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ECTOPARASITES FROM THE NESTS OF THE FAT DORMOUSE (*Myoxus glis*) IN SLOVENIA

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In a mountain area in the Dinaric beech-fir forests of southern Slovenia, sixty summer nests of *Myoxus glis* were collected. In these nests, 1984 males and 2547 females of *Ceratophyllus (Monopsyllus) sciurorum sciurorum*, 9117 flea larvae, 3 males and 4 females of *Ceratophyllus hirundinis*, 1 female of *Ceratophyllus rusticus*, 3 males of *Oeciacus hirundinis* and 3 males and 3 females of *Schizophthirus* sp. were found. This was the second time that *Ceratophyllus rusticus* and *Oeciacus hirundinis* and the third time that *Schizophthirus* sp. were found in Slovenia. The developmental cycle of *Ceratophyllus (Monopsyllus) sciurorum sciurorum* is described.

Key words: *Myoxus glis* (*Glis glis*), Slovenia, nests, ectoparasites, *Ceratophyllus (Monopsyllus) sciurorum sciurorum*, *Ceratophyllus hirundinis*, *Ceratophyllus rusticus*, *Oeciacus hirundinis*, *Schizophthirus sp.*, developmental cycle of *Ceratophyllus (Monopsyllus) sciurorum sciurorum*

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U planinskom području dinarskih bukovo-jelovih šuma južne Slovenije prikupljeno je šezdeset ljetnih gnijezda puha *Myoxus glis*. U tim gnijezdima nađena su 1984 mužjaka i 2547 ženki *Ceratophyllus (Monopsyllus) sciurorum sciurorum*, 9117 ličinki buha, 3 mužjaka i 4 ženke *Ceratophyllus hirundinis*, 1 ženka *Ceratophyllus rusticus*, 3 mužjaka *Oeciacus hirundinis* i 3 mužjaka i 3 ženke *Schizophthirus* sp. Za vrste *Ceratophyllus rusticus* i *Oeciacus hirundinis* to je drugi, a za *Schizophthirus* sp. treći nalaz za Sloveniju. Opisan je razvojni ciklus *Ceratophyllus (Monopsyllus) sciurorum sciurorum*.

Ključne riječi: *Myoxus glis* (*Glis glis*), Slovenija, gnijezda, ektoparaziti, *Ceratophyllus (Monopsyllus) sciurorum sciurorum*, *Ceratophyllus hirundinis*, *Ceratophyllus rusticus*, *Oeciacus hirundinis*, *Schizophthirus* sp., razvojni ciklus *Ceratophyllus (Monopsyllus) sciurorum sciurorum*

INTRODUCTION

The basic taxonomic studies of the ectoparasites of birds and mammals in Slovenia are the work of Savo Brelih (BRELIH & PETROV, 1978; BRELIH, 1986). His study collections include Mallophaga, Anoplura, and Siphonaptera.

In Europe there are thirteen ecological groups of fleas (ROSICKÝ, 1957): fleas of *Sciurus vulgaris* and dormice (mainly *Myoxus glis*); fleas of small ground mammals; fleas of *Oryctolagus cuniculi*; fleas of large ground rodents (*Cricetus, Citellus*); fleas of large Carnivora; fleas of humans, cats, dogs and domestic pigs; fleas of Chiroptera; fleas of *Erinaceus europaeus*; fleas of birds that nest on the ground or water surface; fleas of swallows; fleas of *Riparia riparia*; fleas of *Columba livia* and fleas of small singing birds, which nest in tree canopies, holes, nest boxes and bushes.

In Slovenia only 3 of them are quite well known: those of *Sciurus vulgaris* and dormice, of small ground mammals, and of *Erinaceus europaeus*; all other ecological groups are poorly known.

