



Spatial and temporal variation in the relative contribution of density dependence, climate variation and migration to fluctuations in the size of great tit populations.

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Abstract:

1. The aim of the present study is to model the stochastic variation in the size of five populations of great tit *Parus major* in the Netherlands, using a combination of individual-based demographic data and time series of population fluctuations. We will examine relative contribution of density-dependent effects, and variation in climate and winter food on local dynamics as well as on number of immigrants. 2. Annual changes in population size were strongly affected by temporal variation in number of recruits produced locally as well as by the number of immigrants. The number of individuals recruited from one breeding season to the next was mainly determined by the population size in year t , the beech crop index (BCI) in year t and the temperature during March-April in year t . The number of immigrating females in year $t + 1$ was also explained by the number of females present in the population in year t , the BCI in autumn year t and the temperature during April-May in year t . 3. By comparing predictions of the population model with the recorded number of females, the simultaneous modelling of local recruitment and immigration explained a large proportion of the annual variation in recorded population growth rates. 4. Environmental stochasticity especially caused by spring temperature and BCI did in general contribute more to annual fluctuations in population size than density-dependent effects. Similar effects of climate on local recruitment and immigration also caused covariation in temporal fluctuations of immigration and local production of recruits. 5. The effects of various variables in explaining fluctuations in population size were not independent, and the combined effect of the variables were generally non-additive. Thus, the effects of variables causing fluctuations in population size should not be considered separately because the total effect will be influenced by covariances among the explanatory variables. 6. Our results show that fluctuations in the environment affect local recruitment as well as annual fluctuations in the number of immigrants. This effect of environment on the interchange of individuals among populations is important for predicting effects of global climate change on the pattern of population fluctuations.

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