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Abundance changes of the tick *Dermacentor reticulatus* Fabricius, 1794 (Parasitiformes, Ixodidae) in the northern limit of its distribution

Динамика численности клещей *Dermacentor reticulatus* Fabricius, 1794 (Parasitiformes, Ixodidae) в северной части их ареала

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Ключевые слова: *Dermacentor reticulatus*, динамика численности, диапауза, учёты.
Key words: *Dermacentor reticulatus*, abundance changes, diapausa, accountings.

Abstract. Results of a 5-year tick accounting survey along the southern slope of a low hill in the forest zone of West Siberia are provided. The route taken for this account was from the southern suburb of the City of Tomsk at 56°26.569' N, 084°59.772' E, to a final point at 56°26.711' N, 085°00.228' E. The first individuals of ticks collected from flag-traps were immediately after snow cover had melted as it was assumed that individuals of *Dermacentor reticulatus* Fabricius become active activity after mid-April. Ticks accounting began after the snow had disappeared on the slope, although the snow remained in the forest and at lower levels. Numbers were determined at intervals of 5 to days depending on the climatic conditions until the beginning of July, when almost all adults started their diapause. At the beginning of August, accounting resumed and continued during the autumn until snow covering appeared. The maximum numbers of ticks were registered from the third decade of April until the first decade of May, but strongly decreased thereafter. Spring activity ended with a low abundance of ticks in the third decade of May or the third decade of June, and interchanged with the start of diapause, which lasts until the first decade of August. In comparison with the spring, the number of ticks halved during the autumnal activity, and stopped after the appearance of snow.

Резюме. Представлены данные 5-летних учётных сборов клещей на тропе, проложенной по южному склону невысокой возвышенности в окрестностях г. Томска. Координаты начала тропы 56°26.569' N, 084°59.772' E, конца — 56°26.711' N, 085°00.228' E. Установлено, что первые клещи *Dermacentor reticulatus* Fabricius отлавливаются на флаг сразу после стаивания снежного покрова на склоне, что происходит во второй или третьей декаде апреля. Максимум численности наблюдается в третьей декаде апреля или в первой мая. Затем, количество отлавливаемых в учётах иксодид, резко сокращается. Весенняя активность заканчивается на фоне низкой численности в третьей декаде мая или в третьей декаде июня и начинается диапауза. Выход из диапаузы отмечается в первой декаде августа. В период осенней активности, численность клещей всегда вдвое ниже, по сравнению с весенним периодом. Заканчивают проявлять активность клещи только при установлении отрицательных температур и постоянного снежного покрова.

Introduction

The tick *Dermacentor reticulatus* (Fabricius, 1794) is able more deeply penetrates to the north in comparison with the other meadow tick species [Jakimenko et. al., 2013]. Short summer period of living of the hunger nymphs and larvae, unable for continuous starvation due to behavioral diapause lacks, is general specifics of the genus *Dermacentor* Koch, 1844. Therefore, life-cycle duration in this genus is limited with a year. In addition, many acarologists have noted exceptional survival time of adults of this genus able wintering more than once [Razumova, 1998]. Small part (about 5%) of this species adult individuals may survive during four years, according to N.G. Olsufjev [1953]. It is assumed that active in spring and autumn ticks are represented with different age individuals belonging to three generations at least. Special study reveals that in northern part of the areal the maximal duration of adults life in natural conditions is 463 days with only one wintering. Adults emerged from nymphs sucked blood in summer are wintering predominately. Individuals in natural habitats not limited with meeting of host animal and wintering more that one year have not been found [Romanenko, 2023].

Summer inactivity and diapause of adults both those have sucked blood during June and beginning of July and remained hungry is observed. In result, well-fed females are wintering together with starved. In spring they laying eggs simultaneously with individuals wintering starved but had sucking blood during the new season.

Local species of large animals are typical hosts for feeding of imaginal stage of *Dermacentor* Koch ticks. In the area of the genus distribution this may be different species of hoofed mammals, carnivores or other animals. Near human settlements high number of ticks is provided by domestic animal such as cows, sheeps, goats, and dogs around towns or cities [Romanenko et al., 2017].

Nymphs and larvae of the tick are feed on smaller animals, mainly on small gnawers and hares. Particular species composition of the host species depends on the

region of *Dermacentor* Koch species occurrence. Birds nesting or feeding on soil surface may be suitable hosts for ticks feeding in some locations [Filippova, 1997]. Duration of pre-imaginal stages of tick development strongly limited by warm period of the year. In the central part of Russia larvae occur on rodents from the beginning of summer until July, and nymph from the mid of June to the end of August.

