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Original papers

A new locality of the *Haemaphysalis concinna* tick (Koch, 1844) in Poland and its role as a potential vector of infectious diseases

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ABSTRACT. The *Haemaphysalis concinna* tick is a rare species in Poland. To date, it was found only once a few decades ago. During tick collection for epidemiological studies, a stable population of this arachnid was found in a military training area near Nowa Dęba. This report is particularly important, given the role of *Haemaphysalis concinna* in the spread of dangerous vector-borne diseases.

Keywords: Ixodidae, *Haemaphysalis concinna*, vector-borne diseases, Poland

Introduction

Haemaphysalis concinna Koch, 1844 is classified into the subfamily Amblyomminae Banks, 1907, which has four representatives in Poland. The current occurrence of the species in Poland was noted in a historical locality in the village of Troszyn, Zachodniopomorskie Province. The report of finding one female on the vegetation in this village [4,11,21] dates back to 1956 (Lechmajer). Since that time, there has been no evidence for the occurrence of this species in our country.

Materials and Methods

The investigations conducted as part of the National Health Program („Military NHP" project) are focused on detection of natural reservoirs of infectious diseases transmitted by ticks. The study area is limited to the sites of dislocation of Polish Republic Land Forces, especially in military training districts. The research carried out as part of the project is focused on identification of dangerous and infectious agents, i.e. investigation of the tick fauna and the transmission potential of these arachnids. The investigations of ticks consist in collection thereof from vegetation with the flagging method and morphological analysis of collected specimens for determination of their species affiliation. The next stage involves identification of the genetic material of microorganisms using molecular methods.

The collection was carried out on 28.05.2018 in the area of Stary Staw, col. Jan Szypowski Land Forces Training Centre DĘBA near Nowa Dęba. Using the flagging method, six adult specimens (two females and four males) and one nymph were collected. The ticks did not represent species that were collected most frequently in this area (*Ixodes* spp., *Dermacentor* spp.). The specimens were macerated in lactic acid, X-rayed to visualise all

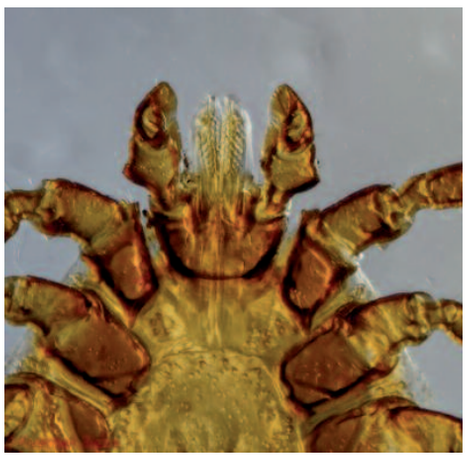

Fig. 1. Details of the hypostome of a *H. concinna* tick

Fig. 2. *H. concinna*; female

morphological structures, and viewed under a light microscope. Based on the identification key, the ticks were identified [4] as the *Haemaphysalis concinna* species (Fig. 1 and 2).

Results

Distribution of *H. concinna* and its epidemiological role

Haemaphysalis concinna is referred to as a Eurasian tick inhabiting a relatively narrow belt of isolated regions where it was found, i.e. from Spain to the eastern border of Russia (Kamchatka) [3], (Fig. 3 and 4). Its specific „insular" occurrence is explained by the impact of specific climatic conditions, geographical barriers, and inability to adapt rapidly to a wide range of environments, unlike that of other frequently occurring species. *Haemaphysalis concinna* prefers habitats located in wooded areas (mixed forests) on the banks of water reservoirs: lakes, backwaters, rivers, and river valleys. It is characterised by high abundance in some regions of Europe and is the third most frequent species after *Ixodes ricinus* and *Dermacentor reticulatus* [3]; in other regions, it occurs sporadically or does not appear at all. Attempts to explain the insular distribution of the species have not yielded conclusive results. Although it is locally reported to occur abundantly, the tick is rarely found in boreal regions, where it is

Fig. 3. Distribution of the *H. concinna* tick

probably introduced by animals (birds) exclusively. The analysis of its occurrence range based on the distribution of temperatures prevailing in the tick species habitats allows formulating a hypothesis that temperature is the main determinant of its occurrence limits [2], which could partly explain the southern location of its habitats in Eurasia (Fig. 3).

