



Suctorian ciliates (Ciliophora, Suctorea) as epibionts of stream-dwelling aquatic beetles (Coleoptera) and water mites (Acari: Hydrachnidia) in the southwestern Palaeartic region

IGOR DOVGAL¹ & VLADIMIR PEŠIĆ²

¹Schmalhausen Institute of Zoology, B. Khmel'nitsky str., 15, 01601, Kiev, Ukraine. E-mail: dovgal@izan.kiev.ua

²Department of Biology, Faculty of Sciences, University of Montenegro, Cetinjski put b.b., 81000 Podgorica, Montenegro. E-mail: vladopesic@gmail.com

Abstract

Based on original data from recent research, numerous new records of the suctorian species living as epibionts on stream-dwelling aquatic beetles (Coleoptera) and water mites (Acari, Hydrachnidia) in the southwestern Palaeartic area are given. The following species are reported for the first time for the national faunas: *Setodiscophrya deplanata* (Matthes, 1954) (Bosnia and Hercegovina, Montenegro, Serbia, Bulgaria, Turkey), *Discophrya helmidis* Matthes, 1954 (Montenegro, Turkey), *Elatodiscophrya hochi* (Matthes, 1954) (Bosnia and Hercegovina, Turkey), *Periacineta buckei* (Kent, 1881) (Montenegro, Greece), *Discophrya lichtensteinii* (Claparede & Lachmann, 1859) (Turkey, Iran). The characteristics of the suctorians as epibionts of stream-dwelling arthropods are briefly outlined.

Key words: aquatic beetles, water mites, suctorian ciliates, epibiont, lotic ecosystems

Introduction

Suctorians (class Suctorea) are a peculiar group of carnivorous or parasitic ciliate (Dovgal 2002), which are poorly known in respect of distribution and species composition living as epibionts on stream-dwelling animals. Many invertebrate groups (i.e., Crustacea, Coleoptera, Acari, etc) living in lotic freshwaters include species that are hosts for epibiotic suctorian ciliates. However, there is considerably lack on the information on suctorian ciliates as epibionts of aquatic beetles and water mites inhabiting lotic ecosystems.

Bameul (1991) reported *Periacineta koepelli* (Matthes, 1954) and *Setodiscophrya deplanata* (Matthes, 1954) as epibionts on aquatic beetles of the family Hydraenidae from streams in Spain and France, respectively. Dovgal (1993) recorded, from the Transcarpathian region in the Ukraine, the following suctorian species as epibionts on aquatic beetles: *Periacineta molesta* (Matthes, 1954) on *Hydroporus* sp. (Dytiscidae), *Discophrya lichtensteinii* (Claparede et Lachmann, 1859) (under synonymic name *Discophrya cybistericola* (Jankowski, 1981) on *Agabus* sp., (Dytiscidae), *Discophrya helmidis* Matthes, 1954 on *Hydraena* sp. (Hydraenidae) and on *Hydroporus* sp. (Dytiscidae), *Discophrya ferrumequinum* (Ehrenberg, 1840) (under synonymic name *Discophrya speciosa* Lachmann, 1859) on *Agabus* sp. (Dytiscidae) and on *Hydrobius fuscipes* (Linnaeus, 1758) (Hydrophilidae), *Misacineta cybistri* (Collin, 1912) on *Platambus maculatus* Linnaeus, 1758 (Dytiscidae), and on *Ilybius fuliginosus* Gschwendtner, 1934 (Dytiscidae).

There are not many records of suctorians living as epibionts of water mites from the lotic environment. Recently, Dovgal & Pešić (2007) described a new suctorian species *Acineta persiensis* Dovgal & Pešić, 2007 on the water mites *Protzia sepaosariani* and *P. invalvaris* (Acari, Hydrachnidia, Hydryphantidae) from Iran and Montenegro, respectively.

During the survey, conducted by the second author (VP), to explore the diversity of the water mite fauna of the Balkan Peninsula, Turkey and Iran, we observed the presence of suctorian ciliates on many representatives of the

benthic community from lotic freshwater, belonging to aquatic beetles (Coleoptera) and water mites (Hydrachnidia).

The aim of the present study is to update the records and distribution of suctorian species living as epibionts on aquatic stream-dwelling aquatic beetles and water mites.

Material and methods

During field work, water mites and aquatic beetles were collected by hand netting, sorted on the spot from other living material and preserved in 75% ethanol.

