

MITES OF THE GENUS *SCHIZOCARPUS* (ACARIFORMES: CHIRODISCIDAE) PARASITIZING THE EURASIAN BEAVER *CASTOR FIBER* (RODENTIA: CASTORIDAE) IN THE VORONEZH NATIONAL RESERVE

A. V. Bochkov^{1,2,*} and H. V. Dubinina¹

Zoological Institute of the Russian Academy of Sciences, Universitetskaya Emb. 1, 199034 Saint Petersburg, Russia; e-mail: prostigmata@zin.ru

²Museum of Zoology, University of Michigan, 1109 Geddes Ave., Ann Arbor, Michigan 48109, USA

*Corresponding author

ABSTRACT: Fauna of fur mites of the genus *Schizocarpus* Trouessart, 1896 (Acariformes: Chirodiscidae) associated with the Eurasian beaver *Castor fiber* L. (Rodentia: Castoridae) in the beaver farm of Voronezh National Reserve (Russia) was examined. Totally, 16 *Schizocarpus* spp. were recorded. Among them 11 species were previously described by Dubinina (1964) from the same locality and four following recovered species were formerly described by Fain and Lukoschus (1985) from *Castor fiber* in Western Europe: *S. pygidialis*, *S. radiatus*, *S. similis*, and *S. subhexapilis*. Available specimens of one more species close to *S. latus* (Dubinina, 1964) are determined as *S. sp.* and probably belong to a new species but are in the poor condition. Seven species described by Dubinina (1964) are redescribed: *S. brevicauda*, *S. grandis*, *S. parvus*, *S. subparvus*, *S. minor*, *S. latus*, and *S. subminor*. Two previously described species, *S. dubininae* Fain et Lukoschus, 1985 syn. nov. and *S. ventricosus* Fain et Lukoschus, 1985 syn. nov., are synonymized with *S. grandis* and *S. latus*, respectively. The record of *S. mingaudi* Trouessart, 1896 on *Castor fiber* from the Voronezh National Reserve by Dubinina (1964) is considered as the host shift from the American beaver *Castor canadensis* Kuhl happened in captivity at the Voronezh beaver farm.

KEY WORDS: *Castor fiber*, Eurasian beaver, mites, *Schizocarpus*, systematics, Voronezh Natural Reserve

INTRODUCTION

Fur mites of the genus *Schizocarpus* Trouessart, 1896 (Acariformes: Chirodiscidae) like all other representatives of chirodiscids are permanent and highly specialized parasites inhabiting undercoat of beavers (Rodentia: Castoridae) (Bochkov 2010). In this genus, species diagnostic is entirely based on male characters; most of them concern the opisthosomal structures (Dubinina 1964; Fain et al. 1984). To date, 50 species of *Schizocarpus* are described from two extant beaver species, the Eurasian beaver *Castor fiber* Linnaeus, 1785 and the American beaver *Castor canadensis* Kuhl, 1829; more than ten mite species could simultaneously parasitize on one host individual locating in different fur zones (Dubinina 1964; Fain et al. 1984; Fain and Lukoschus 1985; Fain and Whitaker 1988; Dubinina et al. 1993). Among *Schizocarpus* spp. 32 species are known exclusively from the Eurasian beaver (Dubinina et al. 1964; Fain et al. 1985), 17 species from the American beaver (Fain et al. 1984; Whitaker and Smith 1985; Fain and Whitaker 1988; Whitaker et al. 1989, 2009; Dubinina et al. 1993), and one species, *Schizocarpus mingaudi* Trouessart, 1896 was recorded on both host species (Trouessart 1896; Dubinina 1964). These mites being strongly specific to their hosts are the excellent example of the phylogenetic synhospitality, an interesting biological phenomenon when the whole monophyletic complex of symbiotic species has evolved exclusively on a single host species (Bochkov and Mironov 2008). In the case

of *Schizocarpus* spp. and beavers, the main reasons of such phenomenon are the allopatric mite speciation caused by the disjunctive ranges of both beaver species and mite adaptations to the particular microhabitats on the beaver body with the probable following synxenic speciation (Dubinina 1964; Fain and Lukoschus 1985; Whitaker 2006; Bochkov and Mironov 2008).

At the end of IX century only eight relict populations of *C. fiber* remained in Eurasia (Durka et al. 2005). Each of these relict populations belongs to a separate subspecies. The main problems being important for the conservation of the present biodiversity of Eurasian beavers are the high potency of previously isolated relict Eastern European populations for spreading and the reintroduction of beavers which has been undertaken without estimation of the phylogeography (Durka et al. 2005). Our previous study of mites of the genus *Listrophoroides* Hirst, 1923 (Atopomelidae) forming synhospitalic mite complexes on *Maxomys surifer* (Miller, 1909) (Rodentia: Muridae) in Southeast Asia clearly showed a high level of coincidence between phylogeny of these mites and their host phylogeography (Bochkov and OConnor 2005). In the same manner, the detailed study of the *Schizocarpus* biodiversity on beavers in each relict population would serve as an outer test for validation of beaver's phylogeography hypotheses.

One of relict beaver populations is the population inhabiting the Don and Voronezh watersheds. These beavers are formally referred to *C. f. orientoeuropaeus* Lavrov, 1981 (A.P. Saveljev,

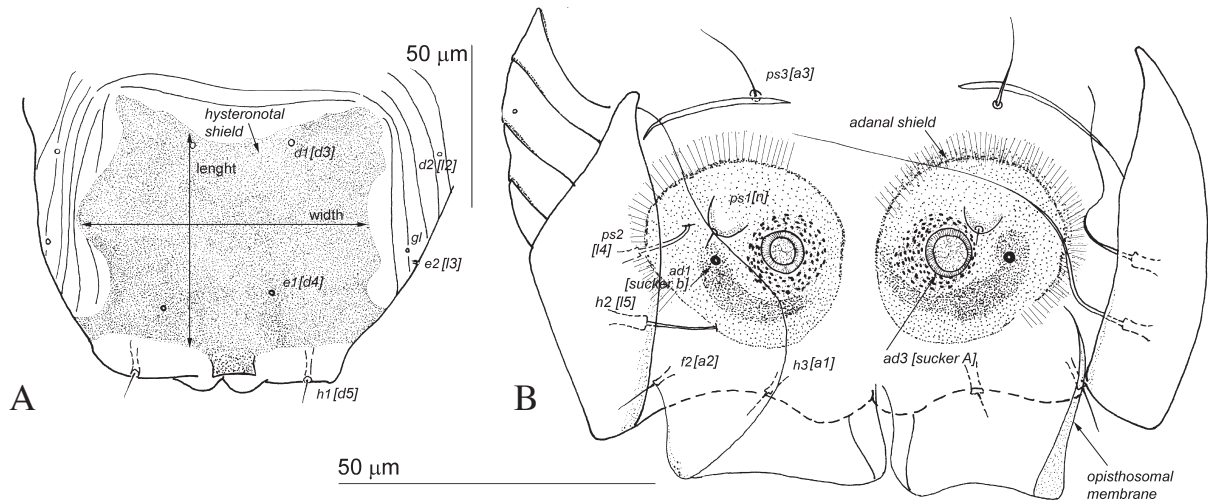


Fig. 1. *Schizocarpus parvus* (Dubinina, 1964), opisthosoma of male lectotype: A — dorsum; B — venter. Setal designations according to Fain et al. (1984) are in brackets.

personal communication). Unfortunately, beavers of this subspecies were extensively hybridized with representatives of another widely distributed beaver subspecies *C. f. belorussicus* Lavrov, 1981 in Russia and neighboring countries. Therefore it is very difficult to address the issue of intraspecific taxonomy in the case of these two subspecies (Ducroze et al. 2005; Durka et al. 2005). However, a detailed examination of the beaver genetics along with the study of their permanent ectoparasites like *Schizocarpus* spp. may help to differentiate these subspecies at least in their *terra typica* localities.

Dubinina (1964) recorded twelve *Schizocarpus* (= *Histiophorus* Friedrich, 1895) species from beavers (*C. f. orientoeuropaeus*) kept in captivity on the beaver farm in the Voronezh National Reserve. Among them eleven species was described as new and recorded only on *C. fiber* [their lectotypes were established by Dubinina et al. (1993)] and *S. mingaudi* was recorded from both beaver species, *C. fiber* and *C. canadensis* from this farm. Fain and Lukoschus (1985) redescribed four Dubinina's species, based on specimens collected from Eurasian beavers from Germany (Elbe River, *C. f. albicus* Matschie, 1970), from the unknown locality in Western Europe (unknown subspecies) and from Mongolia (*C. f. birulai* Serebrennikov, 1929). Other seven species described by Dubinina (1964) were not available to these authors.

