

Dermacentor Reticulatus Biorhythms in the Northern Forest-Steppe of the Tyumen Region

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Abstract—To forecast the number of ticks and take successful measures for decreasing them in population it is necessary to know the features of their phenology in a particular region. The majority of acarologists pays attention to the features of *Ixodes persulcatus*' activity as they transmit ixodic infections. The proved epizootic and epidemiological importance of *Dermacentors* dictates the necessity of developing and organizing the comprehensive control system against this species of ticks to prevent diseases. This demand the fullest and comprehensive studying of ecology and phenology features of *Dermacentor reticulatus* of a particular region. The aim of the research is the detailed studying of bioecology of *Dermacentor reticulatus* ticks, the most widespread ticks in the Tyumen region.

We had monitored over the life cycle features of *Dermacentor reticulatus* in natural biotopes over the 2013 to 2014 period in the subzone of the northern forest-steppe of the Tyumen region.

In natural climatic conditions of the specified climatic zone *Dermacentor reticulatus* are capable to give one generation per a parasitizing season if parasite juvenile forms meet feeders. The whole process of reproduction from egg up to the adult specimen emerge took from 69 to 161 days, and averaged 115±1,99 full days. Metamorphosis of larvae had taken the shortest time period (29,1±2,0 full days or 25,3% of all cycle time), nymph and imago formations had happened practically for equal periods of 34,5±2,3 and 37,0±5,0 full days respectively. Having studied the regularities of the *Dermacentor reticulatus* life cycles we can prove the emergence and the activity peaks of both juvenile, and adult phases of these ticks activity. That allows to plan actions on controlling these parasites in places of their dwelling.

Key words—*Ixodidae*; *Dermacentor reticulatus*; *biorythms*, *biotope*; *feeder*; *egg-laying*; *metamorphosis*, *the Tyumen region*.

I. INTRODUCTION

Nowadays, according to the statistics the infectious diseases with a natural nidality remain the most dangerous in every respect and cause concern with close attention of many scientists and practitioners [1,3,7, 16, 17]. Therefore, it calls for comprehensive studying infectious diseases and developing science-based reasonable anti-epizootic and anti-epidemic actions on a. All this allows not only to expect scientifically, but also to prevent the emergence and spread of many infections, including those which are transferred by ixodid ticks [9,10,11].

Ixodid ticks have great medical and veterinary value. It is defined by their vector-borne transmission of many most dangerous pathogens for humans and farm animals. It is

considered that the list of the expert diagnosed diseases transmitted by ixodid ticks is not nearly complete [2, 4, 5, 12, 13].

At a complication of epidemiologic and epizootologic situations on tick-borne infections it is necessary to start conducting series of measures directed to localization of center of infection as soon as possible. The priority measures in this case are the treatment of natural biotopes and animals by highly effective acaricides, but at the same time it is necessary to know life cycle of a parasite in details as it can be influenced by abiotic and biotic factors [14, 15].

In recent years most of researchers have turned their focus toward studying the features of lifecycles and biological rhythms of Ixodid ticks as they have been considered as the main vector force of spreading tick-borne infections until recently. Lately in press there is much more information about participating *Dermacentor* ticks in this process [6, 8].

Taking into account the wide spreading of ticks *Dermacentor reticulatus* in the Tyumen region and their proved active involvement in saving and transmitting the tick-borne encephalitis virus, Borrelia, Anaplasma and Babesia, it is necessary to study the peculiarities of life cycles of these tick species to control the situation in epizootic and epidemiologic processes [4, 5].

II. MATERIALS AND METHODS

The experimental part of the study has been carried out by the Russian National Research Institute of veterinary entomology and arachnology in the laboratory of acarology under support of Programme of fundamental research of the RAS, project IX. 135.2.3, as well as by the Northern Trans-Ural State Agricultural University at the department of infectious and invasion diseases.

We had observed the life-cycle features of ticks *Dermacentor reticulatus* in natural biotopes over the 2013 to 2014 period.

For trial establishment of ticks in natural conditions they were caught in natural stations in the first decade of September (autumn activity peak). To study the ixodid species' capacity of survival in winter period they were fed on laboratory animals (rabbits) and were put into cages specially prepared for that experiment (Figure 1-3).