For *Myoxus glis* Linnaeus, 1766 (formerly *Glis glis*, WILSON & REEDER, 1993), whether from animals or nests, Central European authors cite 14 species of fleas: *Ceratophyllus (Monopsyllus) sciurorum sciurorum* (Schrank, 1803) (in further text, *C. sciurorum*) (PEUS, 1954, 1958, 1964, 1970, 1972; JURÍK 1957, 1966; ROSICKÝ, 1957; ROSICKÝ & CARNELUTTI, 1959; ROSICKÝ et al., 1959; ROSICKÝ & TODOROVIĆ, 1964; SKURATOWICZ, 1964; HRISTOV, 1968, 1974; SZABO, 1969b; BEAUCOURNU, 1976; SKURATOWICZ & BARTOWSKA, 1977; HAITLINGER, 1978b; TRAUB et al., 1983; BRELIH, 1986; DUDICH, 1993), *Myoxopsylla laverani* (Rothschild, 1911) (PEUS, 1970, 1972), *Ctenophthalmus agyrtes*[1] (Heller, 1896) (ROSICKÝ & CARNELUTTI, 1959; JURÍK, 1966; PEUS, 1970, 1972), *Ctenophthalmus assimilis* (Taschenberg, 1880) (ROSICKÝ, 1957; JURÍK, 1966, 1957), *Ctenophthalmus nifetodes* Wagner, 1933 (ROSICKÝ & CARNELUTTI, 1959; BRELIH, 1986), *Ceratophyllus gallinae* (Schrank, 1803) (PEUS, 1968, 1970, 1972), *Ceratophyllus garei* Rothschild, 1902 (ROSICKÝ, 1957), *Nosopsyllus fasciatus* (Bosc, 1801) (PEUS, 1970, 1972), *Hystrichopsylla talpae* (Curtis, 1826) (PEUS, 1972), *Dasypsyllus gallinulae* (Dale, 1878) (PEUS, 1972), *Megabothris turbidus* (Rothschild, 1909) (JURÍK, 1966; HRISTOV, 1968), *Leptopsylla silvatica* (HRISTOV, 1968), *Doratopsylla dasycnema* (Rothschild, 1897) (HRISTOV, 1968) and *Palaeopsylla similis* Dampf, 1910 (HRISTOV, 1968). Only three of them (*C. sciurorum, Ctenophthalmus agyrtes and Ctenophthalmus nifetodes*) are cited for Slovenia (ROSICKÝ & CARNELUTTI 1959; BRELIH 1986).

The present paper presents ectoparasites living in Slovenia in the nests of *M. glis*, their ecological indices and the developmental cycle of *C. sciurorum*.

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[1] All taxa without subspecific classification.

MATERIALS AND METHODS

Nests of the European fat dormouse (*M. glis*) were collected from boxes designed for birds and bats that were inhabited by dormice. They were placed in a permanent study area (TRILAR, 1991) in the Dinaric beech-fir forest (*Abieti-Fagetum dinaricum*) in the Sviščaki area on Snežnik Mountain (altitude 1250 m, UTM VL54, Figure 1) and in the middle European mixed forest in the Draga area (altitude 840 m, UTM VL75, Figure 1). The contents of the nest were transported from the field in airtight plastic bags to prevent the escape of any arthropods. They were placed over Berlese-Tullgren funnels (SOUTHWOOD, 1978) for altogether 5 days for the collection of arthropods.

The preparation methods of ectoparasites were those of Brelih (TRILAR, 1991) and the specimens were identified by comparison with specimens from Ectoparasite Study Collections in the Slovene Museum of Natural History.

The material is kept in the Slovene Museum of Natural History in Ljubljana.

The following ecological indices were calculated:

Constancy was the percentage of samples in which a species was found compared to all the samples. The following constancy categorisation was applied (BALOGH, 1958): above 75.1 %, euconstant species; 50.1 up to 75.0 % , constant species; between 25.1 and 50.0 %, accessory species; and below 25.0 % , accidental species.

