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Lice (Anoplura) of Small Mammals in the Middle Ob Region

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Abstract—Lice (Anoplura) were studied in 2015–2018 in the middle taiga of West Siberia in the territory of the Middle Ob region (Khanty-Mansi Autonomous Okrug–Yugra). Lice were found on 15 species of small mammals, of which the most significant hosts were *Alexandromys oeconomus*, *Microtus rossiaemeridionalis*, *M. agrestis*, *Myodes glareolus*, and *M. rutilus*. The louse *Hoplopleura acanthopus* had the widest host range and was also dominant among all the louse species found on small mammals. The peaks of louse abundance coincided with those of host reproductive activity in late spring and early autumn. In the most common host *A. oeconomus*, the highest degree of infestation (mainly with *H. acanthopus*) was recorded in adult males; the corresponding indices were significantly lower in adult females and especially low in young mammals. The population structure of *H. acanthopus* showed prevalence of females (about 50%) in comparison with males and larvae. Co-parasitism of lice was especially pronounced on adult host specimens. The lice *Hoplopleura edentula*, *Hoplopleura longula*, and *Polyplax hannswrangeli* were recorded for the first time from the studied territory.

Keywords: lice, small mammals, middle Ob region, middle taiga of West Siberia

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The Middle Ob region within the Khanty-Mansi Autonomous Okrug–Yugra extends from Khanty-Mansiysk in the west to Nizhnevartovsk in the east. The regional economy is largely based on the oil and gas industry and power engineering. The fauna of this territory includes typical West Siberian middle-taiga species of small mammals. The predominant insectivores are the common shrew *Sorex araneus* L., the pygmy shrew *S. minutus* L., and Laxmann's shrew *S. caecutiens* Laxmann. The predominant species among rodents are typically the northern red-backed vole *Myodes rutilus* Pallas and the root vole *Alexandromys oeconomus* Pallas. The northern water vole *Arvicola amphibius* L. may also become dominant in its usual biotopes during its population outbreaks (Starikov et al., 2014); however, during our research in 2015–2018 northern water voles comprised no more than 1% of the total number of small mammals, and the population of this species was in the depression phase (Starikov et al., 2016, 2017).

The species composition, distribution, and ecological features of lice associated with small mammals in the vast territory of West Siberia, including the Middle Ob region, are still insufficiently studied. One of the first summary works on blood-sucking ticks and insects of West Siberia was published by Popov (1953), who listed 6 species of lice based on the sporadic literature data: 3 species infesting humans [according to the modern views, there are only 2 species: *Pediculus humanus* (Linnaeus, 1758) and *Phthirus pubis* (Linnaeus, 1758)], the pig parasite *Haematopinus suis* (Linnaeus, 1758), the brown rat parasite *Polyplax spinulosa* (Burmeister, 1839), and *Hoplopleura acanthopus* (Burmeister, 1839) infesting a wide range of hosts. Data on lice living on small mammals in West Siberia were also published in several other papers in the second half of the XX century. In particular, Popov (1977) gave an overview of 3 louse species from Tyumen Province, Elshin (1987) recorded 6 species for the Yamalo-Nenets Autonomous

Okrug, and 5 species of lice parasitic on small mammals were recorded for Tomsk and Kurgan provinces each (Igolkin, 1978; Starikov et al., 1988).

Lice are permanent parasites that occur on their host all the year round and frequently suck its blood; correspondingly, they can maintain prolonged circulation of agents of a number of natural focal diseases in the populations of small mammals. Of special significance in West Siberia is the association of lice with natural foci of tularemia. The participation of lice in the spread of tularemia was repeatedly demonstrated, especially under congested conditions (Golov, 1934; Olsufjev and Dunaeva, 1960; Olsufjev and Petrov, 1967).

MATERIALS AND METHODS

Our research was performed in May–September 2015–2018 within the territory of Khanty-Mansi Autonomous Okrug–Yugra, in the urban areas of Khanty-Mansiysk, Surgut, and Nizhnevartovsk, in their environs, and also near Tundrino and Yugan villages in Surgutskii District. Surveys of small mammals were carried out in different biotopes in the Ob River floodplain and on the overlying terrace. Small mammals were captured using pitfall trenches (Naumov, 1955), guide fences made of polyethylene film (Okhotina and Kostenko, 1974), and trap lines (Kucheruk, 1963, etc.). Altogether, 6583 mammals were examined; they belonged to 15 species known as hosts of lice: the common shrew *Sorex araneus* L., 1758, Laxmann's shrew *S. caecutiens* Laxmann, 1785, the pygmy shrew *S. minutus* L., 1766, the Siberian chipmunk *Tamias sibiricus* Laxmann, 1769, the northern birch mouse *Sicista betulina* Pallas, 1779, the muskrat *Ondatra zibethicus* L., 1766, the gray red-backed vole *Craseomys rufocanus* Sundevall, 1846, the bank vole *Myodes glareolus* Schreber, 1780, the northern red-backed vole *M. rutilus* Pallas, 1779, the northern water vole *Arvicola amphibius* L., 1758, the root vole *Alexandromys oeconomus* Pallas, 1776, the East European vole *Microtus rossiaemeridionalis* Ognev, 1924, the field vole *M. agrestis* L., 1761, the harvest mouse *Micromys minutus* Pallas, 1771, and the least weasel *Mustela nivalis* L., 1766. The captured mammals were weighed and measured in the standard way, and their sex was determined during dissection (Tupikova, 1964). The age of root voles (the most significant host of lice during the study period) was determined by the scull shape and sculpture, namely the closure of cranial sutures and the degree of development of carinae (Larina and Lapshov, 1974, etc.). The Latin names of small mammals are given after Pavlinov and Lisovsky (2012).