For the preparation of slides, the material was stained by Boehmer's hematoxylin and mounted in Canada balsam (see: Dovgal 1996, 2002). The photomicrography was made with the use of digital video camera DC-1200. Permanent slides of infested animals were deposited in the collections of the Department of Fauna and Systematics of Invertebrate Animals of the Schmalhausen Institute of Zoology, National Academy of Sciences, Ukraine.

Results

Setodiscophrya deplanata (Matthes, 1954)

(Fig. 1)

New records. BOSNIA AND HERCEGOVINA: W Hercegovina, river Lištica near Široki Brijeg, 43°21'N; 17°37'E, 12.xi.2006, on *Hydraena* sp. (Coleoptera, Hydraenidae); MONTENEGRO: Podgorica city, river Cijevna near village Dinoša, 42°23'59.48"N; 19°21'56.26"E, 15.8.2006, on *Hydraena* sp.; Mojkovac town, Dolje Polje village, Ljevok stream, 849 m. a.s.l., 42°59'N; 19°26'E, 10.8.2006, on *Hydraena* sp.; Podgorica city, spring Ribnička Vrela, 50 m. a.s.l., 42°26'14.10"N; 19°17'50.62"E, 05.8.2006, on *Hydraena morio*; Kolašin town, stream Bistrica, 1122 m. a.s.l., 42°48'N; 19°27'E, 30.8.2006, on *Hydraena morio*; Rumija Mt., Medjurječka reka-river near Medjurječje, 15.3.2007, on *Hydraena* sp.; SERBIA: Southern Serbia: Starac Mt., spring near village Gornji Starac, 29.4.2006, on *Hydraena* sp.; Canyon of the Pčinja river, spring near Monastir Prohor Pčinjski (at the road) 26.4.2006, on *Hydraena* sp.; BULGARIA: Eastern Rhodopes., Madzharovo town, Malkata Reka stream, 25.6.2006, on *Hydraena* sp.; TURKEY: Rize Province, Güneysu town, 40°58'19"N; 40°36'46"E, upper part of Kangel stream (tributary of Tašli stream) near Kangel village, 18.7.2005, on *Hydraena* sp.

Diagnosis. Suctorian with disc-shape, flattened, "lenticular" cell with long stalk and clavate tentacles evenly distributed over all the edge of the cell. Macronucleus branched. There are 7–12 contractile vacuoles positioned near the edge of the cell.

Measurements (data combined from Dovgal *et al.* 2006 and our material from the study area): Cell length 62–106 µm, width 56–102 µm, length of stalk 62–172 µm, stalk diameter 4–23 µm.

