



New records of suctorians (Ciliophora: Suctoria) as epibionts of aquatic true bugs (Hemiptera: Prosorrhyncha: Nepomorpha) from two regions: Mexico and Eastern Europe

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Abstract

Here, we provide new records of suctorians (Ciliophora: Suctoria), epibionts of aquatic true bugs (Hemiptera: Prosorrhyncha: Nepomorpha) collected in Ukraine, Belarus and Mexico. The worldwide distribution of the 16 species we found is updated, from which, 15 species are new records as epibionts of 15 species of aquatic true bugs. Only for the suctorian *Discophrya gessneri* Matthes, we confirm the previous record (epibiont of *Aphelocheirus aestivalis* Fabricius). We conclude that the relationship between the suctorians and aquatic true bugs is poorly studied and some suctorian genera (*Discophrya* Lachmann and *Periacineta* Collin) inhabit as nepomorphans as other aquatic insects (Coleoptera). However the high degree of specificity at the species level of these genera is evident, for which we provide some possible explanations according to the group of basibiont.

Key words: Suctorian, nepid, epibiosis, epibiont-basibiont system, Mexico, Ukraine, Belarus

Introduction

There are approximately 8,000 species of ciliated protozoa (Lynn, 2008), and some of them are symbionts of other organisms. Epibiotic suctorian ciliates of aquatic insects (such as hemipterans) are poorly understood worldwide, and few studies have been done for the genera *Corixa* Geoffroy, *Sigara* Fabricius, *Notonecta* Linnaeus, *Plea* Leach, *Nepa* Linnaeus, *Naucoris* Geoffroy and *Aphelocheirus* Westwood (Matthes *et al.* 1988). Recently in Mexico, Mariño-Pérez & Mayén-Estrada (2009) recorded *Discophrya elongata* (Claparède et Lachmann) and *Acineta tuberosa* Ehrenberg as epibionts of the water boatman *Corisella edulis* (Champion). In the Ukraine, Dovgal (1987, 1991) reported *Discophrya lichtensteinii* (Claparède et Lachmann) (under synonym name *D. wrzesniowskii*) as an epibiont of the water scorpion *Ranatra linearis* (Linnaeus), *D. ochthebii* Matthes as an epibiont of the pygmy backswimmer *Plea leachi* McGregor & Kirkaldy, *D. gessneri* as an epibiont of *Aphelocheirus aestivalis*, *Periacineta buckei* (Kent) (under name *P. nepae*) on the water scorpion *Nepa cinerea* Linnaeus, and *Ranatra linearis* and *Periacineta notonectae* (Claparède et Lachmann) as epibionts of the water boatman *Corixa* sp. Only two of these suctorians, *Discophrya lichtensteinii* and *Periacineta buckei* were recorded on *Nepa cinerea*, from Lake Khotin, high-water bed of river Desna, near village Timanovka, Sumy region (Dovgal, 1987). Also, Dovgal (1987, 1991) reported for the first time *D. lichtensteinii* and *D. ochthebii* as epibionts of true bugs.

The aims of the present study are to update and compare the records and distribution of epibiont suctorian attached to some aquatic insects, from two biogeographical areas.

Material and methods

Between the years 1983–2010, several aquatic insects (hemipterans) were collected at certain localities in Ukraine, Belarus, and Mexico. The insects were collected with a 0.5 mm mesh net or by manual sampling and then, fixed and preserved with 70% alcohol or 4% formalin. For microscopical observation, the suctorians ciliates were recorded and identified, fixed with Bouin's fixative for 5 min. and stained with either Heidenhain's or Boehmer's haematoxylin, or fixed with 70% alcohol and stained with Harris' haematoxylin. According to Lynn (2008) the taxonomic status for each species of suctorians is presented. Here, we provide the aquatic true bugs species that carries the epibionts, the country and for some localities the geo-reference. Additional data such as altitude are given in meters above sea level (m.a.s.l.). We include for each species of suctorians ciliate, a diagnosis and morphometrical data. We also compiled the available data about epibiont suctorians providing the previous records of the species and also previous measurements.

Results

We obtained 16 species of suctorians representing three subclasses, five orders, 10 families, and 11 genera. These protozoans were found attached to 15 species of aquatic true bugs representing 11 genera and seven families: Nepidae (*Ranatra linearis*, *Nepa cinerea*, *Ranatra* spp. Fabricius); Belostomatidae (*Belostoma* spp. Latreille, *Lethocerus* sp. Mayr); Naucoridae [(*Naucoris cimicoides* (Linnaeus), *Ambrysus* spp. Stål)]; Pleidae (*Plea leachi*); Corixidae [(*Hesperocorixa laevigata* (Uhler), *Corixa* sp.)]; Aphelocheiridae (*Aphelocheirus aestivalis*) and Notonectidae (*Notonecta unifasciata* Guerin-Meneville).

