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DATA ON THE DISTRIBUTION OF THE *HAEMAPHYSALIS CONCINNA* TICK IN THE IRKUTSK REGION AND THE REPUBLIC OF BURYATIA

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ABSTRACT

The ixodid tick Haemaphysalis concinna (Koch, 1844) is a carrier of pathogens of vector-borne diseases of viral, bacterial and protozoal etiology. This tick was previously considered an adventive relict species in the Baikal region, but has recently shown a tendency to increase its numbers and expand its habitat.

The aim of the study. *To generalize the available and newly received information on the distribution of the H. concinna tick in the Irkutsk region and the Republic of Buryatia; to carry out the comparative analysis of the results in order to identify the dynamics of the development of populations of this species of ixodid ticks in the Baikal region.*

Materials and methods. *The coordinates of H. concinna detection points in our studies were obtained using a GPS navigator directly in the field. Ticks were caught during the period of their maximum activity from plants using a flannel flag. Approximate geographic coordinates of H. concinna tick detection points were established when analyzing the maps published by other researchers.*

Results. *As a result of the generalization of our own data and data from literary sources, 52 georeferenced detection points of H. concinna were obtained on the territory of the Baikal region. A map showing the distribution of H. concinna in the territory of the Irkutsk region and the Republic of Buryatia is presented. It is shown that in a number of surveyed areas there are stable populations of this species of tick, which tend to increase in their numbers and expand their range.*

Conclusions. *Considering these data, as well as the fact that H. concinna ticks are actively involved in the circulation of pathogens of natural focal diseases in humans and animals, we can conclude that it is necessary to systematically monitor the populations of this vector species in the Baikal region.*

Key words: *Haemaphysalis concinna, population, geographical distribution, vector-borne infections, natural foci*

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ДАННЫЕ О РАСПРОСТРАНЕНИИ КЛЕЩА *HAEMAPHYSALIS CONCINNA* НА ТЕРРИТОРИИ ИРКУТСКОЙ ОБЛАСТИ И РЕСПУБЛИКИ БУРЯТИЯ

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РЕЗЮМЕ

Иксодовый клещ Haemaphysalis concinna (Koch, 1844) является переносчиком возбудителей трансмиссивных заболеваний вирусной, бактериальной и протозойной этиологии. Этот клещ, ранее считавшийся в Прибайкалье заносным реликтовым видом, в последнее время демонстрирует тенденцию к увеличению своей численности и расширению территории обитания.

Цель исследования. *Обобщение имеющейся и вновь полученной информации о распространении клеща H. concinna на территории Иркутской области и Республики Бурятия; сравнительный анализ результатов для выявления динамики развития популяций этого вида иксодовых клещей в Байкальском регионе.*

Материалы и методы. *Координаты мест обнаружения H. concinna в наших исследованиях получены с использованием GPS-навигатора непосредственно в полевых условиях. Клещей отлавливали в период их максимальной активности с растительности с помощью фланелевого флага. Приблизительные географические координаты точек обнаружения клещей H. concinna другими исследователями были установлены нами в ходе анализа опубликованных ими карт.*

Результаты. *В результате обобщения собственных данных и данных из литературных источников было получено 52 геопривязанных точки обнаружения H. concinna на территории Байкальского региона. Представлена карта, отражающая распространение H. concinna на территории Иркутской области и Республики Бурятия. Показано, что в ряде обследованных районов присутствуют стабильные популяции клеща этого вида, которые имеют тенденцию к увеличению своей численности и расширению ареала.*

Выводы. *Учитывая эти данные, а также тот факт, что клещи H. concinna активно участвуют в циркуляции возбудителей природно-очаговых заболеваний человека и животных, можно сделать вывод о необходимости систематических наблюдений за популяциями этого вида переносчика на территории Байкальского региона.*

Ключевые слова: *Haemaphysalis concinna, популяция, географическое распространение, трансмиссивные инфекции, природные очаги*

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INTRODUCTION

The ixodid tick *Haemaphysalis concinna* (Koch, 1844) (class Acari, family Ixodidae, genus *Haemaphysalis* Koch.) is the type species for the genus *Haemaphysalis*, is an ancient relict species that evolved in the humid and warm climate of the Tertiary period. Currently, these ticks have survived only in those biotopes where the combination of hydrothermal factor is favourable for their existence [1]. It is the northernmost representative of the ticks of the genus *Haemaphysalis*, the majority of species of which are inhabited in the humid tropics and subtropics. It colonises deciduous and mixed forests in the warm temperate climate zone of Eurasia, especially humid habitats such as the shores of lakes and rivers. *H. concinna* is an exophilic tick with three hosts, uses a pasture type of lurking. During the warm season, ticks in various developmental phases may be active simultaneously on vegetation and feeders. The development period of one generation is 3–5 years [2–4]. Among the hosts of *H. concinna*, 60 species of wild mammals and 77 species of birds have been recorded. The species composition of the hosts that supply blood to ticks is different in each region. The greatest species diversity of *H. concinna* hosts has been found in the Russia's Far East. These ticks also frequently feed on livestock as well as domestic animals [1].

