

# Uncovering Echinococcosis Farm Infection risk in Italy

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## INTRODUCTION

Cystic echinococcosis (CE) is a zoonotic disease caused by the cestode *Echinococcus granulosus sensu lato*, affecting canids and ruminants. It is endemic in central-southern and insular Italy, with sheep, goats, cattle, and water buffalo being the most commonly infected livestock species. In this study, we aimed to investigate the spatial distribution of CE in livestock and estimate the probability of finding animal infection on farms in central-southern and insular Italy using routine surveillance data.



Figure 1. The study area including the type of samples collected from each region.

## METHODS

A Stochastic Partial Differential Equations (SPDE) model was used to analyse animal samples collected from farms of different livestock species between 2019-2021 using INLA. Samples were inspected for *E. granulosus s.l.* cysts through routine surveillance in abattoirs by post-mortem visual examination, palpation, and incision of target organs. The geographic location of the farm of origin was recorded for each sample.

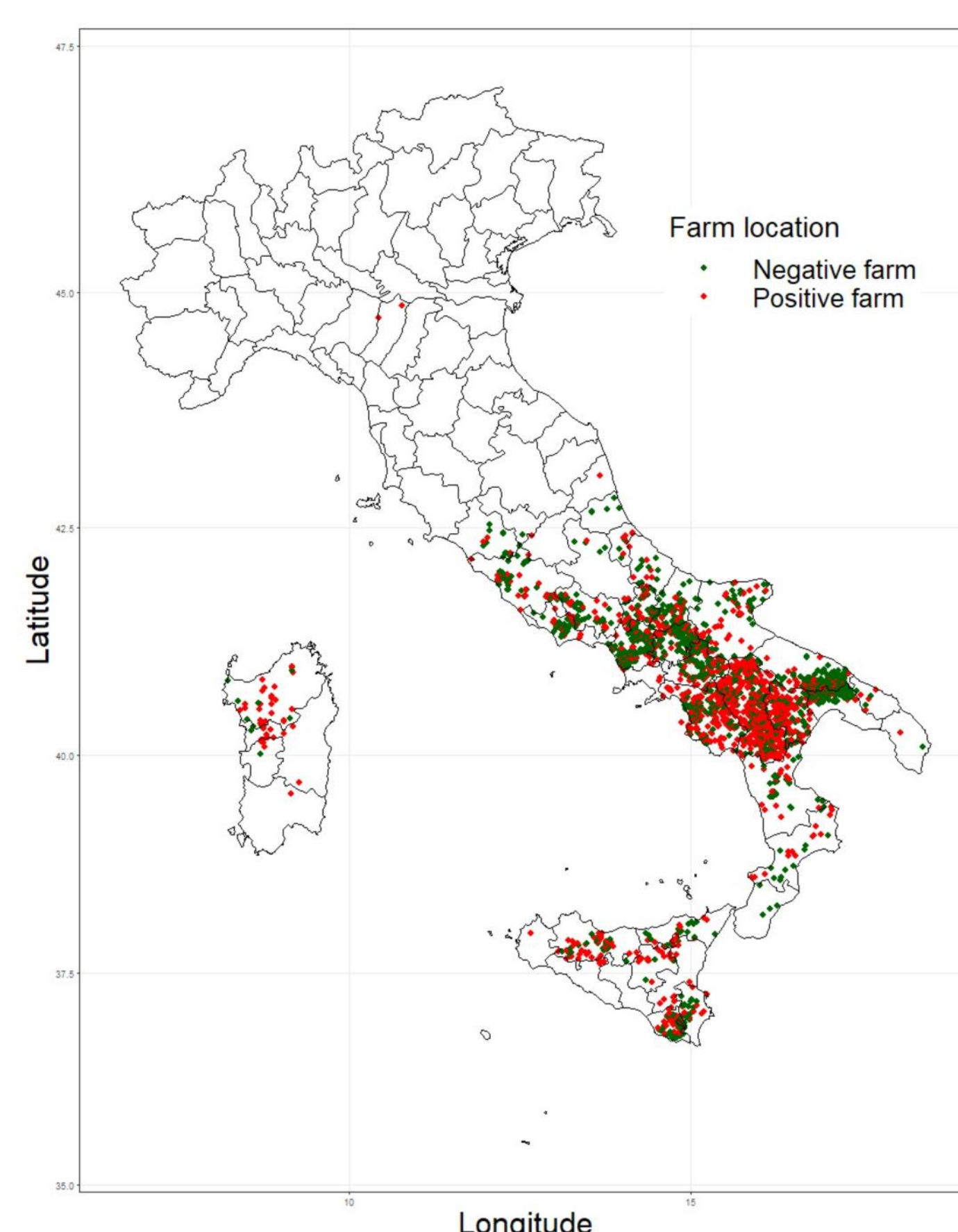


Figure 2. The farm of origin of samples. If a farm contained at least one positive sample, it was considered as positive.