Lice were collected off small mammals following the guidelines of Sosnina and Tikhvinskaya (1969) and Zarubina (1976) and identified using the keys of Blagoveshchensky (1964), Beaucournu (1968), and Zarubina (1986). The Latin names of lice are given after Durden and Musser (1994). Altogether, we recorded 5527 lice of 4 species: *Hoplopleura longula* Neumann, 1909, *H. acanthopus* Burmeister, 1839, *H. edentula* Fahrenholz, 1916, and *Polyplax hannswrangeli* Eichler, 1952. The common parasitological indices were calculated: the occurrence index OI (%), the abundance index AI (ind.), and the infestation intensity II (ind.) (Beklemishev, 1961). The significance of differences in the abundance index was determined by the formula of Terentiev and Rostova (1977):

$$t = \frac{X_1 - X_2}{F} \; ; \quad F = \sqrt{\frac{S_1^2(n-1) + S_2^2(n-1)}{n_1 + n_2 - 2}} * \sqrt{\frac{n_1 + n_2}{n_1 n_2}},$$

where X_1 and X_2 are the abundance indices being compared, S_1 and S_2 are their standard deviations, n_1 and n_2 are the numbers of specimens in the samples. The calculated values of t were compared with the reference values for Student's t distribution (Ivanter and Korosov, 1992).

RESULTS AND DISCUSSION

The distribution of lice on small mammals in the Middle Ob region is shown in Table 1 and Table 2. As can be seen from these data, the great majority of lice occurred on rodents (99.38%), while the number of lice recorded on shrews was 166 times smaller (0.60%), and that recorded on small carnivores was even smaller (0.02%). A similar relative abundance of lice parasitizing rodents and shrews was observed in other regions (Arzamasov and Trukhan, 1966; Volkov et al., 1977; Nikulina, 1978; Sosnina, 1982, etc.). The dominant louse species in our material was *Hoplopleura acanthopus* which occurred on 14 out of 15 species of small mammals and comprised over 90% of all the recorded lice. These lice were most commonly found on the root vole *A. oeconomus* (92.9%), on which they also had the highest abundance index (3.69). We agree with Popov (1977) that the root vole should be regarded as one of the principal hosts of *H. acanthopus* in West Siberia.

Table 1. Distribution of lice *H. acanthopus* and *H. edentula* on small mammals in the Middle Ob region (the middle taiga of West Siberia) in 2015–2018

Species of small mammals	Number of mammals examined	*H. acanthopus*					*H. edentula*				
		number of mammals infested	number of lice collected	infestation parameters			number of mammals infested	number of lice collected	infestation parameters		
				occurrence index OI, %	infestation intensity II, ind.	abundance index AI, ind.			occurrence index OI, %	infestation intensity II, ind.	abundance index AI, ind.
S. araneus	2465	9	11	0.4	1.2	0.004	2	5	0.08	2.5	0.002
S. caecutiens	464	3	12	0.6	4.0	0.03	–	–	–	–	–
S. minutus	582	2	3	0.3	1.5	0.005	–	–	–	–	–
T. sibiricus	32	1	3	3.1	3.0	0.09	–	–	–	–	–
S. betulina	128	2	2	1.6	1.0	0.01	–	–	–	–	–
O. zibethicus	7	1	1	14.3	1.0	0.14	–	–	–	–	–
C. rufocanus	118	1	141	0.8	141.0	1.19	2	12	1.7	6.0	0.10
M. glareolus	98	1	1	1.0	1.0	0.01	12	38	12.2	3.2	0.39
M. rutilus	891	11	32	1.2	2.9	0.04	67	319	7.5	4.8	0.36
A. amphibius	68	2	2	2.9	1.0	0.03	–	–	–	–	–
A. oeconomus	1304	179	4666	14.1	26.1	3.69	3	4	2.4	1.3	0.003
M. rossiae-meridionalis	107	25	99	23.4	4.0	0.93	–	–	–	–	–
M. agrestis	128	11	48	8.6	4.4	0.38	1	1	0.8	1.0	0.008
M. minutus	222	–	–	–	–	–	–	–	–	–	–
M. nivalis	7	1	1	14.3	1.0	0.14	–	–	–	–	–

The occurrence index OI is the number of infested hosts related to the total number of examined hosts (%); the infestation intensity II is the mean number of parasites per 1 infested host individual; the abundance index AI is the mean number of parasites per 1 examined host individual.