The duration of the *H. concinna* activity season largely depends on the region of their habitat. Thus, in the south of the Russia's Far East, in the foothills of the Crimea and the Caucasus, the adults are active from March-April to September-October. The peak of their activity is observed in June-July. In the foothills of the Altai and Sayan mountains, adult ticks appear in late April, but disappear as early as mid-August. The maximum of tick activity in this area can be observed at the end of May – beginning of June. The maximum number of larvae and nymphs is found everywhere at approximately the same time – in June and July [1].

H. concinna is a reliably confirmed vector of various tick-borne pathogens that cause human and animal diseases, and is endemic to vast territories of Europe and Asia [5].

In a study by F. Rubel et al. (2018) an analysis of scientific literature data was undertaken, as a result of which 656 geo-linked locations of *H. concinna* in Eurasia were obtained, modern maps reflecting the geographical distribution and climatic adaptation of this tick species were presented. According to the authors, the distribution area of *H. concinna* extends from the Spanish Atlantic coast in the west to the Russian Kamchatka in the east and is divided into a large number of clusters or individual habitats. *H. concinna* is the second most common species of ticks taken from birds, after *Ixodes ricinus* and the third most common species of ticks collected from vegetation in Central Europe [5].

The south-to-north distribution of *H. concinna* ranges from about 28–64° North latitude. The northern limit of *H. concinna* distribution can be reasonably determined by the southern regions of the Republic of Yakutia, where the tick can be observed up to 63.8° north latitude [6]. In Central China, the tick *H. concinna* was predominantly observed up to 28° north latitude. However, the three locations in China south of 28° north latitude, including the southernmost distribution at 21.93° north latitude/101.29° east longitude, described by R.-X. Sun et al. (2017) [7], should be interpreted with caution. These data have not been confirmed by other publications. The larvae and nymphs of *H. concinna* are also being known to be migrated long distances by birds, and described tick findings have been found in the path of East Asian/Australasian migratory birds [5]. The same may be also true for the finding of ticks of this species far to the north of the Russian Federation in the area of 87.71° east longitude/68.06° north latitude on the Taimyr Peninsula and in the vicinity of Yakutsk, where ticks are probably carried in birds [1]. In connection with these findings, F. Rubel et al. (2018) considered the above-mentioned locations as outliers and not as part of the distribution range of *H. concinna* [5].

In the European part of Eurasia, this type of tick has been found in Spain, France, Germany, Austria, Hungary, the Czech Republic, Slovakia, Italy, Croatia, Bosnia and Herzegovina, Serbia, Poland, Romania, Greece, Turkey, Iran. In eastern Eurasia, *H. concinna* has been found in China, Mongolia, Vietnam, Japan, North Korea, and South Korea [1, 5]. A significant part of the *H. concinna* range can be found in territories that were formerly belonged to the Soviet Union. In the former USSR republics, *H. concinna* was found in Belarus, Moldavia, Georgia, Armenia, Azerbaijan, Kazakhstan, Kyrgyzstan, Turkmenistan, and Uzbekistan [1, 3].

The most extensive habitats of *H. concinna* in Russia (formerly in the Soviet Union) are usually located in the foothills of large mountain systems in the south of the country (Caucasus, Pamir and Tien Shan, Altai and Sayan Mountains) and in the Russian Far East. In the European part of Russia, *H. concinna* inhabits the Crimean region, Krasnodar and Stavropol territories, as well as the northern lowland areas of the Chechen Republic and the Republic of Dagestan, as well as the Republic of Ingushetia. The only finding of a tick of this species in the northern part of Rostov region was most likely due to being carried by birds. In the south of the Urals, the tick *H. concinna* can be found in a strip along the valley of the Ural River in the Orenburg and Chelyabinsk Regions and the Republic of Bashkortostan [1].

