



Methods for collecting ixodid ticks to control the spread of vector-borne diseases in domestic dogs

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Abstract. The issue of selecting methods for collecting ticks, particularly ixodid ticks, has become important for controlling the spread of vector-borne diseases in domestic dogs, which may carry ticks on their coats into their owners' homes and pose a risk of transmitting Lyme borreliosis to humans. The aim of the study was to analyse tick collection methods and substantiate their advantages and limitations. The research included analytical-observational, theoretical-modelling, and generalisation-implementation stages. During the analytical-observational stage, it was established that the principal tick collection methods were Dragging, Flaggging, CO₂ traps (dry ice/baited traps), Host Examination, and Absolute Surface Counts. At the theoretical-modelling stage, the feasibility of using these methods was justified and the most effective approaches were identified. The study determined the methods that were more suitable for use in Ukraine, as they provided an optimal combination of accessibility, reproducibility, and epizootiological informativeness, while also enabling the acquisition of both quantitative and qualitative indicators concerning population density, species composition, and the intensity of ixodid tick infestation. During the generalisation-implementation stage, two tick collection methods were selected that were convenient to use and required lower material costs. In the course of the practical component of the study, 840 ticks were collected from the Polissia region using these methods, indicating potential risks for the spread of vector-borne diseases. In total, 87 dogs were examined, of which 56 had previously been treated with acaricidal preparations based on pyrethroids and isoxazolines. Dogs of various breeds, aged from 9 months to 12 years, kept under different conditions at the selected research locations, were examined. The study established that the role of domestic dogs as reservoirs of vector-borne infections and mechanical

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carriers of ixodid ticks is a more effective method for monitoring the spread of tick populations in urban areas than field collection methods such as Dragging

Keywords: vector-borne infections; Lyme borreliosis; acarological monitoring; ectoparasites; veterinary parasitology

Introduction

Ixodid ticks (*Ixodidae*) are one of the two principal families of parasitic ticks belonging to the order *Ixodida* (subclass Acari, class *Arachnida*). They are responsible for a number of vector-borne diseases in dogs, including anaplasmosis, babesiosis, borreliosis, and rickettsioses. At the same time, domestic dogs may act as a risk factor for human infection, as they are capable of mechanically carrying ticks on their coats, introducing them into residential premises and thereby creating a potential hazard for owners. O. Kravchuk (2025) noted that one of the key preventive measures against Lyme disease was the regular monitoring of tick abundance in natural biotopes, particularly in regions of high tick activity. Monitoring tick populations in different biotopes has become an important component in the prevention of vector-borne diseases, especially Lyme disease. Regular epidemiological studies concerning tick population density have enabled the assessment of pathogen transmission risks and the timely implementation of preventive measures. W. Buczek *et al.* (2024), while analysing the distribution of ixodid ticks in eastern Poland, documented the first confirmed human infestation by *Dermacentor reticulatus*, which had been partially engorged with blood and introduced into a household by a dog.

During investigations of *Ehrlichia canis* (an intracellular bacterium causing canine monocytic ehrlichiosis and transmitted predominantly by *Rhipicephalus sanguineus sensu lato* – the brown dog tick), G. Sgroi *et al.* (2024) documented a confirmed case of human infection

originating from a tick brought into a residence by a dog. In the province of Quebec (Canada), L. Duplaix *et al.* (2021) analysed infestations of dogs and cats by *Ixodes scapularis* and the spread of vector-borne pathogens among domestic animals during 2010-2018, concluding that companion animals had become important “bioindicators” of zoonotic risk to humans. During a study of canine behaviour in north-western Mexico and border regions of the United States, J. Foley *et al.* (2024) identified domestic factors contributing to household tick infestations and the occurrence of vector-borne diseases in humans associated with dogs. The authors also documented outbreaks of RMSF (Rocky Mountain spotted fever) associated with the brown dog tick (*Rhipicephalus sanguineus*). T. Do *et al.* (2024) confirmed that *R. sanguineus* in Vietnam actively transmits zoonotic pathogens, including those capable of infecting humans. The researchers established that domestic dogs serve as a crucial “bridge” between ticks and humans. J. Probst *et al.* (2023) conducted a national-level study in Germany and Austria concerning the risks of tick exposure, particularly *Ixodes ricinus* and *Dermacentor reticulatus*, in domestic animals (dogs and cats) in the context of climate change, range expansion, and associated risks over a 14-month period (March 2020 – October 2021) involving 219 veterinary practices. The study demonstrated that the risk of tick-borne infection in companion animals was not restricted to the “spring-autumn” season.

Ixodes ricinus inhabits many regions of Ukraine, adapting to changing environmental

conditions through variations in idiosoma size, diapause mechanisms, and the ability to parasitise both mammals and birds. The species is well adapted to urban environments, particularly within settlement agglomerations (Panteleienko *et al.*, 2022). R. Cuadrado-Matías *et al.* (2023) investigated the effectiveness of various collection methods for ixodid ticks of the species *Hyalomma lusitanicum*, an important vector of Crimean-Congo haemorrhagic fever virus. Domestic dogs were shown to play a particular role as passive carriers of ticks into households, confirming the importance of systematic monitoring of tick populations both in the environment and on animals themselves in order to rapidly detect changes in species density and adjust preventive measures accordingly. The studies demonstrated that the selection of collection methods significantly influences the assessment of actual tick density and the evaluation of infection risks in dogs. The aim of this article was to analyse the principal methods for collecting ixodid ticks for the control of vector-borne diseases in domestic dogs and to substantiate the most effective approaches to their implementation while considering ecological, epizootiological, and socio-domestic factors.

