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Bacteria spread by ticks affected by humidity and mutual competition

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Researchers at the University of Helsinki, the University of Zurich and the University of Exeter have carried out modelling on how environmental factors affect the occurrence of human-pathogenic

bacteria found in the sheep tick (*Ixodes ricinus*), a tick species common in Europe.

The researchers collected sheep ticks in the Swiss Alps from valleys up to the limit of their area of distribution, identifying all possible pathogenic bacteria living inside the ticks. A number of Borrelia species, which cause Lyme borreliosis, and Rickettsia species, which cause spotted fever, were found in the ticks.

According to the researchers, the modeling did not show any single environmental factor to clearly promote or impair the pathogens. Individual pathogens borne by ticks had different reactions to their environmental conditions, which makes it difficult to assess the impact of climate change.

"For example, temperature has a negligible effect on the kinds of pathogenic bacteria ticks have. More significant are factors related to the humidity of the surroundings, such as the aspect and slope of the sites. Borrelia afzelii is more common in slopes facing north, which are more humid than the hotter southern ones, while the Rickettsia species were more prevalent in steeper slopes that are also drier due to stronger water run-off," explains Tuomas Aivelo, a postdoctoral researcher at the Faculty of Biological and Environmental Sciences, University of Helsinki.

Collecting samples from different elevational gradients is a practical way of studying the effects of environmental conditions.

"Despite the short distances, ticks from varying habitats are easily comparable. A change of a single kilometre in the vertical is the equivalent of a roughly 1,000-kilometre transition between south and north. In the lowest reaches of the study area, the average temperature corresponds with a hotter than average Finnish summer day, whereas the

summer temperatures in the upper reaches of the area over a kilometre higher resemble an average summer in central Finland."

The researchers found that the ticks were likely to be infected with many pathogens simultaneously. In other words, they may promote co-infection.

"On the other hand, ticks infected with Spiroplasma bacteria had much fewer human pathogens, such as Borrelia bacteria. A Spiroplasma infection is known to protect mosquitos against many parasites and pathogens, making a similar phenomenon possible also in ticks," Aivelo points out.

More information: Tuomas Aivelo et al, Bacterial microbiota composition of Ixodes ricinus ticks: the role of environmental variation, tick characteristics and microbial interactions, *PeerJ* (2019). DOI: 10.7717/peerj.8217

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