We reinvestigated significant material mostly collected by Dubinina (1964) from *C. f. orientoeuropaeus* from the Voronezh National Reserve and an additional material of V.I. Bobrovskaya from the same locality collected in 1983. Below we re-describe seven *Schizocarpus* spp. of Dubinina

(1964), which were not redescribed by Fain and Lukoschus (1985), synonymize two species described by Fain and Lukoschus (1985), and provide five new species records (see Table 3). All data about distribution and localization on the hosts of *Schizocarpus* spp. associated with *C. f. orientoeuropaeus* from the Voronezh population are given in Table 3.

MATERIAL AND METHODS

The whole material used in this work was collected from *Castor f. orientoeuropaeus* at the beaver farm (the Voronezh State Natural Biosphere Reserve, Russia) mostly by H.V. Dubinina in 1960 and by V.I. Bobrovskaya in 1983 and is deposited in the Zoological Institute of the Russian Academy of Sciences, Saint Petersburg, Russia. Systematics of host subspecies is given according to Gabryz and Wazna (2003).

In species descriptions, the opisthosomal setation follows Griffiths et al. (1990). All measurements are in micrometers (μm) and were taken as follow: body length = the total length from the palpal extremities to the posterior border of the opisthosoma, excluding membrane; body width = the width at the midlevel between legs II and III; length of hysteronotal shield = maximum length measured along the longitudinal line running via seta *d1* bases; width of hysteronotal shield = measured at the midlevel of the shield; diameter of adanal sucker includes the corolla (see Fig. 1).

Notes on the opisthosomal setation. Systematics of the genus *Schizocarpus* is based on male characters. Males of this genus are characterized by the obligatory precopulatory guarding behavior, bearing the immature female (proto- or

Table 1. Setal designations of opisthosomal setae of *Schizocarpus* spp. (males)

Setal designation of Fain et al. (1984)	Setal designations by Griffiths et al. (1990)
<i>d3</i>	<i>d1</i>
<i>d4</i>	<i>e1</i>
<i>d5</i>	<i>h1</i>
<i>l2</i>	<i>d2</i>
<i>l3</i>	<i>e2</i>
<i>l4</i>	<i>ps2</i>
<i>l5</i>	<i>h2</i>
<i>a1</i>	<i>h3</i>
<i>a2</i>	<i>f2</i>
<i>a3</i>	<i>ps3</i>
<i>n</i>	<i>ps1</i>
additional suckers b (if properly setal bodies absent) or setae <i>n</i> (if setal bodies present)	<i>ad1</i>
additional setae <i>n</i>	<i>ad2</i>
opisthosomal suckers (A or E)	<i>ad3</i>

tritonymph) with primordial legs attached to its opisthosoma (Dubinina 1964; Fain et al. 1984). For this reason, several opisthosomal structures i.e. the opisthosomal membranes, lateral folds of the opisthosoma, the adanal shields, modified setal alveoli (suckers), and some opisthosomal setae form the complicate attaching organ. In composition of this organ, the opisthosomal setae probably play the key role for the correct recognition and orientation of the respective attachment structures of the immature female.

In Table 1 and Fig. 1, we provide the setal designations used in the descriptions of *Schizocarpus* spp. by Fain and coauthors (Fain et al. 1984; Fain and Lukoschus 1985; Fain and Whitaker 1988) and corresponding designations by Griffiths et al. (1990) used in the present work.

Adanal suckers are most probably derivatives of setae *ad3*; in mites from *Castor fiber* corolla of these suckers could be smooth (type A of Fain et al. 1984) or with short external protrusions, wheel-shaped (type E of Fain et al. 1984).

Schizocarpus is the only genus among Psoroptidia whose males have adanal setae *ad1* and in some species also *ad2* represented by alveoli or microsetae; these setae are absent in females. Fain and coauthors (Fain et al. 1984; Fain and Lukoschus 1985; Fain and Whitaker 1988), however, interpreted these setae as neotrichial (*n*). Fain and Lukoschus (1985) supposed that in species of the *hexapilis* group, bearing an additional pair of setae *n* (*ad2* in our sense), these setae are homological to *a2* (*f2*) which are strongly displaced anteriorly from the posterior border of the idiosoma. We

think, however, that these additional setae are adanal *ad2* because in some *Schizocarpus* spp. from *C. canadensis*, for example, *S. postannulatus* Fain et Whitaker, 1988, the full set of the opisthosomal setae in usual position and three pair of the adanal setae, including the adanal suckers, are present (Fain and Whitaker 1988). At the same time setae *f2* are often absent even in the closely related species of *Schizocarpus*, which have no additional adanal setae *ad2*. In males of *Schizocarpus*, the presence of two or even three pairs of the adanal setae, including adanal suckers, is obvious reversion, probably, caused by peculiarities of the life-cycle of these mites.

SYSTEMATICS

Family Chirodiscidae Trouessart, 1892 *Schizocarpus* Trouessart, 1896

Fain and Lukoschus (1985) arranged 33 species of the genus *Schizocarpus* currently known from the Eurasian beavers in five species groups. According to these authors, mites of the *minutus* group mainly differ from species of the *numerosus* group by the presence of setae *n* (setal bodies present) instead of suckers b (only alveoli present). We think, however, that setae *n* and suckers b are both homologous to adanal setae *ad1* which have short setal bodies (setae *n* sensu Fain) or are represented only by alveoli (suckers b sensu Fain) (see Table 1). These two forms of adanal setae *ad1* are difficult to discriminate from each other in practice, because the presence of the intermediate form with almost indistinct setal bodies. Therefore, we include the *minutus* group in the *numerosus* group.

Table 2. Diagnosis of *Schizocarpus* species groups associated with Castor fiber (male characters only)

Group	Corolla of adanal suckers	Setae <i>f2</i>	Setae <i>ad1</i>	Setae <i>ad2</i>	Number of species
<i>numerosus</i>	smooth	absent or present	present	absent	25
<i>hexapilis</i>	smooth	Absent	present	present	3
<i>radiatus</i>	wheel-shaped	Present	present	absent	2
<i>insignis</i>	smooth	Present	absent	absent	1

The diagnoses of species groups are given below, species numbers are provided taking into account the taxonomic changes proposed below (see Table 2).

Species redescriptions

1. *Schizocarpus parvus* (Dubinina, 1964)

Fig. 1

Histiophorus parvus Dubinina, 1964: 134, fig. 15, 1

Schizocarpus parvus, Fain and Lukoschus 1985: 66; Dubinina et al. 1993: 451

Type material. Lectotype male (ZIN T-Chir-2; slide N 30153) from *Castor fiber orienteuropaeus* Lavrov, 1981, RUSSIA: Voronezh Province, Voronezh State Natural Biosphere Reserve, beaver farm, 21 June 1960, coll. H.V. Dubinina.

Microhabitat. Unknown.

Distribution. Described from the Eurasian beaver living in captivity (beaver farm) in Voronezh Reserve (Russia) (Dubinina 1964), colonized the Canadian beaver reared at the same farm (Dubinina et al. 1993).

Redescription (male, lectotype). Body 290 long and 145 wide; body length/width ratio 2:1. Hysteronotal shield 80 long and 90 wide. Anterior margin of hysteronotal shield slightly concave in median part, this concavity almost reaching level of setae *dl*. Setae *el* situated distinctly far from setae *hl* (*el-hl* 25) and posterior margin of hysteronotal shield. Setae *hl* widely separated from each other, distance *hl-hl* about 1.7 times longer than *el-el*. Opisthosomal membranes moderately developed, about 20 long. Setae *ps3* situated at longitudinal line crossed median part of adanal shield. Adanal shields almost oval, distinctly separated from each other, minimal distance between these shields 10. These shields completely punctated, bearing setae *ad1* represented by alveoli. Adanal suckers situated in median part of adanal shields, about 12 in diameter, without dentate corolla (type A), each enclosed in highly sclerotized punctate ring. Setae *ps1* situated on small peduncles antero-lateral to adanal suckers, being located very close to them. Adanal setae *ad1* situated at same transverse level with adanal suckers and lat-

eral to them. Adanal setae *ad2* absent. Distance between adanal sucker and *ad1* subequal or slightly less than diameter of adanal sucker. Ventral anal sclerite indistinct. Lengths of some setae: *f2* 8, *hl* 5, *h2* 60, *h3* 4, *ps2* 30, *ps3* 15.

Remarks. This species belongs to the *numerosus* group. Among species of this group only in *S. parvus* setae *ps1* and adanal setae *ad1* are situated, anterior to the adanal suckers and at the same transverse level with them, respectively.

2. *Schizocarpus minor* (Dubinina, 1964)

Figs. 2A and 3A

Histiophorus minor Dubinina, 1964: 137, fig. 15, 3

Schizocarpus minor, Fain and Lukoschus 1985: 66; Dubinina et al. 1993: 451

Type material. Lectotype male (ZIN T-Chir-3; slide N 30166) from *Castor fiber orienteuropaeus* Lavrov, 1981, RUSSIA: Voronezh Province, Voronezh State Natural Biosphere Reserve, beaver farm, 9 June 1960, coll. H.V. Dubinina.

