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MITE HYPOPI ON TICKS

ГИПОПУСЫ НА КЛЕЩАХ-ИКСОДИДАХ

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ABSTRACT

Hypopi of *Troupeauia nova* (Oudemans, 1906) (Acarina, Sarcoptiformes, Acaridae) were met on the tick-borne encephalitis and borreliosis vector *Ixodes persulcatus* for the first time. The ticks were collected in St.Petersburg Region during 1993 and 1994 seasons of tick activity. Seasonal changes in mite prevalence were noticed. Lower prevalence was noted at the temperatures over 10°C. The mites were more common on females than on males, and on normal ticks more common than on ticks with exoskeleton abnormalities. Among the *Borrelia* sp. infected ticks with changes in the exoskeleton, the occurrence of specimens infested with mites was higher than among the normal ones. The possible causes of the above difference in occurrence are discussed. A morphological description is presented of *T. nova* hypopus, demonstrating its difference from the genus *Schwiebea*.

РЕЗЮМЕ

На клещах *Ixodes persulcatus* в окрестностях Санкт-Петербурга в течение 1993—1994 гг. в сезоны активности этих переносчиков собраны и идентифицированы гипопусы *Troupeauia nova* (Oudemans, 1906) (Acarina, Sarcoptiformes, Acaridae). Отмечены различия в частоте встречаемости гипопусов в течение сезона. С наименьшей частотой они встречались в период со среднедекадной температурой выше 10°C.

Их чаще встречали на самках, нежели на самцах иксодид, и на нормальных клещах чаще, чем на особях с патологическими изменениями экзоскелета. Среди зараженных боррелиями иксодовых клещей гипопусы встречались чаще на особях с измененными хитиновыми покровами, нежели на нормальных особях. Обсуждаются возможные причины отмеченных различий.

Дано морфологическое описание гипопуса *T. nova*, предполагающее его отличие от рода *Schwiebea*.

Hypopi, or heteromorphic deutonymphs, being a phoretic phase of mites belonging to the genus *Troupeauia* Zachvatkin, 1941 (Acarina, Sarcoptiformes, Acaridae), are widely distributed on various species of insects [Oudemans, 1906; Zachvatkin, 1941; Turk, Turk, 1957; Cooreman, 1963; Woodring, 1966]. But we have never met before with any data about *T. nova* distribution and seasonal prevalence of its hypopi on *Ixodes persulcatus*, a vector of tick-borne encephalitis virus and tick borreliosis.

In this communication we attempted at studying *T. nova* hypopi distribution on *I. persulcatus*: on males vs. females; naive vs. *Borrelia*-infected; with vs. without the pathomorphological changes in exoskeleton which we described recently [Alekseev, Dubinina, 1993].

METHODS AND MATERIALS

Ticks. *Ixodes persulcatus* were collected once or twice every ten days during the 1993—1994 seasons of tick activity (April—July), in the recreation zone of St.Petersburg (Morskaya—Lisiy Nos) by flagging. A 3—4 ha zone was crossed randomly.

Only the third decade of May 1993 was missed because of the constant raining. The number of samples totalled 24. The ticks were fixed in the wet gauze bandage. In the evening of the collection day all the ticks were examined using a stereomicroscope. Sex, exoskeleton deformations, and mite presence on the tick body were identified. After estimating the moving activity of each specimen on an inclined tickdrome [Alekseev, 1995] we dissected most of the ticks to determine their infestation by *Borrelia burgdorferi* sensu lato using the dark-field microscope technique. The total number of investigated *I. persulcatus* specimens was 895.

Mites. The hypopi were roughly counted, fixed in 70% ethanol and then in Fora liquor, investigated and taxonomically determined. Their morphological peculiarities are shown in the Fig.1. This species was originally described by Oudemans [1906] who for this purpose used the hypopi from Poppe's collection (Germany) and named the discovered species *Tyroglyphus novus*. The generic name which is currently in use, *Troupeauia*, was proposed by Zachvatkin [1941] and then supported by Fain [1976]. Its coxa

sternalis skeleton (Fig. 1) is quite different from that of *Schwiebea*, the genus to which the mite was attributed by Turk & Turk [1957], Cooreman [1963] and Woodring [1966].

The number of hypopi found on one tick varied from hundreds (very rarely) to tens or even a single specimen.