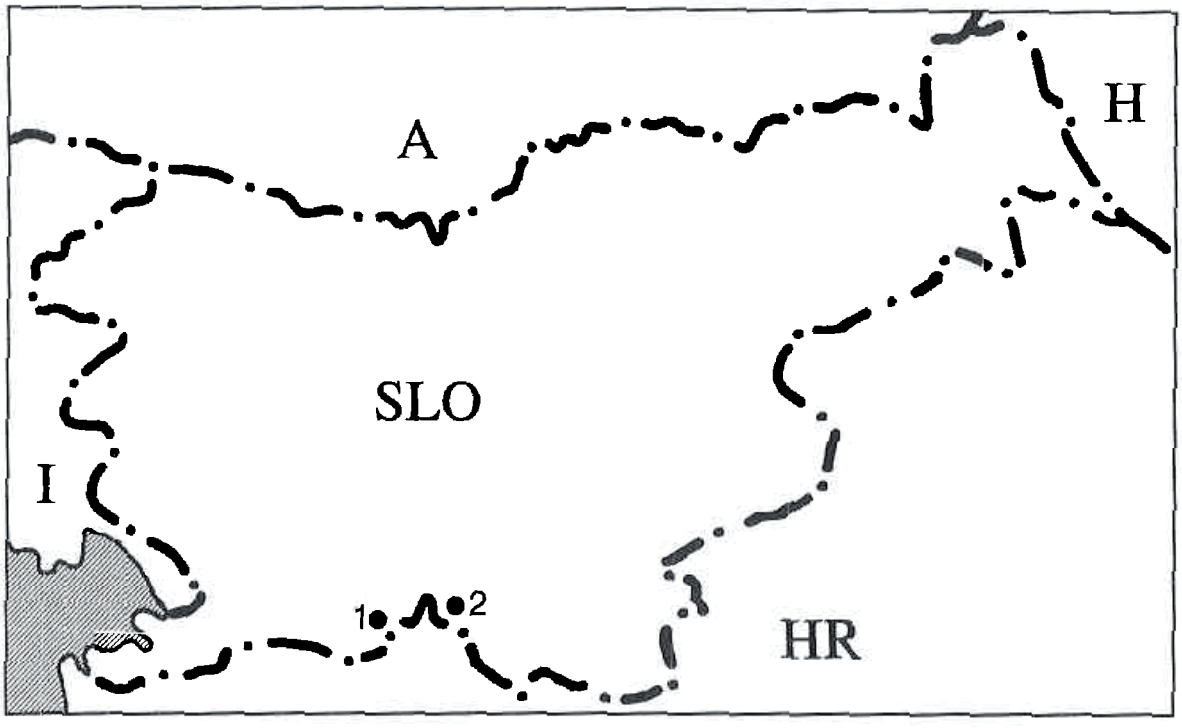

Figure 1. Map of collecting sites
(1 – SLO: Snežnik, Sviščaki, 2 – SLO: Draga)

Index of Occurrence (IO) (IOFF, 1949) is the average number of adults of ectoparasitic species in all inspected samples, whether on animals or in the nests.

Index of Parasitism (IP) (IOFF, 1949) is the average number of adults of ectoparasitic species in infested samples only, whether on animals or in nests. By this index we simply avoid old or inactive nests which are represented in the index of occurrence.

RESULTS

In the Sviščaki area we collected altogether 57 nests of *M. glis* and 3 nests in the Draga area. Seventeen arthropod groups were present (Table 1). Siphonaptera and Diptera appeared euconstantly; Collembola, Coleoptera and Acarina constantly; while Aranea, Hymenoptera, Dermaptera, Chilopoda, Homoptera, Anoplura, Psocoptera, Hemiptera, Diplopoda, Protura, Neuroptera and Lepidoptera appeared accidentally (Table 1).

Table 1. Fauna in the nests of *Myoxus glis* (Σ – Amount (Sum), C(%) – Constancy)

No.	Locality	Date
1	SLO: Snežnik, Sviščaki	17. 2. 1993
2	SLO: Snežnik, Sviščaki	6. 3. 1990
3	SLO: Snežnik, Sviščaki	2. 6. 1990
4	SLO: Snežnik, Sviščaki	30. 6. 1992
5	SLO: Snežnik, Sviščaki	22. 8. 1990
6	SLO: Snežnik, Sviščaki	2. 9. 1992
7	SLO: Draga	9. 9. 1992
8	SLO: Snežnik, Sviščaki	27. 9. 1993

Locality	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Σ**	**C(%)**
No. of samples	18	9	1	9	12	4	3	4	60	
Siphonaptera	11	6	1	8	4	12	3	3	48	80.0
Anoplura	0	0	0	0	1	0	1	0	2	3.3
Chilopoda	0	1	0	0	0	0	0	2	3	4.9
Diplopoda	0	0	0	1	0	0	0	0	1	1.6
Aranea	5	4	0	0	0	3	0	1	13	21.7
Acarina	1	2	1	9	3	11	2	2	31	50.8
Protura	0	0	0	0	1	0	0	0	1	1.6
Collembola	15	7	0	3	1	7	0	3	36	60.0
Dermaptera	0	1	0	0	0	2	1	0	4	6.6
Psocoptera	0	0	0	0	0	0	2	0	2	3.3
Hemiptera	1	0	0	0	0	0	0	1	2	3.3
Homoptera	0	0	0	1	0	2	0	0	3	4.9
Coleoptera	4	2	1	7	4	9	1	4	32	52.5
Hymenoptera	0	1	0	0	0	7	0	0	8	13.1
Neuroptera	0	1	0	0	0	0	0	0	1	1.6
Lepidoptera	1	0	0	0	0	0	0	0	1	1.6
Diptera	18	6	1	8	2	8	1	4	48	78.7