Microhabitat. Unknown.

Distribution. Described from the Eurasian beaver living in captivity (beaver farm) in Voronezh Reserve (Russia) (Dubinina 1964), colonized the Canadian beaver contained at the same farm (Dubinina et al. 1993).

Redescription (male, lectotype). Body 325 long and 150 wide, body length/width ratio 2.2:1. Hysteronotal shield 70 long and 90 wide, slightly more strongly sclerotized in median parts. Anterior margin of hysteronotal shield slightly concave in median part, this concavity reaching level of setae *dl*. Setae *el* situated distinctly far from setae *hl* (*el-hl* 15) and posterior margin of hysteronotal shield. Setae *hl* widely separated from each other, distance *hl-hl* about 1.7 times longer than *el-el*. Opisthosomal membranes moderately developed, about 18 long. Setae *ps3* situated at longitudinal line crossed median part of adanal shield. Adanal shields completely punctated, comma-shaped, minimal distance between these shields about 15. Adanal suckers situated in median part of adanal shields, about 6 in diameter, without dentate wall (type A), each enclosed in strongly

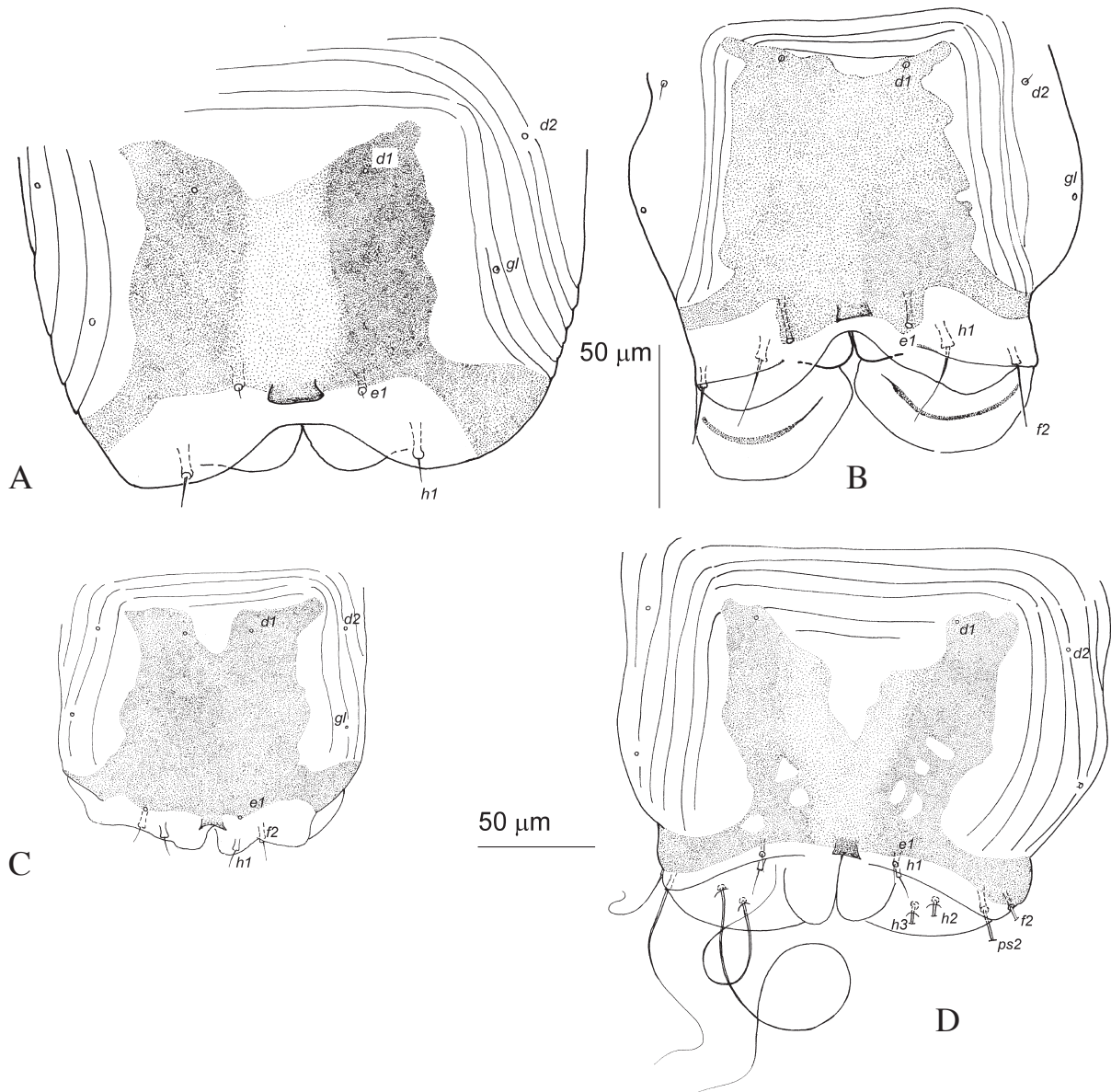


Fig. 2. *Schizocarpus* spp., opisthosoma of male lectotype in dorsal view: A — *S. minor* (Dubinina, 1964); B — *S. brachyurus* (Dubinina, 1964); C — *S. subparvus* (Dubinina, 1964); D — *S. grandis* (Dubinina, 1964).

sclerotized punctate ring which more than 2 times wider than diameter of adanal sucker. Adanal setae *ad1* represented by alveoli, situated mesal and distinctly posterior to adanal suckers, distance between adanal suckers and setae *ad1* about twice as long as diameter of adanal sucker. Adanal setae *ad2* absent. Setae *ps1* situated close to each other on small peduncles slightly mesal and posterior to setae *ad1*, distance *ps1-ps1* subequal in sizes to width of this peduncle. Ventral anal sclerite indistinct. Lengths of some setae: *f2* 14, *h1* 6, *h2* 80, *h3* 10, *ps2* 70, *ps3* 13.

Remarks. This species belongs to the *numerosus* group. It is close to *S. modestus* Fain et Lukoschus, 1985 by the location pattern of the opisthosomal setae but differs from this species by setae *ps1* closely located to each other and situated

mesal to setae *ad1*. In *S. modestus*, setae *ps1* are widely separated from each other and situated at the same longitudinal line with setae *ad1*.

3. *Schizocarpus brachyurus* (Dubinina, 1964)

Figs. 2B and 3B

Histiophorus brachyurus Dubinina, 1964: 125, fig. 10, 1–4

Schizocarpus brachyurus, Fain and Lukoschus 1985: 66; Dubinina et al. 1993: 451

Type material. Lectotype male (ZIN T-Chir-4; slide N 30097) from *Castor fiber orientoeuropaeus* Lavrov, 1981, RUSSIA: Voronezh Province, Voronezh State Natural Biosphere Reserve, beaver farm, 20 June 1960, coll. H.V. Dubinina.

Microhabitat. Bell, anterior and posterior legs, and head ventrally.