## RESULTS

Livestock	No. of farms*	No. of farms with a positive animal	Prevalence (CI 95%)
Sheep	590	462	78.3% (75.0 - 81.6)
Goats	126	36	28.6% (20.6 - 36.6)
Cattle	2049	747	36.5% (34.4 - 38.5)
Water buffalo	434	102	23.5% (19.5 - 27.5)
<b>Total farms</b>	<b>2878</b>	<b>1323</b>	<b>46.0% (44.1 - 47.8)</b>

Table 1. Total number of farms with different livestock sampled for *Echinococcus granulosus s.l.* in Italy.

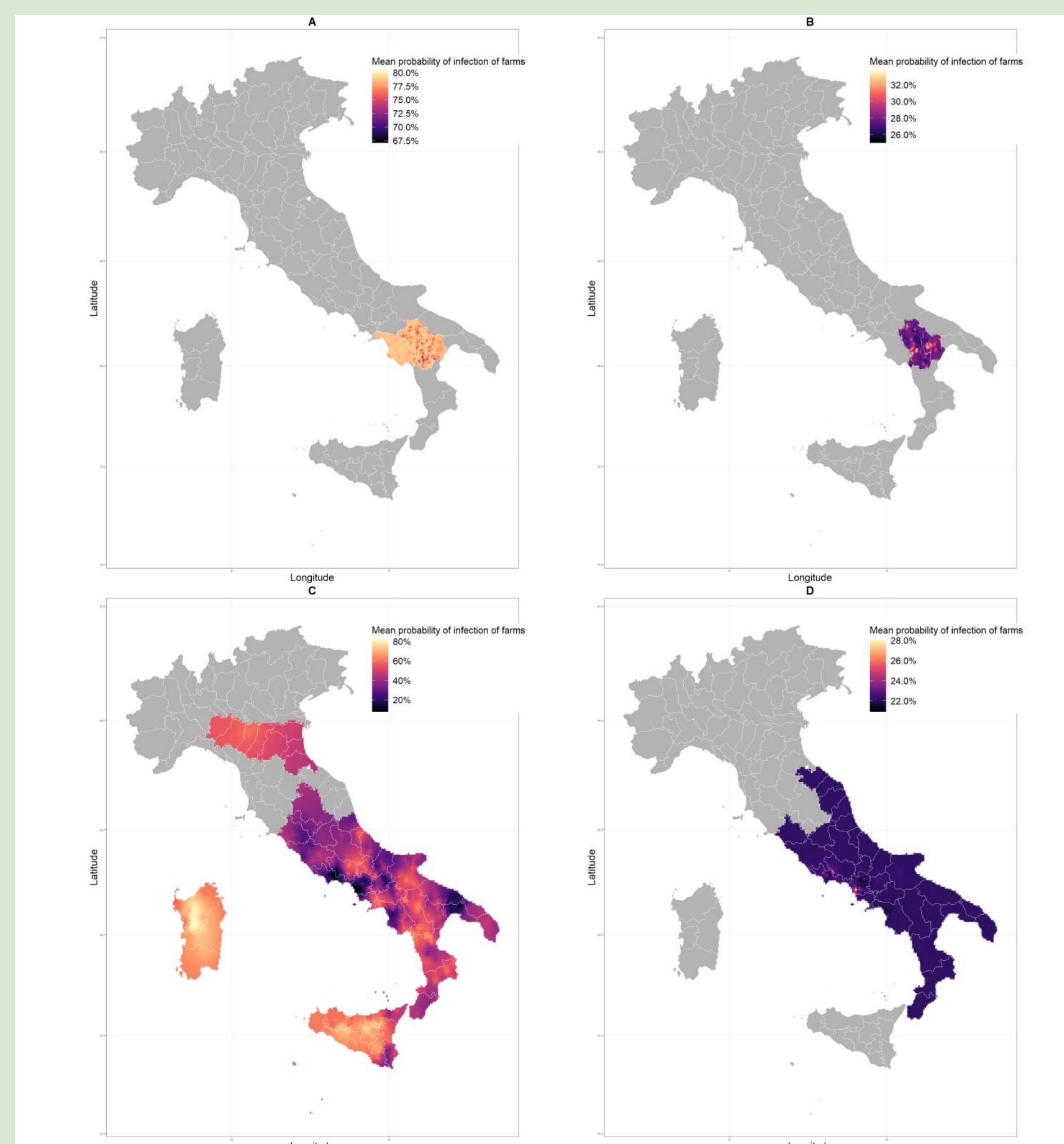


Figure 3. Predicted mean probability of infection with *Echinococcus granulosus s.l.* across Italy in sheep farms (A), goats (B), cattle (C) and water buffalo (D)

A total of 2,878 unique sampled farm locations were registered within the area of Italy. This includes farms of sheep, goats, cattle, and water buffalo. Out of the total number of farm locations, 1,243 (41.8%) were identified to be infected with *E. granulosus s.l.* Between-farm prevalence across the ruminant species evaluated ranged from 23.5% to 78.3%, Table 1.

