

Tick infestation (*Ixodes*) on feral mink (*Neovison vison*) in central Germany

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Abstract

Four species of ticks (*I. hexagonus*, *I. rugicollis*, *I. canisuga*, *I. ricinus*) were found to infest feral American mink (*Neovison vison*) in central Germany. About 45 % of all investigated mink were infested. The most common tick species on mink was *I. hexagonus*. The prevalence = infestation extensity (proportion of infested animals) with *I. hexagonus* was 43.8 %, which is approximately in accordance with the infestation extensity in England and Wales (40 %). The average infestation intensity (number of ticks per infested animal) is 11.0 ticks per infested mink. Two species of ticks were found on 10.9 % of the infested minks. The highest infestation intensity of *I. hexagonus* found on one mink was 43 larvae plus 7 nymphs. The average infestation intensity of the stages of *I. hexagonus* was 4.42 females, 5.91 nymphs and 8.26 larvae per mink. In the investigation areas in central Germany the mink is proved to be a frequent host for *I. hexagonus*. The frequent common wood tick *I. ricinus* parasitised only rarely on mink.

Keywords: ticks, ectoparasites, *Ixodes hexagonus*, *Ixodes ricinus*

1. Introduction

The American mink, *Neovison vison* (Schreber, 1777), is originally distributed throughout North America from Alaska to Florida. For about 100 years now, the mink has been bred in fur farms in Europe. Through freed and escaped farm animals the American mink has been able to colonise many natural areas and to spread further throughout Europe. The mink is associated with diverse semi-aquatic habitats. In its successful colonisation the American mink appears to be exploiting a vacant niche, since the European mink (*Mustela lutreola* Linnaeus, 1761) was extinct in large areas of Europe before the American mink spread in the wild (Pax 1925, Zimmermann 1934). Parasitism by ticks of the American mink in central Europe is not yet widely known. The aim of this study was to record ticks found on wild mink and to investigate the prevalence (infestation extensity) and infestation intensity of ticks, especially of the common and widely distributed species *I. hexagonus* and *I. ricinus* in central Germany.

2. Investigation areas, materials and methods

In two investigation areas of central Germany a total of 121 mink were collected from 1999 to 2008. The northern investigation area (longitude 12° 27' 23" East, latitude 51° 53' 12" North, with about 30 km in radius) is located in the federal state of Saxony-Anhalt (ST) and comprised a territory of 2500 square kilometres between the towns Wolfen, Wittenberg and Schönebeck. In this area 61 minks were trapped during a diploma thesis from November 1999 to March 2002. The southern investigation area (longitude 14° 24' 32" East, latitude 51° 19' 36" North, with about 13 km in radius) is located in the federal state of Saxony (SN) and comprised a territory of 900 square kilometres between the towns Bautzen, Niesky and Hoyerswerda. In this area 60 minks were trapped from 2000 to 2008.

In the preparation laboratory each mink was examined for ticks with tweezers and comb. The collected ticks were preserved in 70 % ethanol. Determination of adults and nymphs was carried out under the stereo microscope. Larvae were macerated in a mixture of glycerol and acetic acid, embedded in a gummi-arabicum mixture on slides and determined under a DIC-light microscope.

3. Results

3.1. Prevalence (infestation extensity) of ticks on wild mink

An unknown period of time always passes between the death of a mink and its movement into a plastic bag for tick examination. Therefore, the detected number of ticks must be regarded as a minimum. The majority of ticks were found in the head and neck areas of the minks, especially on the ears. Among the 121 captured minks, 55 were infested with one or more species of ticks. This corresponds to a prevalence (infestation extensity) of 45 % of the examined minks. In the northern investigation area of Saxony-Anhalt, the prevalence was 49 % (30 of 61 captured minks infested with ticks) and in the southern investigation area of Saxony the prevalence was 41 % (25 of 60 captured minks infested with ticks).

