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TICKS OF THE GENUS *RHIPICEPHALUS* (ACARI, IXODIDAE) AND THEIR DISTRIBUTION IN UKRAINE

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Ticks of the Genus *Rhipicephalus* (Acari, Ixodidae) and Their Distribution in Ukraine. Akimov I. A., Nebogatkin I. V. — Expansion of *Rhipicephalus rossicus* (Jakimov et Kohl-Jakimova, 1911) to the North, due to all its developmental stages have wide range of feeders (from amphibians to mammals) in the new man-made environmental conditions in the steppe and wood-and-steppe of Ukraine and the warming of climate (especially warm winters), is observed. The northern boundary of *R. rossicus* distribution lies in Vinnytsya, Kyiv, Poltava and Sumy Regions. *R. bursa* (Canestrini et Fanzago, 1878) and *R. sanguineus* (Latreille, 1806) occur only on the shores of the Black Sea and Sea of Azov (including the Crimea). Outbreak localities of *R. sanguineus* are in Kerch Peninsula (Crimea) and in the Dnieper floodplain. Both *R. bursa* and *R. sanguineus* are invasive species.

Key words: *Rhipicephalus rossicus*, *R. bursa*, *R. sanguineus*, distribution, Ukraine.

Клещи рода *Rhipicephalus* (Acari, Ixodidae) и их распространение в Украине. Акимов И. А., Небогаткин И. В. — Отмечено расширение ареала *Rhipicephalus rossicus* (Jakimov et Kohl-Jakimova, 1911) на север, благодаря питанию всех стадий развития на широком круге прокормителей (от земноводных до млекопитающих), новым созданным человеком условиям обитания в Степи и Лесостепи в пределах Украины и потеплению климата (мягким зимам). Северная граница ареала *R. rossicus* проходит по Винницкой, Киевской, Полтавской и Сумской областям. Выяснено, что *R. bursa* (Canestrini et Fanzago, 1878) и *R. sanguineus* (Latreille, 1806) обитают только по берегам Чёрного и Азовского морей (включая Крым). Очаги массовых размножений *R. sanguineus* находятся на Керченском полуострове Крыма и в пойме Днепра. *R. bursa* — вид-вселенец, как и *R. sanguineus*.

Ключевые слова: *Rhipicephalus rossicus*, *R. bursa*, *R. sanguineus*, распространение, Украина.

Previously published data on mass ixodid tick species population size and distribution in Ukraine (Akimov, Nebogatkin, 1996, 2010, 2011 a, 2011 b, 2012) reveal some general trends and direction of change of these indicators, especially when distribution boundaries of the studied species partly pass through the territory of the country. This review completes the cycle of articles devoted to the widespread and important species of ixodid ticks of the genus *Rhipicephalus*, first of all, *R. rossicus* (Jakimov et Kohl-Jakimova, 1911), *R. bursa* (Canestrini et Fanzago, 1878) and *R. sanguineus* (Latreille, 1806). This genus is in the focus of molecular taxonomy of Ixodidae (Beati, Keirans, 2001). Also the tendency of its species to expand their distribution (Nebogatkin, 1996) and their epizootiology as main vectors and keepers of *Anaplasma*, *Babesia*, *Ehrlichia*, *Hepatozoon*, *Rickettsia* (Jongejan, Uilenberg, 2004) and the Marseilles fever (Nebogatkin, Novohatny, 2012) are of special interest. This makes determination of distribution of *Rhipicephalus* species in Ukraine to be important and necessary.

Material and methods

To clarify the distribution boundaries of the considered species in Ukraine our material collected in 1977–2013 in the Autonomous Republic of Crimea, 12 regions and the cities of Kyiv and Sevastopol were used. Altogether, about 4,000 tick specimens were trapped on the flag, accountant, and by examination of about 1400 beeves, dogs, other domestic animals, and birds have given for studied. Materials of the short-term (six-month) forecasts and surveys of 25 regional, Kyiv, Alushta, Mariupol and Sevastopol city sanitary and epidemiological station (SES) of Ukraine, personal archive of E. F. Litvinenko and E. M. Emchuk (1953–1960), as well as material from the review by N. A. Filippova (1997) were used. In addition to our data records of more than 80000 specimens of ticks (table 1) were taken into account. A formal administrative-territorial approach was

