Spatiotemporal prevalence of cowpox virus in Finnish field voles

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Background

In northern Europe, rodent populations display cyclic density fluctuations, which are often associated with the human incidence of zoonotic diseases they spread. Field voles (*Microtus agrestis*) are periodically one of the most abundant rodent species in northern Europe. However, little is known of the viruses they carry, let alone of how they are maintained in nature or of the dynamics of their transmission to humans.

The orthopoxvirus (OPV) group includes several important pathogens that affect livestock animals and humans. Of these, infections by cowpox virus (CPXV) have suggested to be increasing globally following the cessation of cross-reactive smallpox vaccinations. Cowpox has been identified as having high seroprevalence in small rodents, which implies that they have a major role as reservoir host.

Methods

To evaluate the role of field voles as a reservoir for cowpox virus in Finland, and how the risk of its zoonotic transmission to humans varies over space and time, we screened 709 field voles, trapped from 14 sites over 3 years, for antibodies against cowpox. Antibodies reactive to CPXV/OPV were detected from heart extracts using immunofluorescent antibody tests.

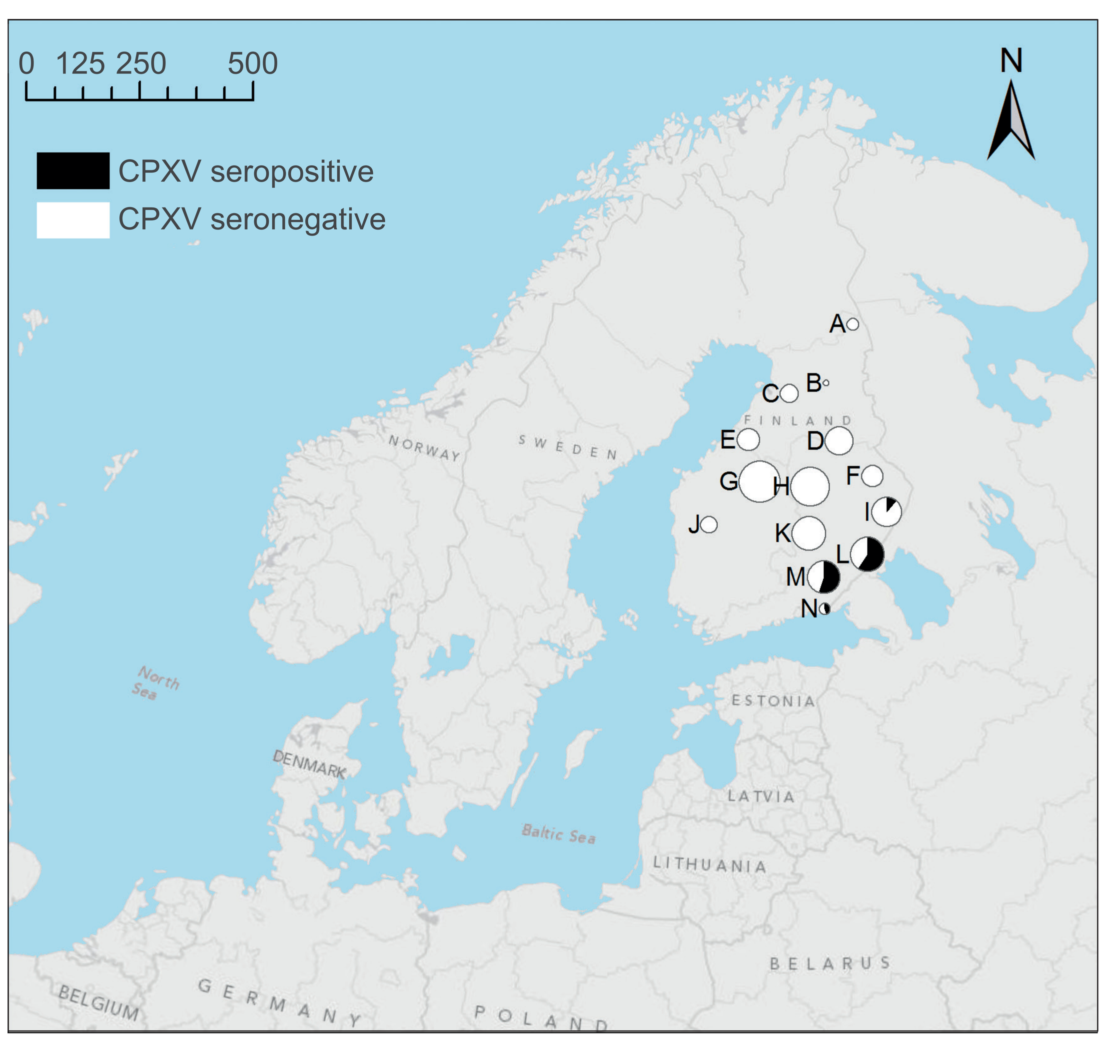

Figure 1. Trapping sites in Finland. Circle size denotes the total number tested (3 [B] to 110 [G] individuals) for antibodies against CPXV. Black and white colors refer to CPXV seropositive and seronegative individuals, respectively.

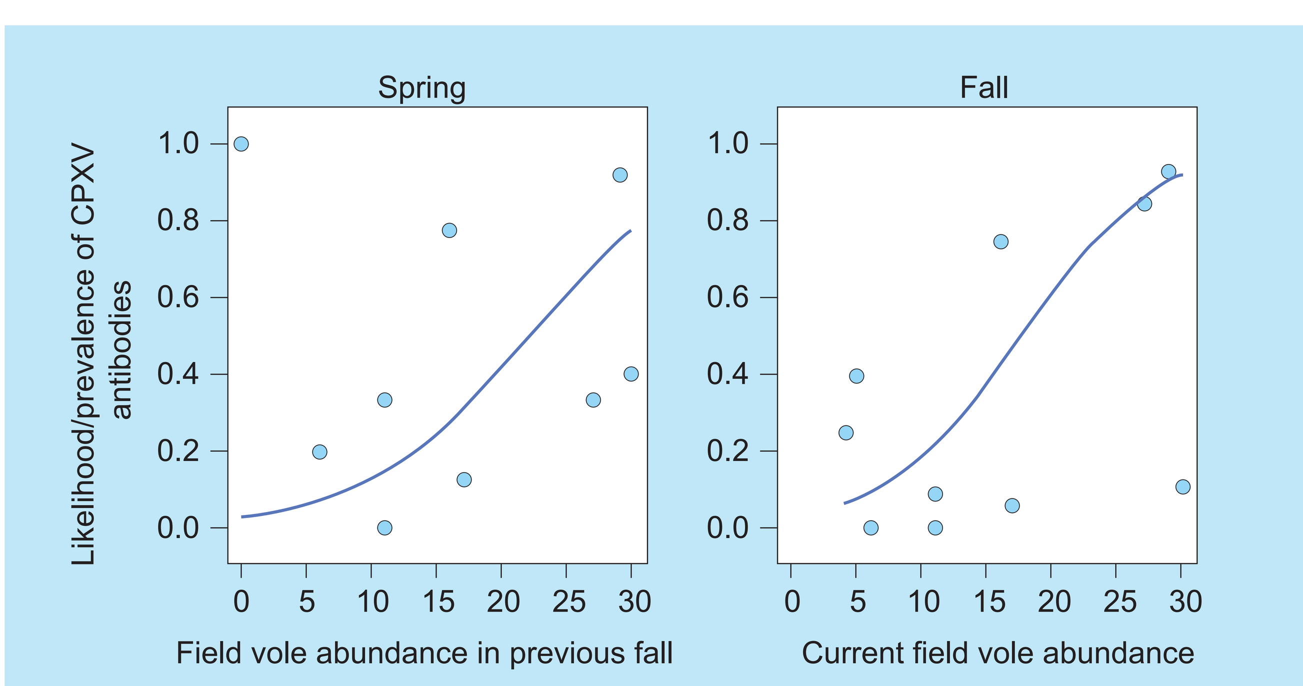

Figure 3. The predicted probability of a field vole being CPXV antibody positive (A) in spring in relation to field vole density the previous fall and (B) in fall in relation to current density based on averaged model coefficients in Table 2. Circles denote observed prevalence.