Fig. 1. Moving of congested female tick into forest litter



Fig. 3. Woodencage with the female tick *D. reticulatus*



Fig. 2. Female tick *Dermacentorreticulatus* innatural conditions

Eachcongestedfemalewasputintoan individualcage, which was stationed atdiscount area in biotopefor wintering. The female ticks were puton September 19, 2013at the air temperature of 11,3°C andrelative humidity of 90%.

III. RESEARCH RESULTS

The female ticks were under observation during the ixodidae's activity season. Asaresult,we have established that none female could lay eggs in autumn period (Figure4-5).



Fig. 4. Observation over female ticks



Fig. 5. Female *D. reticulatus* in forest litter

Considering negative meteorological factors which were characterized by heavy rains and low ambient temperature the terms of tick parasitizing in such conditions have been limited. The last active ticks in 2013 were caught in the nature on 29 September. Such behavior of female ticks was justified. In spite of the fact that the fall was long, air temperature had not been down to below 10°C up to December.

Weather conditions in winter months were standard for the region: the average air temperature was -13,8°C, the average indicator of atmospheric pressure was 755,2 mm Hg, the rainfall was 66 mm, the snow cover depth was 26,5 cm that corresponds to normal climatic indexes for studying region.

The observation over full females was continued at the beginning of the ixodid ticks activity season. The laying was checked on March 24, we stated the existence of all bions in the cages showing life signs. At the same time no one female tick started the process of egg-laying. After opening the cages we continued daily observations over the ticks, in the course of which we established the death of one female from the unknown wrecker (Figure 6), and three female ticks started their egg-laying on 6 May.



Fig. 6. Dead female tick

In 4 days (May 10) two more female ticks started laying eggs, next day the other two female ticks started laying eggs (Figure 7-9)



Fig. 7. The beginning of egg-laying



Fig. 8. Egg-laying by female *D. reticulatus*



Fig. 10. Larvae emerge from egg-laying



Fig. 9. Complete egg-laying

We have noted that females started egg-laying only when the air temperature was stabilized at the level of 15,4-24,9°C. The last alive female had fallen into diapause, it did not lay eggs during all season, and died at the end of the season. As a result, all 9 female ticks successfully overwintered, whereas only 7 females (77,8%) laid eggs.

The duration of the separate stages of *Dermacentor reticulatus* development in natural conditions is presented in the table 1. The table illustrates that the process of egg-laying had lasted for 6-14 days, then the period of larvae formation had started and lasted for 11-26 days, the emerge of the first larvae was registered on June 01. The process of larvae emerge had lasted for 23 days and finished on June 23 (Figure 10-11).

Table 1 –The duration of particular stages of *Dermacentor reticulatus* development in natural conditions from 2013 to 2014.

Stage of development	Duration of development, full day			According to life stages	
	limits	averagely, $M \pm m$	%	days	%
Egg laying	6-14	10.0±2.7	8.7	10.0±2.7	8.7
Larva metamorphosis	11-26	18.5±4.8	16.1	33.5±2.0	29.1
Larva emerge	7-23	15.0±2.0	13.0		
Larva feeding	5-7	6.0±1.0	5.2	34.5±2.3	30.0
Nymph metamorphosis	11-22	16.5±3.6	14.3		
Nymph emerge	9-15	12.0±2.2	10.4		
Nymph feeding	7-18	12.5±3.6	10.9	37.0±5.0	32.2
Imago metamorphosis	13-36	24.5±6.5	21.3		
Imago emerge	-	-	-		
Total period of tick development	69-161	115.0±1.9	100	115.0±6.4	100



Fig. 11. Process of larvae grouping

To actualize life cycles of *Dermacentor reticulatus* the individual cages with female ticks were demounted and all larvae were unified in one cage. The construction was strengthened by metal plates sunked 20 cm into the earth. To feed up larvae the white mice were put into the cage for 5-7 full days (Figure 12-14).