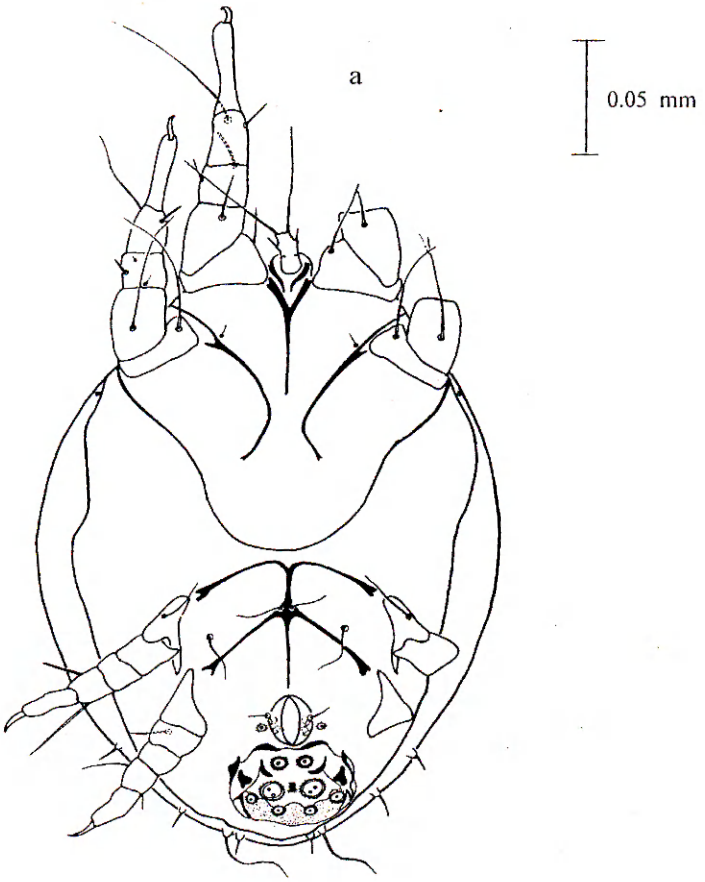

Fig. 1. *Troupeauia nova*, hypopi: a — ventral view, b — idiosoma, dorsal view, c — sucker apparatus, d-g — I—IV tarsi.

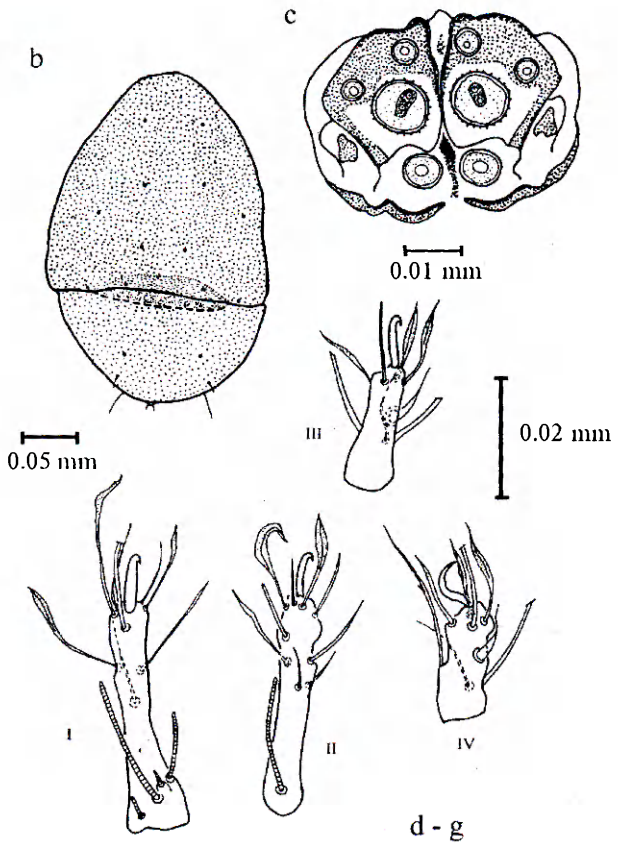

Рис.1. *Troupeauia nova*, гипопус: a — общий вид, вентрально, b — идиосома, дорсально, c — присасывательный аппарат, d—g — лапки I—IV.