3.2. Tick species parasitising American mink

Four species of ticks were found to infest American mink: *I. (Ph.) hexagonus* Leach, 1815, *I. (Ph.) rugicollis* Schulze & Schlottke, 1929, *I. (Ph.) canisuga* Johnston, 1849 and *I. ricinus* Linné, 1758. The tick *I. hexagonus* was found on the majority of the infested minks (53 of 55 animals), corresponding to a *I. hexagonus* prevalence (infestation extensity) of 43.8 %. On 47 minks *I. hexagonus* was the only tick species found and on 6 minks *I. hexagonus* was found together with one other tick species. Only two minks were infested with each another tick species. Details of the infestation of mink with tick species is shown in Tab. 1.

3.3. Infestation intensity of ticks on mink

A total of 607 ticks were found on the 55 infested minks. The average infestation intensity consisted of 11.0 ticks per infested animal and ranged from 1 to 50 ticks. In the northern investigation area of Saxony-Anhalt, 239 ticks were found on the 30 infested minks (average infestation intensity: 7.9 ticks per infested mink). In the southern investigation area of Saxony, 368 ticks were found on the 25 infested minks (average infestation intensity: 14.7 ticks per infested mink). Six of the 55 minks from central Germany with parasitising ticks were

infested with two species of ticks (10.9 %). The infestation intensity ranged here from 3 to 36 ticks, an average of 17.3 ticks per parasitised animal (Fig. 1).

Tab. 1 Infestation of the 121 minks with tick species.

	Investigation area in the federal state of Saxony-Anhalt	Investigation area in the federal state of Saxony	Total in central Germany
captured minks	61	60	121
minks without ticks	31 (51 %)	35 (58 %)	66 (54 %)
minks with only <i>I. hexagonus</i>	26 (43 %)	21 (35 %)	47 (39 %)
minks with <i>I. hexagonus</i> and <i>I. ricinus</i>	2	1	3
minks with <i>I. hexagonus</i> and <i>I. rugicollis</i>	2	1	3
mink with only <i>I. rugicollis</i>	0	1	1
mink with only <i>I. canisuga</i>	0	1	1

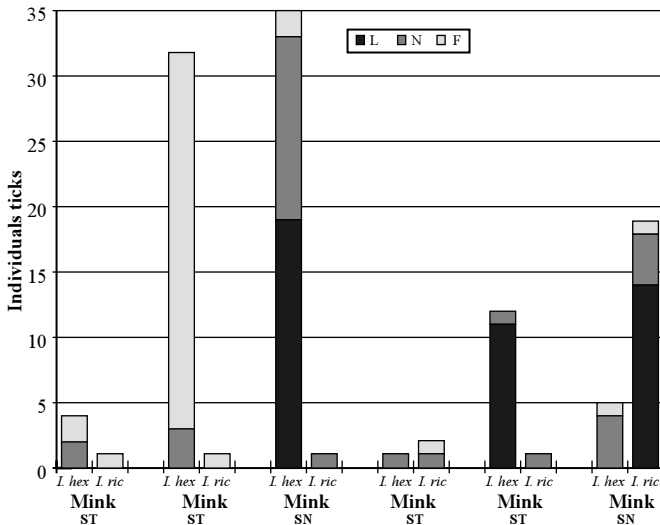


Fig. 1 Mink infested with two tick species each (ST: federal state of Saxony-Anhalt; SN: federal state of Saxony; L: larva; N: nymph; F: female).

3.4. Infestation intensity of *I. hexagonus*

In central Germany, *I. hexagonus* is the most common tick on feral American mink. This tick species was found in 580 individuals on the 53 infested minks, an average of 10.9 *I. hexagonus* individuals per mink. The infestation intensity with *I. hexagonus* was very different in the investigation areas. In the northern investigation area of Saxony-Anhalt 234 individuals of *I. hexagonus* were found on 30 infested minks (average infestation intensity:

7.8 individuals of *I. hexagonus* per infested mink). In the southern investigation area of Saxony, 346 individuals of *I. hexagonus* were found on 23 infested minks (average infestation intensity: 15.0 individuals of *I. hexagonus* per infested mink).