Literature Review

There are numerous scientific studies comparing methods for collecting ticks to control the spread of vector-borne diseases in humans and animals. Given the variety of methods for collecting Ixodidae ticks, the dragging method has emerged as the simplest to use and the least costly, according to researchers. S. Sadangi *et al.* (2025) used the dragging method to assess urban green spaces as natural habitats for *Ixodes ricinus* ticks. The application of this method enabled the researchers to obtain a representative number of ticks of various developmental stages and sexes, which allowed to assess population density and the intensity

of infestation in the study areas, as well as to conduct laboratory studies to identify the pathogens of tick-borne infections. S.J. England *et al.* (2023) conducted a study on the effect of an electric field on the attraction of ticks to hosts. The scientists demonstrated that electrostatic forces can passively attract ticks to an animal's body, which increased the efficiency of their attachment and could influence the spread of vector-borne diseases. Thus, the Dragging and Flagging methods may be sufficiently effective, as dragging a flag through vegetation promoted the accumulation of a static charge that attracted ticks. N. Boulanger *et al.* (2024) noted that the Dragging field method has become one of the most common ways of capturing ticks that were in a host-seeking (questing) state. After collection, the researchers identified the ticks to species (predominantly *Ixodes ricinus*), froze the samples ($\approx -20^{\circ}\text{C}$) and performed molecular analysis (PCR, qPCR) to detect pathogens, in particular *Borrelia burgdorferi* and *Anaplasma phagocytophilum*.

The authors P. Briggs *et al.* (2025) tested the effectiveness of two tick collection methods, namely Dragging – the authors used a white cloth (100% cotton, $\sim 1\text{ m}^2$), stretched over a wooden pole, with ropes at the ends to control the cloth. The researchers dragged it across grass and leaf litter, periodically checking it for ticks and removing them with tweezers into laboratory test tubes. The CO_2 trap method involved using $\sim 1.4\text{ kg}$ of dry ice placed in a polystyrene container with CO_2 outlet holes, which was positioned above a $\sim 1\text{ m}^2$ canvas fitted with double-sided adhesive tape around its edges to trap ticks crawling towards the CO_2 (the trapping duration ranged from 115 to 168 minutes). The researchers concluded that the dragging method is more suitable for collecting nymphs, whilst the CO_2 trap method is better for collecting adult mites. In their study, C.A. Wheeler *et al.* (2026) collected 25,596 ticks during the

spring and summer of 2023 in Texas, Oklahoma and Wisconsin, and confirmed the superiority of CO₂ traps over the standardised CDC method – fabric dragging and flagging. Scientists T. Koser *et al.* (2025) compared the dragging method with the method of surveying an area using a scent-detection dog. The aim of their experiment was to assess whether dogs trained in scent detection could detect *D. albipictus* in natural conditions, and whether they could do so more accurately or quickly than traditional methods such as Tick Dragging and Flagging. The researchers concluded that detection dogs can be effectively used in tick monitoring programmes, particularly in hard-to-reach landscapes or where population density is low; furthermore, they are capable of detecting individual ticks or small clusters, which are virtually impossible to find using the dragging method. K.M. Holcomb *et al.* (2023) analysed two tick collection methods: active – standard dragging of a cloth through vegetation to collect ticks seeking a host; passive – voluntary submission of ticks by the state’s population to a research station for free identification and testing for pathogens. The researchers noted that both methods were sufficiently effective: passive surveillance could serve as the first level of screening, whilst active surveillance could be used where a quantitative risk assessment is required.

J. de la Fuente *et al.* (2023) also highlighted the role of two methodological approaches: active surveillance through flag/drag sampling and passive surveillance through citizen science initiatives and The Tick App, a mobile application in which users independently register detected ticks. P.R. Harman *et al.* (2024) conducted active tick monitoring across 45 sites in four counties of the United States – Hidalgo, Doña Ana, Otero, and Eddy. The authors analysed active collection methods involving dragging flannel cloths (1.2×1.2 m) and stationary CO₂ traps; however, these methods

failed to yield any tick specimens. Passive tick collection involved collaboration with veterinary clinics, dog day-care centres, animal shelters, and farmers who removed ticks from live animals during routine care procedures. Through this approach, 497 ticks representing five identified species were collected from three species of domestic mammals and six species of wild mammals for further investigation. M.E. Tsoumani *et al.* (2023) proposed the prediction of tick distribution, including vector-borne diseases, through the application of climatic models. The authors concluded that climate change has become a major factor influencing the dynamics of tick-borne diseases in Europe. Rising temperatures and changing weather conditions may lead to increased tick abundance, expansion of their geographical range, and higher disease incidence among human populations. In this regard, the use of climatic models and the development of preventive strategies have become essential for reducing future risks. C.H. Wilson *et al.* (2022), during a nationwide monitoring survey involving dogs and their owners, demonstrated that monitoring ticks through direct collection from animals became a key component of epidemiological surveillance systems targeting *Ixodes scapularis*, *Ixodes pacificus*, and their associated pathogens. Thus, the principal methods of tick collection may be identified as Dragging, Flagging, CO₂ traps (dry ice/baited traps), Host Examination, Absolute Surface Counts (ASC), and Scent Detection Dogs.

Materials and Methods

To achieve the stated aim, a comprehensive methodological approach was applied, combining an analysis of scientific literature published between 2021 and 2025, a comparative evaluation of tick collection methods, and the systematisation of data concerning ecological, epizootiological, and socio-domestic

determinants of the risk of vector-borne diseases in domestic dogs. The principal stages of the study included: the analytical-observational stage, which involved analysis of Ukrainian and international experience concerning tick collection methods and was based on the review of scientific publications; the theoretical-modelling stage, which encompassed the substantiation of tick collection methods and the stepwise organisation of the process, including the selection of the optimal period for fieldwork according to seasonal tick activity, preparation of the necessary equipment and materials, direct collection of ticks within natural environments, and their subsequent fixation, labelling, and transportation to the laboratory for further analysis; and the generalisation-implementation stage, which enabled confirmation of the effectiveness of the selected methods. Two methods were selected for tick collection during the study: Dragging and direct collection of ticks from animals. The Dragging method was conducted within selected territories of the Polissia zone during the spring-summer period (May-June) of 2024-2025. In total, 840 ixodid ticks were collected from natural biotopes, including specimens

removed from vegetation and from animals within the selected settlements (Fig. 1).