Table 2. Active stages of ectoparasites in the nests of *Myoxus glis*
(No – number of the nests, M – male, F – female)

			Anoplura		Hemiptera		Siphonaptera						
			Schizophthirus sp.		Oeciacus hirundinis		Larvae	*Ceratophyllus sciurorum*		Ceratophyllus hirundinis		*Ceratophyllus rusticuslus*	
Locality	Date	No	M	F	M	F		M	F	M	F	M	F
Sviščaki	17.2.1993	18	0	0	0	0	0	249	423	0	0	0	0
Sviščaki	6.3.1990	9	0	0	0	0	0	226	311	0	0	0	0
Sviščaki	2.6.1990	1	0	0	0	0	0	1	8	0	0	0	0
Sviščaki	30.6.1992	9	0	0	0	0	3513	649	752	0	0	0	0
Sviščaki	22.8.1990	4	2	2	0	0	493	190	221	3	3	0	1
Sviščaki	2.9.1990	12	0	0	0	0	4761	556	614	0	1	0	0
Draga	9.9.1992	3	1	1	0	0	304	92	184	0	0	0	0
Sviščaki	27.9.1993	4	0	0	3	0	46	21	34	0	0	0	0
Together		60	3	3	3	0	9117	1984	2547	3	4	0	1

Table 2 gives the data for groups of samples in each sampling and for all samplings together. Altogether, in 60 *M. glis* nests (Table 2) we found 3 males of the bug *Oeciacus hirundinis* (Jenyns, 1839), 3 males and 3 females of the louse *Schizophthirus sp.*, 1 female of the flea *Ceratophyllus rusticus* Wagner, 1903, 3 males and 4 females of the flea *Ceratophyllus hirundinis* (Curtis, 1826), and 1984 males and 2457 females of the flea *C. sciurorum*. There were also 9117 flea larvae belonging to all three developmental stages. We consider that most probably all flea larvae belong to *C. sciurorum*. Ticks (Ixodida) were not present in the nests of *M. glis* inspected.

The IO for all flea species was 94.6 and IP 96.5 (Table 3, Figure 2). IO for *Oe. hirundinis* was 0.06 and IP 3.0 (Table 3). For *Schizophthirus* sp. it was IO 0.13 and IP 3.0 (Table 3).

Table 3. Index of occurrence and Index of parasitism for ectoparasites in the *Myoxus glis* nests (IO – Index of Occurrence, IP – Index of Parasitism)

Locality		Snežnik 17.2.'93	Snežnik 6.3.'90	Snežnik 2.6.'90	Snežnik 30.6.'92	Snežnik 22.8.'90	Snežnik 2.9.'93	Draga 9.9.'92	Snežnik 27.9.'93	Total
Schizophthirus	IO	–	–	–	–	1.0	–	0.7	–	0.13
sp.	IP	–	–	–	–	4.0	–	2.0	–	3.0
Oeciacus	IO	–	–	–	–	–	–	–	1.0	0.06
hirundinis	IP	–	–	–	–	–	–	–	3.0	3.0
Ceratophyllus	IO	61.1	89.5	9.0	175.1	102.8	97.5	92.0	18.3	94.4
sciurorum	IP	61.5	107.4	9.0	175.1	102.8	97.5	92.0	18.3	96.4
Ceratophyllus	IO	–	–	–	–	1.5	0.1	–	–	0.15
hirundinis	IP	–	–	–	–	6.0	1.0	–	–	3.5
Ceratophyllus	IO	–	–	–	–	0.2	–	–	–	0.02
rusticus	IP	–	–	–	–	1.0	–	–	–	1.0
Siphonaptera	IO	61.1	89.5	9.0	175.1	104.5	97.6	92.0	18.3	94.6
together	IP	61.5	107.4	9.0	175.1	104.5	97.6	92.0	18.3	96.5