3.5. Infestation intensity of *I. hexagonus* stages

In the studied areas a total of 580 individuals of *I. hexagonus* were collected, which consisted of no males, 124 females (21 %), 266 nymphs (46 %) and 190 larvae (33 %). On the infested minks in the northern area of Saxony-Anhalt, the stages consisted of 73 females (31 %), 119 nymphs (51 %) and 42 larvae (18 %) and in the southern area of Saxony of 51 females (15 %), 147 nymphs (42 %) and 148 larvae (43 %). The distribution of infestation intensity was large with a maximum of 43 larvae plus 7 nymphs of *I. hexagonus* on one mink. More details of the infestation intensity of *I. hexagonus* stages are shown in Fig. 2.

The frequency distribution of infestation intensities (assembled into groups) of different *I. hexagonus* stages on mink shows that the infestation intensity with females (average of 4.42 female *I. hexagonus* per mink) was lower than that with nymphs (on average 5.91 nymphs per mink) and this was lower than the infestation intensity with larvae (average of 8.26 larvae per mink). Females of *I. hexagonus* fed on 53 % of the infested minks, nymphs on 84 % and larvae on only 43 % of the infested minks. On 57 % of the infested minks fed exclusive females or nymphs or both, but no larvae (Tab. 2).

In the investigation areas of central Germany, the mink is a frequent host for *I. hexagonus* both regarding prevalence (infestation extensity) and infestation intensity. The frequent common wood tick, *I. ricinus*, parasitised only rarely on mink, in this study on merely 3 individuals.

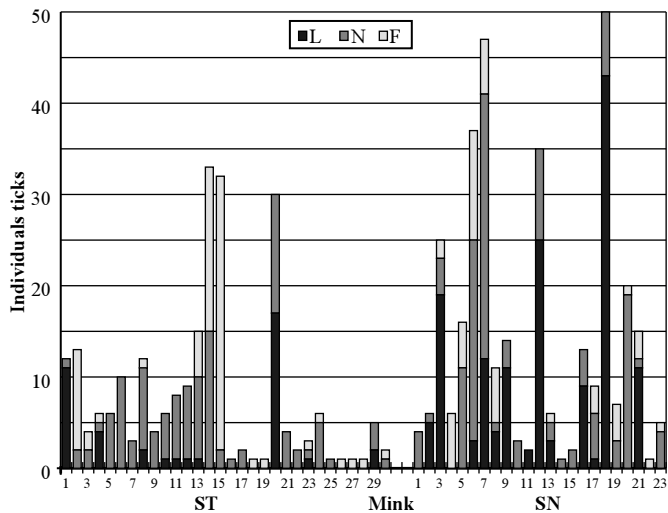


Fig. 2: Infestation intensity of the stages of *I. hexagonus* (ST: federal state of Saxony-Anhalt; SN: federal state of Saxony; L: larva; N: nymph; F: female).

Tab. 2 Frequency distribution of infestation intensities of different *I. hexagonus* stages on mink

Ticks per mink (grouped)	Minks with tick females	Number of tick-females	Minks with tick nymphs	Number of tick-nymphs	Minks with tick larvae	Number of tick-larvae
1	14	14	10	10	6	6
2	2	4	7	14	3	6
3	2	6	5	15	2	6
4	1	4	5	20	2	8
5	2	10	3	15	1	5
6–10	3	18	8	66	1	9
11–20	3	38	5	74	6	82
21–30	1	30	2	52	1	25
30–50	0	0	0	0	1	43
Total number of ticks		124		266		190
Total number of minks with ticks	28		45		23	
Average number of ticks per mink		4.42		5.91		8.26

4. Discussion

In many mammalogical papers, ticks are not mentioned as ectoparasites on feral American mink in Europe (Heptner et al. 1974, Stubbe 1975, Stubbe & Krapp 1993, Mitchell-Jones et al. 1999, Spitzenberger 2001, Baagøe & Jensen 2007). In some mammalian faunas the mink is not included at all (Hauser 1995, Braun & Dieterlen 2005, Bihari et al. 2007). Only Fairley (1980) and Zschille et al. (2004) mentioned ticks as parasites of mink. In the acarological and parasitological literature the mink is often not mentioned in the list of mammalian hosts of ticks (Nuttall & Warburton 1911, Starkoff 1958, Arthur 1963, Babos 1964, Eichler 1968, Černý 1972, Filippova 1977, Liebisch & Walter 1986, Toutoungi et al. 1991). O'Crowley & Wilson (1991) mentioned the mink as a host of *I. hexagonus* and only Page & Langton (1996) examined a large series of mink for infestation with ticks.