The largest parts of the *H. concinna* range are located in the Asian part of the Russian Federation. Extensive habitats are found in the Omsk, Novosibirsk, Tomsk regions, in the foothills of the Altai Mountains (Kemerovo Region, Altai and Krasnoyarsk Territories) [1, 8, 9] and Sayan Mountains (south of the Irkutsk Region, Republic of Buryatia) [10–13], in Yakutia [6] and in the Russian Far East (Zabaikalsky Territory (formerly – Chita region), Amur region, Khabarovsk and Primorsky Territories) [1, 14]. *H. concinna* tick was delivered to Petropavlovsk-Kamchatsky together with rats (a single larva was found). Ticks of this species are periodically imported to Sakhalin Island with livestock from Primorsky Territory, but they do not adapt to the island [1].

In the Crimean mountains, the habitat altitude of this tick reaches 1200 m, in the Caucasus – 2000 m, in the Tien Shan – 2500 m, in Sikhote–Alin – 700–800 m [1, 2].

The identification of the peculiarities of *H. concinna* distribution has become of scientific interest both from the point of view of studying the evolution and zoogeography of ixodid ticks belonging to the genus *Haemaphysalis*, as well as in view of their possible role in the transmission of some vector-borne diseases. This species is a vector for the transmission of tick-borne encephalitis virus. The natural infection of adult *H. concinna* ticks and their ability to preserve and transmit pathogens of tularemia, brucellosis, listeriosis, North Asian tick-borne typhus, piroplasmosis, Western equine encephalitis, and Japanese encephalitis have been established [1, 5]. There is evidence that *H. concinna* is a vector of *Rickettsia heilongjiangensis*, the causative agent of Far Eastern spotted fever [15, 16]. In addition, nucleic acids of Buran virus (BURV) and murine gamma herpes virus 68 [17, 18], bacteria *Anaplasma* ssp. [19], *Ehrlichia* sp. [19, 20], Candidatus *Neoehrlichia mikurensis*, *Borrelia* sp., *Rickettsia* sp., *Coxiella burnetii* [5], protozoa *Babesia* sp., *Theileria* sp. were isolated from ticks of this species [5, 21]. The problem of the possible role of *H. concinna* in the circulation of the above-mentioned pathogens in a certain area is beyond the reach of a clear understanding about the distribution peculiarities of this species.

THE AIM OF THE STUDY

Comparison of the results of our own long-term observations conducted in the Irkutsk Oblast and the Republic of Buryatia with the data of other authors since the first mention of *H. concinna* finding here to reveal the dynamics of population development of this species of ixodid ticks in the Baikal region of the Russian Federation.

MATERIALS AND METHODS

In order to monitor habitats and further surveys for the existence of pathogens, *H. concinna* ticks were collected from vegetation on the flag. Tick sampling was undertaken from mid-April to the end of June. The coordinates of the tick collection points were determined using the GPSMAP 78s multifunction navigator (Garmin, Taiwan). 21 out of 33 districts of the Irkutsk region and 9 out of 21 districts of the Republic of Buryatia were surveyed.

The map published by F. Rubel et al. was used as a basis for visual graphical presentation of information about the distribution of the *H. concinna* tick in the Baikal region. The points marked on it were digitized and supplemented with the results obtained during our own long-term observations. The authorship of the points of *H. concinna* tick findings previously indicated on the map was determined using text and graphical data published by N.N. Lebedeva et al. (1981) [1], G.A. Danchinova et al. (2012) [22]. In selecting tick collection sites, we relied on previously published data of our colleagues from the Irkutsk Research Institute of Epidemiology and Microbiology [10, 22, 23] and the Irkutsk Research Anti-Plague Institute of Siberia and the Russia's Far East [11, 12].

RESULTS AND DISCUSSION

One of the cluster regions where a concentration of *H. concinna* habitats is observed is the Baikal region, a mountainous area in the south of Eastern Siberia, adjacent to Lake Baikal from the west and east in the Irkutsk region and the Republic of Buryatia.

At the first stage of our study, we analysed data published in the scientific literature concerning the distribution of *H. concinna* in the Baikal region from the time of the first findings to the beginning of our research, which allowed us to identify points for monitoring. So far, only a few maps describing the distribution of this tick species in Eurasia have been published [1, 2, 14]. In the study by F. Rubel et al. (2018), all previously obtained data were summarised, analysed using a digital map of the world according to the Köppen – Geiger climate classification and presented in the form of modern maps reflecting the geographical distribution and climatic adaptation of *H. concinna* in Eurasia. One of these maps we have taken as a basis for a visual geographical presentation of the material. Table 1 presents the data that have been collected by the authors of the article since 1990 to the present and data previously published by other authors.

