

## Species Diversity of Ticks (Acari: Ixodida) on Migrating Birds on the Baltic Sea Coast of Poland

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(Accepted December 24, 2012)

**Magdalena Nowak-Chmura, Krzysztof Siuda, Zofia Wegner, and Krzysztof Piksa (2012)** Species diversity of ticks (Acari: Ixodida) on migrating birds on the Baltic Sea coast of Poland. *Zoological Studies* 51(8): 1411-1417. A collection of ticks found on migrating birds from the Baltic Sea coast in Poland was examined. Birds were captured under the ornithological project entitled "Operation Baltic" and examined to detect the presence of ticks. Research programs were conducted separately in the spring and autumn migrations of 1981. In the spring, 588 tick specimens were detected on 245 of 2483 specimens of birds, while in the autumn, 899 tick specimens were found on 257 of 1467 birds that were examined. Four tick species were identified from the spring collection: *Ixodes arboricola*, *I. frontalis*, *I. ricinus*, and *I. eldaricus*, with a dominant role played by *I. ricinus*. In the autumn *I. ricinus* was the only species recorded. The vast majority of collected specimens were poorly fed young larvae and nymphs. <http://zoolstud.sinica.edu.tw/Journals/51.8/1411.pdf>

**Key words:** Ixodida, Ticks, Migrating birds, Transfer, Poland, Baltic Sea.

Many migrating bird species are important hosts to ticks (Acari: Ixodida). Despite parasitological issues directly connected to this fact, infesting birds may enable these parasites to move beyond their natural range of occurrence. Intercontinental migration of birds may contribute to the worldwide spread of zoonoses (Hoogstraal 1979, Comstedt et al. 2006, Georgopoulou and Tsiouris 2008).

According to research papers on ticks parasitizing birds in Poland, several issues were examined: recorded cases of ticks parasitizing certain bird species belonging to the natural Polish fauna (Siuda 1986a b, Złotorzycka 1990, Siuda 1993, Siuda et al. 2006); research on ticks transferred to Poland via migratory birds, such as *Haemaphysalis punctata* Canestrini et Fanzago, 1877 (Lachmajer et al. 1956), 2 cases

of *Hyalomma marginatum* Koch, 1844 (Siuda and Dutkiewicz 1979, Nowak and Solarz 2010), and a single case of *I. festai* Rondelli, 1926 transfer (Siuda and Szymański 1991); and studies on the epidemiological importance of ticks infesting birds in Poland (Gryczyńska et al. 2002 2004, Skotarczak et al. 2006, Michalik et al. 2008).

The current paper presents results of an examination of tick (Acari: Ixodida) species diversity on migrating birds along the Baltic Sea coast in Poland.

### MATERIALS AND METHODS

The examined collection of ticks (Ixodidae) was obtained from the Institute of Maritime and Tropical Medicine, Medical Univ. of Gdańsk

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(Gdynia, Poland). Ticks were collected from migrating birds during their spring and autumn passages along the Baltic Sea coast in Poland in 1981. The collection was made in cooperation with ornithologists involved in “Operation Baltic” a bird research project (Augustyn 2008, Sikora et al. 2011). The main aim of this long-running annual operation, was to register and ring birds migrating along the coast in order to identify their migratory routes.

The spring collection of ticks was conducted on the Hel Peninsula (18°47'E, 54°37'N) from 24 Mar. to 18 Apr. 1981 and on the Vistula Spit (19°18'E, 54°21'N) from 18 Apr. to 15 May 1981. In total, 2483 specimens of birds of 39 species were examined. At the end of the summer and again in autumn 1981, 1467 bird specimens were examined on the Vistula Spit from 24 Aug. to 15 Oct. representing 47 species of birds.

Ticks were preserved in 70% ethanol. Each subsequent collection of ticks was stored in a separate test-tube. Each sample was labeled with

a collection catalogue number, date, host species, and notes concerning the location on the body of the bird. The majority of collected ticks needed to be embedded in microscope preparations using Hoyer's medium. Species affiliation was determined using identification guides published in monographic works on ticks from Poland (Siuda 1993), the Ukraine (Emchuk 1960), Great Britain (Arthur 1963), the former Soviet Union and Russia (Filippova 1977), and Italy (Manilla 1998).

Numbers of examined birds belonging to certain species ranged from a single to several hundred specimens.