Table 1. Number of examined specimens (own and archive data) of the genus *Rhipicephalus* (thousand of specimens) in Ukraine

Таблица 1 Количество исследованных особей (собственные и архивные данные) иксодовых клещей рода *Rhipicephalus* (тыс. экз.) в Украине

Species	Archive	Our Data	
	1953–2000	1977–2001	2001–2012
<i>R. rossicus</i>	64.7	2.6	0.35
<i>R. sanguineus</i>	17.1	1.4	0.42
<i>R. bursa</i>	0.8	0.1	0.07
TOTAL	82.6	3.1	0.84

used to create distribution maps (Akimov, Nebogatkin, 2010). In Ukraine, distribution ranges of ticks were divided into four zones: 1) the territories with high population of ticks and the periodic bursts of mass reproduction; 2) the territories, where ticks are common, and the mass reproduction bursts are very rare; 3) the territories where ticks are found regularly, every 2–3 years, and the mass reproduction bursts have not been recorded even during the favorable conditions; 4) the territories where ticks were found irregularly, several times in 10–20 years. When analyzing material the following quantitative measures: the index of abundance (IA) and the index of infection (II) were used (Tularemia, 1954).

Rhipicephalus rossicus Jakimov et Kohl-Jakimova, 1911

The Ukrainian distribution of this species in the middle of the 1960s was confined to the steppes and mountain-steppe areas of the Steppe zone and Crimea (fig. 1), the localities of mass reproduction bursts were in the mouths of the major rivers of Ukraine and braids of the Black Sea and Sea of Azov (Emchuk, 1960).

The new conditions created in the Steppe and Wood-and-Steppe zones by human activity (as woodland belts on the agricultural lands, artificial reservoirs for storing water, breeding of muskrats and nutrias, forest-protecting plantings along drainage channels, etc.), and not the least, relatively mild winters, have driven this species deeply to the north.

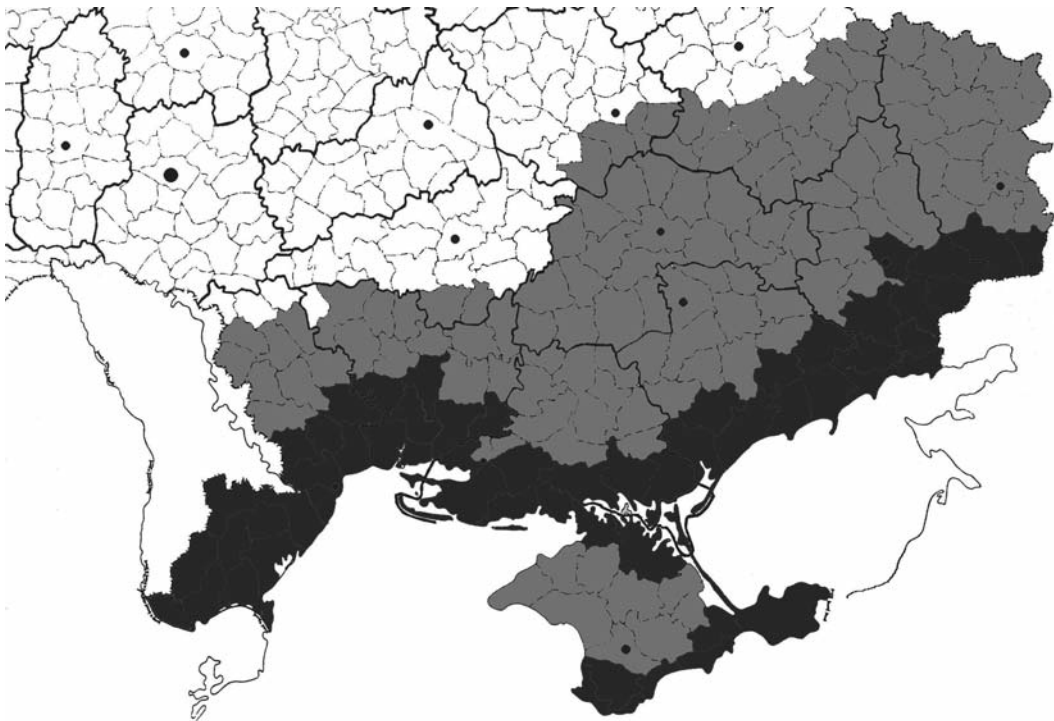


Fig. 1. Distribution of *R. rossicus* in Ukraine, after Emchuk (1960).

