SAMPLING AND SYSTEMATIC ERROR IN A BURROW INDEX TO MEASURE RELATIVE POPULATION SIZE IN THE COMMON VOLE

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Despite their broad use in monitoring relative abundances of voles, various population indices are only rarely supplied with information on the level of uncertainty associated with their estimates. The index of re-opened burrow entrances which has been extensively applied in the common vole (*Microtus arvalis*) presents not only the major tool for management decisions but also the primary source of long-term data for analyzing its population dynamics. Large measurement errors in the estimate of index may have important consequences in both fields. Therefore, it is highly desirable that sampling designs of these indices are optimized in terms of a trade-off between cost and inferential strength. Here we explored random variation in the index by measuring relative and absolute sampling error in dependence on sample size (the number of quadrats 10 × 10 m sampled) and relative population size (mean index). A systematic error (bias) was examined as a relationship between the index values and Jolly-Seber estimates used as a proxy for true population size. We found that relative sampling error is enormous (in hundreds) for low population densities and small sample size. However, the absolute error never exceeds 500 entrances at these low densities, thereby posing no serious problem for decision-makers at predicting further development of a population. On the opposite, at very high relative densities and for sample sizes larger than 5 quadrats (500 m^2), the relative error drops below 10% and the risk of being wrong by prognosing low densities is small. Therefore the number of quadrats sampled can effectively be lowered without any substantial reduction in the precision of estimates. The most critical for managers are the estimates ranging from about 500 to 1000 entrances. We suggest that it may pay to enlarge the area sampled at these population densities in order to achieve a higher precision in estimation. We also reveal a systematic error because of nonlinear relationship between the
absolute and relative population density. The index of re-opened burrow entrances overestimates the population change at high population densities. In autumn when the burrow activity of voles is most intense the counts of re-opened burrow entrances grows faster than the Jolly-Seber estimates. This may have important repercussions in time series analyses of population growth rates in common voles which are primarily based on counts of burrow entrances.