

HIGH HABITAT RICHNESS REDUCES THE RISK OF TICK-BORNE ENCEPHALITIS IN EUROPE: A MULTI-SCALE STUDY.

Francesca Dagostin¹, Valentina Tagliapietra¹, Giovanni Marini¹, Giulia Ferrari¹, Marco Cervellini^{2,3}, William Wint⁴, Neil S. Alexander⁴, Timothée Dub⁵, Duccio Rocchini^{2,6}, Annapaola Rizzoli¹

¹ Research and Innovation Centre, Fondazione Edmund Mach, San Michele all'Adige (TN), Italy. ² BIOME Lab, Department of Biological, Geological and Environmental Sciences, Alma Mater Studiorum University of Bologna, Bologna, Italy. ³ School of Biosciences and Veterinary Medicine, University of Camerino, Italy. ⁴ Environmental Research Group Oxford Ltd, c/o Dept Zoology, Oxford, United Kingdom. ⁵ Department of Health Security, Finnish Institute for Health and Welfare, Helsinki, Finland. ⁶ Department of Spatial Sciences, Faculty of Environmental Sciences, Czech University of Life

BACKGROUND AND AIM

- ❖ Tick-borne encephalitis (TBE) is a growing public health concern in Europe, with an increasing number of reported human cases and new hotspots appearing in previously non endemic areas^{1,2}
- ❖ TBE viral circulation is maintained in the enzootic cycle by ticks and their vertebrate hosts, which are strongly connected to the features of their habitat.
- ❖ Given the ongoing global biodiversity loss, it is crucial to **assess the role played by biodiversity in terms of TBE risk mitigation**. However, little is known about the effects of biodiversity on TBE emergence in Europe.

In this study, we used **habitat richness as a proxy for biodiversity³ to understand how it affects the presence of human TBE cases in Europe, at two different spatial scales.**

METHODS

Epidemiological data

Presence (p) and absence (a) of human TBE cases (2017-2021)

- ❖ **Europe:** TESSy (ECDC). **872 regions** (p = 381, a = 498)
- ❖ **Italy:** local Public Health Agencies (APSS Trento, ULSS1 Belluno). **237 municipalities** (p = 73, a = 164)

Habitat richness index (HRI)

- ❖ HRI was derived from the habitat distribution maps of 222 terrestrial habitats of community interest (Natura 2000)⁴. We used the 95-th percentile value of the normalized index (corrected for actual cell area).