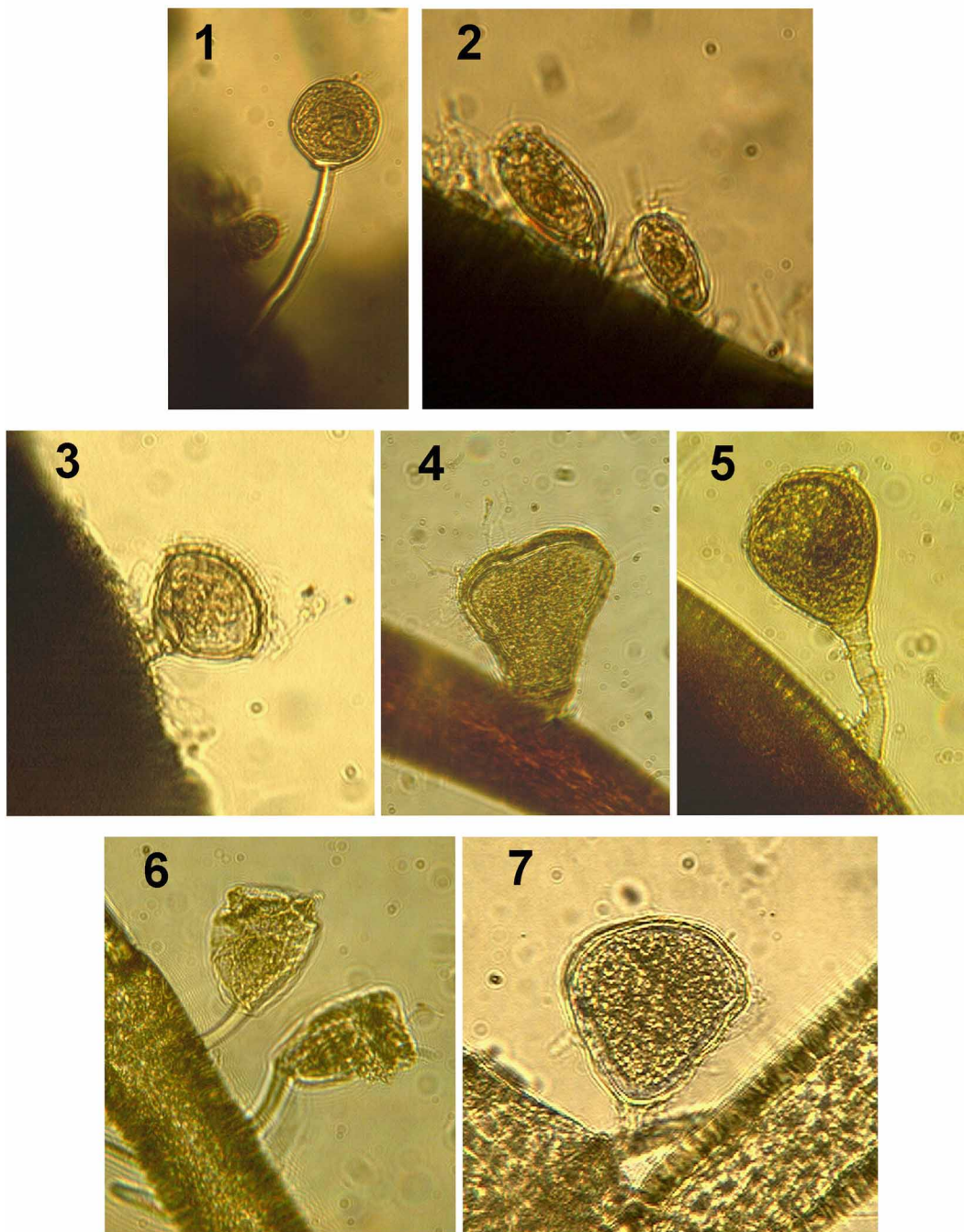
Remarks. New for Bosnia and Hercegovina, Montenegro, Bulgaria and Turkey.

Distribution. Germany: Erlangen vicinity (Matthes 1954c, on *Ochthebius minimus*); France: Lidoire, Carsac-de-Gurson, Dordogne in the Aquitaine region (Bameul 1991, on *Hydraena cordata regularis*); Ukraine: basin of River Seversky Donets (Dovgal *et al.* 2006, without host or substrate identification); Russia: lake Podgorskoe, basin of River Volga near Saratov water reservoir (Dovgal *et al.* 2006, on glass slides); Balkan (present paper, on *Hydraena morio* and *Hydraena* sp.), Turkey (present paper, on *Hydraena* sp.).

Discophrya helmidis Matthes, 1954

(Fig. 2)

New records. MONTENEGRO: Plav town, Grnčar river near Gusinje, 30.viii.2006, on *Hydraena* sp.; TURKEY: Rize Province, Sarayköy stream near Sarayköy village (near Rize city, 41°1'15"N; 40°31'19"E), 270 m. asl., 20.7.2005, on Elmidae (Coleoptera).



FIGURES 1–7. 1 = *Setodiscophrya deplanata* (Matthes, 1954), from *Hydraena* sp. ($\times 640$); 2 = *Discophrya helmidis* Matthes, 1954, from *Hydraena* sp. ($\times 640$); 3 = *Elatodiscophrya hochi* (Matthes, 1954), from *Hydraena* sp. ($\times 640$); 4 = *Periacineta buckei* (Kent, 1881), from *Hydraena* sp. ($\times 640$); 5 = *Discophrya lichtensteinii* (Claparede & Lachmann, 1859), from *Torrenticola barsica* ($\times 640$); 6 = *Acineta* sp. from *Torrenticola barsica* ($\times 640$); 7 = *Acineta persiensis* Dovgal & Pešić, 2007, from *Protzia* sp. ($\times 640$).

Diagnosis. Suctorian with disc-shape, elongated, flattened cell. Stalk short, cylindrical near the substrate and sharply cup-like apically flared, with transversal tucks. Clavate tentacles are few in number and evenly distributed over all the edge of the cell. Macronucleus rounded, elongated. There are up to 8 micronuclei. There are 2–4 apical contractile vacuoles.