Рис. 1. Распространение *R. rossicus* на территории Украины, по данным Е.М. Емчук (1960).

Table 2. Hosts of all stages of *R. rossicus* in UkraineТаблица 2. Прокормители всех стадий развития *R. rossicus* в Украине

Host	♀, ♂	L	N
<i>Mammalia</i>			
<i>Erinaceus concolor</i> Mart.	x	x	
<i>Sorex araneus</i> L.			x
<i>S. minutus</i> L.			x
<i>Crocidura suaveolens</i> Pall.	x	x	x
<i>Mycromys minutus</i> Pall.			x
<i>Sylvvarum flavicollis</i> Melch.	x	x	xx
<i>S. tauricus</i> L.		x	xx
<i>S. agrarius</i> Pall.			x
<i>Rattus norvegicus</i> Berc.			x
<i>M. musculus</i>		x	
<i>Cricetus cricetus</i> L.			x
<i>C. glareolus</i> Schr.			x
<i>Ondatra zibethicus</i> L.		x	x
<i>Arvicola terrestris</i> L.			x
<i>M. arvalis</i> Pall.		x	x
<i>M. oeconomus</i> Pall.			x
<i>M. (Pitymus) subterraneus</i> Sel.-Lon.			x
<i>Vulpes vulpes</i> L.	x		
<i>Capreolus capreolus</i> L.			x
<i>Camelus bactrianus</i> Pall.	x		
Stray dogs	xx		
Stray cats	x	x	x
Large cattle	xx		x
Small cattle	xx		x
<i>Aves</i>			
<i>Parus major</i> L.			x
<i>Turdus merula</i> L.			x
<i>Corvus frugilegus</i> L.	x	x	x
<i>Amphibia</i>			
<i>Rana arvalis</i> Nil.	x		

Note. x — ordinary host; xx — mass host.

Dissemination of the parasite on all of development stages in such number is a result of presence of wide range of hosts, from amphibians to mammals (table 2).

The first mentions and the general trend were outlined in the 1970's, when *R. rossicus* was regularly recorded in Central and Eastern Wood-and-Steppe. By the end of the XX century this species has reached Kiev, where it has formed a stable population (Nebogatkin, 1996).

Measuring of males and females of *R. rossicus* (table 3) show that the overall size of males and females do not differ significantly (paired two-sample t-test $p < 0.95$) and the absence of sexual dimorphism in this character.

The sizes of ticks from Zaporizhzhya (Sea of Azov and the Black Sea), Donetsk, Kyiv, Mykolaiv, Kharkiv and Odessa Regions were compared. Significant differences were not found.

We are the witnesses of the invasion of this species into the areas previously not inherent to it (fig. 2). The situation which happens repeats what happened to *Haemaphysalis punctata* (Akimov, Nebogatkin, 2012) in the XVIII–XIX centuries.

The presence of spontaneous foci conduced intrusion of *R. rossicus* into new areas (Nebogatkin, 1996), which may lead to single cases or unexpected outbreaks of exotic diseases. In this system, the centers of reproduction could have a significant epizootic and