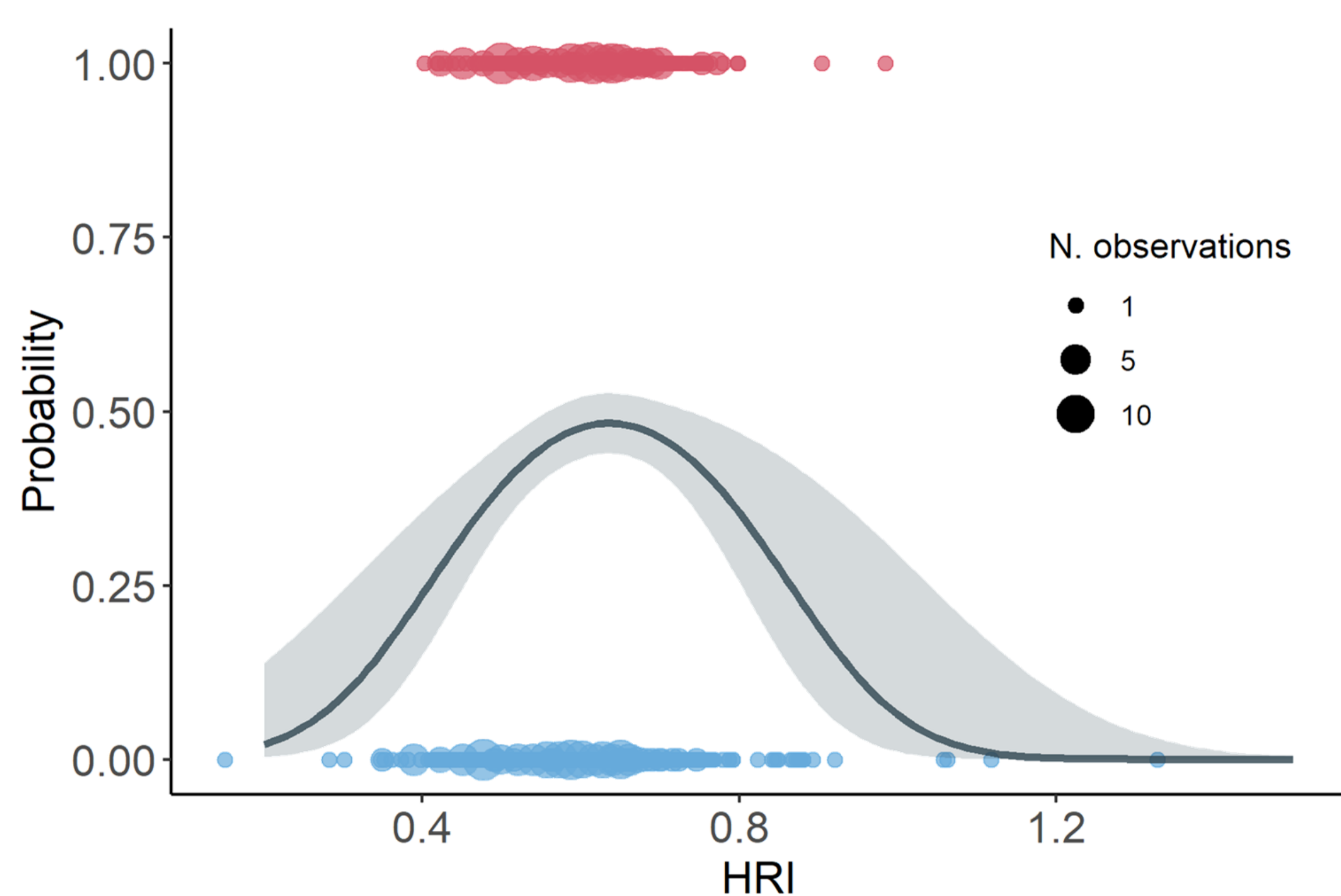
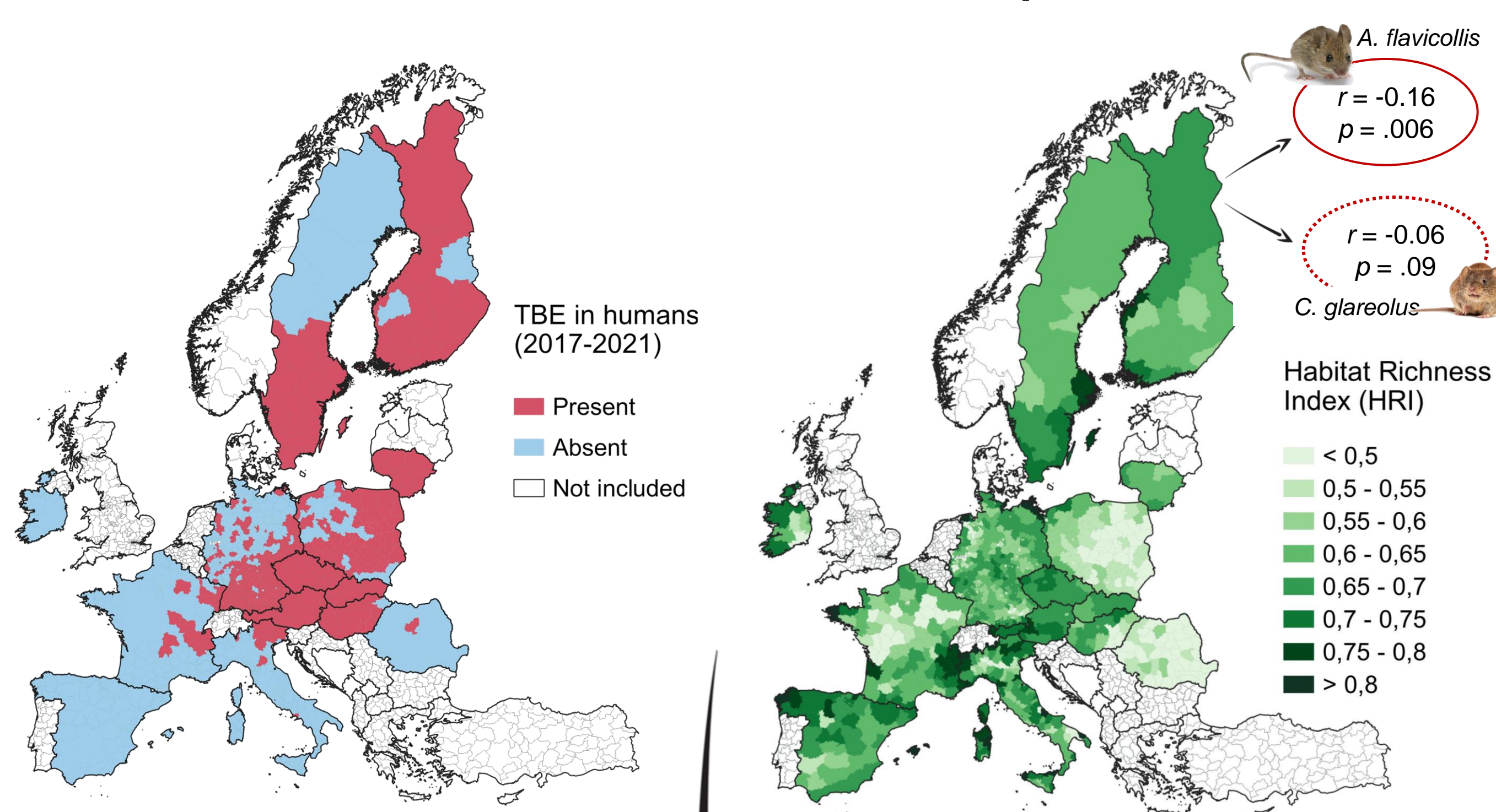
Rodents probability of presence