Table 2. Distribution of lice *H. longula* and *P. hannswrangeli* on small mammals in the Middle Ob region (the middle taiga of West Siberia) in 2015–2018

Species of small mammals	Number of mammals examined	*H. longula*					*P. hannswrangeli*				
		number of mammals infested	number of lice collected	infestation parameters			number of mammals infested	number of lice collected	infestation parameters		
				occurrence index OI, %	infestation intensity II, ind.	abundance index AI, ind.			occurrence index OI, %	infestation intensity II, ind.	abundance index AI, ind.
S. araneus	2465	–	–	–	–	–	2	2	0.08	1.0	0.001
S. caecutiens	464	–	–	–	–	–	–	–	–	–	–
S. minutus	582	–	–	–	–	–	–	–	–	–	–
T. sibiricus	32	–	–	–	–	–	–	–	–	–	–
S. betulina	128	–	–	–	–	–	–	–	–	–	–
O. zibethicus	7	–	–	–	–	–	–	–	–	–	–
C. rufocanus	118	–	–	–	–	–	–	–	–	–	–
M. glareolus	98	–	–	–	–	–	–	–	–	–	–
M. rutilus	891	–	–	–	–	–	1	1	0.1	1.0	0.001
A. amphibius	68	–	–	–	–	–	1	1	1.5	1.0	0.01
A. oeconomus	1304	–	–	–	–	–	32	66	5.2	2.1	0.03
M. rossiae-meridionalis	107	–	–	–	–	–	2	3	1.9	1.5	0.03
M. agrestis	128	–	–	–	–	–	17	41	13.3	2.4	0.32
M. minutus	222	2	7	0.9	3.5	0.03	–	–	–	–	–
M. nivalis	7	–	–	–	1.0	–	–	–	–	–	–

The infestation parameters are explained in Table 1.

Table 3. Infestation of root voles of different sexes and age groups with *Hoplopleura acanthopus* in the Middle Ob region

Age group	Females, males			Females				Males			
	infestation parameters			number of voles examined	infestation parameters			number of voles examined	infestation parameters		
	OI, %	II, ind.	AI, ind.		OI, %	II, ind.	AI, ind.		OI, %	II, ind.	AI, ind.
Subadults	7.9	3.3	0.08	497	8.7	2.6	0.23	374	7.0	4.4	0.30
Adults	27.9	40.4	11.24	157	19.7	11.5	2.28	238	33.2	51.7	17.10

Table 4. Age and sex composition of *Hoplopleura acanthopus* on root voles in the Middle Ob region

Month	Number of voles examined	Number of lice collected	Number of lice, ind.			Relative number of lice, %		
			females	males	larvae	females	males	larvae
May	110	1215	719	352	144	59.2	29.0	11.8
June	383	1001	674	240	87	67.3	24.0	8.7
July	137	10	8	2	–	80.0	20.0	–
August	159	42	10	32	–	23.8	86.2	–
September	472	2398	890	741	767	37.1	30.1	30.1
October	5	–	–	–	–	–	–	–
Total	1266	4666	2301	1367	998	49.3	29.3	21.4

Table 5. Distribution of lice species on root voles in the Middle Ob region

Territory	Number of voles examined	*H. acanthopus*					*H. edentula*					*P. hannswrangeli*				
		number of voles infested	number of lice collected	infestation parameters			Number of voles examined	number of lice collected	infestation parameters			Number of voles examined	number of lice collected	infestation parameters		
				OI, %	II, ind.	AI, ind.			OI, %	II, ind.	AI, ind.			OI, %	II, ind.	AI, ind.
Ob River floodplain	562	65	652	11.6	10.0	1.16	2	2	0.4	1.0	0.004	14	29	2.5	2.1	0.05
Overlying terrace	704	158	4014	22.4	25.4	5.70	1	2	0.1	2.0	0003	18	37	2.6	2.1	0.05

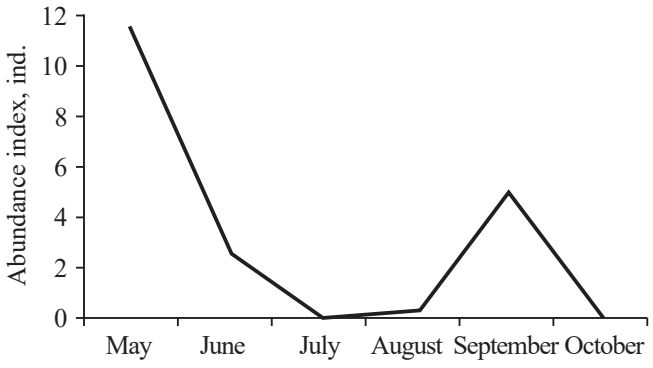

Fig. 1. Seasonal changes in the abundance index of *Hoplopleura acanthopus* on root voles in the Middle Ob region.

