

# Changes of sexstructure of population of ixodid ticks under the action of abiotic factors

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## Abstract:

It is established that the sex structure of the population of ixodid ticks of Dermacentor genus depends on the influence of abiotic factors. The first ticks of Dermacentor genus begin to show their activity already at 3 °C. Spring peak activity lasts from the third decade of April to the first decade of June. It is accompanied by a high index of ticks' abundance (up to 113.5 specimens per flag-hour). An early-autumn peak of activity, which begins from the second decade of August and lasts until the second decade of September, is characterized by smaller indicators of the abundance of ixodids in the study areas-38.4 specimens per flag-hour. It has been noted that in the spring peak of parasitism females prevail over males up to 3.5 times. Female specimens are most active during the whole period of parasitism. However the greatest activity is manifested in the temperature range of 15-18°C with an abundance index of 77.4-83.1 individuals. The best temperature range for male ixodids ranges from 12 to 18 °C. At this time, an abundance index has been 27.8-33.4 specimens per flag-hour. It has been found that the lowest temperatures of autumn are more favorable for them than for females.

**Keywords:** Ixodid ticks, sex structure, population, abiotic factors, air temperature.

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## INTRODUCTION

It is known that ixodid ticks are dangerous for animals, as they are carriers and reservoirs of tularemia, pyroplasmidosis, anaplasmosis. Also, it is suggested that ixodids are able to reserve leukemia virus of cattle [1, 2, 3, 4, 5, 6].

Quantitative ratio of the sex groups of individuals is one of the significant indicators of any population structure. It affects an overall viability and the rate of population growth. Careful and continuous observation and analysis of the sexual composition of Ixodid ticks, taking into account factors affecting their population, has great importance in predicting the number of these parasites [7, 8, 9, 10, 11].

Females who require an absorption of host blood for realization of the gonotrophic cycle are of particular importance in the population of ixodid ticks, while the number of eggs in the oviposition depends directly on its volume. In some cases, these values reach significant amounts up to 500 mg. Females after sufficient nutrition subsequently lay eggs. This helps them to preserve or multiply their own population. Males of ticks do not have great importance – such as for example bloodsuckers, because they feed for a short time, while one of their priority functions is copulation. It is believed that this is the purpose why they attack a potential host, where searching for a female is the primary task for them.

Given the value of knowledge about the structure of the population of ixodid ticks that dominate in the forest-steppe natural and climatic zone of the Northern Trans-Urals, its study is necessary, as well as revealing the influence of environmental factors on the variation of the gender composition of ixodids in the Northern Trans-Urals.

## MATERIALS AND METHODS.

An experimental part of the work was performed in the acarology laboratory of the All-Russian Scientific Research Institute of Veterinary Entomology and Arachnology at the Department of Infectious and Invasive Diseases of the Federal State Educational Institution of Higher Professional Education in the State Agrarian University of the Northern Trans-Urals (Tyumen city) in the forest-steppe zones of the Trans-Urals in the

period from 2002-2015. The study was conducted from the appearance of ticks in nature till the complete cessation of their activity in the daytime from 11 to 16 hours.

Within the study program ticks were collected by using the standard flag recommended for registration collection of ixodids from vegetation (60x100 cm). The flag was made of cotton waffle-cloth material. By the way, those ticks that were collected from the scientists' clothes were also registered. Collection of ticks in the biotopes began immediately after complete melting of the snow and the appearance of the first vegetation. Periodicity of ixodid collection was 1 time in 5 days during the entire season of their activity, excluding the days unfavorable for meteorological conditions. Usually, ixodids were collected during the daytime from 11 to 16 hours local time.

When collecting ticks, the flag was kept parallel to the course of the accountant in such a way that it covered the whole surface during the movement. The ticks obtained during the collection from the flag and clothing of the accountant were removed from the collecting sites. Then we identified their species, sex and quantity. A total of 3,714 adult ticks were collected during the observation period, including 1,216 males and 2,498 females.

Determination of the species of the ixodid mites collected from vegetation was carried out according to the method of Beklemishev V.N. [12] and by using determinants of N.A. Filippova (1977).

## RESULTS

Particular attention to biological features (including the structure of population) was given to such ticks as *Ixodes ricinus* L. and *Ixodes persulcatus* P. Shc. (Ixodoidea, Ixodidae) [4, 13-15, 16-19; 20, 21], while ticks of Dermacentor genus were not given serious significance undeservedly. The sex structure of the population in ticks *D. reticulatus* and *D. marginatus* was described only by E.I. Butakov (2004, 2016) in the Republic of Altai and Altai Territory of the Russian Federation. Thus, the sex composition of *D. reticulatus* ticks varied from 1:0 (males:females) to 1:2, respectively. Significant differences in the sexual population were observed in *D. marginatus* ticks, where the ratio

of males and females was represented in the range from 1:0.7 to 1:8.7 [20, 21]. Despite such significant population variations in the sexual structure of ixodid ticks of the genus *Dermacentor*, the authors did not analyze the factors that affect this variability.

Our observations made it possible to determine that the number of males and females varied during the parasitic season.

It was found that ixodid ticks were activated in nature with the formation of thawed patches. The latter appear in the study region in the third decade of March, and end the season of parasitism at the end of October. In this case, the activity of ixodids has two clearly expressed peaks: in the spring and early autumn. The spring peak activity lasts from the third decade of April to the first decade of June. Its typical feature is a high index of ticks' abundance (up to 113.5 specimens per flag-hour). The early-autumn peak of activity began from the second decade of August and lasted until the second decade of September. During this period the maximum abundance index was 38.4 specimens per flag-hour.