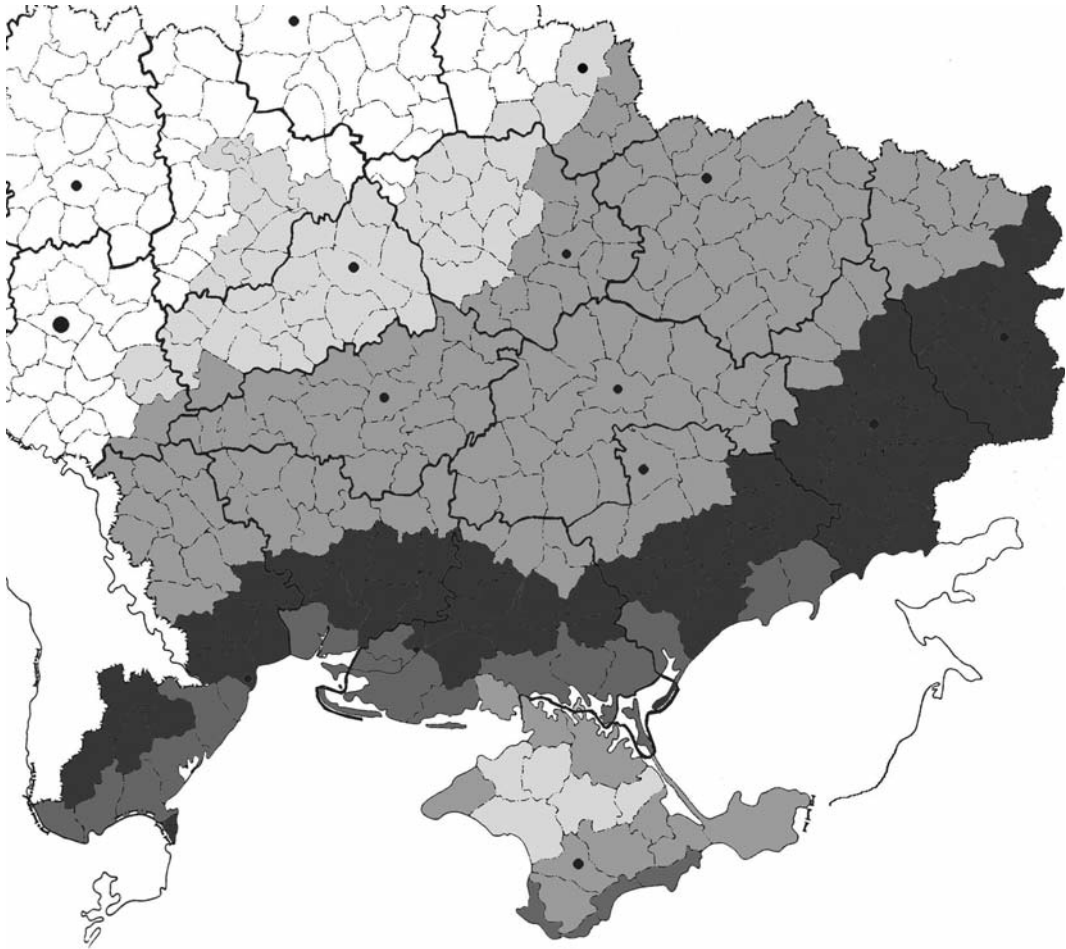


Fig. 2. Distribution of *R. rossicus* in Ukraine at the beginning of the XXI century:
 ■ — areas where this tick is found very rarely and not regularly, few times per 10–20 years;
 ■ — areas where this tick is found regularly (once per 2–3 years), however its mass reproduction was not recorded even under favorable conditions;
 ■ — areas where this tick is common, however its mass reproductions are very rare and due to natural and anthropogenic reasons;
 ■ — areas where this tick is abundant with places of periodic outbreaks of mass reproduction.

Рис. 2. Распространение *R. rossicus* в Украине в начале XXI в.

Table 3. Size of *R. rossicus* ticks caught in the vicinity of Kiev
Таблица 3. Дифференциальные размеры клещей *R. rossicus* отловленных в окрестностях Киева

Character	X min–X max	σ	s
Females			
Body length of gnathosoma (L)	2.096±2.993	0.266	0.070
Length of scutum (Ls)	0.373±1.270	0.256	0.071
Width of scutum (Bs)	0.418±1.315	0.259	0.069
Length of idiosoma (Li)	1.715±2.612	0.262	0.072
Width of idiosoma (Bi)	0.925±1.822	0.269	0.071
Males			
Body length of gnathosoma (L)	2.082±2.752	0.229	0.071
Length of conscutum (Lcs)	0.359±1.029	0.228	0.069
Width of conscutum (Bcs)	0.315±1.074	0.218	0.066