For Ukraine and Belarus, we found nine species as new records, and for Mexico we observed only three new records. Four species of suctorians were found distributed in all three countries (Ukraine, Belarus, and Mexico) as new records. The suctorian *Periacineta buckei* was found in ten species of aquatic true bugs, and *Discophrya elongata* was found in seven basibiont species. The nepomorphs which harboured the highest species richness, were the nepids *Ranatra linearis* (5 species), and *Nepa cinerea* (4 species).

Systematics

Species taxonomy (Lynn, 2008).

Class PHYLLOPHARYNGEA de Puytorac *et al.*, 1974

Subclass Suctorina Claparède et Lachmann, 1858

Order Exogenida Collin, 1912

Family Podophryidae Bütschli, 1889

Genus *Podophrya* Ehrenberg, 1834

Species *Podophrya fixa* (O.F. Müller, 1786)

Family Metacinetidae Bütschli, 1889

Genus *Metacineta* Bütschli, 1889

Species *Metacineta longipes* (Mereschkowsky, 1877)

Family Manuelophryidae Dovgal, 2002

Genus *Manuelophrya* Matthes, 1988

Species *Manuelophrya hanna* (Guhl, 1985)

Order Endogenida Collin, 1912

Family Acinetidae Ehrenberg, 1838

Genus *Acineta* Ehrenberg, 1834

Species *Acineta fluviatilis* Stokes, 1885

Family Tokophryidae Jankowski, 1978

Genus *Tokophrya* Bütschli, 1889

Species *Tokophrya quadripartita* (Claparède et Lachmann, 1859)

Tokophrya lemna (Stein, 1859)

Family Dendrosomatidae Bütschli, 1889

- Genus *Dendrosoma* Ehrenberg, 1838
 Species *Dendrosoma radians* Ehrenberg, 1838
 Family Pseudogemmidae Jankowski, 1978
 Genus *Pseudogemma* Collin, 1912
 Species *Pseudogemma pachystyla* Collin, 1912
 Order Evaginogenida Jankowski, 1978
 Family Discophryidae Collin, 1912
 Genus *Discophrya* Lachmann, 1859
 Species *Discophrya elongata* (Claparède et Lachmann, 1859)
Discophrya gessneri Matthes, 1954
Discophrya lichteinsteinii (Claparède et Lachmann, 1859)
Discophrya ochthebii Matthes, 1954
 Family Periacinetidae Jankowski, 1978
 Genus *Periacineta* Collin, 1909
 Species *Periacineta buckei* (Kent, 1882)
Periacineta notonectae (Claparède et Lachmann, 1859)
 Genus *Kormosia* Dovgal, 2002
 Species *Kormosia linguifera* (Claparède et Lachmann, 1859)
 Family Heliophryidae Corliss, 1979
 Genus *Cyclophrya* Gonnert, 1935
 Species *Cyclophrya magna* Gonnert, 1935

Suctorian species records

Family Podophryidae Bütschli

Podophrya fixa (O.F. Müller, 1786)

Fig. 3c.

The cell is spherical, stalk long, thin, slightly bent. Numerous capitate tentacles, variable in length, equally spaced over the body surface. There is one centrally located, spherical macronucleus, and one contractile vacuole. Reproduction by pseudo-scissiparity producing a bud that is approximately a same size as a mother cell with about 12 longitudinal rows of cilia and several rudimentary tentacles (Curds, 1986). The stalked oviform cyst with four transversal ribs is characteristic for this species.

Dimensions (in μm): body diameter 10–40; length of stalk 80–100; stalk diameter 4–5; macronucleus diameter 11–15; length of tentacles 12–25. Previous measurements: body diameter 25–70; length of stalk 35–140; length of tentacles until 120.

Material examined. Found as epibiont of: *Plea leachi*. **Ukraine.** Small lake in high-water bed of Desna river near village Klad'kovka, Chernigov region, 12.07.1984.

Additional records. On *Cambarus* Erichson (Morado & Small, 1995). On algae; seawater, wastewater; aquatic plants, copepods, sewage treatment plants (Matthes *et al.* 1988). On aquatic plants, copepod, sewage treatment plants (Aladro-Lubel *et al.* 2006). On *Gammarus wilitzkii* Birula (Fernandez-Leborans, 2009; Fernandez-Leborans *et al.* 2006).

Family Metacinetidae Bütschli

Metacineta longipes (Mereschkowsky, 1877)

Fig. 3e.

The cell is spherical or somewhat elongate, covered by stylothea with very long stalk-like protuberance. Macronucleus is ovoid, centrally located. Cell body clamped to the stylothea near the apical aperture. The apical aperture of stylothea has 6 or 7 edges. Tentacles are long, clavate and arranged in 6 or 7 radial rows placed between edges

of stylothea (Rieder, 1985). Reproduction by semi-circumvagative budding with generation of tomit in the partial invagination of trophont cortex.

Dimensions: body diameter 25–37; diameter of macronucleus 10–15; length of tentacles 30–50; stylothea length 175–185; stylothea width 40–50; stalk-like protuberance length 130–200. Previous measurements: body diameter 246; length (with stalk) 2,040.