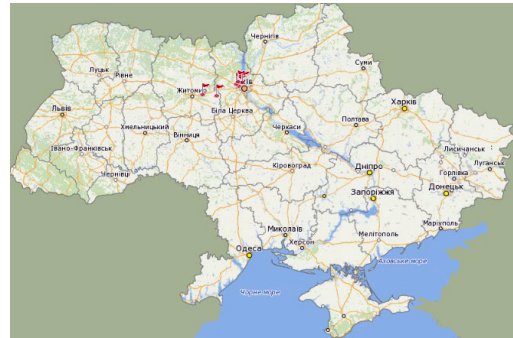


Figure 1. Territories for the collection of ixodid ticks in Kyiv and Zhytomyr regions (marked with red flags)

Source: Meta. Maps of Ukraine (n.d.)

Within Kyiv region, the Obolonskyi district (Pushcha-Vodytsia), Brovary district (village of Semypolky), Bucha district (city of Bucha, village of Kotsiubynske), and Vyshhorod district (village of Dymer) were selected, where a total of 281 ixodid tick specimens were collected. Within the city of Kyiv, the territory of Trukhaniv Island was investigated. In Zhytomyr region (city of Korostyshiv, village of Brusyliv), a total of 187 specimens were collected (Table 1).

Table 1. Total number of ixodid ticks collected in 8 settlements of Kyiv and Zhytomyr regions per 100 m² of territory

Name of settlement	<i>Ixodes ricinus</i>		<i>Dermacentor reticulatus</i>		Number of collected ticks
	Males	Females	Males	Females	
Pushcha-Vodytsia (Obolonskyi district)	9	10	17	24	60
Trukhaniv Island (Kyiv)	9	10	11	21	51
Kotsiubynske village (Bucha district)	10	15	7	14	46
Korostyshiv (Zhytomyr region)	13	23	21	33	90
Bucha	5	3	8	17	33
Brusyliv village (Zhytomyr region)	10	22	25	40	97
Dymer village	7	13	9	16	45
Semypolky village (Brovary district)	5	12	10	19	46
Total					468

Source: compiled by the authors

The comparison of the effectiveness of the Dragging method and the direct collection of ticks from animals had certain limitations due to their differing nature. Within the selected territories, a white cloth measuring 1 m² was deployed and dragged across grassy and shrub vegetation over a distance of 100 m. Nymphal and adult ticks attaching to the material were collected using forceps and placed into Eppendorf tubes. Proper storage of ticks was considered important, as inappropriate conditions could result in degradation of genetic material. In general, studies of this type commonly employ such storage methods as preservation in alcohol, frozen storage, or storage in specialised RNA-preserving buffers (Krupa *et al.*, 2024). Two methods for preserving ixodid tick specimens were selected for the present study. The first method involved storing the material in Eppendorf tubes containing 90% ethanol. Prepared Eppendorf tubes contained between 8 and 10 specimens for subsequent analysis of species composition within the selected territories (Fig. 2).



Figure 2. Example of tick storage from selected areas

Source: photo by the author

The second method (dry) involved freezing the collected specimens in dry Eppendorf tubes at a temperature of -18°C. Parasites preserved using the second method were subsequently submitted for diagnostic testing aimed at monitoring the spread of vector-borne diseases. Since storage in ethanol may inhibit subsequent DNA amplification by polymerase chain

reaction (PCR), ticks stored in dry Eppendorf tubes at -18°C were selected for the study. The investigation involving direct collection of ixodid ticks from dogs was conducted using patients of the veterinary clinic “Innovet”. In total, 87 dogs of different breeds and sexes, aged from 1 to 9 years, kept under various housing conditions (indoor housing and outdoor yard housing), were examined. During history collection from the owners at the time of veterinary examination, a survey was conducted. Owners provided consent for examination of the animals and supplied information concerning the use of acaricidal treatments. A number of questions were asked in order to obtain the necessary information, including the age of the dog (breed was not considered within the study), whether the animal had outdoor access, whether it had been treated with acaricidal preparations, whether previous tick infestations had been recorded, as well as weighing of each examined animal, assessment of mucous membranes, and thermometry. Tick identification was performed using morphological characteristics (magnifying lens and light microscopy), as funding for genetic testing of ticks was not available. The study was conducted in accordance with ARRIVE requirements (n.d.). The density of ixodid ticks was assessed using the ASC method by calculating the number of specimens per unit area (individuals/m²) as the ratio between the total number of collected specimens and the area of the surveyed territory:

$$\text{Density (ticks/m}^2\text{)} = \frac{\text{Total number of ticks collected}}{\text{Total area (m}^2\text{)}}. \quad (1)$$

The results of the study were analysed using Pearson’s statistical method, according to the formula:

$$\chi^2 = \sum \frac{(O-E)^2}{E}, \quad (2)$$

where *O* – observed value, *E* – expected value.