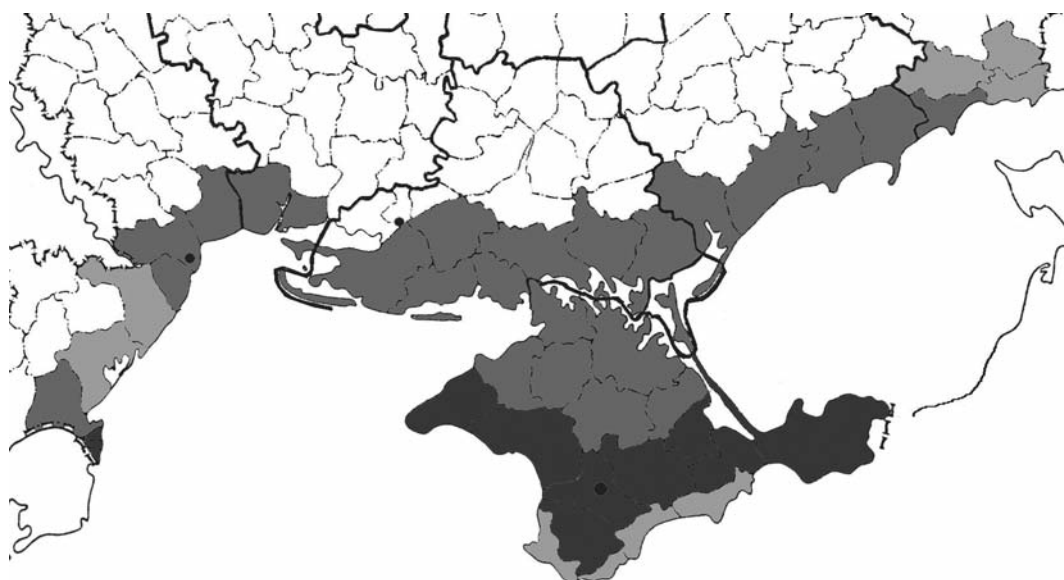


Fig. 3. Distribution of *R. sanguineus* in Ukraine.

Рис. 3. Распространение *R. sanguineus* в Украине.

epidemiological significance, contributing not only spread and transmission of pathogens that are dangerous to human and animals, but also establishing these disease-producing factors in new areas with new unpredictable pathogenic properties.

***R. sanguineus* Latreille (brown dog tick)**

The brown dog tick is a typical parasite of carnivores in Africa, spread with the dog onto all territories suitable for its existence. The peculiarity of this species under conditions of Ukraine is parasitising of all the stages on one host, the dog. Occasionally can be found on cats (IA = 0.01–0.15; II = 6,8–12,3) and foxes (IA = 0.09, II = 12.5). Number of *R. sanguineus* depends on the number of dogs (Nebogatkin, Tovpinets, 1997). In 1990s, uncontrolled growth of the dog population led to the sharp growth of the tick IA in the Crimea (Evstafiev, Tovpinets, 2002). As the tick population grew, the Marseilles fever was spreading (Nebogatkin, Novohatny, 2012), and lethal cases were recorded.

Distribution of this tick in Ukraine has not changed significantly. *R. sanguineus* is usual in its optimal habitats — shores of the Sea of Azov and Black Sea (fig. 3). Limiting factors, in our opinion, are the average annual temperature and humidity; they do not prevent ticks moving from the coast to the North. We found only single cases of the dog tick above 48° N in Ukraine (2 females collected from a dog in a Kyiv park).

***R. bursa* Canestrini et Fanzago**

This species belongs in the subgenus *Digineus* (Filippova, 1997), differing morphologically and biologically; it is a two-hosted parasite, almost never occurring on wild animals (except for the large ones: wild boar, roe deer, deer), and parasitising on sheep, goats and cattle. We found the larvae of *R. bursa* on the gray hamster (*Cricetulus migratorius* Pallas) (IA = 0.3, II = 15.3) in 1991. Until 1960–1965 *R. bursa* was one of the most common species of Crimean ticks. As a result of transfer cattle to stabling and handling it with acaricides, these ticks have virtually disappeared from the fauna of the Kerch Peninsula and mountain area of Crimea, and from 1960s to 1990s, *R. bursa* has not been

Table 4. Indices of abundance of all stages of *R. bursa* on hosts per months in the Crimea
Таблица 4. Индексы обилия всех фаз развития *R. bursa* по месяцам в Крыму на прокормителях

Months	L	N	I	Total
January		0.14		0.14
February		0.09	0.1	0.19
March		0.02	0.5	0.52
April			5.6	5.6
May			8.2	8.2
June			15.4	15.4
July			30.3	30.3
August	0.05		0.7	0.75
September	0.14		0.3	0.17
October	0.21		0.2	0.41
November	0.08	0.09	0.2	0.37
December		0.12		0.12
Total	0.48	0.46	61.5	62.44

recorded in the mainland. Currently, this species is found most often found on sheep, which are common hosts for many tick species. This species has been registered in the forests of the mainland, in the end of 1990s, i. e., there is an established tendency of *R. bursa* to move northwards to the places of its native habitat.