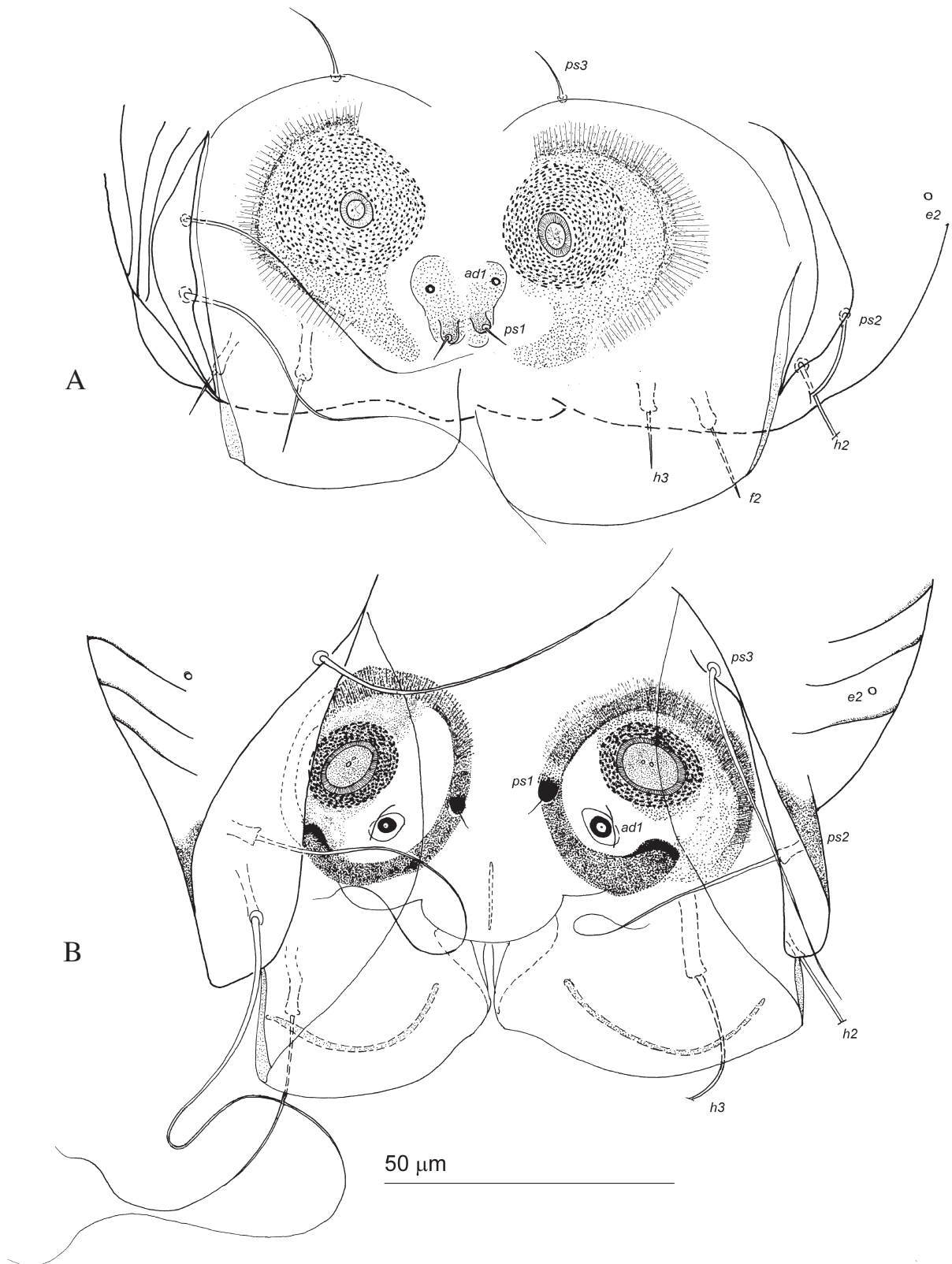


Fig. 3. *Schizocarpus* spp., opisthosoma of male lectotype in ventral view: A — *S. minor* (Dubinina, 1964); B — *S. brachyurus* (Dubinina, 1964).

Distribution. Described from the Eurasian beaver living in captivity (beaver farm) in Voronezh Reserve (Russia) (Dubinina 1964).

Redescription (male, lectotype). Body 360 long and 150 wide, body length/width ratio 2.4:1. Hysteronotal shield 90 long and 75 wide. Anterior

margin of hysteronotal shield slightly concave in median part, this concavity reaching level of setae *dl*. Setae *e1* situated close to posterior margin of hysteronotal shield, distance *e1-h1* 10. Setae *h1* widely separated from each other, distance *h1-h1* about 1.5 times longer than *e1-e1*. Setae *ps3* situated laterally outside to adanal suckers. Opisthosomal membranes distinctly developed, about 25 long, armed with transverse cost. Adanal shields widely rounded, bordered by strongly sclerotized band, punctated in external half, minimal distance between these shields about 16. Adanal suckers situated in antero-mesal part of adanal shields, about 9 in diameter, without dentate wall (type A), each enclosed in strongly sclerotized punctate ring about 2 times narrower than diameter of adanal sucker. Adanal setae *ad1* represented by alveoli, situated slightly postero-mesal to adanal suckers, distance between adanal suckers and setae *ad1* subequal to diameter of adanal suckers. Adanal setae *ad2* absent. Setae *ps1* situated on small peduncles located on inner margin of adanal shield immediately posterior to level of adanal suckers and anterior to level of setae *ad1*, distance *ps1-ps1* 16. Ventral anal sclerite indistinct. Lengths of some setae: *f2* 20, *h1* 22, *h2* 140, *h3* 65, *ps2* 70, *ps3* 59.

Remarks. This species belongs to the *numerosus* group. It differs from all other species of the group by the location of setae *ad1* slightly postero-mesal to the adanal suckers and setae *ps1* situated on the inner margin of the adanal shield immediately posterior to the level of the adanal suckers and anterior to the level of setae *ad1*.

4. *Schizocarpus subparvus* (Dubinina, 1964)

Figs. 2C and 4A

Histiophorus subparvus Dubinina, 1964: 134, fig. 15, 2

Schizocarpus subparvus, Fain and Lukoschus 1985: 66; Dubinina et al. 1993: 451

Type material. Lectotype male (ZIN T-Chir-5; slide N 30212) from *Castor fiber orientoeuropaeus* Lavrov, 1981, RUSSIA: Voronezh Province, Voronezh State Natural Biosphere Reserve, beaver farm, 6 June 1960, coll. H.V. Dubinina.

Microhabitat. Unknown.

Distribution. Described from the Eurasian beaver living in captivity (beaver farm) in Voronezh Reserve (Russia) (Dubinina 1964), colonized the Canadian beaver contained at the same farm (Dubinina et al. 1993).

Redescription (male, lectotype). Body 320 long and 145 wide, body length/width ratio 2.2:1.

Hysteronotal shield 80 long and 75 wide. Anterior margin of hysteronotal shield with deep median incision about 4 times shorter than this shield. Setae *e1* situated at posterior margin of hysteronotal shield, distance *e1-h1* 14. Setae *h1* located slightly close to each other, distance *h1-h1* about 2 times shorter than *e1-e1*. Setae *h3* closely located to each other, distances *h3-h3* about 1.5 times shorter than *h1-h1*. Setae *ps3* situated medially at same longitudinal line with adanal suckers. Opisthosomal membranes weakly developed, about 12 long. Adanal shields slightly elongated, completely punctated, and strongly sclerotized in external half; minimal distance between these shields about 12. Adanal suckers situated in posterior half of adanal shields, about 6 in diameter, without dentate wall (type A), each enclosed in strongly sclerotized punctate ring which about 2 times wider in inner half than diameter of adanal sucker. Adanal setae *ad1* represented by alveoli, situated posterior to and almost at same longitudinal line with adanal suckers, distance between adanal suckers and setae *ad1* subequal to diameter of adanal sucker. Adanal setae *ad2* absent. Setae *ps1* situated on small peduncles located on posterior margin of adanal shield mesal and slightly posterior to adanal setae *ad1*, distance *ps1-ps1* 20. Ventral anal sclerite indistinct. Lengths of some setae: *f2* 8, *h1* 5, *h2* 65, *h3* 6, *ps2* 40, *ps3* 10.

Remarks. This species belongs to the *numerosus* group and is very close to *S. brevis* Fain et Lukoschus, 1985. In both these species, setae *h3* are closely situated to each other, setae *ps1* are located on the posterior margin of the adanal shield mesal to adanal setae *ad1*, and setae *ad1* are located posterior to and almost at the same longitudinal line with the adanal suckers. It differs from *S. brevis* by situation of the adanal suckers in the posterior third of the adanal shields and by the location of setae *ps1* off the punctate area.

5. *Schizocarpus grandis* (Dubinina, 1964)

Figs. 2D and 4B

Histiophorus grandis Dubinina, 1964: 129, figs. 12, 1-2, 13, 1-2

Schizocarpus grandis, Fain and Lukoschus 1985: 66; Dubinina et al. 1993: 451

Schizocarpus dubininae Fain et Lukoschus, 1985: 53, figs. 33-36, 38, syn. nov.

Type material. Lectotype male (ZIN T-Chir-6; slide N 30059) from *Castor fiber orientoeuropaeus* Lavrov, 1981, RUSSIA: Voronezh Province, Voronezh State Natural Biosphere Reserve, beaver farm, 5 June 1960, coll. H.V. Dubinina.