Results and Discussion

The process of collecting ticks in different types of landscapes (woodlands, open meadows, mixed ecosystems) showed that landscape characteristics had a significant impact on the abundance and distribution of *Ixodes ricinus*. To reduce the risk of tick-borne infections, it is recommended that landscape types be taken into account when planning preventive measures; studies of tick abundance should consider the interactions between landscape, climate change and tick biology to generate more accurate predictions of their population dynamics. With this in mind, sites were selected that allowed for an adequate assessment of tick presence. The study results indicated the prevalence of two species of ixodid ticks – *I. ricinus* and *D. reticulatus* – with their distribution varying depending on the natural habitat, host animals and region. In total, 700 m² were surveyed (100 m² covered in each zone), encompassing seven sites within the Polissia region. To assess the population density of ixodid ticks per 1 m², the ASC calculation method was selected, using which the ticks collected with a 1×1 m² gauze sheet from

the soil surface and vegetation within a clearly defined area were counted. The selected area was dominated by grassland vegetation, namely: weed (segetal) vegetation, clover and mixed grasses. Unlike traditional methods – dragging (dragging a cloth), flagging (flag method), and CO₂ traps – the ASC method was used for direct observation of the mite population in a specific area. This method was developed specifically to determine the behavioural characteristics of ticks in accordance with the ecological conditions of the areas: adult ticks actively moved across open surfaces and often concentrated locally in areas of host activity. To obtain results analysing the population density of ixodid ticks in selected areas of the Polissia region, the collected ticks were counted and a morphological identification of the species composition of the parasites was carried out. For each animal, the number of ticks removed and the chosen product for further protection against ectoparasites were recorded. The individual characteristics of the animals, their housing conditions, the number of ticks detected and the recommended products are presented in Table 2.

Table 2. Dogs treated with acaricidal preparations and the number of ticks removed from them

No.	Dogs (breed, age)	Housing conditions	Number of ticks removed	Preparations of choice
1	Crossbreed, 5 years	Indoor	2	Sarolaner
2	English Toy Terrier, 2 years	Indoor	3	Fluralaner
3	Miniature Pinscher, 4 years	Country house	4	Sarolaner
4	Labrador Retriever, 7 years	Indoor with walks in wooded areas	2	Lotilaner
5	Shiba Inu, 3 years	Indoor	2	Afoxolaner
6	Crossbreed, 5 years	Rural housing	2	Sarolaner
7	Crossbreed, 3 years	Indoor with walks in fields	3	Fluralaner
8	Belgian Griffon, 3 years	Rural housing	4	Lotilaner
9	Weimaraner, 9 years	Indoor	2	Sarolaner
10	Medium German Spitz, 4 years	Indoor	2	Fluralaner
11	Crossbreed, 1 year	Rural housing	4	Fluralaner
12	Crossbreed, 6 years	Indoor with walks in wooded areas	3	Sarolaner
13	Crossbreed, 5 years	Indoor	2	Lotilaner
14	Crossbreed, 7 years	Indoor	3	Permethrin
15	Crossbreed, 2 years	Indoor	3	Afoxolaner
16	Malinois, 3 years	Indoor with walks in wooded areas	2	Sarolaner

Table 2. Continued

No.	Dogs (breed, age)	Housing conditions	Number of ticks removed	Preparations of choice
17	Yorkshire Terrier, 6 years	Indoor	2	Fluralaner
18	Dobermann, 8 years	Kennel housing	2	Fluralaner
19	Spitz, 4 years	Indoor with walks in wooded areas	4	Sarolaner
20	Crossbreed, 9 years	Indoor with walks in wooded areas	3	Sarolaner
21	Maltipoo, 4 years	Indoor	2	Lotilaner
22	Maltipoo, 6 years	Indoor	2	Permethrin
23	Yorkshire Terrier, 9 years	Indoor with walks in wooded areas	2	Afoxolaner
24	Yorkshire Terrier, 7 years	Rural housing	3	Sarolaner
25	Husky, 8 years	Indoor with walks in wooded areas	2	Fluralaner
26	Crossbreed, 8 years	Indoor	4	Afoxolaner
27	Akita Inu, 4 years	Indoor	3	Fluralaner
28	Crossbreed, 3 years	Indoor with walks in wooded areas	2	Fluralaner
29	Malinois, 2 years	Indoor	4	Lotilaner
30	Central Asian Shepherd Dog, 8 years	Indoor with walks in wooded areas	2	Sarolaner
31	Spitz, 4 years	Indoor	3	Sarolaner
32	Spitz, 7 years	Indoor with walks in wooded areas	3	Sarolaner
33	Crossbreed, 3 years	Indoor	2	Fluralaner
34	Crossbreed, 2 years	Indoor	4	Fluralaner
35	Jack Russell Terrier, 4 years	Indoor	2	Lotilaner
36	German Shepherd, 9 years	Kennel housing	2	Permethrin
37	Hungarian Short-Haired Vizsla, 5 years	Outdoor yard housing	3	Afoxolaner
38	Maltipoo, 4 years	Indoor	4	Sarolaner
39	English Cocker Spaniel, 3 years	Outdoor yard housing	2	Sarolaner
40	Pug, 7 years	Indoor	2	Sarolaner
41	Boston Terrier, 4 years	Indoor with walks in wooded areas	2	Fluralaner
42	Italian Cane Corso, 6 years	Indoor with walks in wooded areas	3	Fluralaner
43	Crossbreed, 3 years	Indoor	2	Fluralaner
44	Crossbreed, 6 years	Indoor with walks in wooded areas	2	Lotilaner
45	Crossbreed, 2 years	Indoor	2	Permethrin
46	Tibetan Spaniel, 5 years	Indoor	2	Afoxolaner
47	Kurzhaar, 4 years	Outdoor yard housing	3	Fluralaner
48	Crossbreed, 3 years	Indoor	3	Permethrin
49	Yorkshire Terrier, 4 years	Indoor	2	Sarolaner
50	Bichon Frise, 5 years	Indoor with walks in wooded areas	2	Sarolaner
51	Malinois, 4 years	Kennel housing	1	Sarolaner
52	Crossbreed, 5 years	Outdoor yard housing	4	Sarolaner
53	Pug, 3 years	Indoor with walks in wooded areas	4	Fluralaner
54	Rottweiler, 6 years	Kennel housing	2	Fluralaner
55	Crossbreed, 7 years	Indoor	2	Lotilaner
56	Belgian Griffon, 5 years	Indoor	3	Afoxolaner