Until the end of the 70s of the twentieth century, only two isolated finds of *H. concinna* ticks were recorded in the Baikal region. This species was considered to be a non-native species and only occasionally found on vegetation and feeders [4]. The first report of finding *N. concinna* near Irkutsk dates back to 1950. [24]. Later, the nymph of *H. concinna* was met on a grouse in Usolsky district [25]. This fact casts doubt on the assumption that *H. concinna* was brought to the Baikal region by birds, since the grouse is not a migratory bird [23]. Since the late 1970s *N. concinna* has been consistently found on the territory of Usolskiy District in an average of one to five specimens, which also excludes bringing it by birds as a cause of its presence here. In June 1983, 57 individuals of this species were collected in this area, and its abundance in one of the sites amounted to 38 specimens per 1 flag/km. The tick was found on the above-floodplain terraces in birch and mixed mixed-grass forests on the gentle slopes of hills in cuttings. But more often than in other places, it was found on the sides of old logging roads [4, 23]. The existence of stable local populations of this tick has been shown in the lower reaches of the Belaya River, in the valley of the Haita River, in the vicinity of the Aransahoy settlement. In 2008, we collected 5 specimens of *H. concinna* ticks per flag in the vicinity of this settlement. During the 2019–2022 monitoring, a survey of the vicinity of Aransakhoy village and the floodplain of the Haita river was undertaken. It should be noted that tick collection points and route length were similar in these years. The number of *H. concinna* ticks captured from vegetation per flag is shown in Table 1. 88 specimens

were collected in 2019, 108 specimens in 2020, 141 specimens in 2021, and 167 specimens in 2022.

During monitoring studies in natural foci of tick-borne infections in suburban areas of Irkutsk, single specimens of *H. concinna* were found along the main highways (Table 1). In 1992, we collected 2 specimens (43 km) from vegetation on the road adjacent to the Baikalsky Tract. In 2020, 1 specimen was found on the 53 km of this tract. *H. concinna*. In 2014, 1 specimen was collected on the 7–9 km road to Mel'nichnaya Pad. *H. concinna*. In 2021 and 2022, we found 1 specimen of tick in the vicinity of Dobrolet village (Goloustnensky Tract). In June 2011, a male tick of this species was found on vegetation in the Angarsk region [26].

Since the early 1980s, *H. concinna* has been regularly found in single specimens in other areas of the Baikal region. Thus, in 1970 ticks of this species were observed in the Alarsky district [13], in 1987 – in Bayandaevsky [23], in 2007 – in Nukutsky [22]. 22 years later, we managed to collect 2 specimens of *H. concinna* ticks in the vicinity of the village of Turgenevka in Bayandaevsky district. Tick habitats were observed in the territories of the Ust-Ordynsky Buryat district. The thesis work of O.V. Melnikova (2018) reported the capture of 163 specimens of *H. concinna* on the Kachugsky Tract and the territory of the Ust-Ordynsky Buryat district in the period from 2005 to 2015. In 2008, we captured 51 specimens of *H. concinna* per flag in this area on the side of the road Yelovka – Krasny Yar village; 1 specimen of this tick was collected in 2009, in 1 km from Ust-Orda village. E.A. Vershinin et al. reported the detection of a sustainable tick population of this species inhabiting a swampy area of an abandoned forest road between spruce-green-moss forest and ploughed farmland in the vicinity of the Yelovka village. The number of *H. concinna* in this area reached 14 specimens per flag-hour [27]. Between 2009 and 2012, we collected 169 specimens of *H. concinna* from vegetation per flag in the Ekhirit-Bulagatsky district. *H. concinna*. During the 2013–2022 monitoring period, we captured a total of 388 specimens of *H. concinna*. The ticks were collected from vegetation in a mixed forest, in birch forest outliers, along paths and roads, in shrubby thickets and on the territory of a swampy meadow. We noted a slight decrease in the number of *H. concinna* ticks since 2016, which may be associated with the drying up of bogs, as well as with the relocation of livestock grazing to other pastures. Only 6 specimens of *H. concinna* were possible to collect at these locations in 2021, which was caused by flooding of the monitoring sites due to the extremely snowy winter and abundant rainfall in early spring of this year.

The first mention of *H. concinna* ticks being found in the Cheremkhovsky district dates back to 1970 [13]. We found ticks of this species in the vicinity of Talniki village in 1992 (2 specimens) and near Nizhnyaya Iret village in 2020 (17 specimens). There is evidence in the literature about the presence of *H. concinna* ticks in the Ziminsky, Kachugsky and Slyudyansky districts of the Irkutsk region [22, 27].