RESULTS

On 895 *I. persulcatus* specimens, the hypopi were found 33 times (less than 4% of cases), on females a bit more frequently (57.6%) than on males, but in our samples the females prevailed (52.5%). The difference in number between males and females was not great, and their ratio was approximately 1:1 (Table 1). We collected mites more frequently on the normal ticks (Table 2) than on specimens with changed exoskeleton: in 3.96 vs. 3.28 % of cases,

the difference being statistically significant ($P < 0.001$). It is of interest that among ticks with exoskeletal pathology the mites were found mainly on *Borrelia*-infected specimens (5 of 8 cases). Among the normal ticks, only in one of 12 cases the mites were found on an infected *I. persulcatus* male. Our data are modest, but the difference in mite prevalence between the infected and naive, normal and morphologically abnormal ticks is also statistically significant. As can be seen from Figs.2 & 3, the mites were met, especially on the male ticks, mainly in the beginning and in the middle of the tick activity period (April, May, first half of June) and mainly when the 10-day mean temperature was below 10°C. Among the 8 samples collected at temperatures below 10°C, the mites were found in 6 (75% of cases). At higher temperatures only 31.25% of tests were mite-positive (Table 3). During the unusually hot summer of 1995 we found a mite-infested tick only once among 230 checked specimens. Among the mite-positive tick samples collected within the same season (Table 4), the number of mite-infested tick samples among those collected at higher temperatures was more than 1.5 times greater than among samples collected at lower ones. At lower temperatures most mites were collected on normal ticks; at higher temperatures the rate of mite-infested ticks was lower in normal ticks than in transformed ones. Measuring tick activity immediately after collecting them showed that *Borrelia*-infected specimens with mites were slightly more active than mite-infested but *Borrelia*-free ones. Repeated activity evaluation just before the tick dissection revealed that the activity indices of hypopi-infested, naive, and borrelia-infected ticks were practically identical.

DISCUSSION

Most of the mites found at their phoretic phase and taken from their arthropod hosts are known and identifiable on the species level only as hypopi. Our species, *Troupeauia nova* was discovered by Zachvatkin [1941] on wasps and beetles near Moscow. As already mentioned in the introductory section of our communication, we never met with any data about phoresia of mites on the *Ixodes* ticks or about hypopi prevalence on their host depending on the host's sex and seasonal conditions. Such peculiarities were reported only for the hypopi collected from fleas of some rodents in Kenyan grassland [Schwan, 1993]. Among the flea species in question, females dominated during the whole year, and it was just on females that the mites dominated. There was one seasonal peak in the number of mites on *Xenopsylla cheopis* bantorum fleas, and mites were nearly three times more abundant on females of this species than on males.

In our study females also prevailed (52.5%) among the collected ticks, and mites were also found on females more often (57.6%). This means that as well as in the case of fleas, female ticks may be more important dispersers

of *T. nova* hypopi than males. Females attach to their vertebrate host for a much longer period, and hypopi have therefore a chance to be dispersed more widely. According to Hagvar's data [1984], hypopi of *Shwiebea nova* mites (synonym of *Troupeauia nova*) were most abundant in acid soils with pH of 3.5—4. In the area where we collected our tick samples, the soil was much less acid (pH 5.0—5.5), and maybe this was why the total number of ticks with *T. nova* hypopi was less than 4% (Table 1).

Table 1

Mites on males and females of *Ixodes persulcatus*

Таблица 1

Гипопусы на самцах и самках *Ixodes persulcatus*

Ticks	Sex				Total	Mite infested
	Males (M)		Females (F)			
	Total	Mites infected	Total	Mites infected		
Abs	425	14	470	19	895	33
%	47.5	3.29	52.5	4.04	—	3.69
Rate of mite infested specimens among M & F	—	42.4	—	57.6	—	100.0

Table 2

Prevalence of mites on *Borrelia* infected and naive ticks with and without exoskeletal changes

Таблица 2

Преобладание клещей на зараженных *Borrelia* иксодовых клещах и на иксодидах с и без изменений экзоскелета

Tick characteristic	Prevalence of ticks with mites			Prevalence of mites on *Borrelia* infected ticks		
	No of tested specimens	No of positive tests		No of ticks tested for *Borrelia* infection	No of positive tests	
		abs	%		abs	relative
Normal	530	21	3.96+0.8	12	1	0.083+0.079
With exoskeletal changes	365	12	3.28	8	5	0.625+0.171