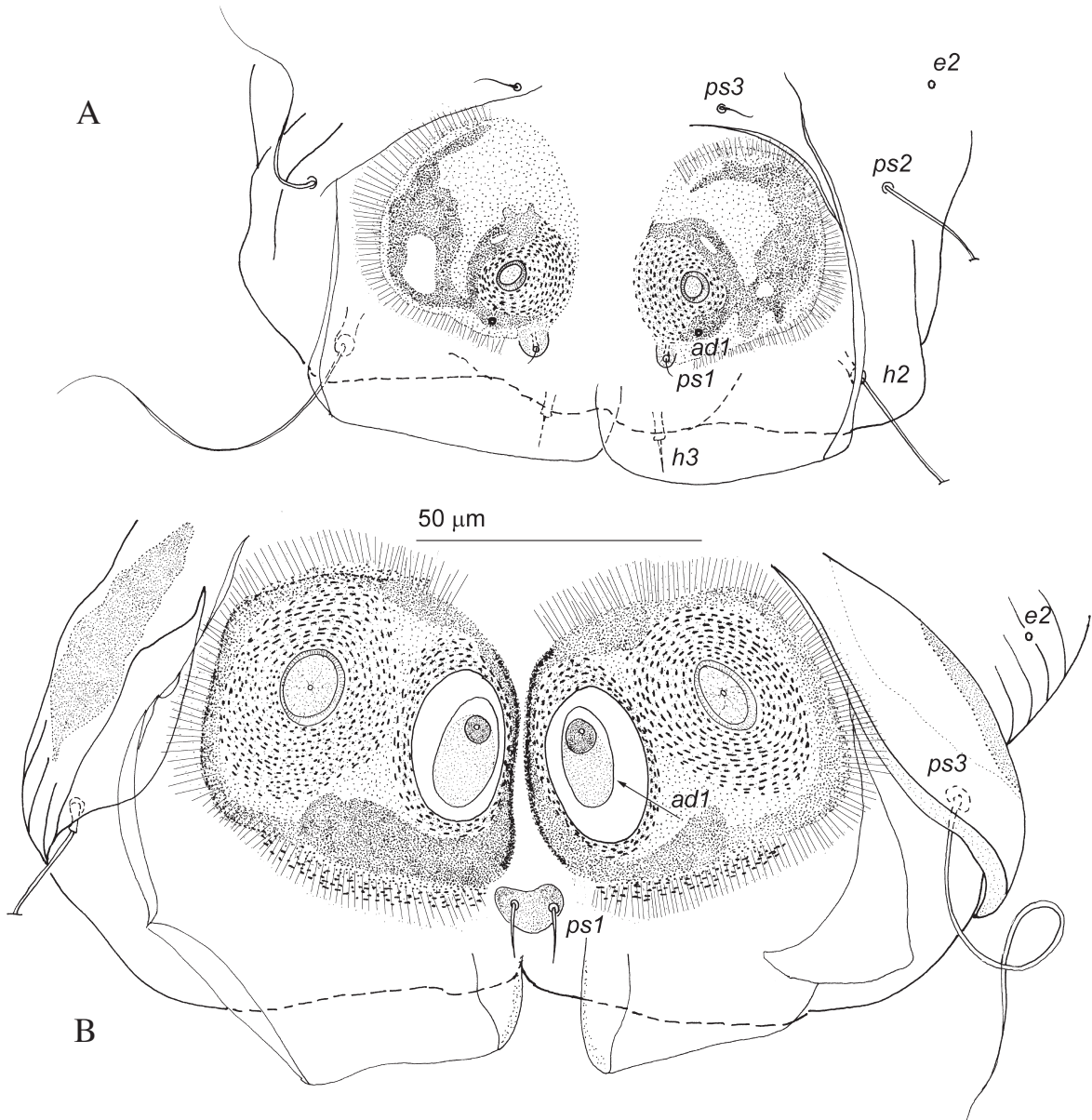


Fig. 4. *Schizocarpus* spp., opisthosoma of male lectotype in ventral view: A — *S. subparvus* (Dubinina, 1964); B — *S. grandis* (Dubinina, 1964).

Microhabitat. Chest, throat, head near vibrissae and groin (Dubinina 1964; Fain and Lukoschus, 1985).

Distribution. Described from the Eurasian beaver living in captivity (beaver farm) in Voronezh Reserve (Russia) (Dubinina 1964), colonized the Canadian beaver contained at the same farm (Dubinina et al. 1993).

Redescription (male, lectotype). Body 440 long and 200 wide, body length/width ratio 2.2:1. Hysteronotal shield 100 long and 110 wide. Anterior margin of hysteronotal shield with very deep median incision, only 1.8 times shorter than this shield. Setae *e1* situated immediately behind posterior margin of hysteronotal shield, very close to se-

tae *h1*. Setae *h1* widely separated from each other, distances *e1-e1* and *h1-h1* subequal. Setae *ps3* situated laterally. Opisthosomal membranes weakly developed, about 12 long. Adanal shields adjoining to each other, subsquared, completely punctated, and marginally bordered by strongly sclerotized band. Adanal suckers situated in median part of adanal shields close to their external half, about 13 in diameter, without dentate wall (type A), each enclosed in strongly sclerotized punctate ring which subequal to diameter of adanal sucker. Adanal setae *ad1* represented by alveoli 6 in diameter, located in anterior third of narrowly oval structures about 2 times larger than adanal suckers, these oval structures situated between adanal shields. Distance be-

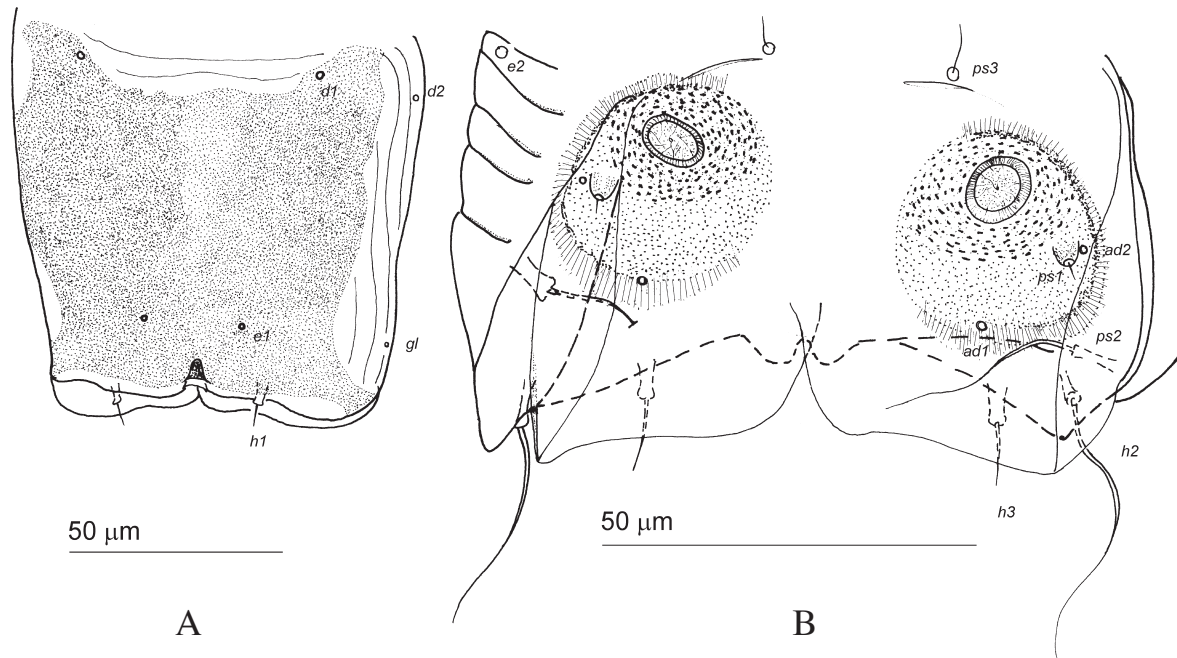


Fig. 5. *Schizocarpus subminor* (Dubinina, 1964), opisthosoma of male lectotype: A — dorsum; B — venter.

tween adanal suckers and oval structures carrying setae *ad1* slightly longer than diameter of adanal sucker. Adanal setae *ad2* absent. Setae *ps1* situated on distinctly developed ventral anal sclerite situated between and slightly posterior to adanal shields. Lengths of some setae: *f2* 40, *h1* 6, *h2* 300, *h3* 100, *ps2* 95, *ps3* 85.

Remarks. This species is not discernible from *S. dubininae* Fain et Lukoschus, 1985 described from the skin of the Eurasian beaver of unknown origin (Fain and Lukoschus 1985). Type specimens of *S. grandis* were not available for these authors and the oval structures carrying setae *ad1* were mistakenly interpreted as the adanal suckers based on the original figures by Dubinina (1964): “P. 41: suckers A [adanal suckers — our note] paramedian, contiguous in the midline and very large”. We consider here *S. dubininae* **syn. nov.** as a junior synonym of *S. grandis*. This species is very close to *S. similis* Fain et Lukoschus, 1985 (*numerosus* group) described from *C. fiber albicus* Matschie, 1907 from Elbe River (Germany) (Fain and Lukoschus 1985) and differing from it by much shorter setae *f2* 10 (vs. 40 in *S. grandis*) and *h3* 18 (vs. 100).

6. *Schizocarpus subminor* (Dubinina, 1964)

Fig. 5

Histiophorus subminor Dubinina, 1964: 137, fig. 15, 4
Schizocarpus subminor, Fain and Lukoschus 1985: 66;
Dubinina et al. 1993: 451

Type material. Lectotype male (ZIN T-Chir-7; slide N 30196) from *Castor fiber orien-*

toeuropaeus Lavrov, 1981, RUSSIA: Voronezh Province, Voronezh State Natural Biosphere Reserve, beaver farm, 27 February 1958, coll. V.A. Romashov.

Microhabitat. Unknown.