DISCUSSION

The arthropod fauna in *M. glis* nests is quite varied, but we cannot compare it with other European regions, because the literature does not cite a complete survey, but only portions of the ectoparasites. Thus, from the nonparasitic species in *M. glis* nests, we would only mention the preying bug *Lyctocoris dimidiatus* (Spinola, 1837) (Anthocoridae, Hemiptera) which was found in Slovenia for the first time (GOGALA, 1996). Of the ectoparasitic species, this is the second finding of *C. rusticus* and *Oe. hirundinis* in Slovenia, and the third for *Ceratophyllus hirundinis; Schizophthirus sp. C. sciurorum* is generally widespread in Slovenia.

The greatest number of ectoparasites in one *M. glis* nest was 606 *C. sciurorum* adults. This enormous number of ectoparasites in the nests has, however, no effect on the *M. glis* brood size (TRILAR, 1995).

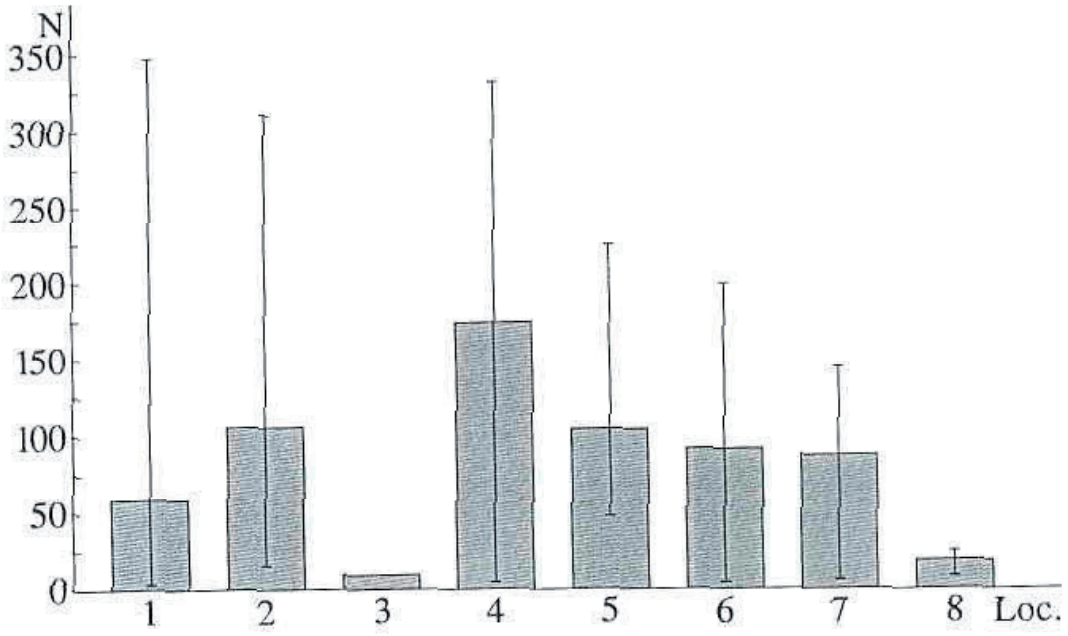

Figure 2. Index of parasitism for ectoparasites in the *Myoxus glis* nests (Height of bar – Value of Index of parasitism, Line – Minimum and maximum of ectoparasites in the nests)

No.	Locality	Date
1	SLO: Snežnik, Sviščaki,	17. 2. 1993
2	SLO: Snežnik, Sviščaki,	6. 3. 1990
3	SLO: Snežnik, Sviščaki,	2. 6. 1990
4	SLO: Snežnik, Sviščaki,	30. 6. 1992
5	SLO: Snežnik, Sviščaki,	22. 8. 1990
6	SLO: Snežnik, Sviščaki,	2. 9. 1992
7	SLO: Draga,	9. 9. 1992
8	SLO: Snežnik, Sviščaki,	27. 9. 1993

Samples from the *M. glis* nests in Slovenia showed three species of fleas, *C. sciurorum*, *C. hirundinis*, and *C. rusticus*. *M. glis* is the major host for *C. sciurorum*, which ecologically belongs to the group of squirrel and dormice fleas (ROSICKÝ, 1950, 1957; JURÍK 1976). *M. glis*, and also *Sciurus vulgaris* Linnaeus, 1758, in the Balkan peninsula are 100% infested with *C. sciurorum* (BRELIH, 1986).