Results

Seropositive field voles were encountered only in southeastern Finland (Fig. 1). The prevalence of cowpox antibodies was relatively high (range 0–47 %) but variable among sites and phases of the vole cycle (Fig. 2). Within these sites, antibody prevalence showed delayed density dependence in spring and direct density dependence in fall (Fig. 3). Seroprevalence was overall higher in spring than in fall.

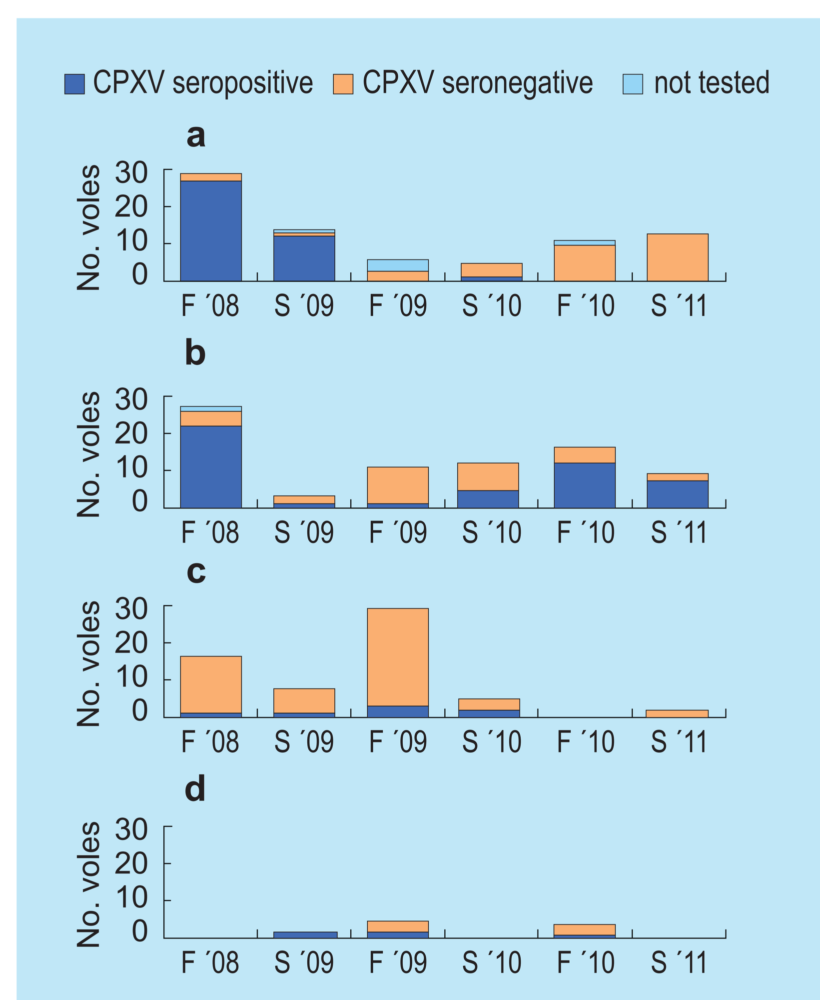

Figure 2. Summary information of CPXV seropositive sites (S = spring, F = fall); a) Luumäki (M in Figure 1), b) Punkaharju (L), c) Tohmajärvi (I) and d) Virolahti (N).

Conclusions

The pattern of density dependence, along with earlier findings demonstrating that cowpox reduces field vole survival, indicates that cowpox may contribute locally to the regulation of cyclic vole populations. However, cowpox is an unlikely general causal mechanism for vole cycles, as crashes also occurred in areas with no cowpox detections. The role of other voles species, e.g. the bank vole, requires further investigation.

Our findings highlight the significance of regular rodent monitoring as a tool for assessing spatiotemporal variation in the risk of not only cowpox infections in humans, but also that of other zoonotic pathogens.

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