Distribution. Described from the Eurasian beaver living in captivity (beaver farm) in Voronezh Reserve (Russia) (Dubinina 1964).

Redescription (male, lectotype). Body 290 long and 130 wide, body length/width ratio 2.2:1. Hysteronotal shield 70 long and 75 wide. Anterior margin of hysteronotal shield concave, this concavity reaching level of setae *d1*. Setae *e1* situated distinctly far from posterior margin of hysteronotal shield, distance *e1* – posterior margin of hysteronotal shield 15. Setae *h1* widely separated from each other, distance *e1–e1* 1.2 times longer than *h1–h1*. Setae *ps3* situated slightly mesal to adanal suckers. Setae *f2* absent. Opisthosomal membranes weakly developed, about 10 long. Adanal shields widely rounded and completely punctate. Adanal suckers situated medially, in anterior half of adanal shields, about 9 in diameter, without dentate wall (type A), each enclosed in strongly sclerotized and punctate ring which subequal to diameter of adanal sucker. Adanal setae *ad1* represented by alveoli situated on posterior margin of adanal shield at same longitudinal line with adanal suckers, distance *ad1*–adanal suckers in 1.5 times longer than diameter of adanal suckers. Setae *ps1* situated on peduncles lateral and slightly posterior to adanal suckers being located near external mar-

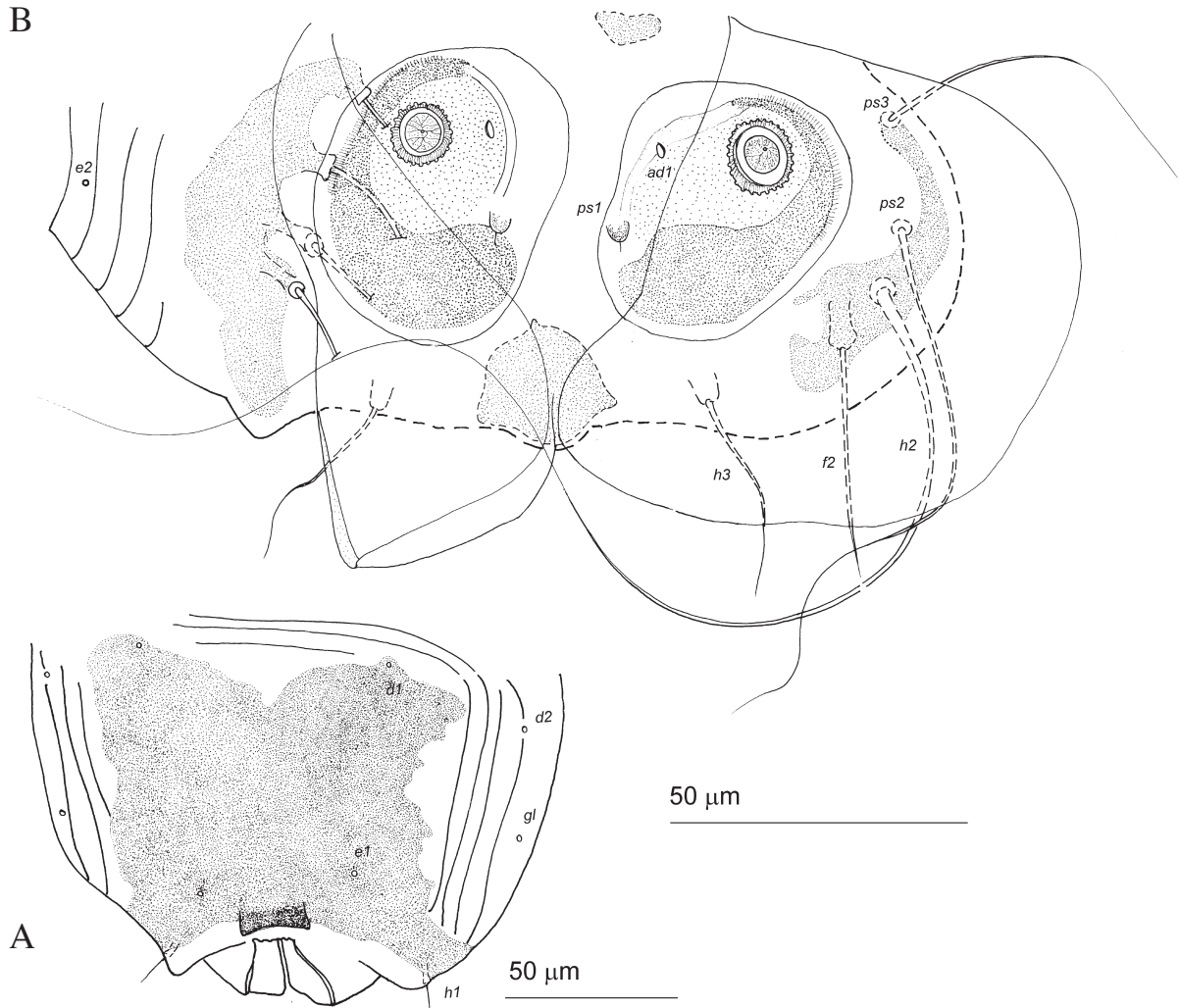


Fig. 6. *Schizocarpus latus* (Dubinina, 1964), opisthosoma of male lectotype: A — dorsum; B — venter.

gin of adanal shield and off punctuate ring enclosing adanal suckers; distance adanal suckers – *ps1* subequal to diameter of adanal suckers. Adanal setae *ad2* represented by indistinct alveoli adjoining lateral to peduncles bearing setae *ps1*. Ventral anal sclerite indistinct. Lengths of some setae: *h1* 4, *h2* 35, *h3* 10, *ps2* 25, *ps3* 8.

Remarks. This species belongs to the *hexapilis* group and easily differs from other three representatives of this group by the pattern of locations of setae *ad1*, *ad2*, and *ps1*.

7. *Schizocarpus latus* (Dubinina, 1964)

Fig. 6

Histiophorus latus Dubinina, 1964: 132, fig. 14, 2–4
Schizocarpus latus, Fain and Lukoschus 1985: 66; Dubinina et al. 1993: 451
Schizocarpus ventricosus Fain et Lukoschus, 1985: 65, figs. 75–77, 81, syn. nov.

Type material. Lectotype male (ZIN T-Chir-8; slide N 30117) from *Castor fiber orientoeuropaeus* Lavrov, 1981, RUSSIA: Voronezh

Province, Voronezh State Natural Biosphere Reserve, beaver farm, 20 June 1960, coll. H.V. Dubinina.

Microhabitat. Dorsum, flanks (Fain and Lukoschus 1985), tail base (Dubinina 1964).

Distribution. Described from the Eurasian beaver living in captivity (beaver farm) in Voronezh Reserve (Russia) (Dubinina 1964), colonized the Canadian beaver contained at the same farm (Dubinina et al. 1993).

Redescription (male, lectotype). Body 420 long and 210 wide, body length/width ratio 2:1. Hysteronotal shield 90 long and 95 wide. Anterior margin of hysteronotal shield concave, this concavity reaching level of setae *d1*. Setae *e1* situated distinctly far from posterior margin of hysteronotal shield, distance *e1*–posterior margin of hysteronotal shield 20. Setae *h1* widely separated from each other, distance *e1*–*e1* 1.7 times shorter than *h1*–*h1*. Setae *ps3* situated laterally distinctly outside to adanal suckers. Opisthosomal membranes

distinctly developed, about 25 long. Adanal shields rounded and weakly punctated in median part, external half of these shields bordered by wide and heavily sclerotized band. Small median sclerite present anterior of adanal shields. Adanal suckers situated medially in anterior half of adanal shields, about 12 in diameter, with dentate wall (type E). Adanal setae *ad1* represented by poorly distinct alveoli situated at same transverse level with adanal suckers and slightly mesal, distance *ad1*–adanal suckers subequal to diameter of adanal suckers. Setae *ps1* situated on peduncles slightly mesal and significantly posterior to adanal setae *ad1*, distance *ps1*–*ad1* subequal to diameter of adanal sucker. Distinct median sclerite situated between and posterior to adanal shields. Adanal setae *ad2* absent. Ventral anal sclerite distinctly developed. Lengths of some setae: *f2* 40, *h1* 5, *h2* 190, *h3* 35, *ps2* 100, *ps3* 60.

Remarks. This species is indiscernible from *S. ventricosus* Fain et Lukoschus, 1985 described from the skin of *C. fiber* from unknown locality (Fain and Lukoschus 1985). The type material of *S. latus* was not available for these authors. Such features of this species as the dentate corolla of the adanal suckers and the alveoli of setae *ad1* were missed in the description by Dubinina (1964). Therefore Fain and Lukoschus (1985) based on the “absence” of setae *ad1* considered this species as closely related to *S. insignis* Fain et Lukoschus, 1985 and established the *latus* group for these two species. We include here *S. latus* in the *radiatus* group and consider *S. ventricosus* **syn. nov.** as a junior synonym of this species. *Schizocarpus latus* differs from *S. radiatus* Fain et Lukoschus, 1985, the second species of this group, by the laterally located setae *ps3* (vs. mesally in *S. radiatus*) and by the usual position of setae *h3* posterior to the adanal shields (vs. anterior to adanal shields and near to *ps3*).