The *H. concinna* tick is much less likely to attack humans and is of less epidemiological importance in the transmission of infectious agents than the taiga tick. This is confirmed by the data of the Center for the Diagnosis and Prevention of tick-borne infections of the Scientific Centre for Family Health and Human Reproduction Problems. During the period 2007–2011, only 7 cases of human bites by ticks of this species were registered (4 females and 3 males). The attacks occurred throughout the spring-summer period, from April to August. The geography of *H. concinna* tick bites once again proves their widespread distribution in the Pre-Baikal region: these are the Ekhirit-Bulagatsky district (Gakhany, 2007), the vicinity of Shelekhov (2008) and Irkutsk (2008) cities, Kachugsky district (2010), Usolsky district (2011), Oyok and Revyakino villages of Irkutsk district [26]. These data were also considered in preparing a map of the distribution of the *H. concinna* tick in the Irkutsk region.

H. concinna tick in the Republic of Buryatia is characterized by sporadic occurrence and mosaic distribution over the territory. There are references in the literature about single finds of ticks of this species in Barguzinsky, Pribaikalsky [10, 11], Ivolginsky, Selenginsky [4, 12, 14], Kabansky and Tunkinsky districts [4, 10]. We discovered *H. concinna* ticks in 1992 in the vicinity of the Mishikha River (Kabansky district, 1992), the floodplain of the Irkut River (Tunkinsky district, 1992, 2019), and the vicinity of Gusinoozersk (Selenginsky district, 2019). In 2021, we observed ticks of this species on the road leading to Ust-Barguzin village (1 specimen) and on the Holy Nose peninsula (2 specimens) (Barguzin district, 2021).

Within the territory of the Baikal region there are zones of sympatry of ticks of different species, while in forest and taiga landscapes, as a rule, the *I. persulcatus* tick dominates, and in steppe dominates tick of *Dermacentor* genus. These tick species differ significantly both in territorial distribution and in activity peaks, so it is rarely possible to collect representatives of all three genera in one natural habitat at the same time.

During monitoring studies (2018-2022) in the Usolsky, Ekhirit-Bulagatsky and Cheremkhovsky districts, we collected ticks of *I. persulcatus* and *Dermacentor* species along with *H. concinna*. At the same time, *H. concinna* accounted for from 51.4 to 95.4 % of the total collection of captured ticks in the Usolsky district, and from 11.3 to 28.9 % in the Ekhirit-Bulagatsky district. One should note that the number of ticks of different species was compared when they were captured simultaneously at the same monitoring point. In 2020, ticks of three species were simultaneously collected from vegetation in the Cheremkhovsky district in the vicinity of Nizhnyaya Iret village, and *H.* concinna was the most abundant of them (46 %).

According to our observations, in the Usolsky district, we can assume the displacement of the *I. persulcatus* tick by the *H. concinna* tick. While in the 80s only single specimens were found in this area [27], the current percentage of *H. concinna* from the total number of ticks caught here is 51–95 % (Table 2). In the Ekhirit-Bulagatsky district, the abundance of *H. concinna* varies significantly over the years. At the same time, the share of ticks of this species from the total number of ticks in the collection is 11–30 %. These data indicate the presence of stable populations of the *H. concinna* tick in these three areas.

TABLE 1

LOCATIONS OF *HAEMAPHYSALIS CONCINNA* TICKS IN THE SURVEYED AREAS OF IRKUTSK REGION AND THE REPUBLIC OF BURYATIA

Area where H. concinna ticks have been found	Year of collection	Coordinates of the area	Qty. of findings	Ref.
Irkutsk region				
Irkutsk district				
Recreational area of Irkutsk*	1950	–	1	[24]
Surroundings of Irkutsk*	2008	52.292° N, 104.238° E	1	[26]
Mill pad, 7-9 km of road 25N-218	2014	52.1749° N, 104.3145° E	1	
Baikal Tract, 43 km	1992	52.0345° N, 104.6454° E	2	
Bolshaya Rechka village, 53 km of the Baikal Tract	2020	51.957° N, 104.755° E	1	
Goloustnensky Tract, floodplain of the Ushakovka river*	–	52.330° N., 104.810° E	–	[13]
Goloustnensky Tract, Dobrolet village	2021 2022	52.2517° N, 104.8402° E	1 1	
Alexandrovsky Tract, floodplain of the river*	2006	52.887° N, 103.797° E	–	[22]
The surroundings of Ust-Baley* village	2006	52.648° N, 103.984° E	–	[22]
The surroundings of Moskovshchyna village	2022	52.547° N, 104.116° E	2	
Kachugsky Tract, Oyok* village	2011	52.576° N., 104.470° E	1	[26]
Revyakina* village	2011	52.582° N, 104.623° E	1	[26]
Angarsk district*	2011	52.406° N, 103.965° E	1	[26]
Shelekhovsky district, the surroundings of Shelekhov*	2008	52.209° N, 104.133° E	1	[26]
Slyudyansky district				
Surroundings of Slyudyanka* city	2011	51.712° N, 103.583° E	1	[27]
Highway R-258, near the Murino* village	2011	51.465° N, 104.414° E	–	[27]
Usolsky district				
The floodplain of Haita river*	1965	–	1 nymph	[25]
The floodplain of Haita river*	1970	52.646° N, 103.350° E	–	[13]
The floodplain of Haita river, the road to Aransakhoy village	2019 2020 2021 2022	52.694° N, 103.286° E 52.702° N, 103.280° E 52.701° N, 103.276° E 52.694° N, 103.282° E	45 56 79 70	