The ticks of the genus *Dermacentor* Koch are active disease carriers of the feral herd infections of viral, bacterial and protozoan etiology [Filippova, 1997; Balashov, 1998]. Ticks may provide their progenies with viruses via transphase and transovarial transmission. Etiological factor of ticks in transmission of the Omsk hemorrhagic fever and tick-borne encephalitis viruses and other arboviral diseases spread abroad Russia is registered [Naumov, Gutova, 1979; Moskvitina et al., 2009; Korobitsyn et al., 2021, Voronkova et al., 2023]. *Dermacentor* Koch ticks are also active carriers of rickettsiosis, such as Q feaver, epidemic tick-borne typhus of North Asia, etc.

Ixodidae ticks are considered as serious carrier of an anaplasmosis, the etiological factor of hematozoon and fever diseases of livestock (cattle, sheeps, goats) [Filippova, 1997; Balashov, 1998; Chausov et al., 2011; Kartashov et al., 2019a, b].

Detection of the tick *Dermacentor reticulatus* Fabricius abundance changes in the northern limit of its distribution in the forest zone of West Siberia is a purpose of the present study.

Materials and methods

The path for accounting rout was organized along the slope of southern exposition in not high upland at the southern suburb of the City of Tomsk with coordinates of the starting point 56°26.569`N, 084°59.772`E, and final point 56°26.711`N, 085°00.228`E. The path is 1.5 km remote from the buildings and 1 km from the river Tom. Several small enterprises are situated in the interval between houses and the path; their territory is enclosed with a high fence. The path is located in 30–50 m distance from the fence.

The route distance was 1 km, ticks were collected from both sides of the path in the slope with grassy meadow. At the foot of the slope garages and small service centers are located. Material was collected from the mid of May 2018, and during all seasons of ticks activity from the second decade of April to the beginning of November 2019–2022.

Common techniques for sampling tick populations included flagging-dragging using 120×60 cm flag. 6 mm diameter rod were sewed in narrow apex of the flag to provide closer contact with grass and more effective collection of ticks.

Ticks accountings were begun after the slope released from the snow, although in forest and low place snow remained. Accountings were held each 5–7 day depending on the climate conditions, until the beginning of July when almost all adults start diapause. At the beginning of August the accountings resumed and continued for all autumn until snow covering appeared.

R version 4.0.2 [R Core Team, 2020] was used for statistical analysis of ticks. Fisher's Exact Test [Fisher, 1934] was applied for comparison of tick distribution by months of different years. average monthly temperatures are used according Laboratory of Atmosphere Composition Climatology of the Institute of atmospheric optics, Siberian branch of the Russian academy of sciences data (lop.iao.ru/RU/other/tstat).

The present work is registered in ZooBank (www.zoobank.org) under LSID urn:lsid:zoobank.org:pub:10A227C2-4628-4A0E-B2AA-B3524FCD451E.