H. concinna is a typical three-host tick, whose individual stages feed on vertebrates: larvae on small mammals [6] and nymphs and adults on warm-blooded vertebrates, including humans. They infest particularly cervids (Cervidae) [7]. The peak of their feeding activity in temperate climates is noted in May–July for adult stages and April-October for nymphs and larvae [5]. Similar to *Ixodes ricinus*, the *H. concinna* tick feeds on a wide range of hosts. In some provinces of China, it massively attacks domestic animals [1].

An important role in the spread of the tick species is played by birds, especially those migrating in autumn and spring and associated with aquatic environments.

The *H. concinna* tick is a vector of a number of pathogenic microorganisms transmitting bacterial and viral diseases in particular.

Viruses. The tick-borne encephalitis (TBE) virus from the Flaviridae family is a common virus of encephalitis and meningitis transmitted by ticks. The transmission of this virus by *H. concinna* has been confirmed, and this tick species is considered one of its major vectors in its occurrence range [8].

The Burana virus represents the family Bunyaviridae, which comprises viruses transmitted by arthropods and causing diseases of varied severity from mild to haemorrhagic fevers. The cases of isolation of both genetic material and the virus from ticks collected in Kyrgyzstan and animals infested by *H. concinna* confirmed the involvement of this tick species in the transmission of this group of viruses [9].

The Crimean-Congo Haemorrhagic Fever virus (CCHFV), belonging to the family Bunyaviridae together with the Burana virus, is a biological agent of weapons of mass destruction (WMD). It causes a