## RESULTS

In spring 1981, 2483 birds migrating towards the north were checked, of which 245 specimens (9.9%) were infested with ticks (Table 1). In total, 588 specimens of ticks were found belonging to 4 species: *Ixodes arboricola* Schulze et Schlottko,

**Table 1.** Ticks (Ixodida) collected from migratory birds in the spring of 1981 in Poland

Species	Bird host No of hosts/ no. infested (%)	Tick species																			
		<i>Ixodes arboricola</i>				<i>I. frontalis</i>				<i>I. ricinus</i>				<i>I. eldaricus</i>				<i>Ixodes</i> spp.			
		L	N	♀	♂	L	N	♀	♂	L	N	♀	♂	L	N	♀	♂	L	N	♀	♂
<i>Anthus trivialis</i>	3/1 (33.3)									1	2										
<i>Troglodytes troglodytes</i>	24/4 (16.7)			2						18											
<i>Prunella modularis</i>	19/12 (63.1)									8	30					1					1
<i>Erithacus rubecula</i>	699/73 (10.4)					3				74	48					1	2	1	1		
<i>Luscinia luscinia</i>	3/3 (100)									5	5										
<i>Phoenicurus phoenicurus</i>	55/13 (23.6)									5	19										
<i>Phoenicurus ochruros</i>	5/1 (20.0)									1											
<i>Turdus merula</i>	22/13 (59.1)									3	29										
<i>Turdus iliacus</i>	20/8 (40.0)									1	16										
<i>Turdus philomelos</i>	115/14 (12.2)					1	2			5	11										
<i>Sylvia curruca</i>	18/2 (11.1)									4	6										
<i>Sylvia communis</i>	2/1 (50.0)									1											
<i>Sylvia atricapilla</i>	27/3 (11.1)									3	3										
<i>Phylloscopus sibilatrix</i>	52/3 (5.7)									2	1										
<i>Phylloscopus trochilus</i>	24/4 (16.7)									14	6										
<i>Phylloscopus collybita</i>	9/1 (11.1)									1	2										
<i>Regulus regulus</i>	988/66 (6.7)					9				8	65							1	2		
<i>Ficedula hypoleuca</i>	38/1 (2.6)									1											
<i>Parus montanus</i>	4/1 (25.0)			1																	
<i>Parus cristatus</i>	4/1 (25.0)									1	1										
<i>Parus caeruleus</i>	71/2 (2.8)	44	6																		
<i>Parus major</i>	155/13 (8.4)	68	10	1						12	11										
<i>Fringilla coelebs</i>	63/3 (4.8)									3	3										
<i>Carduelis spinus</i>	14/2 (14.3)			2																	
Other bird species	49/0 (0.0)																				
<b>Total</b>	<b>2483/245 (9.9)</b>	<b>112</b>	<b>21</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>14</b>	<b>0</b>	<b>0</b>	<b>169</b>	<b>260</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>4</b>	<b>0</b>	<b>0</b>

L, larva; N, nymph.

1929, *I. frontalis* (Panzer, 1798), *I. ricinus* (Linnaeus, 1758), and *Ixodes eldaricus* Djaparidze, 1950. A significant number of ticks collected were damaged when they were detached from the bodies of the birds, which meant that only a limited number of ticks could be determined taxonomically with the help of a stereoscopic microscope without prior preparation. Within this number, there were also 2 larvae and 4 nymphs of *Ixodes* spp., the taxonomy of which could not be accurately determined as they were seriously damaged, although an assumption was made that they were *I. ricinus*.

By the end of the summer and in the autumn, the total number of examined birds migrating south equaled 1467. Ticks were found on 257 birds (17.5%) (Table 2). In total, 899 tick specimens were collected (559 larvae and 340 nymphs) of which 891 belonged to the species *I. ricinus*, and

8 heavily damaged ticks were described as *Ixodes* spp., although they most probably belonged to *I. ricinus*. The ticks were mostly located on the head of the host's body, especially around the beak and eyes.

### Characteristics of ticks collected from birds

*Ixodes arboricola*. The current study revealed cases of *I. arboricola* parasitizing *Troglodytes troglodytes*, *Parus montanus*, *P. caeruleus*, *P. major*, and *Carduelis spinus* bird species in the spring. Birds from the genus *Parus* nest in hollows, nest boxes etc. and are the main host for *I. arboricola* in Poland. The majority of materials obtained during the spring collection period were larvae (112 specimens), nymphs (21 specimens), and a single female (Table 1).