With exception of *C. sciurorum* and *Myoxopsylla laverani*, *M. glis* is an occasional or accidental host for the other 12 listed flea species (see Introduction), therefore their absence in our siphonapterofauna from *M. glis* nests is not surprising as such. *M. glis* comes into contact with flea species which ecologically belong in the flea group of small ground mammals (*Ctenophthalmus agyrtes*, *Ctenophthalmus assimilis*, *Ctenophthalmus nifetodes*, *Nosopsyllus fasciatus*, *Hystrichopsylla talpae*, *Megabothris turbidus*, *Leptopsylla silvatica*, *Doratopsylla dasycnema* and *Palaeopsylla similis*) during underground winter hibernation. At least some of them from this ecology group could be expected in the *M. glis* nests, because in a permanent study area of the Sviščaki

region (TRILAR, 1991) we found 7 flea species on small mammals from this ecology group: *Hystrichopsylla talpae, Atyphloceras nuperus* (Jordan, 1921), *Ctenophthalmus agyrtes, Doratopsylla dasycnema, Palaeopsylla soricis* (Dale, 1878), *Rhadinopsylla integella* Jordan & Rothschild, 1921 and *Peromyscopsylla bidentata* (Kolenati, 1863).

The presence of *C. hirundinis* and *C. rusticus* in *M. glis* nests was very surprising. Both belong to the group of swallow fleas (ROSICKÝ, 1950,1957; JURÍK, 1975, 1976, 1978), and *M. glis* is an accidental host. We have not been able to find them in the literature pertaining to *M. glis* nests. The intermediate host which mediated this transfer from the swallow group into the nests of the dormouse was most probably *Sitta europaea* Linnaeus, 1758 (TRILAR, 1995).

Three male specimens of the bug *Oe. hirundinis* were also found in the nests. This bug species could be ecologically classified into the group of swallow ectoparasites by analogy with fleas. It is the first finding in any mammalian nest (TRILAR *et al.*, 1997).

In comparison with other European regions, the lowest values of IO for fleas are small, while the higher ones are much in excess of those quoted in the literature. The indices of occurrence in Germany are between 55.3 and 77.0 (calculated from PEUS, 1970, 1972). Again, comparison with other European regions shows the lowermost values of IP for fleas to be very low, while the higher ones are much greater than in the literature. Indices of parasitism in Germany lie between 77.0 and 77.4 (calculated from PEUS, 1970, 1972).

We have been able to reconstruct the developmental cycle of *C. sciurorum*. *M. glis* moves into boxes designed for birds and bats at the end of April, or even the end of May, building summer nests, raising their young, and departing by the middle of October. The dormice remain in the boxes five and a half months or even less; in the remaining six and a half months the boxes are empty.

To reconstruct the developmental cycle of *C. sciurorum* we used data of one sampling in February (11 nests), March (6 nests), and August (4 nests). The data for June (9 nests) are the average of two samplings, and for September (18 nests), of three.

The adults of *C. sciurorum* spent the entire winter in the nests and their numbers showed a slight decrease: in September the average number of adults was 83.4 *per* nest, in February 61.1 (Figure 3). Their numbers increased in May to 89.5, as a result of the hatching of those which had overwintered in cocoons with the first spring warmth. Their numbers were greatest in June with average 156.7 *per* nest; in the summer their numbers fell: in August there were 102.8 and 83.4 in September.

In their development the larvae showed two peaks, one in June, the other in September. In June the 3rd developmental stage was the most frequent with an average number of 157.1 per nest, followed by the 2nd stage with 147.2, while the least frequent was stage 1 with 68.0 (Figure 3). By August the number of larvae fell and the most frequent were the 2nd and 3rd stages with 53.8, followed by stage 1 with 17.8. In September their numbers increased again; then the most frequent was stage 1 with an average of 149.6 per nest, followed by stage 3 with 80.5, while the smallest was stage 2 with 53.6. A good month later the larvae had fully developed and

