ology
letters
B . . (2007) , 280–283
doi:10.1098/rsbl.2007.0053
k 20 March 2007
Evolutionary biology

C M. [1,*] D. R N [2]

partial migration; habitat loss;
population dynamics

## 1. IN ROD C ION

Annual migration is a widespread adaptation to seasonally varying environments, but the factors that influence the decision to migrate are poorly understood. Within a species, populations may be completely migratory, completely sedentary or partially migratory. Partial migration, where some individuals within the population migrate and others do not, occurs in a wide array of taxa including insects, fishes and birds (Lundberg 1988; Dingle 1996). Breeding experiments demonstrate that migratory behaviour in birds can be selected for, or against, in few generations (
We use an equilibrium population model to derive the range of parameter values within which we predict different migration strategies to occur and use this modelis given by

$$_{+(1/2)} = \;( - {}'( \; + \; )). \qquad (2.1)$$

We assume that migrants arrive later and, therefore, experience reduced competitive ability during winter (e.g. Adriaensen & Dhondt 1990; Perez-Tris & Telleria 2002). We model this by including a parameter $\delta \geq 1$, representing asymmetric competition. The number of migrants at the end of the winter $_{+(1/2)}$ is given by

$$_{+(1/2)} = \;( - \delta\, {}'( \; + \; )). \qquad (2.2)$$

Reproductive output is similarly modelled with a density-independent ( $_{R}$ for residents and $_{M}$ for migrants) and a density-dependent component ( $'_{R}$ for residents and $'_{M}$ for migrants). At the beginning of the next winter, the number of residents and migrants is given by

$$_{+1} = \; _{+(1/2)}( _{R} - {}'_{R} \; _{+(1/2)}), \qquad (2.3)$$

All parameters are shown in table 1. Substituting only the boundary between residency and partial migration is affected by changing $'_{\mathrm{R}}$.

Higher density dependence on either breeding site increases the range of survival values in which partial migration is expected to occur and lower density dependence decreases the range of survival values for partial migration. Graphically, the upper bound on figure 1 moves down towards the dotted line as $'_{\mathrm{M}} \to 0$ and the lower bound moves up towards the dotted line as $'_{\mathrm{R}} \to 0$. When there is no density dependence at either breeding site, the two boundaries are convergent on the dotted line and partial migration will not occur. In this case, the condition for complete migration is given by

$$> \frac{\mathrm{R}}{\quad}$$

# NOTICE OF CORRECTION

The abstract is now correct. 23 March 2007