Measurements (from Dovgal 1996): Cell length 19–50 μm , width 15–42 μm , length of stalk 7–30 μm .

Remarks. New for Montenegro and Turkey.

Distribution. Germany (Matthes 1954c, on *Hydraena gracilis*, *H. polita*, *H. riparia*), Ukrainian Carpathians (Dovgal 1993, on *Hydraena* sp., *Hydroporus* sp.), Balkan (present paper, on *Hydraena* sp.), Turkey (present paper, on Elmidae).

Elatodiscophrya hochi (Matthes, 1954)

(Fig. 3)

New records. BOSNIA AND HERCEGOVINA: W Hercegovina, river Lištica near Široki Brijeg, 43°21'N; 17°37'E, 12.xi.2006, on *Hydraena* sp.; TURKEY: Artvin Province, Çiftekop stream, a tributary of Çoruh river, 28.7.2005, on *Hydraena* sp.

Diagnosis. Suctorian with disc-shape, flattened cell. Cell located on a very broad, bed-shaped stalk, in such a way that the cell is covered by widening from one side only. Clavate tentacles are few in number and evenly distributed along the upper edge of the cell and not united in bundles. Macronucleus band-like, sometimes branched. There are 3 or 4 contractile vacuoles positioned near the edge of cell.

Measurements: Cell length 19–57 µm (41–58 µm after Matthes 1954a), width 26–78 µm (61–88 µm after Matthes 1954a), stalk length 8–23 µm, length of macronucleus 17–29 µm.

Remarks. New for Bosnia and Hercegovina and Turkey.

Distribution. Germany (Matthes 1954a, Matthes & Plachter 1975, on *Helophorus flavipes*), Balkan (present paper, on *Hydraena* sp.), Turkey (present paper, on *Hydraena* sp.).

Periacineta buckei (Kent, 1881)

(Fig. 4)

New records. MONTENEGRO: Kolašin town, stream Bistrica, 1122 m. a.s.l., 42°48'N; 19°27'E, 30.7.2006, on *Hydraena morio*; Berane town, spring near Monastir Djurdjevi Stupovi, 42°51'N; 19°51'E, 29.9.2006, on *Dryops* sp. (Coleoptera, Dryopidae); Mojkovac town, Lepenac stream, 30.ix.2006, on *Hydraena* sp.; GREECE: Evia Island, the region of Ochi, stream Gefira Dimosaris, downstream between Kalergo and Kallianos vill., 30.6.2007, on *Hydraena* sp.

Diagnosis. Suctorian with trapeziform, flattened, loricate cell. Lorica smooth, and there is a short stalk. Macronucleus spheroidal or elongate. Clavate tentacles arranged in two apical fascicles. There are from two to four contractile vacuoles.

Measurements: Cell length 16–120 µm, width 19–59 µm.

Remarks. New for Montenegro and Greece.

Distribution. Widespread species; North America (Nutting 1888 as *Acineta compressa*, Mariño-Pérez et al. 2011); Japan (Nozawa 1938 as *Periacineta tenuis*); Europe: Germany (Matthes 1954d), Ukraine (Dovgal 1996), Balkan (present paper); observed on different hosts (*Belostoma* sp., *Lethocerus* sp., *Ranatra* sp., *R. linearis*, *Nepa cinerea*, *N. rubra*, *Naucoris cimicoides*, *Hydraena* sp., *Argyroneta aquatica*, *Anacharis* sp., *Planorbis* sp., *Planorbarius corneus*, *Lymnaea stagnalis*, *Hydrous* sp., *H. aterrimus*, *Helophorus* sp., *Helophorus flavipes*, *H. fallax*, *H. asperatus*, *Hydraena* sp., *H. morio* and *Dryops* sp.) and inanimate substrates.

Discophrya lichtensteinii (Claparede & Lachmann, 1859)

(Fig. 5)

New records. TURKEY: Erzurum Province, Teke stream, 23.7.2006, 39°51'50"N; 41°13'26"E, 2000 m. a.s.l., on *Protzia* sp. (Hydrachnidia, Hydryphantidae); Konya Province, Akşehir, Yayla Stream, 18.4.2004, 38°19'07"N; 31°27'21"E, 1060 m. a.s.l., on *Protzia* sp.; IRAN: Shanderman (Chafrood) stream 15 km from Masal city, 37°29'N; 49°06'E, 20.7.2006, on *Torrenticola barsica* (Hydrachnidia, Torrenticolidae).

