Numerical fluctuations in the northern short-tailed shrew: evidence of non-linear feedback signatures on population dynamics and demography

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Summary

1

We studied a fluctuating population of the northern short-tailed shrew (*Blarina brevicauda*) in the Appalachian Plateau Province of Pennsylvania, USA, spanning 21 years of monitoring. We analysed the pattern of annual temporal variation fitting both time-series models and capture–mark–recapture (CMR) statistical models for survival and recruitment rates.

2

We determined that non-linear first-order models explain almost 80% of the variation in annual per capita population growth rates. In particular, a non-linear self-excited threshold autoregressive (SETAR) model describes the time-series data well. Average snowfall showed positive and non-linear effects on population dynamics.

3

The CMR statistical models showed that a non-linear threshold model with strong effects of population density was the best one to describe temporal variation in survival rates. On the other hand, population density or climatic variables did not explain temporal variation in recruitment rates. Survival rates were high during the study period. Weekly changes in population size attributable to new recruits entering in the population fluctuate between 21% and 0%, while the changes in population size related to survival fluctuate between 79% and 100%.

4

Two important results arise from this study. First, non-linear models with first-order feedback appear to capture the essential features of northern short-tailed shrew dynamics and demography. Secondly, climate effects represented by snowfall appear to be small and non-linear on this insectivore. The population dynamics of this shrew in the Appalachian Plateau are determined apparently by a strong non-linear first-order feedback process, which is related to survival rates.

5

This study links population dynamics and demography by detecting the underlying demographic mechanisms driving population dynamics. The feedback structure of this shrew suggests the existence of population dynamics dominated by intraspecific competitive interactions, such as aggression, solitary nesting, non-overlapping home ranges and territoriality.