Behavioral responses of voles along fences patrolled by natural predators

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Abstract

In a two year field experiment in Switzerland we tested if vole barriers combined with traps was a suitable tool to protect meadows and orchards from vole damage. We used a special kind of vole live trap that could be opened by terrestrial predators to feed on the captured animals. The experiment was designed to compare fences with traps, fences without traps and control lines without fences or traps. Predators preferred to move along fences with traps, which has been presented elsewhere. Voles on the other hand showed a preference for control lines as a general pattern but clear effects were masked by other factors. In practice, however, self service traps will attract natural predators and can therefore enhance the effect of simple fences to stop invading voles.

Keywords: *Arvicola*, damage, *Microtus*, orchards, plant protection, predation, rodents

Introduction

In European landscapes voles (*Microtus ssp. Arvicola ssp.*) are abundant and highly reproductive mammals. They can cause severe damage in agricultural areas (Walther et al., 2008) and are therefore often regarded as pests. Vole control measures, biological as well as conventional ones, can be locally effective but voles re-colonise the attractive habitats within a short time. Barriers to stop invading voles have been tested with different results (Witmer, 2007; Walther and Pelz, 2006). These rodents, however, are not only a pest to farmers but also an important resource for numerous predators (Halle, 1993). Consequently the question arises whether the combined effects of physical vole barriers and the threat by natural predators are able to protect high value crops (Malevez and Schwitzer, 2005). To test this hypothesis a two year field trial in Switzerland was done.

Materials and methods

The experiment was carried out from November 2006 until December 2008 at three sites in central and western Switzerland. Eschenbach (E) and Oensingen (O) are located in the Swiss Midland whereas Saignelégier (S) is in the Jura Mountains. All three sites had grassland mainly used for pasture, as well as grass and hay production. At each site three lines of 150 m length were defined. The first and the second lines' fences were made of 12x12 mm wire mesh, reaching 40 cm above and 20 cm below ground. The third line was a control with no major obstacle for moving voles. The difference between the first and the second line was a set of custom made live traps. The traps had two entrance doors for voles and a top which could be opened by terrestrial predators to take the captured voles as easy prey. 20 of these self service traps were set on both sides of the fences at each trial site. To measure the vole activity above ground, 10 cm high obstacles were placed right angled to the fences and control lines. 22 obstacles were set along each line. An obstacle had two tubes to count vole passages (according to Halle and Lehmann, 1987). Below ground activity of the voles was measured by heat sensors carefully placed in the vole tunnels.

The above and below ground activity counts were pooled to 15-day intervals for all three sites and analysed by the programme Permanova (Anderson, 2001), a non-parametric ANOVA method based on permutations of the data. Analyses were performed to determine the effect of the factors site (three levels: E, O, S; fixed), fence type (three levels: fence+traps, fence alone, control; fixed), year (two levels: year 1, year 2; fixed) and time of day (two levels: day, night; fixed) on aboveground activity of voles and activity of predators.

Results

Signs and trapping results revealed that *Arvicola amphibius* was dominant in Eschenbach, *Microtus arvalis* in Oensingen, and in Saignelégier both species were abundant. The Permanova analyses showed that the recorded above ground activity was significantly different between all sites and line types, with p=0.001 in an a posteriori test for sites and p=0.004 for line types, respectively. The highest activity was measured in Oensingen, followed by Saignelégier and Eschenbach. Significantly more activity was measured at controls compared to fences with traps and fences alone. In addition, the interaction term of site x line type was also significant (p=0.001). For below ground activity the same procedure was applied. There were no significant differences between sites or fence types for below ground activity.

In general the above ground vole activity increased from the first to the second year. This pattern was most pronounced at the control lines. In Saignelégier the activity along fences with traps and fences alone slightly decreased from the first to the second year and increased along control lines during the same period. The a posteriori test revealed that the decrease of activity at fences alone was statistically significant (p=0.001).

Discussion

During this field experiment in Switzerland the behaviour of predators and prey was manipulated by traps and fences set in a grassland habitat. Vole activity was highest along control lines, whereas predators, in the same experimental trial, moved significantly more often along fences with traps than along fences without traps or control lines (Fuelling et al., 2011). This pattern can be explained by assuming that the predators were attracted along fences because of a better hunting success and especially along fences with self service traps. Voles react to this increased predation risk with a decreased above ground activity. Below ground the fences had no effect on the predation risk and therefore no differences in below ground activity of voles could be observed. For voles the interaction between site and line type, however, was significant too but when each location was analysed separately, the pattern was not clear any longer. This might be explained by local differences, e.g. the occurrence of *Arvicola* and/or *Microtus* voles. Furthermore, vole behaviour is driven by more than just predator avoidance. According to Halle (1993), timing of vole activity is probably primarily driven by other factors than predators. His main argument was that in natural conditions no predator free time seems to exist during a day. Additionally, the above ground activity increased from 2007 to 2008. As vole populations are known to show multiannual fluctuations (Krebs, 1996), a population increase might explain this pattern. Nevertheless, the general pattern of increase was not consistent as in Saignelégier vole activity along the two fences decreased while it increased along the control line.

Local species composition, changing population densities in two consecutive years and other natural and anthropogenic factors may have masked the behavioural response of voles. Nevertheless, we conclude that for practical issues fences and especially fences equipped with self service traps are beneficial to protect valued crops like orchards. The physical fence barrier combined with the increased predation risk is a serious obstacle for voles to enter such a protected orchard (Walther and Pelz, 2006; Fuelling et al., 2011) even if the effects on vole behaviour are minor.

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