*Ixodes frontalis*. The current study confirmed

**Table 2.** Ticks (Ixodida) collected from migratory birds in the autumn of 1981 in Poland

Species	Bird host No of hosts/ no. infested (%)	Tick species							
		<i>Ixodes ricinus</i>				<i>Ixodes</i> spp.			
		L	N	♀	♂	L	N	♀	♂
<i>Anthus trivialis</i>	6/2 (33.3)	1	5						
<i>Troglodytes troglodytes</i>	8/3 (37.5)	10	2						
<i>Erithacus rubecula</i>	210/76 (36.2)	179	54				1		
<i>Phoenicurus phoenicurus</i>	83/12 (14.4)	12	16			1	1		
<i>Saxicola rubetra</i>	28/3 (10.7)	1	2						
<i>Turdus merula</i>	23/17 (73.9)	64	63						
<i>Turdus iliacus</i>	13/4 (30.8)	12	6						
<i>Turdus philomelos</i>	87/31 (35.6)	89	66						
<i>Muscicapa striata</i>	22/1 (4.5)		2						
<i>Ficedula hypoleuca</i>	26/1 (3.8)	2	1						
<i>Acrocephalus schoenobaenus</i>	20/1 (5.0)	4	2						
<i>Acrocephalus scirpaceus</i>	67/2 (3.0)		2						
<i>Phylloscopus trochilus</i>	123/7 (5.7)	2	9						
<i>Sylvia curruca</i>	7/2 (28.6)	2	1						
<i>Sylvia communis</i>	8/1 (12.5)	1	1						
<i>Sylvia borin</i>	94/5 (5.3)	1	4						
<i>Sylvia atricapilla</i>	50/11 (22.0)	14	4						
<i>Regulus regulus</i>	138/1 (0.7)	1							
<i>Parus palustris</i>	3/1 (33.3)		3						
<i>Parus ater</i>	4/1 (25.0)		1						
<i>Parus caeruleus</i>	125/10 (8.0)	29	9			1			
<i>Parus major</i>	231/53 (22.9)	85	62						
<i>Sturnus vulgaris</i>	1/1 (100)	5	1						
<i>Fringilla coelebs</i>	14/9 (64.3)	37	21			4			
<i>Carpodacus erythrinus</i>	3/2 (66.7)	2	1						
Other bird species	73/0 (0.00)								
<b>Total</b>	<b>1467/257 (17.5)</b>	<b>553</b>	<b>338</b>	<b>0</b>	<b>0</b>	<b>6</b>	<b>2</b>	<b>0</b>	<b>0</b>

L, larva; N, nymph.

the occurrence of *I. frontalis* on the following bird species during the spring research program: *Erithacus rubecula*, *Turdus philomelos*, and *Regulus regulus*. Only immature stages were collected: 1 larva and 14 nymphs (Table 1).

*Ixodes ricinus*. The current study confirmed that most birds examined in the spring were infested with *I. ricinus* (Table 1). In the autumn, *I. ricinus* was the only species recorded among all of the research material (Table 2).

*Ixodes eldaricus*. Adult *I. eldaricus* feeding on birds was recorded in the spring collection, with hosts being species of *Prunella modularis* and *E. rubecula* (Table 1).

General prevalences of individual tick species collected from birds in the Hel Peninsula and Vistula Spit also greatly differed (Table 3). In spring, prevalences ranged from 0.1% for *I. eldaricus* to 9.0% for *I. ricinus*, while in the autumn, it reached 17.5% for *I. ricinus*.

## DISCUSSION

Our research showed that migratory birds are hosts to different tick species, and therefore migratory birds may play important roles in transmitting diseases via ticks. The study carried out for this publication also supported earlier data obtained in other studies (Nuorteva and Hoogstraal 1963, Kahl 1971, Hoogstraal 1972, Kaiser et al. 1974, Walter et al. 1979, Mehl et al. 1984, Marie-Angèle et al. 2006, Literák et al. 2007, Kolonin 2008, Pietzsch et al. 2008, Hasle et al. 2009, Laakkonen et al. 2009, Kjelland et al. 2010).

Geographical distances of tick transfer depend on the territorial range of the host birds. They also depend on the tick development cycle, as 2-host ticks are possibly attached to their hosts

for longer times. A host is attacked by a larva, which after engorgement, develops into a nymph which then detaches itself from the host. This significantly extends the time of contact with the 1st host than in the case of 3-host tick species.

Examples of 2-host tick species covering long distances due to transfer by birds are: *Hyalomma marginatum* Koch and *H. rufipes* Koch, which were transferred from Africa and the Mediterranean territories to central and northern Europe (Nuorteva and Hoogstraal 1963, Siuda and Dutkiewicz 1979, Walter et al. 1979, Mehl 1983, Mehl et al. 1984, Hasle et al. 2009, Nowak and Solarz 2010). It is of considerable interest that examining a relatively large number of birds (3950) revealed no case of *Hyalomma* transfer to the Baltic Sea.

The possibility that feeding adult female ticks, regarded as either exclusively or generally ornithophilous, have reached northern central Europe, has now been proven by the discovery of the transfer of a female *I. festai* on the Hel Peninsula (Siuda and Szymański 1991) and *I. eldaricus* adults (males and females) recorded during the current research.

