Towards the influence of climatic covariates in the spatio-temporal differential expression of common vole abundance in Castilla-Y-León Region (Spain)

Constantino Caminero-Saldaña[1,2*], Ana Baños-Herrero[1], Yesica de los Ángeles Pallavicini-Fernández[1], Javier Plaza[2], Rodrigo Pérez-Sánchez[2], Mercedes Fernández-Villán[1], Elena Fuertes-Marcos[1], Alberto Rodríguez-Martínez[1], Nilda Sánchez[2], Juan José Juan José Luque-Larena[3], María Carmen García-Ariza[1]

[1]Castilla-y-León Agrarian Technological Institute (ITACyL), Pest Area, Valladolid, Spain
[2]University of Salamanca, Faculty of Agricultural and Environmental Sciences, Salamanca, Spain
[3]University of Valladolid, ETSIIAA, Department of Agroforestry Sciences, Palencia, Spain
*email of corresponding author: camsalco@itacyl.es

The common vole (*Microtus arvalis* Pallas) is considered one of the most harmful pests for agriculture in Europe, since its natural cyclical outbreaks are linked to risk situations that can lead to significant crop losses. Furthermore, it can also constitute a public health problem as a potential environmental amplifier of zoonotic diseases, some of which are transmissible to humans.

In Castilla-y-León region (Spain), after a quick process of colonization from the mountainous areas that border it, the common vole invaded the agrarian ecosystems of its central plateau. Until the 2007-08 campaign, a cyclicity tending to five years was observed for the general population dynamics, although since then the pattern has been shortened to a three-year trend.

However, both the parameters related to the population abundance curve and the final impact on crops depend on, and are modulated by, a complex system of intrinsic and extrinsic factors. There is no a scientific consensus on the final explanation underlying this intricate system.

In this study we prospect for the possible influence of climatic factors in the expression of this phenomenon in Castilla-y-León. A database of common vole abundance monitored during a decade has been used, linked to reservoir-type and crop-type habitats and distributed in 42 zones across the more than 3 million hectares of arable land in the region. The temporal distribution considered has been the continuous succession of three types of four-monthly periods, summarized as spring, warm and cold periods. The climatic covariates to be considered have been estimated from the daily information of about 100 weather stations located in the vicinity of the study areas.

Main results show a complex pattern in terms of the spatio-temporal differential expression of abundance, with significance both for the zone, period and type of habitat factors as well as for all their possible interactions.

When including the climatic covariates to explain the aforementioned spatio-temporal differential expression of abundance, the influence of temperature and rainfall that occurred up to a year before appeared to be of special interest. In addition, the relationship of these climatic covariates with the evolution of abundance seems to be dependent, even changing sign, on the moment of the population cycle.

Although further studies are needed to deepen into the influence of these covariates, including their inclusion in models considering other types of factors, in the light of our results the expression of temperatures and rainfall seem to be of great interest in terms of predictive modelling of demographic events of the common vole and of the derived risk for crops. The development of this type of predictive tools is one of the objectives pursued to optimize the tasks that, both farmers and the different agents involved, must carry out for a proper Integrated Management of this agricultural and health problem.