A single specimen of *H. acanthopus* was found on the least weasel, which probably got the louse from some small mammal among its prey. The louse *H. edentula* was recorded on six species of small mammals and was the most abundant on voles of the genera *Myodes* and *Craseomys*. The louse *P. hannswrangeli* was also recorded on six host species, but its overall abundance in the Middle Ob region was 18 times lower than that of *H. acanthopus* and 2 times lower than that of *H. edentula*. Still lower abundance was observed in *H. longula*, a parasite of the harvest mouse.

Lice are known to have seasonal fluctuations of abundance, which may affect their position in communities and the wideness of their ecological niches (Balashov, 2005). Seasonal changes in the rate of infestation with lice, mostly with *H. acanthopus*, were most completely characterized by our collections of root voles. The highest infestation with *H. acanthopus* was recorded in May, after which it gradually decreased during summer and increased again in September, reaching approximately 50% of the spring level (Fig. 1). No lice were recorded on root voles in October. In our opinion, such seasonal dynamics of louse infestation was related to changes in the reproduction intensity of the host. At the same time, according to the data of Nikulina (1981) for a section of the Baikal-Amur Railroad within the Chara Depression in Northeast Transbaikalia, high abundance of *H. acanthopus* on root voles was recorded either in the beginning and last thirds of July and the last third of August, or in the beginning and last thirds of May and the beginning third of June. In the opinion of the cited author, the abundance of lice had several seasonal peaks separated by intervals of 10–20 days and not always coinciding with high abundance of the host.

Root voles also demonstrated different rates of louse infestation depending on their age and sex (Table 3). As could be expected, the infestation parameters of adult males were the highest, exceeding those of adult females by 7.5 times; in our opinion, the difference is related to the higher activity of males during the reproductive period. The subadult root voles did not reveal significant sex-related differences ($p = 0.05$, $t = 0.11$), while their overall infestation was tens of times lower.

The age and sex composition of the lice *H. acanthopus* (Table 4) showed prevalence of females (49.3%) and considerably lower shares of males and larvae. Similar trends in the sex and age composition of *H. acanthopus* on the northern water vole were observed by Sosnina and Tikhvinskaya (1969) in the Volga-Kama region.

As opposed to the excessively humid floodplain of the Ob River, the overlying terrace has a more stable complex of biotopes with conditions favorable for root voles. It is no coincidence that the parameters of infestation with lice, mostly with *H. acanthopus*, were 1.9–4.9 times higher on the terrace (Table 5).

Simultaneous presence of 2–3 species of lice was recorded for the voles *Myodes rutilus*, *Microtus agrestis*, and *M. rossiaemeridionalis*. This phenomenon was the most pronounced in the root vole population from the environs of Tundrino Village in Surgutskii District, where co-parasitism was observed in 14% of the examined hosts ($n = 130$), with the incidence of 57.9% in May, 36.8% in June, and 5.3% in September. Co-parasitism of different louse species was the most typical of adult mammals (79%).

CONCLUSIONS

1. Lice were recorded on 15 species of small mammals in the Middle Ob region. The most important hosts of lice were the voles *Alexandromys oeconomus*, *Microtus rossiaemeridionalis*, *M. agrestis*, *Myodes glareolus*, and *M. rutilus*.

2. The louse *Hoplopleura acanthopus* predominated in the collections and had a wide range of hosts.

3. The abundance peaks of lice occurred in late spring and in early autumn and coincided with peaks of reproduction activity of the hosts.

4. Co-parasitism of different louse species on the same species of small mammals was a relatively rare phenomenon, most typical of adult hosts.

5. The presence of *Hoplopleura acanthopus* on small mammals was confirmed for the Middle Ob region; *Hoplopleura edentula*, *Hoplopleura longula*, and *Polyplax hannswrangeli* were recorded from the region for the first time.

COMPLIANCE WITH ETHICAL STANDARDS

The authors declare that they have no conflict of interest. All the applicable international, national, and/or institutional guidelines for the care and use of animals were followed. All the procedures performed in studies involving animals were in accordance with the ethical standards of the institution or practice at which the studies were conducted.

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