The highest number of *I. arboricola* ticks were collected from birds in the genus *Parus* (Table 1). The majority of species within *Parus* are sedentary birds, although during the winter, northern *Parus* populations move a little to the south where winters are milder. For example, in Poland, *P. caeruleus* is a nesting species that occurs in great numbers, and many individuals choose to winter in Poland. These birds which favor a milder climate migrate in winter to southern France, and their place is taken by birds from Scandinavia. In migration seasons (Mar.-Apr. and Sept.-Oct.) they arrive in large numbers on the Polish Baltic coast (Busse 1976). It is likely, however, that *I. arboricola* ticks collected in the nesting season did not represent

**Table 3.** Prevalence of invasion by particular tick species collected from migrating birds during their spring and autumn migratory passages along the Baltic Sea Coast in 1981 in Poland

Tick species	No. of examined birds	No. of infested birds	Prevalence of infestation (%)
	Spring N = 2483 Autumn N = 1467		
<i>Ixodes arboricola</i>	2483	9	0.4
<i>I. frontalis</i>	2483	14	0.6
<i>I. ricinus</i>	2483	224	9.0
<i>I. eldaricus</i>	2483	2	0.1
<i>Ixodes</i> spp.	2483	3	0.1
<i>I. ricinus</i>	1467	257	17.5
<i>Ixodes</i> spp.	1467	5	0.3

ticks transported by migratory birds, but came from sites not very far away from the stations where they were captured. A case of *I. arboricola* ticks being collected from migratory birds in North Africa was reported by Clifford and Hoogstraal (1965).

*Ixodes arboricola* is a burrow nest-dwelling parasite, and an exclusively ornithophilous tick, which associates with birds inhabiting tree holes and nest boxes. This includes birds from the *Parus* genus that primarily nest in tree holes carved by themselves in rotting wood or abandoned by other birds (e.g., woodpeckers) or nests abandoned by squirrels (Singer 2001). As such, the birds normally come in contact with *I. arboricola* ticks either in tree holes or on the edges of the tree trunk near the nests, or albeit rarely, when the birds are foraging on the ground.

In Poland, the majority of known sites of *I. arboricola* are situated west of the Vistula River, although this species probably occurs all over Poland, particularly in tree holes and nest boxes that have been occupied by birds over a number of years (Siuda 1993, Siuda and Sebesta 1997, Siuda et al. 2006). Future studies should establish the percentage of birds investigated in the present study of the genus *Parus* which were not actually migrating, but that came from areas close to the sites where the birds were captured for the purpose of this research.

*Ixodes ricinus* was the most frequent and numerous tick parasitizing migrating birds on the Baltic Coast, during both the spring and autumn migrations (Table 3). Most of the larvae and nymphs of *I. ricinus* from the collected material were poorly engorged, which indicates that their feeding on the host bird had not lasted long, and contact with the host was likely not made very far from the place where the birds were collected. This species frequently occurs on birds migrating within the Baltic Sea basin (Alekseev et al. 2001, Comstedt et al. 2006, Franke et al. 2010, Kjelland et al. 2010, Hasle et al. 2011).

Spring migrations, more so than those in the autumn, create more possibilities for the transfer of various tick species to central Europe, including Poland. This observation was confirmed by the fact that 4 species, one of which, *I. eldaricus*, does not belong to the indigenous Polish fauna, were recorded in the spring collection.

In the examined host material, 2 bird species, *Regulus regulus* and *Erithacus rubecula*, predominated and together accounted for 51.5% of the total examined host material, while in spring alone, they represented as much as 67.9% of the

material (Tables 1, 2). Our study confirmed that migrating birds, especially those that feed on the ground, are vulnerable to being parasitized by tick larvae and nymphs.

The long-lasting and abundant feeding by parasites on a host has consequences for the general health of the host organism (Bartosik et al. 2008, Nowak 2010, Ho et al. 2011, Tang et al. 2012). Ticks feeding on birds can cause local skin lesions on the host and result in secondary infections in these birds. They can also adversely affect the bodily functions of these birds, thus upsetting the normal development of the hosts, e.g., by reducing body weight and disturbing reproduction (Chastel et al. 1981, Schilling et al. 1981, Hesse 1985, Szèp and Möller 1999 2000, Grigor'eva 2001). In the material examined in this study, ticks were most frequently found on the head, especially around the beak and eyes.

The fact that *I. ricinus* was the dominant tick species parasitizing birds migrating through Poland extends the possibility of the spread of tick-borne diseases, the pathogens of which are being vectored by this species. Migrating birds significantly contribute to the transfer of hundreds of ticks infested with microorganisms to various territories. The risk is underlined by the fact that environmental conditions allow this tick to permanently inhabit the territory of Poland and all of central Europe.

There is the necessity and at the same time, scientific interest, to conduct additional studies in the same area of the Baltic Sea coast in Poland. Verifying and comparing changes in the tick fauna transported by birds are important scientific objectives. One would expect an answer to an interesting question as to whether a new study carried out after 31 yr would reveal changes in the tick fauna transferred to Poland via birds.

**Acknowledgments:** We thank Mr. M. Pawłowicz for collecting the bird-feeding ticks.

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