TABLE 1 (*continued*)

1.7 km southwest of Aransakhoy village, floodplain of Haita river	2019 2020 2021 2022	52.624° N, 103.234° E 52.622° N, 103.235° E 52.622° N, 103.232° E 52.624° N, 103.230° E	43 52 62 97	
Surroundings of Aransakhoy village	2008	52.636° N, 103.221° E	5	
In the lower course of Belaya river*	1987	–	2-57	[23]
In the valley of Haita river*	1987	–		[23]
Alarsky district*	1970	53.209° N, 103.191° E	–	[13]
Nukutsky district*	2007	53.77° N, 103.12° E	–	[22]
Bayandaevsky district				
Highway 25N-013 between Olzony village and Lura village*	1987	52.932° N, 105.370° E	–	[23]
Turgenevka village	2009	53.016° N, 105.656° E	2	
Ekhirit-Bulagatsky district				
Floodplain of Murin river*	2006	52.720° N, 104.875° E	–	[22]
Near Gakhana village*	2007	53.048°N, 104.893° E	1	[26]
3-4 km from Yelovka village on the way to Krasny Yar village (roadside)	2008	52.593° N, 104.835° E 52.585° N, 104.845° E	32	
6-7 km from Yelovka village on the way to Krasny Yar village (roadside)	2008	52.575° N, 104.868° E 52.569° N, 104.880° E	19	
4.5 km from Yelovka village, (mixed forest, birch forest outliers, shrubby thickets, slightly swampy meadow)	2009–2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022	52.584° N, 104.849° E The territory within the coordinates: 52.578°N, 104.877° E 52.568° N, 104.860° E 52.591° N, 104.852° E 52.579° N, 104.832° E	169 84 80 59 21 15 27 21 31 6 44	
1 km from Ust-Orda	2009	52.822° N, 104.810° E	1	
Cheremkhovsky district				
The road to Nizhnyaya Iret village*	1970	52.825° N, 102.496° E	–	[13]
Surroundings of Talniki village	1992	52.784° N, 102.440° E	2	
Surroundings of Nizhnyaya Iret village	2020	52.969° N, 102.501° E	17	
Ziminsky district, the bank of Kimiltey river*	2007	54.185° N, 102.017° E	–	[22]
Kachugsky district				

TABLE 1 (*continued*)

The floodplain of Manzurka river, highway 25N-013*	2006	53.700°N, 105.978° E	–	[22]
The floodplain of Kulenga river*	2006	53.774° N, 105.361° E	–	[22]
The surroundings of Kachug village*	2010	–	1	[26]
The Republic of Buryatia				
Barguzinsky district				
The floodplain of Barguzin river*	1970	53.867° N, 109.953° E	1	[10]
The road to Ust-Barguzin	2021	53.2914° N, 108.8439° E	1	
Svyatoy Nos Peninsula	2021	53.6805° N, 108.9885° E	2	
Pribaikalsky district				
The floodplain of Irkilik river, the R438 road*	1962	52.154° N, 107.753° E	–	[11]
The floodplain of Khaim river*	1970	52.688° N, 108.509° E	–	[10]
Ivolginsky district				
The section along the A-340 highway*	1974	51.687° N, 107.162° E	–	[14]
The coast of Selenga river along the R-258 highway*	2006	51.539° N, 107.346° E	–	[22]
Selenginsky district				
Surroundings of Gusinoozersk	2019	51.234° N, 106.586° E	6	
The floodplain of Selenga river along the A-340 highway*	2006	51.033° N, 106.653° E	–	[22]
Kabansky district				
Mishikha river	1992	51.629° N, 105.539° E	1	
The floodplain of the Bolshaya Kultushnaya river*	1970	51.883° N, 106.135° E	–	[10]
The floodplain of Bolshaya Rechka river*	1970	51.743° N, 106.463° E	–	[10]
The floodplain of Selenga river near Nikolsk village*	1966	52.061° N, 106.864° E	–	[12]
Surroundings of Oymurskoye village*	2006	52.338° N, 106.851° E	–	[22]
Tunkinsky district				
Highway A-333, the floodplain of Irkut river*	1970	51.696° N, 102.041° E	–	[10]
The surroundings of Tunka village, Akhalik river*	1970	51.770° N, 102.604° E	–	[10]
The floodplain of Irkut river	1992	–	27	
The river bank away from the A-333 highway	2019	51.6179° N, 102.7160° E	1	

