

Winter activity of *Ixodes ricinus* in a Berlin forest

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Accepted 25 January 2008

Abstract

Nymphs and adults of the hard tick *Ixodes ricinus* typically quest in Central Europe from March/April to October/early November. The recent trend towards milder winters raises the question whether *I. ricinus* will gradually extend its seasonal activity and use mild winter periods for questing. The present study followed the host-seeking activity of *I. ricinus* from early September 2006 to early March 2007 in a Berlin forest. Field-collected larval and nymphal ticks were allowed to take a full blood meal in the laboratory and to moult. The resultant unfed nymphs ($n = 125$) and adults ($n = 149$) were released onto three field plots ($1 \times 1 \text{ m}^2$) in early September 2006. A second group of field-collected unfed *I. ricinus* nymphs ($n = 79$) and adults ($n = 47$) were released onto a field plot in early September 2006. Each plot was covered by an approximately 10 cm thick layer of leaf litter (mostly of oak and beech) to provide a humid microclimate refuge and shelter for non-active ticks. Wooden rods (60 cm high) arranged in a 6×8 grid on these field plots were climbed by questing nymphs and adults. Active ticks were observed on each of 33 observation dates. The winter activity revealed by this experiment was confirmed by flagging for ticks on two occasions in January and February 2007 with remarkably high numbers of collected ticks. This appears to be the first time that extended or even continuous winter activity of *I. ricinus* nymphs and adults has been demonstrated in Central Europe, most probably caused by the extremely mild winter of 2006/2007. The fact that *I. ricinus* now can be active during the whole winter, a time of the year when these ticks historically have been dormant when the weather is normal, is relevant to the public because people who enter forest areas should be well aware of the risk of getting tick bites and tick-borne infections in mild winter periods.

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Keywords: *Ixodes ricinus*; Questing activity; Field plots; Winter; Central Europe; *Dermacentor reticulatus*

Introduction

The seasonal questing activity of the hard tick *Ixodes ricinus* has been the subject of numerous field studies (reviewed by Gray, 1991). It is very variable depending on the region but it may also be rather flexible in a given

region depending on macro- and microclimatic conditions. Nymphs and adults of this important vector of human pathogens (e.g., Lyme borreliosis spirochaetes, tick-borne encephalitis [TBE] virus) usually quest from March/early April to October/early November in Central Europe depending on the weather situation in early spring and late autumn, respectively. The seasonal activity pattern may, however, be impacted by climate warming (cf. Gerstengarbe and Werner, 2008). The present study monitored the host-seeking activity of *I. ricinus* in a Berlin

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forest from early autumn 2006 into the winter months up to early March 2007. The hypothesis was that spells of mild weather may cause intermittent tick activity during the Central European winter.

Materials and methods

There were two different groups of ticks (Table 1). Group 1 ticks were field-collected as larvae or nymphs in a Berlin forest at different times of the year (between autumn 2005 and early summer 2006), then allowed to take a full blood meal in the laboratory on Mongolian gerbils (*Meriones unguiculatus*) and to moult to the next life stage in the summer of 2006. The engorged ticks (larvae, nymphs) were kept in desiccators over saturated MgSO₄-solution at approximately 90% RH (Kahl and Knülle, 1988) under quasi-natural temperature and light conditions at a shady place until after their moult. The resultant unfed nymphs ($n = 125$) and adults ($n = 149$) were dorsally marked with fluorescent dye (Pelikan, Hannover, Germany) and then released onto three $1 \times 1 \text{ m}^2$ large field plots in a Berlin forest in early September 2006.

Group 2 ticks were field-collected as nymphs ($n = 79$) or adults ($n = 47$) in a Berlin forest in early September 2006, then dorsally marked and released onto a field plot like the group 1 ticks (Table 1).

Although *I. ricinus* moulting, the developmental phase from apolysis to ecdysis, is limited to the warmest months (June to September) in Central Europe (Chmela, 1969; Kahl, 1989), ticks in the field even when questing at the same time in the same site may have very different developmental histories (e.g., previous blood meal in autumn – overwintering engorged in diapause – moult in the following summer, or, alternatively, previous blood meal in spring (nymphs only) or in early

summer – moult in the following summer after a more or less short engorged phase without diapause). This was the rationale for including ticks with different developmental histories and also unfed field-collected ticks.

Each field plot was covered by an approximately 10 cm thick layer of leaf litter (mostly from oak and beech) to provide a humid microclimate refuge and shelter for non-active ticks (Fig. 1). Wooden rods (60 cm high), arranged in a 6×8 grid, were placed at a $75\text{--}80^\circ$ angle in each of the plots. Each plot was bordered by a 25 cm high anti-snaill fence made of stainless steel and painted with fluon on the inside to prevent escape of ticks.

Tick questing activity in these field plots was observed from mid-September to the end of October 2006 on 14 occasions and subsequently from early November 2006 to early March 2007 on 19 occasions. Ticks that climbed a wooden rod were regarded as active.

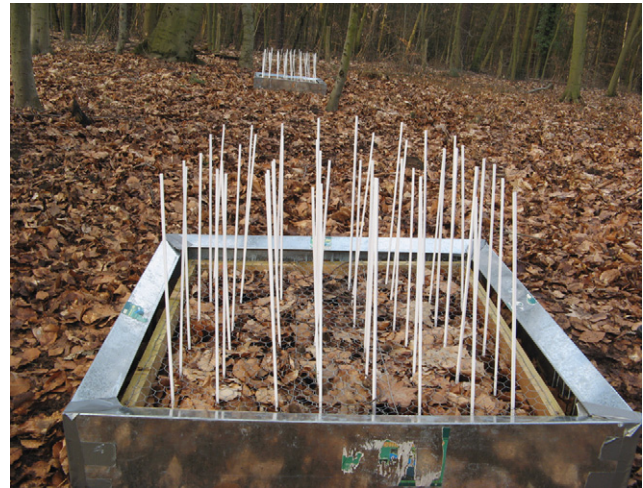


Fig. 1. Set-up of field plots used for observing *Ixodes ricinus* questing activity in a Berlin forest.

Table 1. Different groups of *Ixodes ricinus* ticks released onto four field plots in a Berlin forest in September 2006 and used in the present study

History of ticks	Group 1a	Group 1b	Group 1c	Group 2
Field-collected	September 2005 (larvae, nymphs)	April 2006 (nymphs)	June 2006 (larvae, nymphs)	Early September 2006 (nymphs, adults)
Fed in the laboratory and kept under quasi-natural conditions	+	+	+	–
Moulted	Summer 2006			Presumably some in summer 2005 and others in summer 2006
Marked and released	Early September 2006			
No. of released individuals	Ny: 76 FF: 25 MM: 25	Ny: – FF: 25 MM: 25	Ny: 49 FF: 25 MM: 24	Ny: 79 FF: 25 MM: 22

Ny, nymphs; FF, females; MM, males.

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