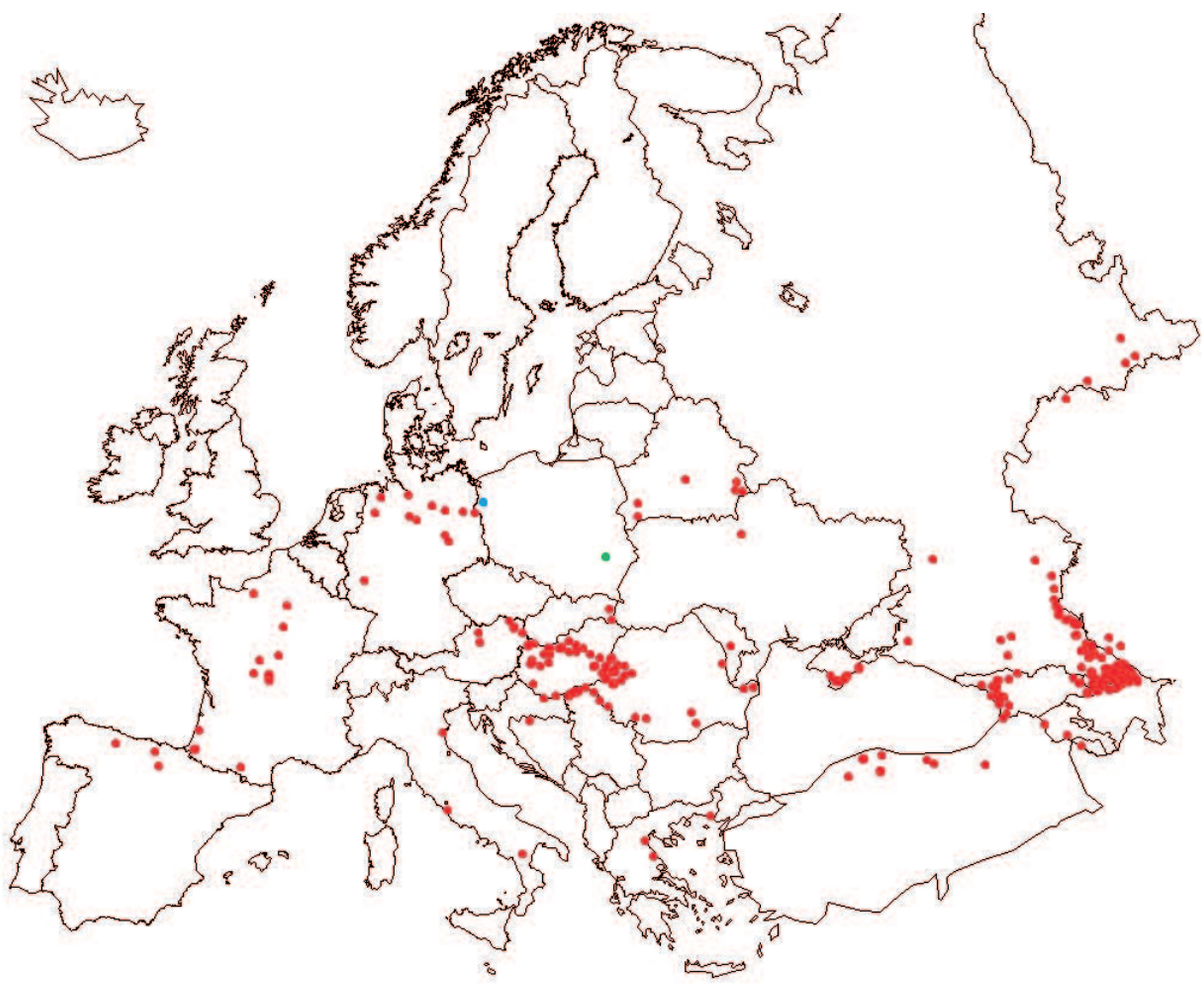

Fig. 4. Localities of the *H. concinna* tick in Europe: red colour; blue colour: locality detected in 1956; green colour: locality described in this report

disease called Crimean-Congo haemorrhagic fever characterised by varied severity and high mortality. Transmission of the disease by *H. concinna* was confirmed in analysis of ticks collected in Turkey [10]. Currently, this is the only vector of this very dangerous disease occurring permanently in Poland.

The Western and Japanese Encephalitis (WEE, JEE) viruses representing the Togaviridae and Flaviviridae families are the biological factors of weapons of mass destruction. They cause animal and human encephalitis, which can often have a complicated course in immunocompromised patients [12].

Bacteria. *Borrelia afzelii*, *Borrelia garinii*, and *Borrelia miyamotoi* are Gram-negative bacteria from the family Spirochaetaceae causing Lyme disease, which is one of the most frequent tick-borne zoonoses diagnosed in recent years not only in Poland. Borreliosis is a multisystem disease with a severe course [13–15].

Coxiella burnetii, a small Gram-negative bacterium representing the family Coxiellaceae, is a biological agent of WMD. It causes a disease called Q fever in animals and humans, which is a dangerous zoonosis. The disease has flu-like symptoms with varied severity and is highly contagious, as infection can be caused by even one bacterium [16].

Francisella tularensis is a Gram-negative rod from the family Francisellaceae and a biological factor of WMD. The bacterium is dangerous to both human and animal health. It is one of the most dangerous factors transmitted by *H. concinna* ticks in their occurrence range causing ulceroglandular or glandular disease and leading to development of septicaemia [17].

Rickettsia sensu lato is a tiny Gram-negative rod from the family Rickettsiaceae. *H. concinna* has been shown as a vector of *R. helvetica* [18], *R. raoulti* [19], *R. sibirica* [20], and *R. heilongjiangensis* [19]. Rickettsiae cause a number of diseases classified as spotted fevers, which are dangerous to humans and are characterised by an acute course and skin lesions.

Discussion

The detected locality is the first dense occurrence site in the country. The number of collected specimens in two developmental stages in one area allows formulation of a thesis of the permanent occurrence of the species in the area, which can be regarded as its permanent habitat.

The demonstration of the dense locality of *H. concinna* occurrence is a valuable faunistic observation of the distribution of the species in the country complementing the available data on this issue.

The transmission potential of this species is very high and the range of transmissible vector-borne diseases makes it one of the most important tick species in our climate. Interestingly, the tick is largely carried by migratory birds. Birds that overwinter in regions of endemic occurrence of some infectious illnesses, including dangerous tick-borne diseases, can become primary vectors transmitting parasites infected with these microorganisms to previously unaffected areas. This can increase the disease ranges, posing a threat to the health and lives of humans and animals. A major risk for humans is the possibility of transmission of dangerous viral diseases that have not been diagnosed in Poland so far, e.g. CCHF, WEE, or JEE, which may have serious implications for public health or constitute a new severe risk of occupational exposure in some groups.

Furthermore, since the temperature criterion determines the distribution of habitats, the locality reported from our country may be related to the global warming observed in Poland. In a wider perspective, this may be associated with a gradual expansion of the northern occurrence ranges of other tick species and other vectors [22], which can have negative consequences for public health on a global scale.

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