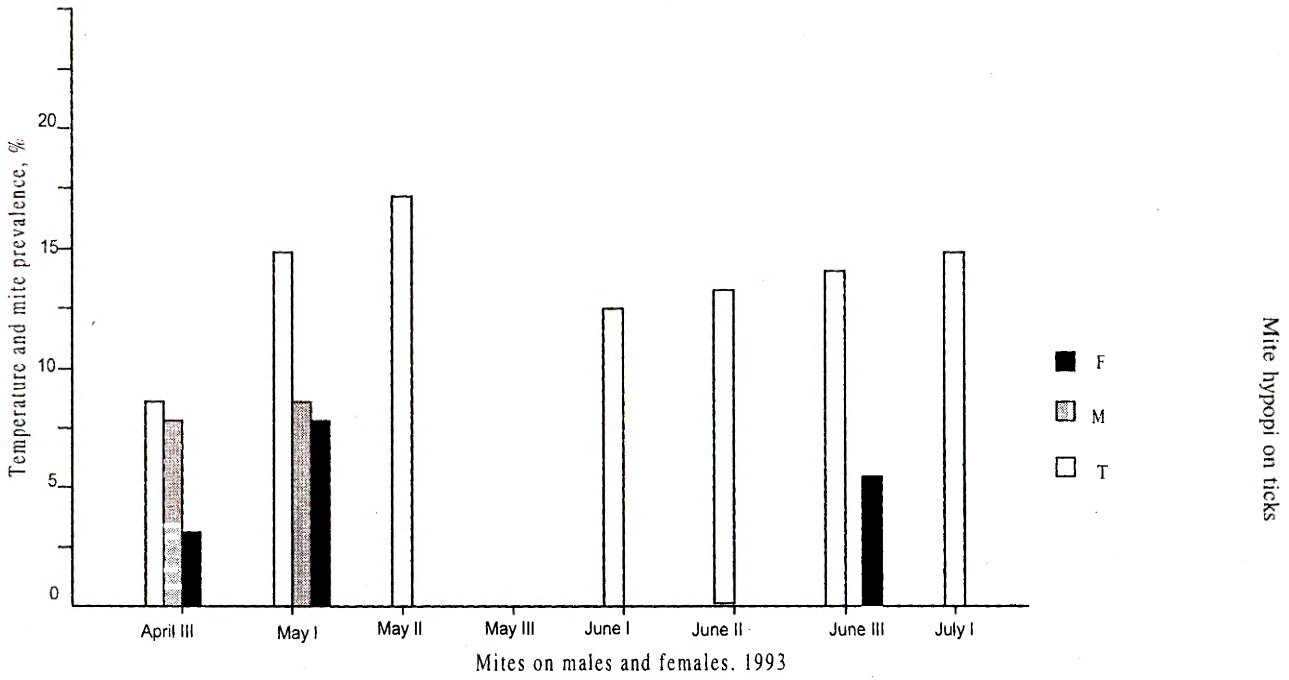

Fig.2. Mite prevalence on *I. persulcatus* during the season of tick activity in 1993. T — 10-day mean temperature, M — mite prevalence on *I. persulcatus* males, F — same, on females.

Рис.2. Встречаемость гипопусов на *I. persulcatus* в течение сезона их активности в 1993 году. T — среднедекадная температура, M — встречаемость гипопусов на самцах *I. persulcatus*, F — то же на самках.

Table 3
Number of mite-positive tests among tick samples collected at different temperatures
Таблица 3
Количество гипопусов на иксодидах, собранных при различных температурах

Mean 10-day temperature	No of samples	No of positive samples	
		abs	%
10° or lower	8	6	75.0+15.3
Over 10°	16	5	31.25+11.9
Total	24	11	45.8

Table 4
Number of tick with mites among tick samples collected at different temperatures
Таблица 4
Количество иксодид с гипопусами среди клещей, собранных при различных температурах

Mean 10-day temperature	No of collected ticks		No of tick with mites	
			abs	%
10° or lower	Among positive samples	385	18	4.7+1.08
	Among all samples	427	18	4.2+0.97
Over 10°	Among positive samples	193	15	7.8+1.93
	Among all samples	468	15	3.2+0.8
Total		895	33	3.7