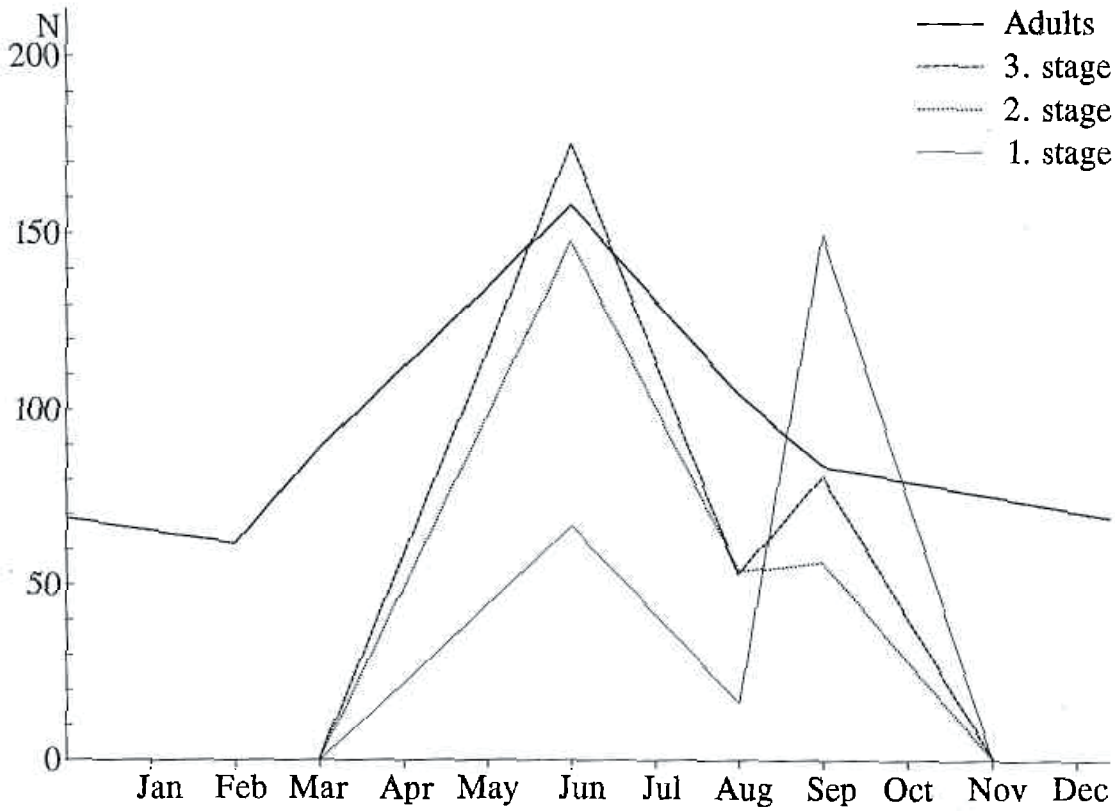

Figure 3. Developmental cycle of *Ceratophyllus (Monopsyllus) sciurorum sciurorum*

in the winter months could not be found in *M. glis* nests. The two peaks indicate two generations of *C. sciurorum* in a year.

The developmental cycle of *C. sciurorum* in *M. glis* nests demonstrates a dependency on the biology of the host and its dynamics in rearing its young. The long periods in the absence of the host are survived by *C. sciurorum* as an active adult or as a fully developed, resting adult in the cocoon. Active adults in the nests are helped in their long wait for their host by the winter cold, which freezes them along with the nest. Repeated freezing and thawing does not have an effect on *C. sciurorum* (TRILAR, unpublished data).

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Sažetak

Ektoparaziti iz gnijezda sivog puha (*Myoxus glis*) u Sloveniji

Tomi Trilar

U 60 pregledanih gnijezda bilo je 1984 mužjaka i 2457 ženki *Ceratophyllus sciurorum*, 9117 ličinki buha, 3 mužjaka i 4 ženke *Ceratophyllus hirundinis*, 1 mužjak *Ceratophyllus rusticus*, 3 mužjaka *Oeciacus hirundinis* i 3 mužjaka i 3 ženke *Schizophthirus* sp. Krpelji nisu pronađeni u istraživanim gnijezdima *M. glis*. Najveći broj ektoparazita u jednom gnijezdu bio je 606 odraslih *C. sciurorum*. To je drugi nalaz *C. rusticus* i *Oe. hirundinis* za Sloveniju, a treći za *C. hirundinis* i *Schizophthirus* sp. *C. sciurorum* je općenito široko rasprostranjena u Sloveniji.