Source: compiled by the author

Thus, it was determined that 56 dogs had previously been treated with acaricidal preparations and had additional protection in the form of collars. The dogs were kept under

different housing conditions, including indoor housing with walks in urban parks and outdoor yard housing with walks in field areas. During interviews with the owners, information was obtained regarding the most commonly used preparations, particularly that they were administered in tablet form and used once monthly or once every three months. The results for tick density saturation within the selected territory according to the ASC method were as follows:

$$\frac{468}{700(\text{m}^2)} \approx 0.67.$$

The value of 0.67 indicated a low density of ixodid tick distribution within the investigated sites, suggesting a reduced risk of parasite attacks and transmission of vector-borne infections during the spring-summer period of 2024-2025. This may have been associated with climatic conditions, as the temperature regimes were unfavourable for the reproduction of ixodid ticks. Additional protective measures were used by animal owners only during walks in wooded areas. It was established that 31 dogs had not received treatments against ectoparasites, although some of the examined dogs had protection in the form of repellent collars (Table 3).

Table 3. List of dogs not treated with acaricidal preparations and the number of ticks removed from them

No.	Dogs (breed, age)	Housing conditions	Number of ticks removed
1	Crossbreed, 7 years	Outdoor yard housing	7
2	Crossbreed, 4 years	Kennel housing	6
3	Crossbreed, 3 years	Free-range housing	9
4	Chihuahua, 10 years	Indoor	8
5	Shih Tzu, 11 years	Found on the street	6
6	German Shepherd, 6 years	Kennel housing	8
7	Crossbreed, 6 years	Outdoor yard housing	8
8	Hungarian Short-Haired Vizsla, 5 years	Kennel housing	6
9	Crossbreed, 4 years	Outdoor yard housing	10
10	Chihuahua, 7 years	Indoor	9
11	Crossbreed, 8 years	Free-range housing	7
12	Boxer, 10 years	Outdoor yard housing	7
13	Crossbreed, 3 years	Outdoor yard housing	8
14	Dalmatian, 6 years	Indoor	8
15	Italian Greyhound, 4 years	Indoor	8
16	Chihuahua, 11 years	Outdoor yard housing	6
17	English Spaniel, 7 years	Outdoor yard housing	5
18	Laika, 5 years	Kennel housing	8
19	Labrador Retriever, 8 years	Indoor	9
20	Labrador Retriever, 2 years	Kennel housing	7
21	Laika, 8 years	Outdoor yard housing	7
22	Crossbreed, 3 years	Indoor	5
23	Crossbreed, 8 years	Free-range housing	10
24	Crossbreed, 5 years	Kennel housing	5
25	Dachshund, 3 years	Indoor	5
26	Chihuahua, 4 years	Indoor	6
27	Crossbreed, 4 years	Outdoor yard housing	7
28	German Shepherd, 4 years	Kennel housing	9

Table 3. Continued

No.	Dogs (breed, age)	Housing conditions	Number of ticks removed
29	Crossbreed, 9 years	Kennel housing	8
30	Crossbreed, 6 years	Indoor	8
31	Labrador Retriever, 3 years	Kennel housing	7

Source: compiled by the author

A total of 372 ticks were collected from the dogs, with between 2 and 4 ticks of the family *Ixodidae* being removed from each dog (Table 4). From animals kept in yard conditions

and walked in forested areas (Kyiv and Zhytomyr regions) or in the park zones of Kyiv, between 5 and 10 tick specimens were removed in some cases.

Table 4. Results of the examination of dogs for the presence of ticks

Removed	<i>Ixodes ricinus</i>		<i>Dermacentor reticulatus</i>		Total
	Nymphs	Females	Nymphs	Females	
Treated dogs	29	35	37	45	146
Untreated dogs	54	63	43	66	226
Total					372

Source: compiled by the author

The number of dogs treated (n) = 56, and the number of ticks removed from them = 146; between 2 and 4 ticks were removed from each dog:

$$X = \frac{146}{56} = 2.61,$$

where the mean intensity was 2.61 ticks per animal, with a min-max range of 2-4 ticks; in untreated dogs (n = 31), a total of 226 ticks were removed, with between 5 and 10 ticks being collected from a single dog:

$$X = \frac{226}{31} = 7.29.$$

Thus, the obtained results indicate a high level of effectiveness of acaricidal treatments in dogs. In treated animals, the mean intensity of parasitism was substantially lower, amounting to 2.61 ticks per animal (min-max: 2-4), whereas in untreated dogs this indicator reached 7.29 ticks per animal (min-max: 5-10). Therefore, the use of acaricidal products contributed to a marked reduction in tick infestation levels and a decrease in the parasitic burden on animals. The method for storing and preserving ticks was described in the work by E. Krupa *et*

al. (2024), in which the researchers emphasised that after removing ixodid ticks or extracting them from the external environment, they must be preserved for further storage. The study also indicated that material preserved in ethanol (70-97%) can be stored for 10 years without changes to DNA/RNA, which is important for further research into *Ixodidae* ticks and vector-borne diseases. As a result of statistical analysis using Pearson's chi-square test, no significant difference was found in the frequency of tick detection between treated and untreated dogs ($\chi^2 = 2.88$; $P > 0.05$). The distribution of ticks by species (*Ixodes ricinus*, *Dermacentor reticulatus*) and developmental stage (nymphs, females) did not depend on whether acaricidal treatment had been carried out.

The preventive measures applied in the study sample did not demonstrate statistically significant effectiveness in reducing tick numbers. The absence of significant differences was due to the insufficient efficacy of the preparations used; violations of the frequency or technique of treatment; a high level of infestation

pressure in the environment; or an insufficient sample size. The data obtained highlighted the need to improve preventive measures and conduct further research, taking into account

additional risk factors for tick infestation. During the study, a comparison of the effectiveness of the Dragging and Host Examination methods was carried out using Pearson's χ^2 test (Table 5).