Fig. 12. The cage for feeding pre-imago ixodidae in the biotope



Fig. 13. Larvae creeping to the feeder

On the 8th day of the observation (June 30) there were no any larvae on the mice (Figure 14).



Fig. 14. Keeping feeders in the cage

Nymph metamorphosis from larvae had lasted for 11-22 full days, then on July 8 we had noticed the nymph emerges in cage, which had lasted for 9-15 days and had finished on July 23. To feed up nymphs and continue their metamorphosis, we put white mice into the cage on July 24 for 7-18 days as they were feeders for ixodidae at nymphal stage. We stopped feeding nymphs on 10 August. The imago metamorphosis had lasted for the most long time (13-36 full days), and the first adult had appeared in the cage only on August 22, and the imago emerge had stopped by September 4, i.e. it had lasted for 13 days.

Analyzing the data presented in table 1 we have revealed that the duration of separate stages of *D. reticulatus* development is various. Thus, larva metamorphoses had taken the smallest time period ($29,1 \pm 2,0$ full days or 25,3% of all time of a cycle) in comparison with the other active phases of ixodidae formation. Nymph and imago formations happened practically in equal periods of $34,5 \pm 2,3$ and $37,0 \pm 5,0$ full days respectively. We have noted that, *Dermacentor reticulatus* ticks are capable to give one generation for a parasitizing season if parasite juvenile forms meet feeders. All the process of reproduction from egg up to the emergence of an adult tick takes from 69 to 161 days, and averagely $115 \pm 1,99$ full days. During the observation we noticed that the preimaginal stages of the *D. reticulatus* spend 18,5% of time in metamorphosis by eating on an animal (without imago feeding time).

IV. CONCLUSIONS

In natural climate conditions of the Northern Trans-Ural region the *Dermacentor reticulatus* ticks are capable to give one generation for a parasitizing season on condition of meeting juvenile forms of a parasite with a feeder. All process of reproduction from egg up to the emergence of an adult tick takes from 69 to 161 days, averagely $115 \pm 1,99$ full days. Metamorphoses of larvae takes the smallest time period - $29,1 \pm 2,0$ full days or 25,3% of all time of a cycle, the formation of nymphs and imagos happens practically in equal time periods of $34,5 \pm 2,3$ and $37,0 \pm 5,0$ full days respectively. Having studied these regularities of life cycles of the *Dermacentor reticulatus* ticks of we can prove the emergence and the peaks of activity of both juvenile, and adult phases of these ticks activity that allows to plan actions for extermination of these parasites in places of their dwelling.

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References

[1] P. Bourdeau, T. Ximenes, O. Beziade, "Characteristics of *Dermacentor reticulatus* and *Ixodes ricinus* infestations in 191 dogs in France", *Journal Veterinary Dermatology*, vol. 15, pp. 49, 2004.

[2] K. Brugger, M. Walter, L. Chitimia-Dobler, G. Dobler, F. Rubel, Prediction of *Ixodes ricinus* nymphal density next season: an example of southern Germany 2018.

[3] A. Buczek, Z. Zając, A. Woźniak, D. Kulina, K. Bartosik, "Locomotor activity of adult *Dermacentor reticulatus* ticks (Ixodida: Ixodidae) in

natural conditions", *Ann Agric Environ Med*. 2017 May 11;24(2):271-275. doi: 10.5604/12321966.1230736.

[4] Yu. V. Glazunov, L. A. Glazunova, "Changes of sexstructure of population of ixodid ticks under the action of abiotic factors", *Journal of Pharmaceutical Sciences and Research*, Vol. 10(1), 2018, pp. 129-131.

[5] Yu. V. Glazunov, L. A. Glazunova, "Phenology of Pasture Ticks in The Trans-Urals", *Indian Vet. J.*, January 2018, no. 95 (01) pp. 19 – 22.

[6] L. A. Glazunova, Yu. V. Glazunov, A. A. Ergashev, "Ecological-epizootical situation on telasiosis among large cattle in Northern Ural region", *Research Journal of Pharmaceutical, Biological and Chemical Sciences.* Vol. 4. pp. 1687-1693, 2018.