Diagnosis. Suctorian ciliate with flattened, disc-shaped or elongate cell. Macronucleus ovoid, centrally located. Contractile clavate tentacles evenly distributed over all the edge of the cell, in some cases only at apical

part. Stalk cup-shaped or elongate with different lengths, uniformly expanding upwards, with transversal folds. There are from one to three contractile vacuoles in apical part of the cell.

Measurements: Cell length 25–180 µm, width 15–160 µm, length of stalk 17–192 µm.

Remarks. New for Turkey and Iran.

Distribution. Germany (Matthes 1954b, on *Dytiscus marginalis*, *Cybister laterimarginalis*, *Dytiscus circumflexus*, *Graphoderes zonatus*, *G. cinereus*, *G. bilineatus*, *Haliplus laminatus*, *H. flavicollis*, *H. fluviatilis*, *H. ruficollis*, *H. wehnkei*, *Peltodytes caesus*, *Brychius elevatus*, *Graptodytes pictus*, *Hyphydrus ovatus* and *Coelambus impressopunctatus*), Ukraine (Dovgal 1996, on *Agabus* sp., *Potamonectes* sp., *Cybister* sp., *Graphoderes* sp., *Haliplus* sp., *Peltodytes* sp., *Brychius* sp., *Coelambus impressopunctatus*, *Potamonectes elegans*, *Dytiscus circumflexus*, *Hyphydrus ovatus* and *H. bicolor*; Dovgal 1993 as *Discophrya cybistericola*, on *Agabus* sp.), Mexico (Mariño-Pérez et al. 2011, on *Ambrysus* sp.), Turkey (present paper, on *Protzia* sp.), Iran (present paper, on *Torrenticola barsica*).

Acineta sp.

(Fig. 6)

New records. BOSNIA AND HERCEGOVINA, river Lištica near Široki Brijeg, 43°21'N; 17°37'E, 12.11.2006, on *Sperchon* gr. *denticulatus* (Hydrachnidae, Sperchontidae); MONTENEGRO: Rumija Mt., Medjurječka reka-river near Medjurjecje, 15.3.2007, on *Partnunia naprintua* (Hydrachnidia, Hydryphantidae); Komovi Mt., Štavna, rheohelocrenic spring in forest, 42°42'N; 19°40'E, 27.5.2007, on *Partnunia naprintua* (Hydrachnidia, Hydryphantidae); TURKEY: Rize province, small stream in lower part of Gaplayam stream near Findikli town (40°52'N; 39°57'E), 23.7.2005, on *Torrenticola barsica* (Torrenticolidae); Turkey, Artvin Province, Hopa stream near Koyuncular village (near Hopa town, 41°24'N; 41°26'E), ca. 450 m. a.s.l., 28.7.2005, on *Torrenticola barsica* (Torrenticolidae); Başovacık stream, Ilica, Erzurum Province, 08.9.1995, 40°15'16"N; 41°05'18"E, 2100 m. a.s.l., on *Protzia* sp. (Hydriphantidae); Erzurum Province, Sırlı stream, Ilica, 14.9.2006, 40°14'39"N; 41°07'00"E, 2200 m. a.s.l., on *Atractides* sp. (Hydrachnidia, Hygrobatidae); IRAN: Shanderman (Chafrood) stream 15 km from Masal city, 37°29'N; 49°06'E, 20.7.2006, on *Torrenticola barsica* (Torrenticolidae).

Description. Suctorian ciliate with trapeziform, weakly laterally flattened, loricated cell. There are two fascicles of tentacles located at the apical cell surface. Actinophores absent. Macronucleus rounded, centrally located. Lorica thin-walled, wrinkled. Stalk is solid, slightly apically extended.

Measurements: Cell length 30–33 µm, width 23–28 µm, length of stalk 16–23 µm, diameter of stalk 4–5 µm.

Remarks. *Acineta* Ehrenberg, 1834 is the largest suctorian genus comprising 62 species (Dovgal 2002) and many of these species are morphologically very similar (Curds 1985, Matthes et al. 1988). The examined specimens resemble *Acineta tuberosa* Ehrenberg, 1834, *A. foetida* Maupas, 1881 and *A. fluviatilis* Stokes, 1885, and differ from *A. tuberosa* by the slightly apically flared stalk and the presence of folds of the lorica (due to this character it differs also from *A. fluviatilis*), from *A. foetida* by the absence of characteristic disc-like widening at the tip of the stalk. Furthermore, it is worthy of note that both, *Acineta tuberosa* and *A. foetida* are marine species (Dovgal 1996). Since the variability of the above mentioned species needs to be examined in order to clarify the taxonomy, the introduction of a new name at this stage will create more confusion given the present state of knowledge.