Table 5. Comparative effectiveness of the selected methods

Method	Number of ticks	Percentage (%)
Dragging	468	55.7
Host Examination	372	44.3
Total	840	100

Source: compiled by the author

According to Table 5, the dragging method was more productive in terms of the total number of ticks collected, which is due to its ability to cover large areas in a short period of time. At the same time, Host Examination had significantly higher epizootiological value, as it allowed, firstly, to assess the actual level of infestation in animals; secondly, to determine the intensity of parasitism; and thirdly, to directly link the presence of ticks with the risk of pathogen transmission. To test the statistical significance of differences between the number of ticks collected using the selected methods, Pearson's χ^2 test was applied (Egbuchulem, 2024). The total number of ticks collected was 840, of which: 468 were collected using the Dragging method and 372 using the Host Examination method. To assess the effectiveness of the two methods, the total number of ticks detected was conditionally divided equally between the methods, i.e. the expected value for each method was 50% of the total number.

$$E = \frac{840}{2} = 420.$$

Thus, the Expected values are: Dragging – 420, Host Examination – 420. The calculation for the Dragging method was as follows:

$$\frac{(468-420)^2}{420} = \frac{48^2}{420} = \frac{2,304}{420} \approx 5.49.$$

For the Host Examination method:

$$\frac{(372-420)^2}{420} = \frac{(-48)^2}{420} = \frac{2,304}{420} \approx 5.49.$$

Final value:

$$\chi^2 = 5.49 + 5.49 = 10.98 \approx 11.0.$$

Number of degrees of freedom (df) for two categories:

$$df = k - 1 = 2 - 1 = 1.$$

With $df = 1$, the obtained χ^2 value of ≈ 11.0 corresponded to $P < 0.001$, indicating that the differences between the methods were highly statistically significant. Thus, the results of the statistical analysis confirmed that the Dragging method yielded a significantly higher number of collected ticks compared with the Host Examination method, and that the observed difference was not due to chance. The χ^2 (chi-square) value reflected the degree of discrepancy between the observed (actual) and expected (theoretical) frequencies; the df (degrees of freedom) value represents the number of independent parameters that could vary within the statistical model; the p -value indicated the probability that the observed difference arose by chance. The work of A. Springer *et al.* (2026) proved important for the study; they analysed the influence of local landscape characteristics, such as vegetation types, the presence of forests, pastures and water resources, on tick

population dynamics. Furthermore, the researchers identified the factors that most contributed to the survival and activity of *Ixodes ricinus* and analysed seasonal variations in tick abundance depending on local landscapes. S. Zanet *et al.* (2020) demonstrated that clinical examination of dogs and molecular testing of ticks collected from them in Southern Italy enabled the reliable identification of the circulation of *Anaplasma spp.*, *Babesia vogeli* and *Ehrlichia canis* in the region. In Germany, researchers K. Köppen *et al.* (2025) confirmed that systematic Host Examination proved particularly effective in the early detection of *Dermacentor reticulatus* infestations and in assessing the risk of canine babesiosis transmission. V. Levytka & A. Mushynskiy (2020) also confirmed the effectiveness of this approach, demonstrating the value of collecting ticks directly from companion animals in clinical settings as one of the most reliable tools for monitoring the epizootic situation. The researchers demonstrated that regular examinations of dogs and cats enabled the detection of changes in the population structure of *Ixodes ricinus*, *Dermacentor reticulatus* and other species, as well as the recording of seasonal peaks in activity and the frequency of attacks on animals in various biotopes of Western Ukraine. This approach has made it possible not only to assess the actual risk of vector-borne infections, in particular Lyme disease, anaplasmosis and babesiosis, but also to rapidly identify localised areas of increased tick activity.

Conclusions

As a result of the conducted study, the principal methods identified for tick collection were Dragging, Host Examination, and ASC. At the same time, it was important to consider the limitations of these methods. Dragging was effective primarily for collecting ticks in open biotopes; however, its efficiency depended significantly on the type of vegetation cover,

humidity, temperature, and season. Consequently, this method underestimated the actual abundance of ticks present in the soil litter or already parasitising hosts. The Host Examination method provided the most epizootiologically relevant data, although its limitations included dependence on the availability of animals, their behaviour, the regularity of examinations, and the subjective factor of the researcher. The ASC method demonstrated high accuracy only within limited control areas and was poorly suited for large-scale territorial studies due to its labour intensity and time consumption. Thus, the method of collecting ticks directly from dogs is effective provided that the dogs do not receive regular treatment with acaricidal preparations. The Dragging method is also effective, as it enables the acquisition of a comprehensive picture of the spatial distribution of ixodid ticks within natural biotopes. The Dragging method demonstrated greater collection efficiency, accounting for 55.7% of the collected ticks, whereas the Host Examination method yielded 44.3% of the tick specimens. Considering the minor percentage difference, both methods may be regarded as effective. Accordingly, the Dragging and Host Examination methods may be used in combination in studies investigating the species composition of ixodid ticks and the intensity of their populations within particular territories. Prospects for further research include a detailed analysis of additional ixodid tick collection methods within the Polissia zone of Ukraine, with subsequent determination of the species composition and seasonal dynamics of their populations.

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Conflict of Interest

None.