- ❖ 1-km data about the probability of presence of *A. flavicollis* and *C. glareolus*, derived using RF and BRT based spatial modeling techniques.

- Statistical analysis** ❖ Binomial regression with autocovariate to remove spatial autocorrelation. We tested both linear and quadratic models (AIC).

RESULTS

European scale

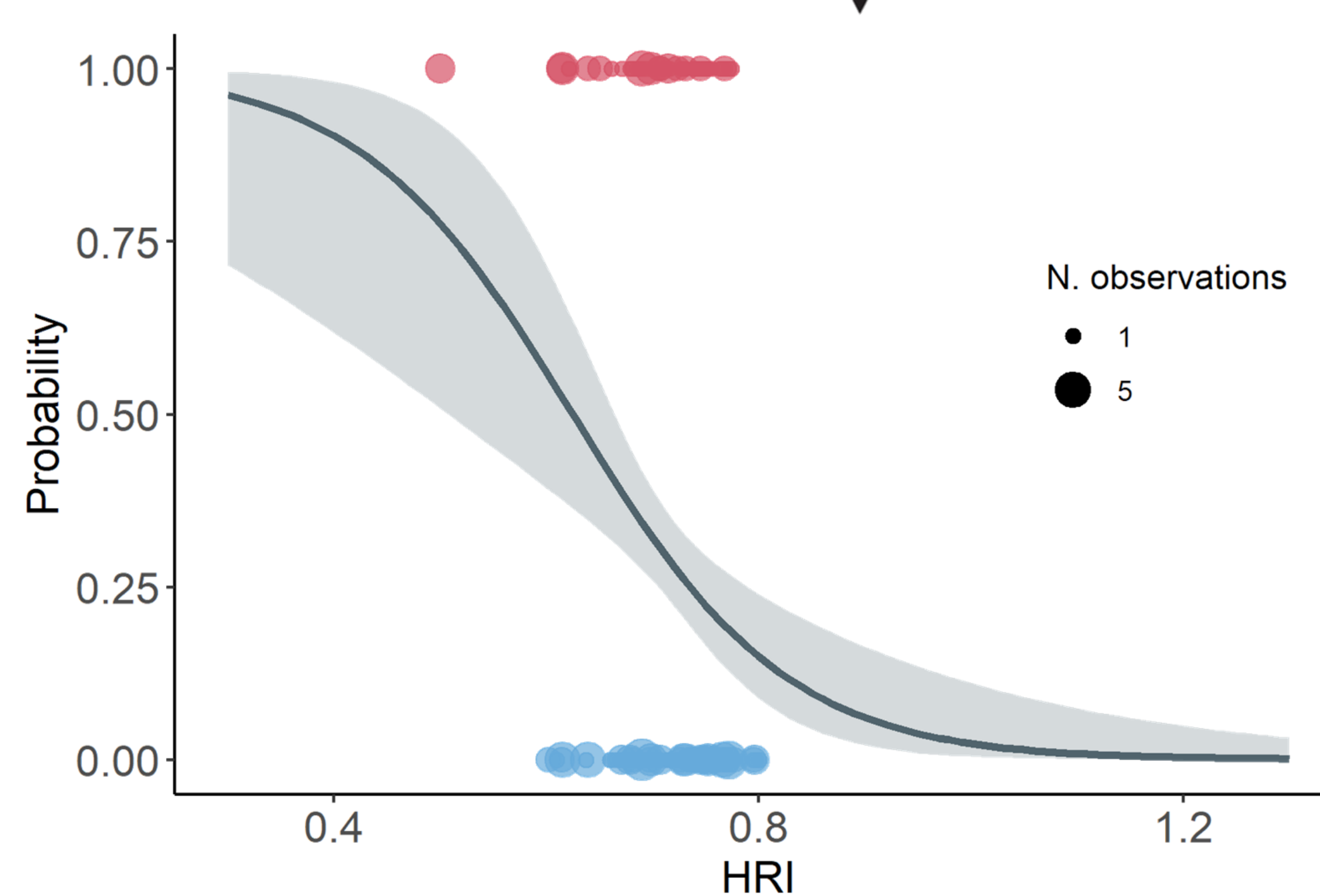
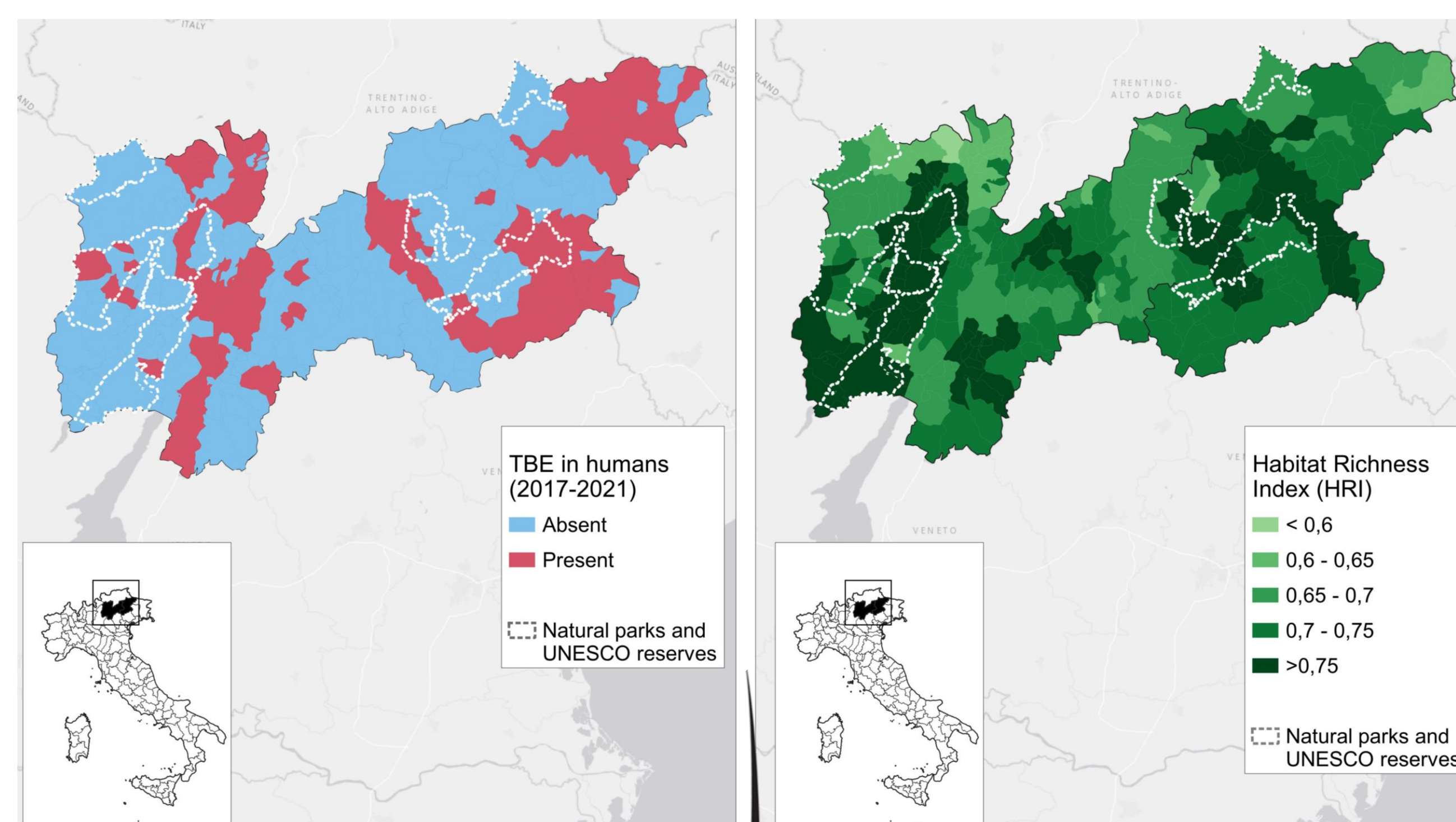