Acineta persiensis Dovgal & Pešić, 2007

(Fig. 7)

New records. MONTENEGRO: Kolašin town, stream Bistrica, near village Crkvine, 1122 m. a.s.l., 42°48'N; 19°27'E, 30.ix.2006, on *Protzia invalvaris* (Hydriphantidae); IRAN: Kerman Province, Jebal Barez Mts., Jiroft city, Temnoieh, Rezvan spring, 15. 6. 2009, on *Nilotonia persica* (Hydrachnidia, Anisitsiellidae).

Diagnosis. Suctorian ciliate with pear-shaped, laterally flattened, loricated cell. There are two fascicles of tentacles located at the apical cell surface. Actinophores absent. Macronucleus in the form of irregular ellipse, located about centre of the cell. The very thick walls of lorica is characteristic for the species. There is short stalk composed of an adhesive disk.

Measurements: Cell length 34–58 µm, width 34–41 µm, length of stalk 5–7 µm.

Distribution. Iran (Dovgal & Pešić 2007, present paper; on *Protzia sepaosgosariani* and *Nilotonia persica*); Montenegro (Dovgal & Pešić 2007, present paper; on *Protzia invalvaris*).

Discussion

In the lotic habitat, ciliates are exposed to a complex of hydrodynamic factors and most of above listed suctorians have some specific adaptations to hydrodynamic loads on the surface, due to the flow of water (Dovgal & Kochin 1997, Dovgal 2008) e.g., *Periacineta buckei*, *Acineta persiensis* and *Acineta* sp. have a lorica, *Elatodiscophrya hochi* bears an extremely flared one-limbed apical part of the stalk which covers the cell, from the side opposite to the host's body surface, while *Discophrya lichtensteinii* has a stalk of a different length depending on the position on the host's body (Dovgal & Kochin 1997, Dovgal 2008). However, all the above mentioned suctorian species also occur in stagnant water, and the adaptations listed, in most cases, are because they are living on motile hosts (Dovgal & Kochin 1997, Dovgal 2008, Mariño-Pérez & Mayén-Estrada 2009). Thus we can not indicate any specific adaptations to living in lotic habitats. Nevertheless, it can be assumed that the species which have well developed adaptations to hydrodynamic loads, are accordingly better adapted to the conditions in streams with rapid currents and consequently they are more dominant in such habitats.

In this study, *Setodiscophrya deplanata* (Matthes, 1954) and *Periacineta buckei* (Kent, 1881) were the most widespread epibionts on aquatic beetles. These two species were found at 10 and 4 sampling sites, respectively. In contrast, *Discophrya helmidis* Matthes, 1954 and *Elatodiscophrya hochi* (Matthes, 1954) are found at only two sampling sites, respectively. *Setodiscophrya deplanata* has been recorded only as an epibiont of members of genus *Hydraena*.

The most widespread epibiont on water mites was *Acineta* sp. This species was found at eight sampling sites, while the two other epibionts on water mites, *Discophrya lichtensteinii* (Claparede & Lachmann, 1859) and *Acineta persiensis* Dovgal & Pešić, 2007, were found at three and two sampling sites, respectively. The epibiotic suctorian ciliates on water mites have not shown specificity to any particular water mite family in the lotic habitat. They have been recorded mainly as epibionts on members of the families Hydryphantidae and Torrenticolidae, which are typical slow moving representatives of the water mites in the lotic habitat. It is worthy of note that *Tokophrya wenzeli* Matthes & Stiebler, 1970, the first described epibiotic suctorian ciliate from water mites, was not observed in our study, and it seems likely that this species is a characteristic epibiont of freshwater mites from lentic water (Dovgal *et al.* in press).

Our study reveals interesting patterns for some species, for example, records of *Discophrya lichtensteinii* on water mites, which are not characteristic for these suctorians (most records coming from aquatic beetles, see Matthes *et al.* 1988), indicating that this suctorian species, in the lotic habitat, probably prefers water mite hosts. On the other hand, numerous records of such extremely rare species as *Setodiscophrya deplanata*, indicate that this suctorian species probably prefers conditions characteristic of the lotic habitat.

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