On feral mink in Europe, up to now 5 species of ticks have been observed: *I. hexagonus* (Fairley 1980, O'Crowley & Wilson 1991, Page & Langton 1996, Zschille et al. 2004, present study), *I. rugicollis* (Zschille et al. 2004, present study), *I. canisuga* (Page & Langton 1996, present study), *I. ricinus* (Page & Langton 1996, Zschille et al. 2004, present study) and *I. acuminatus* (Page & Langton 1996). The tick species *I. hexagonus* is the most common tick on mink in Europe and the generally widespread wood tick *I. ricinus* parasitised only a few mink individuals.

The recorded prevalence (infestation extensity) of *I. hexagonus* on wild mink in central Germany (43.8 %) is similar to the infestation rate on mink in England and Wales (40 %: Page & Langton, 1996). Fairley (1980) found only 2 females and 15 nymphs of *I. hexagonus* on 5 of 108 examined feral minks in Ireland (4.6 %). It thus appears that the infestation rate of mink in Europe can be very heterogeneous. The differences between the recorded prevalences in the investigation areas in central Germany may have many causes. Probably the very different length of the study period (ST 1999 to 2002, SN 2000 to 2008) and the variable weather in each year had an impact on the tick population and prevalence of mink.

The infestation intensity of *I. hexagonus*-stages on mink is also very variable. In the present study the distribution of infestation intensity had a maximum of 43 larvae plus 7 nymphs of *I. hexagonus* on one mink. Page & Langton (1996) reported from England and Wales a maximum of infestation intensity of more than 500 larvae of *I. hexagonus* on one mink. In Ireland Fairley (1980) found only a maximum of 5 nymphs of *I. hexagonus* on one mink.

The frequency distribution of infestation intensities of different *I. hexagonus* stages on mink also showed differences between central Germany and England / Wales. The infestation intensity of *I. hexagonus* in England and Wales (Page & Langton 1996) is lower (on average 1.87 female per mink) than the infestation intensity in central Germany (with an average of 4.42 female per mink). Also the infestation intensity of 4.81 nymphs per mink on average in England and Wales (Page & Langton 1996) is lower than the infestation intensity of 5.91 nymphs per mink in central Germany. However, the infestation intensity of an average of 20.0 larvae per mink is in England and Wales (Page & Langton 1996) higher than in central Germany (8.26 larvae per mink).

It seems that *I. hexagonus* is the most frequent tick on feral mink in Europe. The same tick species is on the otter (*Lutra lutra*) in the Oberlausitz-region, Saxony, the most frequent tick (Christian 1997). Both mammalian species associated with diverse semi-aquatic habitats and lives in burrows in the soil of the embankment of running or standing waters. In these burrows the tick *I. hexagonus* apparently has good conditions for development. In contrast, the pine marten, which does not use burrows, is mainly parasitised by the common wood tick *I. ricinus* and *I. hexagonus* parasitised only a few pine marten individuals (Christian 2002).

The present study indicates that a non-indigenous mammal, the American mink, which has become feral, can host a well-developed population of native ticks and can further spread these tick species, which can also transmit pathogens.

5. Acknowledgments

I would like to thank Jana Zschille for providing ticks from minks of the investigation area in the federal state of Saxony-Anhalt. I thank the colleagues in the preparation laboratory of the museum for sampling ticks from the minks of the investigation area in the federal state of Saxony. I would also like to thank Kerstin Franke for preparation of tick larvae on slides and much other technical assistance.

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Accepted 23 June 2010