U uzorcima iz gnijezda *M. glis* pronađene su tri vrste buha, *C. sciurorum*, *C. hirundinis*, i *C. rusticus*. *M. glis* je glavni domadar za *C. sciurorum*, koja ekološki pripada grupi vjeveričjih i puhovih buha (ROSICKÝ, 1950, 1957; JURÍK, 1976).

C. hirundinis i *C. rusticus* su u grupi lastavičjih buha (ROSICKÝ, 1950, 1957; JURÍK, 1975, 1976, 1978), a *M. glis* je slučajni domadar. U literaturi nismo mogli pronaći njegovu vezanost za gnijezda *M. glis*. Međudomadar koji je posredovao u prijenosu od lastavica u puhova gnijezda bio je vjerojatno brgljez *Sitta europaea* (TRILAR, 1995).

U gnijezdu su također pronađena tri mužjaka stjenice *Oe. hirundinis*. Ova vrsta stjenica se ekološki može svrstati u grupu lastavičjih parazita prema analogiji s buhama. Ovo je njen prvi nalaz u gnijezdu sisavaca (TRILAR *et al.*, 1997).

Indeks pojavljivanja (IO) (IOFF, 1949) za sve vrste buha bio je 94.6, a indeks parazitizma (IP)) (IOFF, 1949) je bio 96.5 (tablica 3, slika 2). IO za *Oe. hirundinis* bio je 0.06, a IP 3.0 (tablica 3). Za *Schizophthirus* sp. IO je bio 0.13, a IP 3.0 (tablica 3).

Opisan je razvojni ciklus *C. sciurorum* u gnijezdu *M. glis*. Ciklus pokazuje ovisnost o biologiji domadara i potpunu usklađenost s njegovom dinamikom podizanja mladih.

Summary

Ectoparasites from the nests of the fat dormouse (*Myoxus glis*) in Slovenia

Tomi Trilar

In 60 *Myoxus glis* nests examined there were 1984 males and 2457 females of *Ceratophyllus sciurorum*, 9117 Siphonaptera larvae, 3 males and 4 females of *Ceratophyllus hirundinis*, 1 males of *Ceratophyllus rusticus*, 3 males of *Oeciacus hirundinis*, and 3 males and 3 females of *Schizophthirus* sp. Ticks (Ixodida) were not present in the nests of *M. glis* inspected. The greatest number of ectoparasites in one nest was 606 *C. sciurorum* adults. This is the second time *C. rusticus* and *Oe. hirundinis* have been found in Slovenia, and the third time for *C. hirundinis* and *Schizophthirus* sp. *C. sciurorum* is widespread in Slovenia.

Samples from the *M. glis* nests showed three species of fleas, *C. sciurorum*, *C. hirundinis*, and *C. rusticus*. *M. glis* is the major host for *C. sciurorum*, which ecologically belongs to the group of squirrel and dormice fleas (ROSICKÝ, 1950, 1957; JURÍK, 1976). *C. hirundinis* and *C. rusticus* are in the group of swallow fleas (ROSICKÝ, 1950, 1957; JURÍK, 1975, 1976, 1978), but *M. glis* is an accidental host. We have not been able to find them in the literature pertaining to *M. glis* nests. The intermediate host which mediated this transfer from the swallow group into the nests of the dormouse was most probably *Sitta europaea* (TRILAR, 1995).

Three male specimens of the bug *Oe. hirundinis* were also found in the nests. This bug species could be ecologically classified into the group of swallow ectoparasites by analogy with fleas. It is the first finding in any mammalian nest (TRILAR *et al.*, 1997).

The index of occurrence (IO) (IOFF, 1949) for all flea species was 94.6 and the index of parasitism (IP) (IOFF, 1949) 96.5 (Table 3, Figure 2). IO for *Oe. hirundinis* was 0.06 and IP 3.0 (Table 3). For *Schizophthirus sp.* it was IO 0.13 and IP 3.0 (Table 3).

The developmental cycle of *C. sciurorum* in the nests of *M. glis* is described. The cycle demonstrates a dependency on the biology of the host and complete synchronisation with its dynamics in rearing its young.