New records of *Schizocarpus* spp.

8. *Schizocarpus subhexapilis* Fain et Lukoschus, 1985

Schizocarpus subhexapilis Fain et Lukoschus, 1985: 64, figs. 65, 66, 71; Dubinina et al. 1993: 451

Material. 1 male (ZIN slide 30837) from *Castor fiber orientoeuropaeus* Lavrov, 1981, RUSSIA: Voronezh Province, Voronezh State Natural Biosphere Reserve, beaver farm, 1 July 1983, coll. V.I. Bobrovskaya.

Microhabitat. Chest, throat, head (Fain and Lukoschus 1985).

Distribution. Described from the Eurasian beaver (undetermined subspecies) from unknown locality in Europe (Fain and Lukoschus 1985), colonized the Canadian beaver contained at the same farm (Dubinina et al. 1993).

9. *Schizocarpus pygidialis* Fain et Lukoschus, 1985

Schizocarpus pygidialis Fain et Lukoschus, 1985: 48, figs. 22–24

Material. 1 male (ZIN slide 30699) from *Castor fiber orientoeuropaeus* Lavrov, 1981, RUSSIA: Voronezh Province, Voronezh State Natural Biosphere Reserve, beaver farm, same host and locality, 24 May 1983, coll. V.I. Bobrovskaya; 1 male (ZIN slide 30522), same host and locality, 19 June 1983, coll. V.I. Bobrovskaya.

Microhabitat. Tail base (Fain and Lukoschus 1985; our data).

Distribution. Described from the Eurasian beaver (undetermined subspecies) from unknown locality in Europe (Fain and Lukoschus 1985) and from *C. fiber orientoeuropaeus* from Russia (Voronezh Reserve, beaver farm) (our material).

10. *Schizocarpus radiatus* Fain et Lukoschus, 1985

Schizocarpus radiatus Fain et Lukoschus, 1985: 64, figs. 5, 73, 74, 80

Material. 1 male (ZIN slide 30119) from *Castor fiber orientoeuropaeus* Lavrov, 1981, RUSSIA: Voronezh Province, Voronezh State Natural Biosphere Reserve, beaver farm, 9 June 1960, coll. H.V. Dubinina; 1 male (ZIN slide 30198), same host and locality, 20 June 1960, coll. H.V. Dubinina.

Microhabitat. Dorsum and flanks (Fain and Lukoschus 1985).

Distribution. Described from the Eurasian beaver (undetermined subspecies) from unknown locality in Europe (Fain and Lukoschus 1985) and from *C. fiber orientoeuropaeus* from Russia (Voronezh Reserve, beaver farm) (our material).

11. *Schizocarpus similis* Fain et Lukoschus, 1985

Schizocarpus similis Fain et Lukoschus, 1985: 54, figs. 36, 37

Material. 7 males (ZIN) from *Castor fiber orientoeuropaeus* Lavrov, 1981, RUSSIA: Voronezh Province, Voronezh State Natural Biosphere Reserve, beaver farm 9 June 1960, coll. V.I. Bobrovskaya.

Microhabitat. Head and throat (Fain and Lukoschus 1985).

Distribution. Described from the Eurasian beaver (undetermined subspecies) from unknown locality in Europe (Fain and Lukoschus 1985) and from *C. fiber orientoeuropaeus* from Russia (Voronezh Reserve, beaver farm) (our material).

12. *Schizocarpus* sp.

Material. 1 male (ZIN) from *Castor fiber orientoeuropaeus* Lavrov, 1981, RUSSIA: Voronezh Province, Voronezh State Natural Biosphere Reserve, beaver farm, 24 May 1983, coll. V.I. Bobrovskaya; 1 male (ZIN), same host and locality, 1 July 1983, coll. V.I. Bobrovskaya.

Microhabitat. Unknown.

Distribution. *C. fiber orientoeuropaeus* from Russia (Voronezh Reserve, beaver farm) (our material).

Remarks. This species is very similar to *S. latus* but differs from it by the absence of setae *f2* and more laterally situated setae *h3*. Both specimens of this species are mounted laterally and therefore new individuals are necessary to describe it formally.

DISCUSSION

Dubinina (1964) recorded 12 species of *Schizocarpus* spp. from the Voronezh population of *C. f. orientoeuropaeus*. Among them 11 species were described as new and one species was determined as *S. mingaudi* originally described from the American beaver *Castor canadensis* (Trouessart 1896). All examined hosts lived in captivity (beaver farm) together with American beavers and Dubinina (1964) recorded *S. mingaudi* on the both host species.

Fain and Lukoschus (1985) examined Eurasian beavers from Germany (*C. f. albicus*), from an unknown locality in Europe (unknown subspecies) and from Mongolia (*C. f. birulai*). They recorded 25 *Schizocarpus* spp. — 21 new species and four species described by Dubinina (1964) — *S. capitis*, *S. brevicauda*, *S. fedjushini*, and *S. numerosus*. They also mentioned that specimens determined by Dubinina (1964) as *S. mingaudi* probably belong to a separate species.

Haitlinger (1991) recorded three *Schizocarpus* spp., *S. numerosus*, *S. fedjushini*, and *S. brachyurus*, from *C. fiber* (unknown subspecies) from Popielno, Poland. Kadulski (1998) recorded ten *Schizocarpus* spp. from the same host and locality — all of them were described by Dubinina (1964). He recollected three species recorded by Haitlinger (1991) and additionally recorded seven species: *S. brevicauda*, *S. capitis*, *S. latus*, *S. mi-*

nor, *S. mingaudi*, *S. parvus*, and *S. subparvus*. In both papers (Haitlinger 1991; Kadulski 1998), the paper by Fain and Lukoschus (1985) was not referred and it is probably that the authors just overlooked this key publication. For this reason, the results of investigations on beavers in Poland are highly questionable, because these authors could incorrectly determine several species being morphologically very similar to the species described by Dubinina (1964). Our examination of *Schizocarpus* spp. from the Poland population of *C. fiber* revealed many species described by Fain and Lukoschus (1985) as well as several new species (Bochkov et al., in preparation). Therefore, the results obtained by Haitlinger (1991) and Kadulski (1998) should be ignored and re-examination of mites from beaver in Popielno is highly desirable.

We confirm the validity of all eleven species described by Dubinina (1964). Additionally, one undescribed species (*S. sp.*) and four species described by Fain and Lukoschus (1985) were recorded: *S. pygidialis* Fain et Lukoschus, 1985, *S. radiatus* Fain et Lukoschus, 1985, *S. similis* Fain et Lukoschus, 1985, and *S. subhexapilis* Fain et Lukoschus, 1985.

The records of *S. mingaudi* on *Castor fiber* require a special consideration. Until the work by Dubinina (1964), the genus *Schizocarpus* was monotypic and all records of *Schizocarpus* were referred to *S. mingaudi* (for old references see: Dubinina 1964). She collected only a few specimens of this species from *C. f. orientoeuropaeus* lived in captivity together with American beavers at the beaver farm (the Voronezh National Reserve). Therefore, it is quite probably that *S. mingaudi* being widely distributed on *C. canadensis* (Fain et al. 1984; Whitaker et al. 1989, 2009; Whitaker and Smith 1985; Dubinina et al. 1993) colonized Eurasian beavers in the farm conditions. In this farm, the similar cases were observed for some species normally associated with *C. fiber*, for example, *S. numerosus*, which had successively colonized *C. canadensis* (Dubinina et al. 1993). *S. mingaudi* was not recorded by Fain and Lukoschus (1985) on the Eurasian beavers and these authors stated that “P. 65: the true *S. mingaudi* seems to be restricted to *Castor canadensis* from North America. It is very abundant on this host.” We did not record this species from various collections of *Schizocarpus* spp. from Russia (the Okskiy Reserve), Belorussia, and quite extensive material from Poland. The record of this species from Poland on the Eurasian beaver by Kadulsky

(1998) is probably the result of incorrect determination.

Thus, the complex of *Schizocarpus* spp. on beavers from the Voronezh National Reserve includes presently 16 species (see Table 3) and additional species records from this population are possible but not so much expectable.