$$\text{logit}(p) \sim \text{ac} + \text{HRI} + \text{HRI}^2$$

Predictor	Coefficient	SE	z-value	p-value
Intercept	-8.14	2.22	-3.66	<0.001
HRI	25.06	7.28	3.44	<0.001
HRI ²	-19.69	5.93	-3.32	<0.001
ac	6.22	0.63	9.84	<0.001

Results of quadratic binomial regression. The habitat richness index (HRI) and autocovariate (ac) were used as predictors, for which the estimated regression coefficients, standard errors SE, z-values, and p-values are given. Observations = 872. AIC = 1010.96.

Local scale (Italy)



$$\text{logit}(p) \sim \text{ac} + \text{HRI}$$

Predictor	Coefficient	SE	z-value	p-value
Intercept	6.34	2.03	3.13	<0.001
HRI	-9.93	2.84	-3.49	<0.001
ac	0.88	0.24	3.68	<0.001

Results of linear binomial regression. The habitat richness index (HRI) and autocovariate (ac) were used as predictors, for which the estimated regression coefficients, standard errors SE, z-values, and p-values are given. Observations = 237. AIC = 270.7.

REMARKS

- ❖ Data on wildlife abundance are very limited. Hence, we tested a new indicator, the habitat richness index (HRI) as a proxy for biodiversity³.
- ❖ Our results suggested a **buffering effect of high habitat richness on the presence of TBE human cases**, at both spatial scales.

At local scale, diverse host communities could affect the role of competent rodent species on tick infection prevalence by lowering the encounter rates between infected vectors and hosts, and thus reduce the natural hazard of TBEV circulation.

At EU scale, HRI correlates negatively with rodents prob. of presence, suggesting a lower chance to find rodents in high-diversity areas, and a decreasing probability of TBE presence in such regions.

At both scales, human exposure to tick bites is enhanced in the proximity of easily accessible forests and urban or peri-urban recreational areas with low to moderate HRI values.

This is, to our knowledge the first attempt to explore the relationship between TBE and biodiversity. Understanding this relationship is crucial to prevent future disease outbreaks, but also to inform community efforts aimed at the conservation of species and ecosystems in the EU.

References

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Contacts

francesca.dagostin@fmach.it

