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# Abstract

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## Tick richness may be correlated with abundance of a specific host*

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Ticks are important vectors of several zoonoses such as severe fever with thrombocytopenia syndrome (SFTS), tick-borne encephalitis (TBE), and Japanese spotted fever (JSF), which have been increasing and expanding from west to east in Japan. Since there are no vaccines or treatments for SFTS and TBE and it is difficult to treat JSF in time, tick vector control is necessary. Given that a variety of tick species are involved in the transmission processes, host-animal control might be most effective.

To examine the relationship between ticks and mammal host species, we surveyed ticks and wildlife in a mountainous forest area in the Kanto region, Japan, where SFTS virus has recently been found and JSF infections have been increasing. We set up 12 survey sites in Tochigi Prefecture and another 12 sites in the neighboring Ibaraki Prefecture where sika deer did not occur. In each site, we set two sensor camera traps for middle- to large-sized mammals. We collected ticks by dragging a white cloth (70 cm wide and 120 cm long) on the forest floor and identified adults and nymphal ticks to the species level in our laboratory. The survey was conducted between April and November in 2018 in Tochigi, and during the same months in 2019 to 2021 in Ibaraki. In Tochigi, dominant mammal species were sika deer (*Cervus nippon*), wild boar (*Sus scrofa*) and racoon dog (*Nyctereutes procyonoides*), while only a small number of mammal species except for wild boar was recorded in Ibaraki. The total number of ticks collected in Tochigi was approximately 10 times of that in Ibaraki in a single year. In Tochigi, we collected 8 tick species; *Haemaphysalis kitaokai*, *H. megaspinosa, H. flava* and *Ixodes ovatus* were the dominant ones. We frequently collected *H. flava*, *I. ovatus* and *Amblyomma testudinarium* but rarely collected other species in Ibaraki. *A. testudinarium* was collected in southern Ibaraki where wild boars were abundant, but it was never collected in Tochigi although wild boars were present. The survey sites in Tochigi were placed farther north and at higher elevations than those in Ibaraki, and probably the lower annual and/or winter temperatures affected the distribution of the species. Using the Tochigi data, we further conducted statistical analyses to identify which tick species was associated with sika deer density, and how tick density was affected by the micro-environment. The results showed a positive correlation between sika deer density and the number of *H. megaspinosa*, *H. kitaokai* and *H. fava*, suggesting that these species prefer sika deer as a host. When we compared three sampling lines (forest, forest edge, and forest trail) within each site, ticks tended to be most abundant at the forest edge. This was likely because the forest edge had the highest understory vegetation cover, which keeps moisture necessary for the survival of questing ticks.

Based on these findings, we suggest that controlling the density of large mammals such as sika deer and wild boar is a key measure to reduce tick density and, ultimately, the risk of tick-borne diseases transmitted by multiple vector species. Basic tick-bite prevention measures, such as using repellents, and avoiding brushy forest edge, would be particularly important in forested areas with high deer abundance.

**Keywords**: ecosystem management, forest, sika deer, wildlife, zoonoses

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