Note. * – data are obtained from literary sources; "–" – no data available.

CONCLUSION

Thus, in the course of this study we have summarised and substantially supplemented the available data about the distribution of the *H.* concinna tick throughout the territory of the Baikal region. This tick was found in 12 out of 21 surveyed districts of the Irkutsk region and in 6 out of 9 studied districts of the Republic of Buryatia. The results obtained indicate the sporadic occurrence and mosaic distribution of the tick of this species in the territory of the Baikal region. The tendency to expand the range of thermophilic ticks *H. concinna* has been observed in recent decades as a result of favourable changes in the thermal regime. It is increasingly being observed on old logging roads, cuttings, in secondary mixed forests, drying bogs in the Irkutsk region, where it has not been found before.

The existence of stable local populations of *H. concinna* at the territory of Ekhirit-Bulagatsky, Usolsky, and, apparently, Cheremkhovsky districts of the Irkutsk region has been confirmed (Table 2). We can assume, based on our observations of the ixodid tick population in Usolsky district, that in certain natural habitats there is a displacement of the *I. persulcatus* tick by the *H. concinna* tick. In the Irkutsk region, *H. concinna* is regularly found on roads adjacent to major highways, but in single specimen.

Figure 1 shows all the habitats of *H. concinna* in the territory of the Baikal region, which we have succeeded in obtaining so far. The habitat of this tick species can be assumed to be confined to the southern regions of Irkutsk region. The distribution of *H. concinna* has been established in the range from 51.465° to 54.185° N. Among the surveyed areas in which this tick was not observed, all are north of these boundaries. However, this may be explained by the greater remoteness of these territories from Irkutsk city, and hence by their less frequent monitoring. The northernmost areas were not surveyed during this study. Neither did we find in the literature any reports by other authors about findings of this tick in more northern territories of the Irkutsk region.

Several new *H. concinna* tick detection points have been added in the Republic of Buryatia. These are two geo-linked points in the Barguzinsky district and one point each in Kabansky, Selenginsky and Tunka districts (Table 1). The others have been determined by analysing publications of other authors [10, 13, 14] and distribution maps of this tick species that they submitted [1, 5, 22]. Similar to the Irkutsk region, the areas adjacent to Lake Baikal and on the way of the main highways turned out to be more surveyed (Table 1, Fig. 1). The distribution of *H. concinna* has been established in the range from 51.033° to 53.867° N. We can, however, assume that the probability of finding *H. concinna* in the territory of other districts of the Republic of Buryatia that are located to the south of Lake Baikal is quite significant, since this tick has been found in the southern districts of the Trans-Baikal Territory (formerly Chita region) [1, 14] and in the northern districts of Mongolia [4].

Despite the fact that *H. concinna* is not the dominant species of ixodid ticks in the territory of the Baikal region, it can play a certain epidemiological role as a vector of a number of vector-borne diseases. It is important to consider that some natural foci at the territory of the Baikal region are zones of sympatry of ticks of the genera *Ixodes*, *Dermacentor*, *Haemaphysalis*. These closely related ticks may be able to preserve and transmit the same pathogens by feeding on the same feeders, which facilitates a wider spread of pathogens across different biotopes. In turn, the transfer of pathogens of vector-borne diseases from one vector to another through the same reservoir hosts can contribute to their more intense genetic variability and thus accelerate the evolution of pathogens.

The present data collection and analysis can be considered only as a first step towards a more complete determination of the distribution of *H. concinna* and subsequent identification of its involvement in the persistence and transmission of vector-borne pathogens of human and animal diseases in natural foci throughout the territories adjacent to Lake Baikal.