Results and discussion

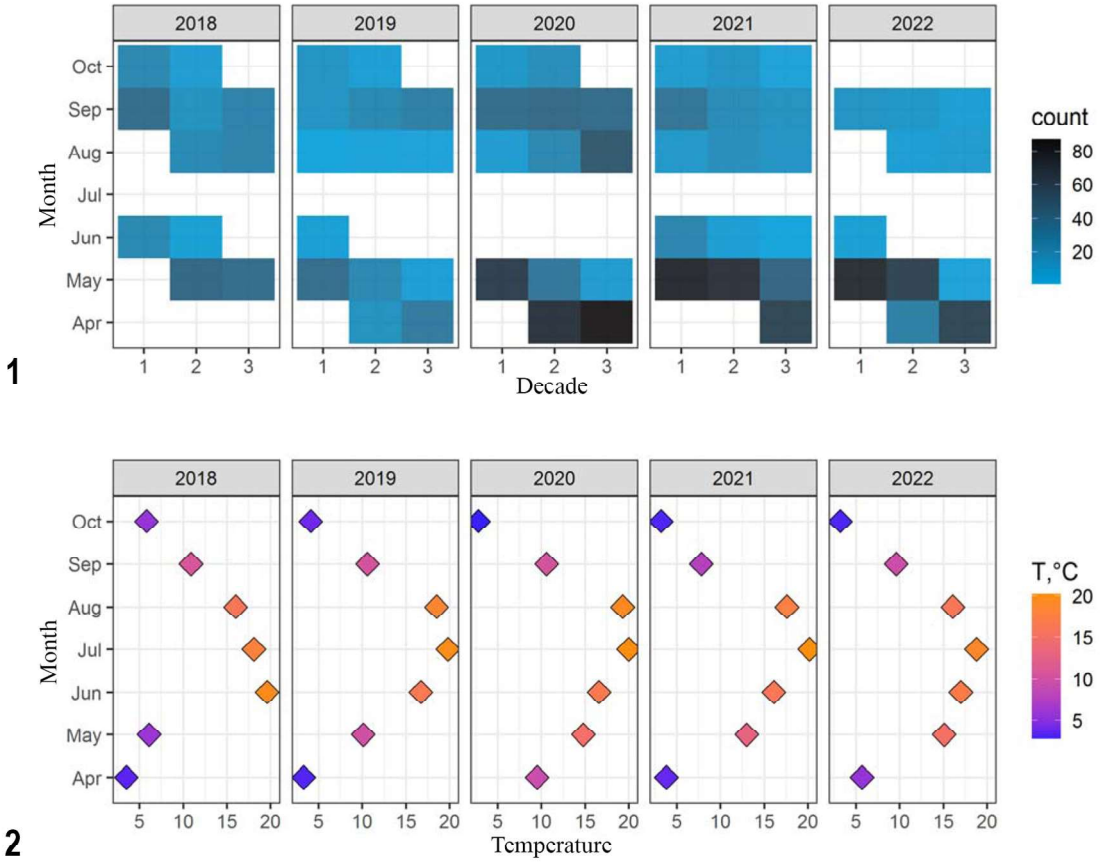
Statistical significant differences of abundance dynamics of ticks are revealed in dependence of year of observation (fisher.test, p-value = 0.004), the temperature is registered as one of the main weather indexes impact to abundance dynamics of ticks.

The study revealed that the first tick appear immediately after snow cover melted in the second or third decade of April (Figs 1, 2). Tick emergence after wintering depends on weather conditions in the second part of April. If the weather warm and snow cover actively melting, then the first accountings may registered up to 72 individuals per 1 km as it was in 2020. If return frosts with snowfall occurred, then abundance of ticks was represented with 12 individuals per 1 km. For technical reasons, accounting in 2018 was started in the middle of May when the number of tick was sharply decreased.

Abundance peak usually registered either at the end of the third decade of April or in first decade of May. Usually, high number of ticks is provided during a month and strongly decreased afterwards (Fig. 1). The spring minimum abundance is registered in June, or even in the end of May, as it was recorded in 2020.

At the beginning of June the dynamic of tick abundance in 2019 and 2020 was 2–3 individuals per 1 km only, but in 2018 and in 2021 the number of caught tick was higher, about 20 individuals per 1 km. The spring activity ends during June, at the first or third decade of the month. After third decade of June ticks in the accountings lacked. Probably, during June ticks started diapause, which lasts from three to six decades (Fig. 1). In southern regions, for example in East-Kazakhstanskaya Oblast of Kazakhstan, summer diapause is longer and lasts during 5–6 decades [Evkurov, Romanenko, 2012].

The diapause lasts to the beginning of August, and first ticks of the autumnal activity appears in the first decade of the month. Number of ticks increases more evenly. In comparison with *Dermacentor reticulatus* Fabricius occurring in Poland a number of Siberian species is always 2–3 times higher than in period of spring [Bartosik et al., 2011; Buczek et al. 2013]. A number of ticks during warm autumn may reach 40–50 individuals per 1 km. Also, autumnal period of ticks activity may be more prolonged than in spring, and always ends only



Figs 1–2. The tick *Dermacentor reticulatus* Fabricius in the northern limit of its distribution, observation during 2018–2022. 1 — abundance changes of the tick; 2 — average monthly temperatures.

Рис. 1–2. Учёты клеща *Dermacentor reticulatus* Fabricius в северной части ареала в период с 2018 по 2022 года. 1 — динамика численности клещей; 2 — среднемесячные температуры воздуха.

after sustainable negative temperatures establishment, usually together with the first snow fall.

Thus, *D. reticulatus* Fabricius may assemblage high number populations on southern open slope under conditions of taiga zone. The maximal meanings of tick number were registered during a spring period, and they are 2–3 times lower during an autumn. The studied slope was almost completely lacking trees, that provided warming of upper soil level and favoured for larva and nymph successful development. In so doing, the stray dogs, usual residents of garages feed by garage owners or workers of small enterprises, successfully provide imago with nutrition.

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