References

- [1] ARRIVE. (n.d.). Retrieved from <https://arriveguidelines.org/>.
- [2] Boulanger, N., Aran, D., Maul, A., Camara, B.I., Barthel, C., Zaffino, M., Lett, M.-C., Schnitzler, A., & Bauda, P. (2024). Multiple factors affecting *Ixodes ricinus* ticks and associated pathogens in European temperate ecosystems (northeastern France). *Scientific Reports*, 14, article number 9391. doi: 10.1038/s41598-024-59867-x.
- [3] Briggs, P., Trimmell, L., & Monzón, J.D. (2025). Is dragging a drag or is trapping a trap? A comparison of two methods for collecting *Amblyomma americanum* ticks in sites near the species range boundary. *Experimental and Applied Acarology*, 94, article number 7. doi: 10.1007/s10493-024-00977-6.
- [4] Buczek, W., Bartosik, K., & Buczek, A. (2024). Development of *Dermacentor reticulatus* ticks in human household conditions. *Journal of Pest Science*, 97, 1069-1079. doi: 10.1007/s10340-023-01695-5.
- [5] Cuadrado-Matías, R., Casades-Martí, L., Peralbo-Moreno, A., Baz-Flores, S., García-Manzanilla, E., & Ruiz-Fons, F. (2023). Testing the efficiency of capture methods for questing *Hyalomma lusitanicum* (Acari: Ixodidae), a vector of Crimean-Congo hemorrhagic fever virus. *Journal of Medical Entomology*, 61(1), 152-165. doi: 10.1093/jme/tjad127.
- [6] de la Fuente, J., et al. (2023). Perception of ticks and tick-borne diseases worldwide. *Pathogens*, 12(10), article number 1258. doi: 10.3390/pathogens12101258.
- [7] Do, T., et al. (2024). The detection of zoonotic microorganisms in *Rhipicephalus sanguineus* (brown dog ticks) from Vietnam and the frequency of tick infestations in owned dogs. *Frontiers in Veterinary Science*, 11, article number 1435441. doi: 10.3389/fvets.2024.1435441.
- [8] Duplaix, L., Wagner, V., Gasmi, S., Lindsay, L.R., Dibernardo, A., Thivierge, K., Fernandez-Prada, C., & Arsenaault, J. (2021). Exposure to tick-borne pathogens in cats and dogs infested with *Ixodes scapularis* in Quebec: An 8-year surveillance study. *Frontiers in Veterinary Science*, 8, article number 696815. doi: 10.3389/fvets.2021.696815.
- [9] Egbuchulem, K.I. (2024). [The Karl Pearson's chi-square: A medical research libero, and a versatile test statistic: An editorial](#). *Annals of Ibadan Postgraduate Medicine*, 22(2), 5-8.
- [10] England, S.J., Lihou, K., & Robert, D. (2023). Static electricity passively attracts ticks onto hosts. *Current Biology*, 33(14), 3041-3047. doi: 10.1016/j.cub.2023.06.021.
- [11] Foley, J., López-Pérez, A.M., Rubino, F., Backus, L., Ferradas, C., Barrón-Rodríguez, J., Mendoza, H., Arroyo-Machado, R., Inustroza-Sánchez, L.C., & Zazueta, O.E. (2024). Roaming dogs, intense brown dog tick infestation, and emerging rocky mountain spotted fever in Tijuana, México. *The American Journal of Tropical Medicine and Hygiene*, 110(4), 779-794. doi: 10.4269/ajtmh.23-0410.
- [12] Harman, P.R., Mendell, N.L., Harman, M.M., Draney, P.A., Boyle, A.T., Gompper, M.E., Orr, T.J., Bouyer, D.H., Teel, P.D., & Hanley, K.A. (2024). Science abhors a surveillance vacuum: Detection of ticks and tick-borne pathogens in southern New Mexico through passive surveillance. *Plos One*, 19(1), article number e0292573. doi: 10.1371/journal.pone.0292573.