[7] S. Hornok, M. L. Meli, E. Gönczi, R. Hofmann-Lehmann, "Seasonally biased or single-habitat sampling is not informative on the real prevalence of *Dermacentor reticulatus*-borne rickettsiae - A pilot study", *Acta Vet Hung*, 2017 Mar, no. 65(1), pp. 81-88. doi: 10.1556/004.2017.008.

[8] E. T. Machtinger, A. Y. Li, "Evaluation of four commercial natural products for repellency and toxicity against the lone star tick, *Amblyomma americanum* (Acari: Ixodidae)", *Exp Appl Acarol*, 2017, Dec, no. 73(3-4), pp. 451-460. doi: 10.1007/s10493-017-0185-z

[9] J. M. Medlock, K. M. Hansford, A. G. C. Vaux, B. Cull, S. Abdullah, M. E. Pietzsch, R. Wall, N. Johnson, L. P. Phipps, "Distribution of the tick *Dermacentor reticulatus* in the United Kingdom", *Med Vet Entomol*, 2017, no. 31(3), pp. 281-288. doi: 10.1111/mve.12235

[10] G. M. Moraru, J. S. Portugal, A. Bednarova, S. J. Mcinnis, C. D. Paddock, T. Becker, T. C. Smith, Z. Svobodova, J. J. Goddard, "Morphometric Analysis of Adult *Dermacentor parumapertus* Neumann (Acari: Ixodidae), From Various Locations Within its Geographical Range", *Med Entomol.*, 2018, no. 55(4), pp. 871-876. doi: 10.1093/jme/tjy009.

[11] E. Olivieri, A. L. Gazzonis, S. A. Zanzani, F. Veronesi, M.T. Manfredi, "Seasonal dynamics of adult *Dermacentor reticulatus* in a peri-urban park in southern Europe," *Ticks Tick Borne Dis.*, 2017, no. 8(5), pp. 772-779. doi: 10.1016/j.ttbdis.2017.06.002. Epub 2017 Jun 15.

[12] J. Radzijeuskaja, D. Mardosaitė-Busaitienė, A. Aleksandravičienė, A. Paulauskas, "Investigation of *Babesia* spp. in sympatric populations of *Dermacentor reticulatus* and *Ixodes ricinus* ticks in Lithuania and Latvia", *Ticks Tick Borne Dis.*, 2018, no. 9(2), pp. 270-274. doi: 10.1016/j.ttbdis.2017.09.013. Epub 2017 Sep 21.

[13] M. Selmi, L. Tomassone, L. A. Ceballos, A. Crisci, C. Ragagli, M. D. Pintore, W. Mignone, A. Pautasso, M. Ballardini, C. Casalone, A. Mannelli, "Analysis of the environmental and host-related factors affecting the distribution of the tick *Dermacentor marginatus*", *Exp Appl Acarol.*, 2018, no. 75(2), pp. 209-225. doi: 10.1007/s10493-018-0257-8.

[14] L. Skipin, E. Gaevaya, E. Zaharova, V. Petukhova, K. Sidorova "Biogeochemistry of heavy metals in trophic chain in terms of the south of Tumen region", *Procedia Engineering*, Vol. 165. pp. 860-868, 2016.

[15] O.A. Stolbova, Yu.V. Glazunov, L.N. Skosyrskikh, "Ticks-parasites of dogs in Northern Trans-Urals", *Indo American journal of pharmaceutical sciences*. vol. 05 (03), pp. 1675-1682, 2018.

[16] M. Yu. Tohou, S. N. Lutsuk, Yu.V. Dyachenko, Phenology of ticks of the genus *Dermacentor* in the Central Ciscaucasia, *Parasitology*, 2013, Vol. 47, no. 6, pp. 437-447.

[17] K. Vongphayloth, J. C. Hertz, K. Lakeomany, D. A. Apanaskevich, R. G. Robbins, I. W. Sutherland, P. T. Brey, "The Genus *Dermacentor* (Acari: Ixodidae) in Laos: A Review and Update of Species Records", *J Med Entomol*, 2018, no. 55(4), pp. 1047-1050. doi: 10.1093/jme/tjy041.