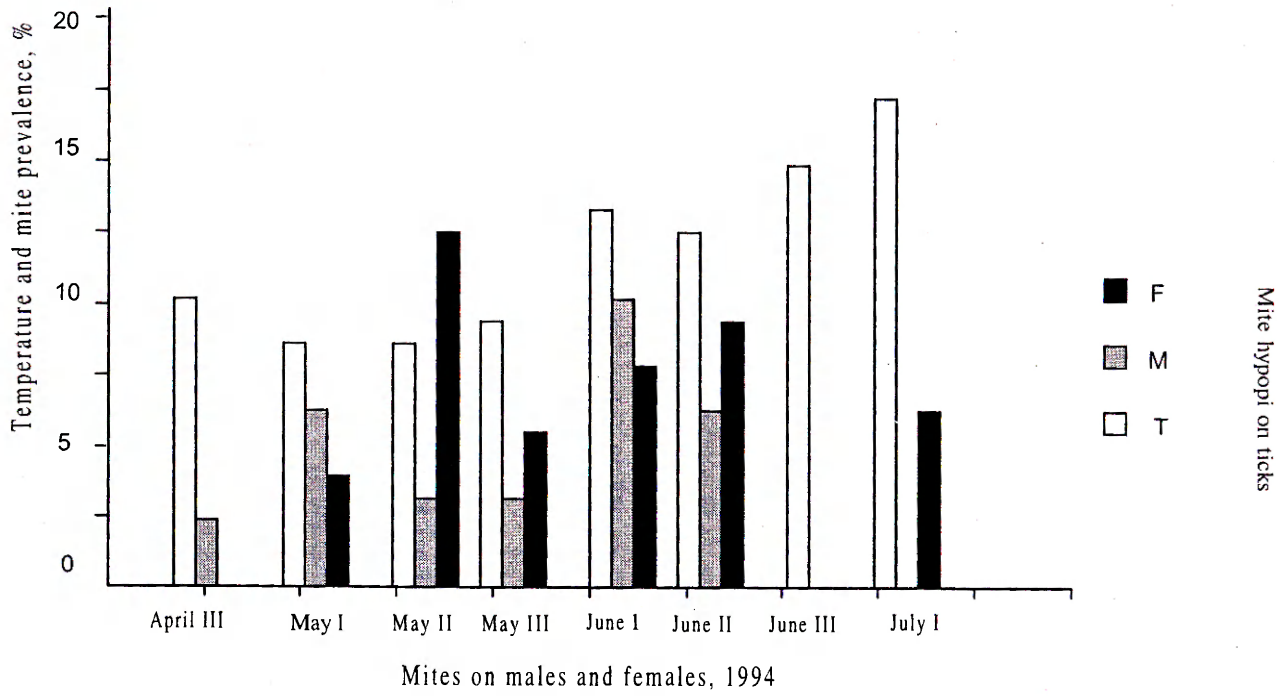

Fig.3. Mite prevalence on *I. persulcatus*. Season of 1994. Designations as in Fig.2.
Рис.3. Встречаемость гипопусов на *I. persulcatus*. Сезон 1994 года. Обозначения как на рис.2.

The prevalence of hypopi on *I. persulcatus* roughly correlated with their abundance during the season of tick activity, but is evidently dependent of the mean 10-day temperature: at the temperatures higher than 10°C their prevalence was lowest, especially on males (Fig. 2 & 3). It is known [Zachvatkin, 1941] that the phoretic phase of Acaridida is most abundant during the period within the season that is unfavorable for their hosts. The latter makes it probable that the low mite prevalence at temperatures over 10°C was a consequence of the preceding weeks when the temperature was lower than 10°C. It is of interest that despite the lower abundance of ticks with exoskeletal pathologies (38.6%), the prevalence of mites on them was nearly equal to that on normal specimens (Table 2). The mean *Borrelia* prevalence among ticks is 19.6%, among ticks with changed exoskeleton 24% [Dubinina, Alekseev, 1994]. The figures of hypopi detection on infected ticks are greater (31.2% of cases) than the value of the mean infection rate (19.6%). Of interest is the fact that highest was the prevalence of hypopi on the infected specimens with transformed exoskeleton (5 of 8 cases), whereas only one infected normal tick was mite-positive among the 12 investigated. We supposed at first that the cause of this difference consists in the lower moving activity of infected specimens, which is typical of them in general [Alekseev, 1995], but the moving activity of specimens investigated in this study was the same as, and sometimes even slightly higher than, that of hypopi-free ones. This means that the intriguing question of the preferential hypopi infestation of infected tick as a marker of *Borrelia* infection remains open.

All hypopi found were fixed on the intersegmental membranes of legs or between the hypostome and the idiosomal scutum; their abundance on one tick specimen fluctuated from singles to hundreds.

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