), successful breeder (SB), failed breeder (FB), skipper (SK) or dead (†). An intermediate state (first-time breeder ‘B1’) was included to model the recruitment. In the field, the possible observations made were: '0' (not detected), '1' (detected and assigned as a non-breeder, *i.e.* pre-breeder or skipper), '2' (bird observed and identified as failed breeder), '3' (bird observed and identified as successsful breeder) and '4' (bird observed but successful status not ascertained).

All birds were prebreeders when first captured and the initial state vector Π was thus defined as:

$$\Pi = \begin{array}{cccc} \mathrm{PB} & \mathrm{SB} & \mathrm{FB} & \mathrm{SK} \\ 1 & 0 & 0 & 0 \end{array}$$

We defined the survival matrix S, the recruitment matrix R (conditional on survival) and transition between mature breeding states matrix T (conditional on survival and recruitment), the detection matrix P and the breeding success assignment matrix SA (conditional on detection) as:

$$S = \begin{array}{c|ccccc} & \mathrm{PB} & \mathrm{SB} & \mathrm{FB} & \mathrm{SK} & \dagger \\ \mathrm{PB} & \phi & 0 & 0 & 0 & (1-\phi) \\ \mathrm{SB} & 0 & \phi & 0 & 0 & (1-\phi) \\ \mathrm{FB} & 0 & 0 & \phi & 0 & (1-\phi) \\ \mathrm{SK} & 0 & 0 & 0 & \phi & (1-\phi) \\ \dagger & 0 & 0 & 0 & 0 & 1 \end{array}$$

$$R = \begin{array}{c|cccccc} & \mathrm{PB} & \mathrm{B1} & \mathrm{SB} & \mathrm{FB} & \mathrm{SK} & \dagger \\ \mathrm{PB} & (1-\Psi) & \Psi & 0 & 0 & 0 & 0 \\ \mathrm{SB} & 0 & 0 & 1 & 0 & 0 & 0 \\ \mathrm{FB} & 0 & 0 & 0 & 1 & 0 & 0 \\ \mathrm{SK} & 0 & 0 & 0 & 0 & 1 & 0 \\ \dagger & 0 & 0 & 0 & 0 & 0 & 1 \end{array}$$

$$T = \begin{array}{c|ccccc} & \mathrm{PB} & \mathrm{SB} & \mathrm{FB} & \mathrm{SK} & \dagger \\ \mathrm{PB} & 1 & 0 & 0 & 0 & 0 \\ \mathrm{B1} & 0 & \Psi & (1-\Psi) & 0 & 0 \\ \mathrm{SB} & 0 & \Psi & \Psi' & (1-\Psi-\Psi') & 0 \\ \mathrm{FB} & 0 & \Psi & \Psi' & (1-\Psi-\Psi') & 0 \\ \mathrm{SK} & 0 & \Psi & \Psi' & (1-\Psi-\Psi') & 0 \\ \dagger & 0 & 0 & 0 & 0 & 1 \end{array}$$

$$P = \begin{array}{c|cccc} & \text{Not detected} & NB & SB & FB \\ \hline PB & (1-p) & p & 0 & 0 \\ SB & (1-p) & 0 & p & 0 \\ FB & (1-p) & 0 & 0 & p \\ SK & (1-p) & p & 0 & 0 \\ \dagger & 1 & 0 & 0 & 0 \end{array}$$

$$SA = \begin{array}{c|ccccc} & 0 & 1 & 2 & 3 & 4 \\ \hline \text{Not detected} & 1 & 0 & 0 & 0 & 0 \\ NB & 0 & 1 & 0 & 0 & 0 \\ SB & 0 & 0 & 0 & (1-\beta) & \beta \\ FB & 0 & \beta & (1-\beta-\beta') & 0 & \beta' \end{array}$$

In the matrices P and SA, ‘NB’ corresponds to the state ‘non-breeders’ (i.e. pre-breeders and skippers together). To simplify notation, we did not distinguish probabilities in matrices. However, transitions are not all equal. According to effects we wanted to test, we differentiated some probabilities from the others. For example, if we considered that survival probabilities of prebreeders and breeders were different, we differentiated the probability ϕ in the first raw from the other rows. This comment is valid for all matrices.