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REFERENCES

- Bochkov, A.V. 2010. A review of mammal associated Psoroptidia (Acariformes: Astigmata). *Acarina*, 18: 99–260.
- Bochkov, A.V. and Mironov, S.V. 2008. [The phenomenon of «phylogenetic synhospitality» in acariform mites (Acari: Acariformes) – the permanent parasites of vertebrates]. *Parazitologiya*, 42: 81–100. [In Russian with English Summary]
- Bochkov, A.V. and OConnor, B.M. 2005. Phylogeny and host associations of the fur-mite subgenus *Listrophoroides* (sensu stricto) Hirst (Acari: Atopomelidae) with an intriguing example of synhospitality on rats of the genus *Maxomys*. *Invertebrate Systematics*, 19: 437–498.
- Dubinina, H.V. 1964. [Mites of the genus *Histiophorus* (Listrophoridae) parasites of beavers]. *Parazitologicheskiy Sbornik*, 22: 111–152. [In Russian]
- Dubinina, H.V., Bochkov, A.V., and Bobrovskaya, V.I. 1993. [Notes on systematics of mites of the genus *Schizocarpus* (Acariformes: Chirodiscidae)]. *Parazitologiya*, 27: 450–453. [In Russian with English summary]
- Ducroz, J.-F., Stubbe, M., Saveljev, A.P., Heidecke, D., Samjaa, R., Stubbe, A., and Durka, W. 2005. Genetic variation and population structure of the Eurasian beaver *Castor fiber* in Eastern Europe and Asia. *Journal of Mammalogy*, 86: 1059–1067.
- Durka, W., Babik, W., Ducroz, J.-F., Heidecke, D., Rosell, F., Samjaa, R., Saveljev, A., Ulevi, A., and Stubbe, M. 2005. Mitochondrial phylogeography of the Eurasian beaver *Castor fiber* L. *Molecular Ecology*, 14: 3843–3856.
- Fain, A. and Lukoschus, F.S. 1985. The genus *Schizocarpus* Trouessart, 1896 (Acari, Chirodiscidae) from the beaver *Castor fiber* L. An example of multiple speciation. *Entomologische Abhandlungen*, 49: 35–58.
- Fain, A. and Whitaker, J.O.Jr. 1988. Mites of the genus *Schizocarpus* Trouessart, 1896 (Acari, Chirodiscidae) from Alaska and Indiana, USA. *Acarologia*, 29: 395–409.
- Fain, A., Whitaker, J.O.Jr. and Smith, M.A. 1984. Fur mites of the genus *Schizocarpus* Trouessart, 1896 (Acari, Chirodiscidae) parasitic on the American Beaver *Castor canadensis* in Indiana, U.S.A. *Bulletin and Annales de la Société royale Belge d'Entomologie*, 120: 211–239.
- Gabrys, G. and Wazna, A. 2003. Subspecies of the European beaver *Castor fiber* Linnaeus, 1758. *Acta Theriologica*, 48: 433–439.
- Griffiths, D.A., Atyeo, W.T., Norton, R.A., and Lynch, C.A. (1990). The idiosomal chaetotaxy of astigmatid mites. *Journal of Zoology (London)*, 220: 1–32.
- Haitlinger, R. 1991. Arachnid occurring on European beaver (*Castor fiber* L.) in Poland. *Wiadomosci Parazytologiczne*, 37: 107–109.
- Kadulski, S. 1998. Ectoparasites of the beaver *Castor fiber* L. from Popielno. *Wiadomosci Parazytologiczne*, 44: 729–736.
- Trouessart, E.L. 1898. Description de *Schizocarpus mingaudi* (Arachn.), nouveau sarcoptide pilicole vivant sur le *Castor*. *Bulletin de la Société Entomologie de France*, 4: 91–97.
- Whitaker, J.O.Jr. 2006. Ectoparasites of North American aquatic rodents and comparison to European forms. *Acarina*, 14: 137–145.
- Whitaker, J.O.Jr., Fain, A. and Jones, G.S. 1988. Ectoparasites from beavers from Massachusetts and maine. *International Journal of Acarology*, 15: 153–162.
- Whitaker, J.O.Jr., Ruckdeschel, C. and Bochkov, A.V. 2009. Species of the genus *Schizocarpus* Trouessart, 1896 (Acari: Chirodiscidae) from Florida and Georgia beavers. *Florida Scientist, Biological Sciences*, 72: 18–21.
- Whitaker, J.O.Jr. and Smith, M.A. 1985. Ectoparasites from the North American beaver, *Castor canadensis*, from Indiana. *Bulletin and Annales de la Société royale Belge d'Entomologie*, 121: 233–242.

Table 3. *Schizocarpus* spp. parasitizing *Castor fiber orientoeuropaeus* Lavrov, 1981 in the Voronezh National Reserve

Mite species	Host subspecies	Locality	Microhabitat	Reference
Species group <i>numerosus</i>				
* <i>S. numerosus</i> (Dubinina, 1964)	<i>C. f. orientoeuropaeus</i>	Russia (VR)	Entire dorsal body surface, rarely on flanks	Dubinina (1964)
	<i>C. f. albicus</i>	Germany (Elbe River)	Head (mainly on ears)	Fain and Lukoschus (1985)
<i>S. capitis</i> (Dubinina, 1964)	<i>C. f. orientoeuropaeus</i>	Russia (VR)	Head	Dubinina (1964)
	<i>C. f. albicus</i>	Germany (Elbe River)		Fain and Lukoschus (1985)
	<i>C. fiber</i> unknown subspecies	Europe		
<i>S. fedjushini</i> (Dubinina, 1964)	<i>C. f. orientoeuropaeus</i>	Russia (VR)	Mostly on flanks	Dubinina (1964)
	<i>C. fiber</i> unknown subspecies	Europe	Mostly on head	Fain and Lukoschus (1985)
<i>S. brachyurus</i> (Dubinina, 1964)	<i>C. f. orientoeuropaeus</i>	Russia (VR)	Head venter, abdomen, legs	Dubinina (1964)
<i>S. brevicauda</i> (Dubinina, 1964)	<i>C. f. orientoeuropaeus</i>	Russia (VR)	Abdomen	Dubinina (1964)
	<i>C. f. albicus</i>	Germany (Elbe River)	Unknown	Fain and Lukoschus (1985)
* <i>S. grandis</i> (Dubinina, 1964) (= <i>dubininae</i> Fain et Lukoschus, 1985 syn. nov.)	<i>C. f. orientoeuropaeus</i>	Russia (VR)	Anterior legs, groin	Dubinina (1964)
	<i>C. fiber</i> unknown subspecies	Europe	Head, throat, chest	Fain and Lukoschus (1985)
<i>S. similis</i> Fain et Lukoschus, 1985	<i>C. f. albicus</i>	Germany (Elbe River)	Head, throat	Fain and Lukoschus (1985)
	<i>C. fiber</i> unknown subspecies	Europe	Head	Fain and Lukoschus (1985)
	<i>C. f. orientoeuropaeus</i>	Russia (VR)		Present paper
* <i>S. parvus</i> (Dubinina, 1964)	<i>C. f. orientoeuropaeus</i>	Russia (VR)	Unknown	Dubinina (1964)
* <i>S. subparvus</i> (Dubinina, 1964)	<i>C. f. orientoeuropaeus</i>	Russia (VR)	Unknown	Dubinina (1964)
* <i>S. minor</i> (Dubinina, 1964)	<i>C. f. orientoeuropaeus</i>	Russia (VR)	Unknown	Dubinina (1964)
<i>S. pygidialis</i> Fain et Lukoschus, 1985	<i>C. fiber</i> unknown subspecies	Europe	Tail base	Fain and Lukoschus (1985)
	<i>C. f. orientoeuropaeus</i>	Russia (VR)		Present paper
Species group <i>radiatus</i>				
<i>S. radiatus</i> Fain et Lukoschus, 1985	<i>C. fiber</i> unknown subspecies	Europe	Dorsum, flanks	Fain and Lukoschus (1985)
	<i>C. f. orientoeuropaeus</i>	Russia (VR)	Unknown	Present paper
* <i>S. latus</i> (Dubinina, 1964) (= <i>ventricosus</i> Fain et Lukoschus, 1985 syn. nov.)	<i>C. f. orientoeuropaeus</i>	Russia (VR)	Tail base	Dubinina (1964)
	<i>C. fiber</i> unknown subspecies	Europe	Dorsum, rarely on flanks	Fain and Lukoschus (1985)
<i>S. sp.</i>	<i>C. f. orientoeuropaeus</i>	Russia (VR)	Unknown	Present paper
Species group <i>hexapilis</i>				
<i>S. subminor</i> (Dubinina, 1964)	<i>C. f. orientoeuropaeus</i>	Russia (VR)	Unknown	Dubinina (1964)
* <i>S. subhexapilis</i> Fain et Lukoschus, 1985	<i>C. fiber</i> unknown subspecies	Europe	Chest, throat, head	Fain and Lukoschus (1985)
	<i>C. f. orientoeuropaeus</i>	Russia (VR)	Unknown	Present paper

Type host and locality — given first; * — species colonized *Castor canadensis* in captivity; VR — Voronezh Reserve.