Screening for multiple tick-borne pathogens in *Ixodes ricinus* ticks from birds in Denmark during spring and autumn migration seasons

Presently, it is uncertain to what extent seasonal migrating birds contribute to the introduction of ticks and tick-associated pathogens in Denmark. To quantify this phenomenon, we captured birds during the spring and autumn migration at three field sites in Denmark and screened them for ticks. Bird-derived ticks were identified to tick species and screened for 37 tick-borne pathogens using real-time PCR. Overall, 807 birds, representing 44 bird species, were captured and examined for ticks during the spring (292 birds) and autumn migrations (515 birds). 10.7% of the birds harboured a total of 179 *Ixodes ricinus* ticks (38 ticks in spring and 141 in the autumn) with a mean infestation intensity of 2.1 ticks per bird. The European robin (*Erithacus rubecula*), the common blackbird (*Turdus merula*), and the common redstart (*Phoenicurus phoenicurus*) had the highest infestation intensities. 60.9% of the ticks were PCR-positive for at least one tick-borne pathogen. *Borrelia* DNA was found in 36.9% of the ticks. The *Borrelia* species detected were *B. spielmanii* (15.1%), *B. valaisiana* (13.4%), *B. garinii* (12.3%), *B. burgdorferi* s.s. (2.2%), *B. miyamotoi* (1.1%), and *B. afzelii* (0.6%). In addition, 10.6% and 1.7% of the samples were PCR-positive for spotted fever group rickettsiae and *Candidatus Neoehrlichia mikurensis*. All of the tick-borne pathogens that we found in the present study are known to occur in Danish forest populations of *I. ricinus*. Our study indicates that migrating birds can transport ticks and their pathogens from neighboring countries to Denmark including sites in Denmark without a sustainable tick population. Thus, a tick-borne pathogen affecting human or animal health emerging at one location in Europe can rapidly be introduced to other countries by migrating birds. These movements are beyond national veterinary control. The current globalization, climatic and environmental changes affect the potential for introduction and establishment of ticks and tick-borne pathogens in Northern Europe. It is therefore important to quantify the risk for rapid spread and long distance exchange of tick-borne pathogens in Europe.

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