The ratio of sex groups during the parasitic season has different indicators. For example, females predominate in the population of ixodid mites during the spring period of activity, while their number has a consistently high level. The proportion of females slightly decreases in the population to the end of the spring period of activity. In the summer-autumn period the situation changes to the opposite: at the beginning of the season the number of females is still at high level, by the first decade of September their number is virtually equalized. Then the proportion of active males increases and by the end of the parasitizing season the ixodid population consists mainly of males.

The facts established in the difference of the sexual structure of ixodid ticks population served as a stimulus for studying the dependence of the activity of male and female ticks on abiotic factors. For this purpose, when capturing ixodids, an air temperature was monitored. The results are shown in the Figure 1.

During an observation, it was established that the first ticks of the genus *Dermacentor* began to show their activity already at 3 °C. The number of parasites in nature increased with the increase in temperature, and reached the maximum values in the temperature range of 15-18 °C.

When comparing the activity of different sexual groups of ixodid ticks of the *Dermacentor* genus and an air temperature, it was noted that it had its own peculiarities in males and females. It was found that females had the most critical response to changing the temperature of the environment. Thus, an increase in

the temperature above 9 °C activated females. The maximum comfort temperature for them was 15-18 °C, when their abundance indices per flag-hour reached 77.4-81.1 specimens. As the temperature of the air increased, the activity of the females gradually decreased, and at 26 °C an abundance index was 30.6 individuals per flag-hour. At the same time, the proportion of males in population had smaller changes. Thus, the greatest abundance of males was observed when the air temperature was in the range from 10 to 20 °C. In such temperature indicators, the number of males was at the stable level in the range of 22.0-32.4 individuals per flag-hour. The least comfortable temperatures for them were above 22 °C and below 9 °C. During the observations, it was noted that the quantitative indices of females in some days of recording prevailed over those in males more than 2.5 times. In the most favorable temperature range the number of females exceeded that of males 3.5 times. It was noted that male and female ixodids were equally affected by the ambient temperature of 7-9 °C when the ratio of the number of individuals of these groups was at the same level.

### CONCLUSION

Summarizing the observations, we can conclude that depending on the season of the year the structure of population of ixodid ticks had its own peculiarities. Thus, in the spring period, female specimens predominated in the population of ixodid ticks, which could be explained by the fact that part of the group was represented by overwintered hungry imago which tended to feed. Females appeared in the population after the spring metamorphosis from the nymphs. By the end of the spring activity season, a decrease in the number of females was recorded, which could be explained by their retirement from the population due to feeding and laying eggs. At the same time, in the autumn the number of females with respect to the number of males noticeably decreased. We assume that this is caused by retirement of females as a result of protracted summer diapause. Females cannot always exit this diapause even in the following year. The number of males during the season remained at the stable level. It was found that the temperature of the environment affected the activity of the ticks. Thus, females were most active in the temperature range of 15-18 °C, with an abundance index of 77.4-81.1 specimens. Males were less critical to the temperature factor. Optimal temperatures for them were 10 to 20 °C, when the abundance index was 22.0-33.4 specimens per flag-hour.

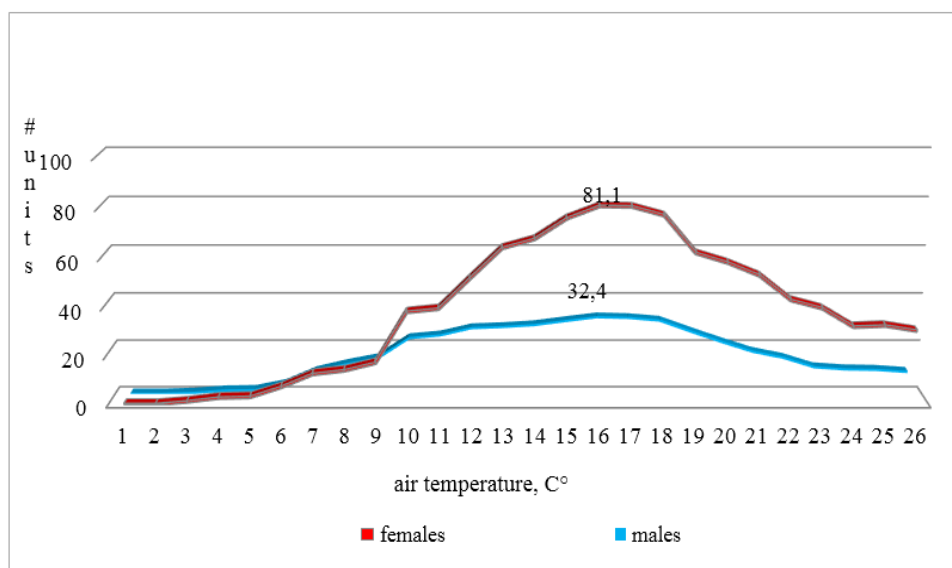


Figure 1 - Activity of females and males of *Dermacentor* genus as function of the air temperature.

In the spring period, female specimens prevailed in the population of *Dermacentorreticulatus* ticks. A decrease in the number of females was recorded by the end of the spring activity, in the autumn the number of females relatively to the number of males decreased significantly. The number of males remained stable throughout the season. Females were most active in the temperature range of 15-18 °C with an abundance index of 77.4-81.1 individuals. Males were less critical to the temperature factor; optimal temperatures for them were at the range of 10 to 20 °C, when the abundance index was 22.0-33.4 individuals per flag-hour.

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