The SPDE model including all livestock farms estimated the mean predicted probability of infection ranges from 14.8% to 78.7%, Figure 4. The lowest mean probability of infection was estimated for the region of Puglia, and the highest in the Sardinia region, with farms in Sardinia, Sicily and Basilicata regions consistently showing a higher probability of infection, above 60%.

The northern regions of Italy show a very uniform distribution due to the paucity of the data available to us (a very low number of samples collected from those regions, see Table 1). When evaluating the species-specific spatial models considering only either sheep, goat, cattle, or water buffalo farms, the mean predicted probability of infection ranged geographically from 67.1% to 80.3%, 25.0% to 33.7%, 7.7% to 82.1%, and from 20.9% to 28.1% respectively, Figure 3.

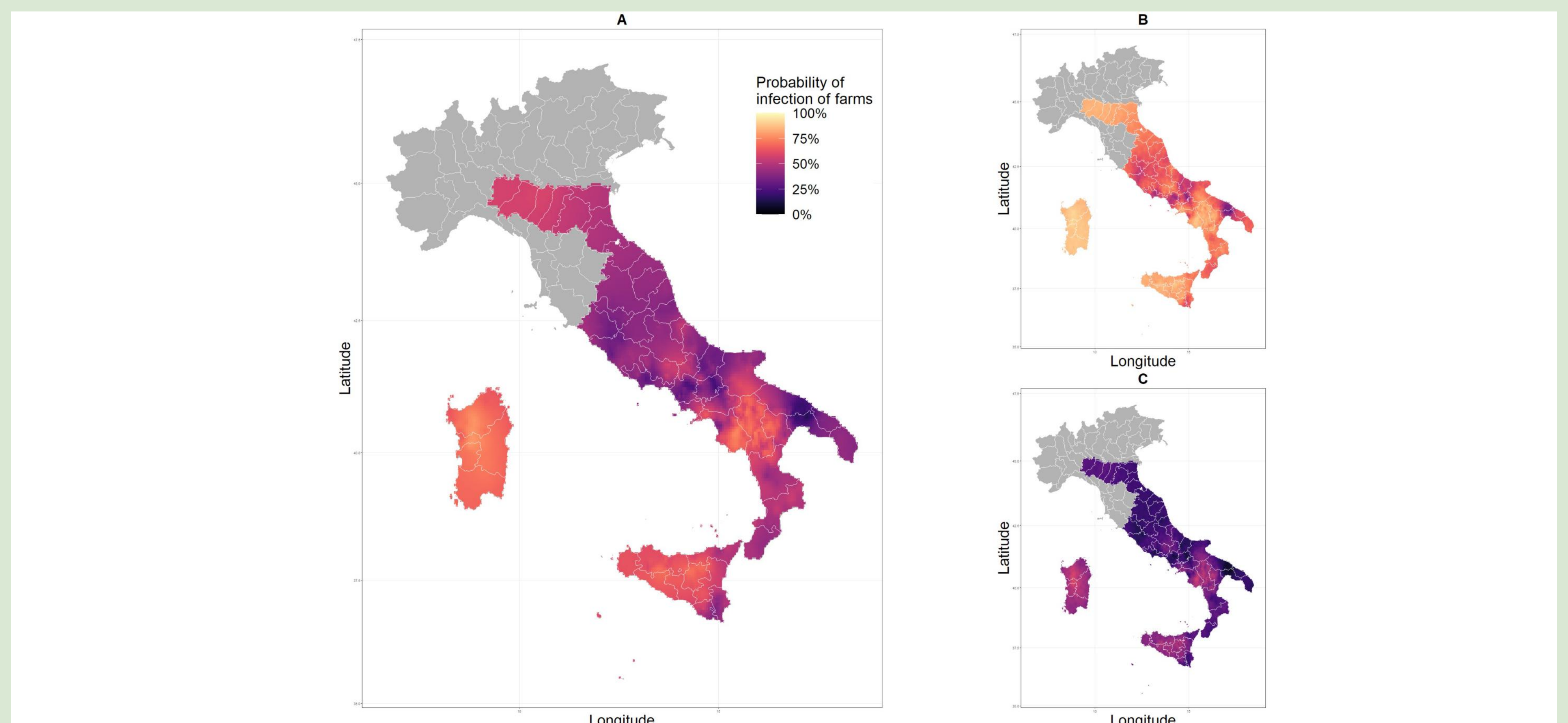


Figure 4. Predicted values of probability of infection of *Echinococcus granulosus s.l.* across Italy output from the fitted model showing the mean (A) lower (B) and upper (C) 95% confidence intervals.

## CONCLUSION

The present study has identified CE hotspots, where farms positive with CE are clustered across central-southern, and insular Italy. This information is important to understand the epidemiology of the disease better and to inform areas with high disease risk, to both humans and animals, that require increased surveillance and control. These surveillance and control strategies can be further optimized at a local level by considering different strategies for different species. Further studies are required to gain greater insights into the distribution of the disease in northern Italy, investigating the prevalence of disease in sheep and goats in the wider Italian region or further considerations around diagnostics.