TABLE 2

PERCENTAGE OF TICKS OF DIFFERENT SPECIES IN THREE DISTRICTS OF THE IRKUTSK REGION

District of Irkutsk region	Type of tick	Number of collected specimens / percentage by year				
		2018	2019	2020	2021	2022
Ekhirit-Bulagatsky	*I. persulcatus*	197 / 86.4	69 / 76.7	139 / 81.8	47 / 88.7	108 / 71.1
	H. concinna	27 / **11.8**	21 / **23.3**	31 / **18.2**	6 / **11.3**	44 / **28.9**
	Dermacentor sp.	4 / 1.8	–	–	–	–
Usolsky	*I. persulcatus*	–	6 / 6.4	102 / 48.6	25 / 25.1	8 / 4.6
	H. concinna	–	88 **/ 93.6**	108 / **51.4**	141 / **84.9**	167 / **95.4**
Cheremkhovsky	*I. persulcatus*	–	–	13 / 35.1	–	–
	H. concinna	–	–	17 / **46.0**	–	–
	Dermacentor sp.	–	–	7 / 18.9	–	–

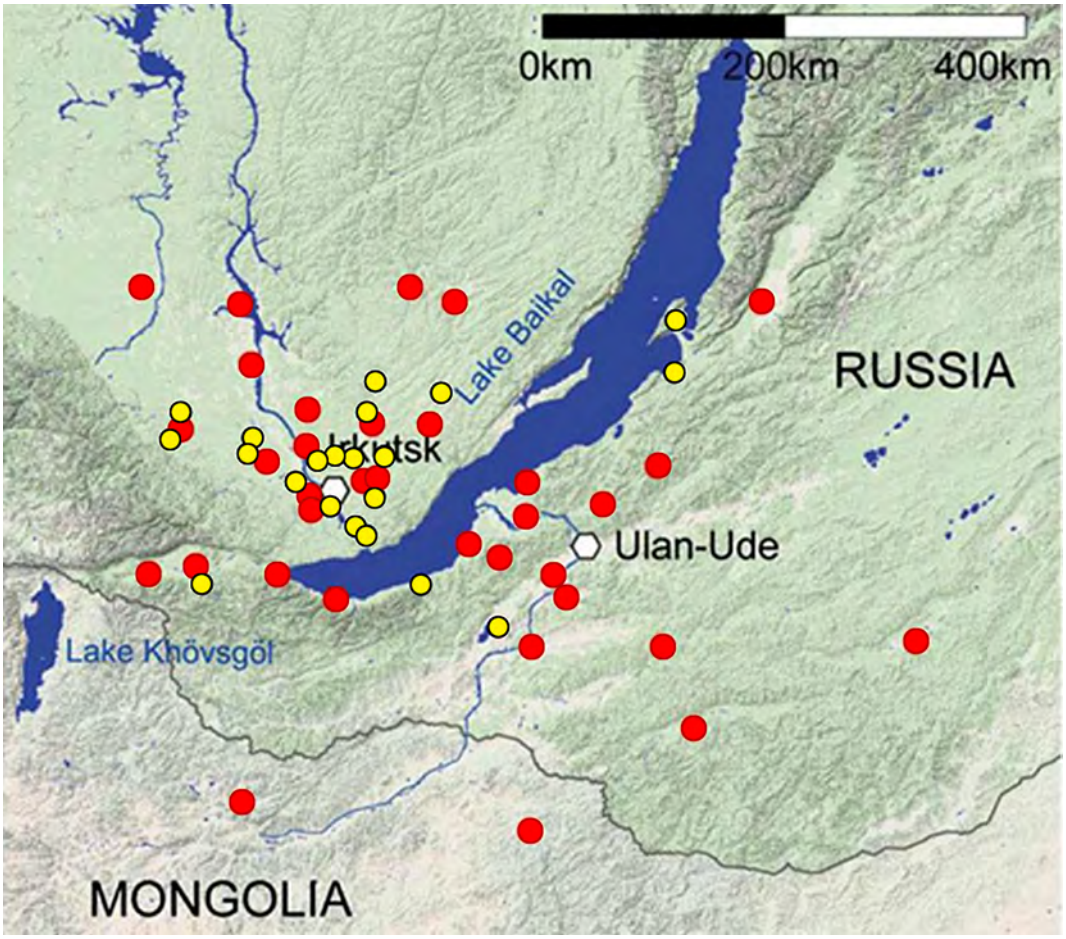

FIG. 1.

Points of H. concinna tick detection in the districts of the Irkutsk region and the Republic of Buryatia: yellow colour indicates the points identified in our study and superimposed on the map published earlier (cited in [5]).]

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Conflict of interest

The authors of this article declare the absence of a conflict of interest.

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