- [13] Holcomb, K.M., Khalil, N., Cozens, D.W., Cantoni, J.L., Brackney, D.E., Linske, M.A., Williams, S.C., Molaei, G., & Eisen, R.J. (2023). Comparison of acarological risk metrics derived from active and passive surveillance and their concordance with tick-borne disease incidence. *Ticks and Tick-Borne Diseases*, 14(6), article number 102243. doi: [10.1016/j.ttbdis.2023.102243](https://doi.org/10.1016/j.ttbdis.2023.102243).
- [14] Köppen, K., Zmarlak-Feher, N.M., Dörre, A., Hagedorn, P., Kohl, C., & Heuner, K. (2025). Country-wide assessment of tick-borne pathogens collected in ticks between 2021 and 2024 in Germany, with a focus on *Francisella*: A one health pilot study. *One Health*, 21, article number 101190. doi: [10.1016/j.onehlt.2025.101190](https://doi.org/10.1016/j.onehlt.2025.101190).
- [15] Koser, T., Hurt, A., Thompson, L., Courtemanch, A., Wise, B., & Cross, P. (2025). Scent detection dogs detect a species of hard tick, *Dermacentor albipictus*, with comparable accuracy and efficiency to traditional tick drag surveys. *Parasites & Vectors*, 18, article number 126. doi: [10.1186/s13071-024-06519-8](https://doi.org/10.1186/s13071-024-06519-8).
- [16] Kravchuk, O. (2025). The main drug mechanisms, efficacy assessment and criteria for the prevention and treatment of Lyme borreliosis. *Theoretical and Applied Veterinary Medicine*, 13(2), 3-9. doi: [10.32819/2025.13006](https://doi.org/10.32819/2025.13006).
- [17] Krupa, E., Dziedzic, A., Paul, R., & Bonnet, S. (2024). Update on tick-borne pathogens detection methods within ticks. *Current Research in Parasitology & Vector-Borne Diseases*, 6, article number 100199. doi: [10.1016/j.crvpbd.2024.100199](https://doi.org/10.1016/j.crvpbd.2024.100199).
- [18] Levytska, V., & Mushynskiy, A. (2020). Ixodid ticks in the Western Ukraine. *Scientific Messenger of Lviv National University of Veterinary Medicine and Biotechnologies. Series "Veterinary Sciences"*, 22(97), 187-193. doi: [10.32718/nvvet9730](https://doi.org/10.32718/nvvet9730).
- [19] Meta. Maps of Ukraine. (n.d.). Retrieved from <https://map.meta.ua/ua/#zoom=6&lat=48.5&lon=31.2&base=B00>.
- [20] Panteleienko, O., Makovska, I., & Tsarenko, T. (2022). Influence of ecological and climatic conditions on the spread of *Borrelia burgdorferi* in domestic dogs in Ukraine. *Regulatory Mechanisms in Biosystems*, 13(4), 431-442. doi: [10.15421/022257](https://doi.org/10.15421/022257).
- [21] Probst, J., Springer, A., & Strube, C. (2023). Year-round tick exposure of dogs and cats in Germany and Austria: Results from a tick collection study. *Parasites & Vectors*, 16, article number 70. doi: [10.1186/s13071-023-05693-5](https://doi.org/10.1186/s13071-023-05693-5).
- [22] Sadangi, S., Parčina, M., Mutters, N.T., & Falkenberg, T. (2025). Assessment of human health risks to tick-borne infections in urban green spaces (UGS) – a study protocol. *BMC Infectious Diseases*, 26, article number 170. doi: [10.1186/s12879-025-12364-6](https://doi.org/10.1186/s12879-025-12364-6).
- [23] Sgroi, G., D'Alessio, N., Veneziano, V., Rofrano, G., Fusco, G., Carbonara, M., Dantas-Torres, F., Otranto, D., & Iatta, R. (2024). *Ehrlichia canis* in human and tick, Italy, 2023. *Emerging Infectious Diseases*, 30(12), 2651-2654. doi: [10.3201/eid3012.240339](https://doi.org/10.3201/eid3012.240339).
- [24] Springer, A., Kahl, O., Król, N., Pfeffer, M., Chitimia-Dobler, L., Lindau, A., Mackenstedt, U., & Strube, C. (2026). Ticks in the landscape: Fragmentation impacts density of Europe's principal tick-borne disease vector, *Ixodes ricinus*, across Germany. *Ticks and Tick-borne Diseases*, 17(2), article number 102621. doi: [10.1016/j.ttbdis.2026.102621](https://doi.org/10.1016/j.ttbdis.2026.102621).
- [25] Tsoumani, M.E., Papailia, S.I., Papageorgiou, E.G., & Voyiatzaki, C. (2023). Climate change impacts on the prevalence of tick-borne diseases in Europe. *Environmental Sciences Proceedings*, 26(1), article number 18. doi: [10.3390/environsciproc2023026018](https://doi.org/10.3390/environsciproc2023026018).
- [26] Wheeler, C.A., et al. (2026). Traps baited with dry ice outperform cloth drags for capturing ticks (*Acari: Ixodidae*) in 3 widely separated geographic regions. *Journal of Medical Entomology*, 63(1), article number tjaf183. doi: [10.1093/jme/tjaf183](https://doi.org/10.1093/jme/tjaf183).

- [27] Wilson, C.H., *et al.* (2022). Surveillance for *Ixodes scapularis* and *Ixodes pacificus* ticks and their associated pathogens in Canada, 2019. *Canadian Communicable Disease Report*, 48(5), 208-218. doi: [10.14745/ccdr.v48i05a04](https://doi.org/10.14745/ccdr.v48i05a04).
- [28] Zanet, S., Battisti, E., Pepe, P., Ciuca, L., Colombo, L., Trisciuglio, A., Ferroglio, E., Cringoli, G., Rinaldi, L., & Maurelli, M. (2020). Tick-borne pathogens in Ixodidae ticks collected from privately-owned dogs in Italy: A country-wide molecular survey. *BMC Veterinary Research*, 16, article number 46. doi: [10.1186/s12917-020-2263-4](https://doi.org/10.1186/s12917-020-2263-4).

Методи збору іксодових кліщів для контролю розповсюдження трансмісивних хвороб у домашніх собак

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Анотація. Проблема вибору методів збору кліщів, зокрема іксодових, стала важливою для контролю розповсюдження трансмісивних хвороб у домашніх собак, які можуть переносити кліщів на шерсті до осель своїх власників та становити загрозу зараження людини хворобою Лайм-бореліоз. Метою дослідження було здійснення аналізу методів збору кліщів та обґрунтування їх переваг й обмежень. Дослідження охоплювало аналітико-констатувальний, теоретико-моделювальний, узагальнювально-впроваджувальний етапи. Під час аналітико-констатувального етапу було встановлено, що основними методами збору кліщів є Dragging, Flagging, CO₂ пастки (dry ice/baited traps), Host Examination, Absolute Surface Counts. На теоретико-моделювальному етапі було обґрунтовано доцільність використання зазначених методів та виокремлено найбільш ефективні. У ході дослідження визначалися методи, які зручніші для застосування на території України, оскільки вони забезпечували оптимальне поєднання доступності, відтворюваності та епізоотологічної інформативності, а також дозволяли отримувати як кількісні, так і якісні показники щодо щільності популяції, видової структури та інтенсивності інвазії іксодових кліщів. На узагальнено-впроваджувальному етапі було обрано два методи збору кліщів, які були зручними у використанні та потребували менших матеріальних затрат. У процесі виконання практичної частини дослідження за допомогою цих методів було зібрано 840 кліщів з території Полісся, що вказувало на потенційні ризики розповсюдження трансмісивних хвороб. Загалом було обстежено 87 собак, із яких 56 попередньо оброблялись акарицидними препаратами на основі піретроїдів та ізоксозолінів. Обстежувались собаки різних порід, віком від 9 місяців до 12 років, які утримувалися в різних умовах на обраних локаціях для дослідження. У результаті дослідження було з'ясовано, що роль домашніх собак як резервуарів векторних інфекцій та механічних переносників іксодових кліщів є більш ефективним методом для контролю розповсюдження популяції кліщів у міській місцевості, ніж польові методи їх збирання (Dragging)

Ключові слова: векторні інфекції; Лайм-Бореліоз; акарологічний моніторинг; ектопаразити; ветеринарна паразитологія