The duration of the life cycle depends on the weather and lasts an average of one year. Imago are parasitise virtually all the warm season (table 4). The pick of the infestation by ticks is in April-June; the immature stages peak of occurrence is: for larvae from August to November, for nymphs from October to March. Ticks usually hibernate as the nymphs or as nymphs and adults.

Distribution of *R. bursa* in Ukraine is associated with the sheep breeding, and this species occur mainly on the coasts and braids of the Black Sea and Sea of Azov. It is absent only in the central regions of the Crimean peninsula (fig. 4).

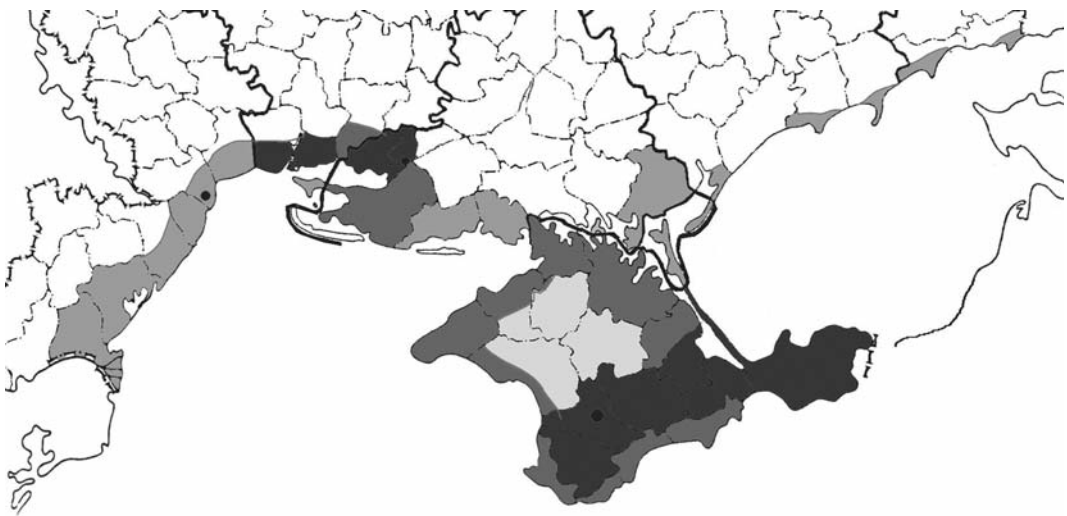


Fig. 4. Distribution of *R. bursa* in Ukraine.

Рис. 4. Распространение *R. bursa* в Украине.

Conclusions

In Ukraine, the northern boundary of *R. rossicus* distribution lies through Vinnytsya, Kyiv, Poltava and Sumy Regions. This species is a parasite of various hosts, from amphibians, birds, wild ungulates, small mammals and domestic animals. The populations of adult *R. rossicus* ticks in Ukraine do not differ in their basic measurements.

Dogs are the main host of *R. sanguineus* ticks in Ukraine, but this species occurs only on the shores of the Black Sea and Sea of Azov. Outbreak localities are in the Kerch Peninsula of Crimea and in the floodplain of the Dnieper. Occasionally, it can be found on cats and foxes.

Rhipicephalus bursa, as well as *R. sanguineus*, are usual for the shores Black Sea and Sea of Azov (including the Crimea), and occasionally can be found on the mainland and in the forests. It feeds usually on farm animals (mainly sheep), almost absent on wild mammals, except in woods, where can parasitise on wild boars and other ungulates. The tendency of *R. bursa* to expand northwards is noted.

Rhipicephalus bursa and *R. sanguineus* are invasive species.

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