Synchronous population fluctuations of forest and field voles: implications for population management

Tkadlec, E.[1,3], Suchomel, J.[2], Purchart, L.[2], Heroldová, M.[1], Čepelka, L.[2], Homolka, M.[1]
[1]Institute of Vertebrate Biology AS CR, Brno, Czech Republic
[2]Mendels University, Brno, Czech Republic
[3]Palacky University, Olomouc, Czech Republic, emil.tkadlec@upol.cz

DOI: 10.5073/jka.2011.432.052

Abstract

High population densities of field and forest voles cause economic losses by consuming crop or slowing down forest regeneration by damaging the bark of young trees. Consequently, programs to monitor abundances are often implemented as part of population management. Whereas abundances of the common vole (*Microtus arvalis*) in the Czech Republic has regularly been checked by the State Phytosanitary Administration for decades, no monitoring program has so far been invented to monitor forest voles. Because population numbers of different vole taxa are often observed to fluctuate in phase, we explored the possibility whether the monitoring data for the common vole can be used to forecast numbers of forest voles. Since 2002, we have monitored by snap-trapping bank vole (*Myodes glareolus*) populations in three forests situated in southern Moravia, Czech Republic. Correlation analysis of time series of yearly population changes for the common and bank vole revealed that populations of field and forest voles in southern Moravia fluctuate in a close synchrony, the correlations being consistently higher than 0.8. This result provides the reasonable possibility of exploiting the data from the extensive common vole population monitoring program for prediction in population management of forest voles.

Keywords: bank vole, common vole, *Microtus, Myodes*, correlation of population fluctuations

Introduction

In forestry, small rodents cause damage by chewing of the young tree bark and consuming seeds (Gill, 1992). The voles, primarily of the genera *Myodes* and *Microtus* are known for their temporal regular fluctuations in population numbers called population cycles (Hansson, 2002; Tkadlec and Zejda, 1998). The impact of vole populations on forest ecosystems should vary accordingly, with the highest damage at peak density and the lowest one at population lows. Long-term regular monitoring program is a prerequisite for a well-informed population management capable of forecasting vole numbers in the next year. However, collection of these data on a larger spatial scale is not simple because the methods of vole trapping are fairly laborious. On the other hand, there is already an extensive program in the Czech Republic for monitoring common vole populations in farmland organized by the State Phytosanitary Administration. It is based on a burrow index which is very easy to be estimated by pure inspection with no need of trapping. There is suggestive evidence that populations of different rodent taxa largely fluctuate in a close synchrony (e.g., Hansson, 2002). This phenomenon thus offers the possibility for rodent pest population management of exploiting data on abundances of one species for predicting population numbers of the others. In this study, we measure the degree of spatial synchrony between population dynamics of the common vole from open farmland and those of the bank vole from forest areas in southern Moravia between 2002 and 2010 to explore whether monitoring data for the common vole can be used for prediction in population management of forest voles.

Materials and methods

To assess the degree of synchrony between the bank and common vole, we monitored regularly in spring and autumn the abundances of the bank vole by snap-trapping in three forest complexes in southern Moravia: Rumunská bažantnice, Hájek and Horní les. The first forest, Rumunská bažantnice, was the most variable forest with mixed broad-leaved and coniferous trees. The second was a typical production forest dominated oak and hornbeam, with rich herb stratum. The third was a semi-natural lowland oak forest. Five lines of 20 traps were laid 5 m apart for three days. Relative abundance rA was calculated as the number of voles per 100 trap nights. For the common vole, we used a burrow index collected twice a year within a monitoring program organized by the State Phytosanitary Administration for a district Břeclav, southern Moravia. The index is estimated as the number of active burrow entrances per hectare.

In brief, the active burrow entrances are counted by walking across the field along four 100-m strips each 2.5 m wide. Hence, the entrances were counted for a total area of 1,000 m^2. Each year, 20 to 60 fields with different crop (mostly lucerne, winter wheat and rape) were sampled and the mean index then calculated for the district. Prior to analysis, the data on autumn abundances of both species were log-transformed and then converted by differencing to series of yearly population growth rates per capita r_t obtained as r_t=ln N_t-N_{t-1}. This is because we are interested in synchrony of processes rather than population numbers. Then the Pearson coefficients of correlation were calculated between 3 series of bank vole populations and one series of the common vole population.

Results

Population dynamics of 3 bank vole populations were highly synchronous with the growth rate of the common vole population from the district Břeclav (Figure 1, population rate), with correlations being all >0.8 ($p<0.05$). The correlations for Rumunská bažantnice, Hájek and Horní les were 0.88, 0.86 and 0.82, respectively. The mean correlation was 0.85 which is a reasonably high value suggesting that the data on population change in the common vole have a high predictive value for management of forest voles.

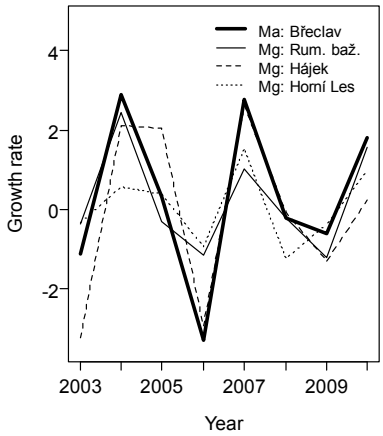

Fig. 1 Population growth rate of the bank vole (Mg) and the common vole (Ma) in southern Moravia.

Discussion

We confirmed that populations of forest and field voles fluctuate in a close synchrony and that the data collected for the common vole can be of great predictive value for forest vole management. Similar correlations were observed for the bank vole and the field vole (*Microtus agrestis*) in Sweden (Hansson, 2002). The underlying mechanisms behind the observed synchrony remain unclear. In bank voles, it is generally accepted that the multiannual changes in numbers can well be driven by variability in food resource availability (e.g. Pucek et al., 1993). It is known that seed masting can stimulate population growth in several forest rodents, such as voles and mice. However, there is no information at all what kind of resource could affect population growths in common vole populations during the same period of time. This remains the important task for future studies.

References

Gill RMA 1992 A review of damage by mammals in north temperate forests. 2. Small mammals. Forestry 65: 281–308

Hansson L 2002 Cycles and traveling waves in rodent dynamics: a comparison. Acta Theriologica 47: 9-22

Pucek Z, Jędrzejewski W, Jędrzejewska B, Pucek M 1993 Rodent population dynamics in a primeval deciduous forest (Białowieża National Park) in relation to weather, seed crop, and predation. Acta Theriologica 38: 199-232

Tkadlec E, Zejda J 1998 Small rodent population fluctuations: the effect of age structure and seasonality. Evolutionary Ecology 12: 191-210