Material examined. Found as epibiont of: *Nepa cinerea*. **Belarus.** River Ubort' near village Borovoe, 13.08.1983.

Additional records. On *Lemna* Linnaeus, *Ceratophyllum* Linnaeus (Matthes *et al.* 1988).

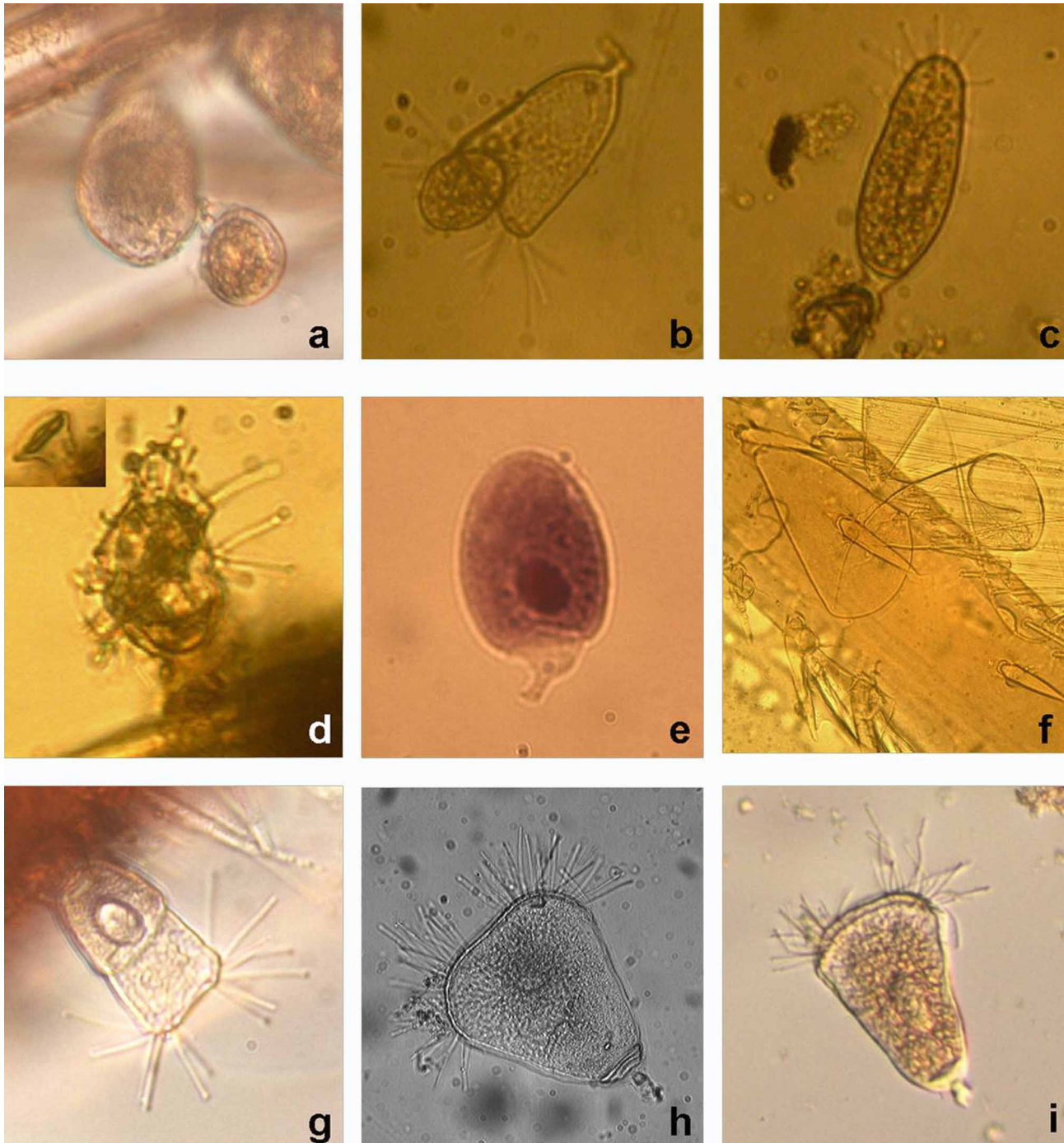


FIGURE 1. Some epibiotic suctorians of nepomorphans. **a.** *Manuelophrya hannaе* parasite of peritrich epibiont of *Lethocerus* sp. (Mexico). **b.** *Pseudogemma pachystyla* parasite of *Periacineta buckei* attached to *Ranatra* sp. (Mexico). **c.** *Discophrya elongata* on *Ranatra* sp. (Mexico). **d.** *Discophrya gessneri* epibiont of *Aphelocheirus aestivalis* (Ukraine); the insert shows the shape of the stalk. **e.** *Discophrya lichteinsteini* found on *Ambrysus* sp. (Mexico). **f.** Empty loricae of *Periacineta notonectae* from *Corixa* sp. (Ukraine). **g-i.** *Periacineta buckei* from *Ranatra* sp., *Belostoma* sp. and *Lethocerus* sp., respectively (Mexico).

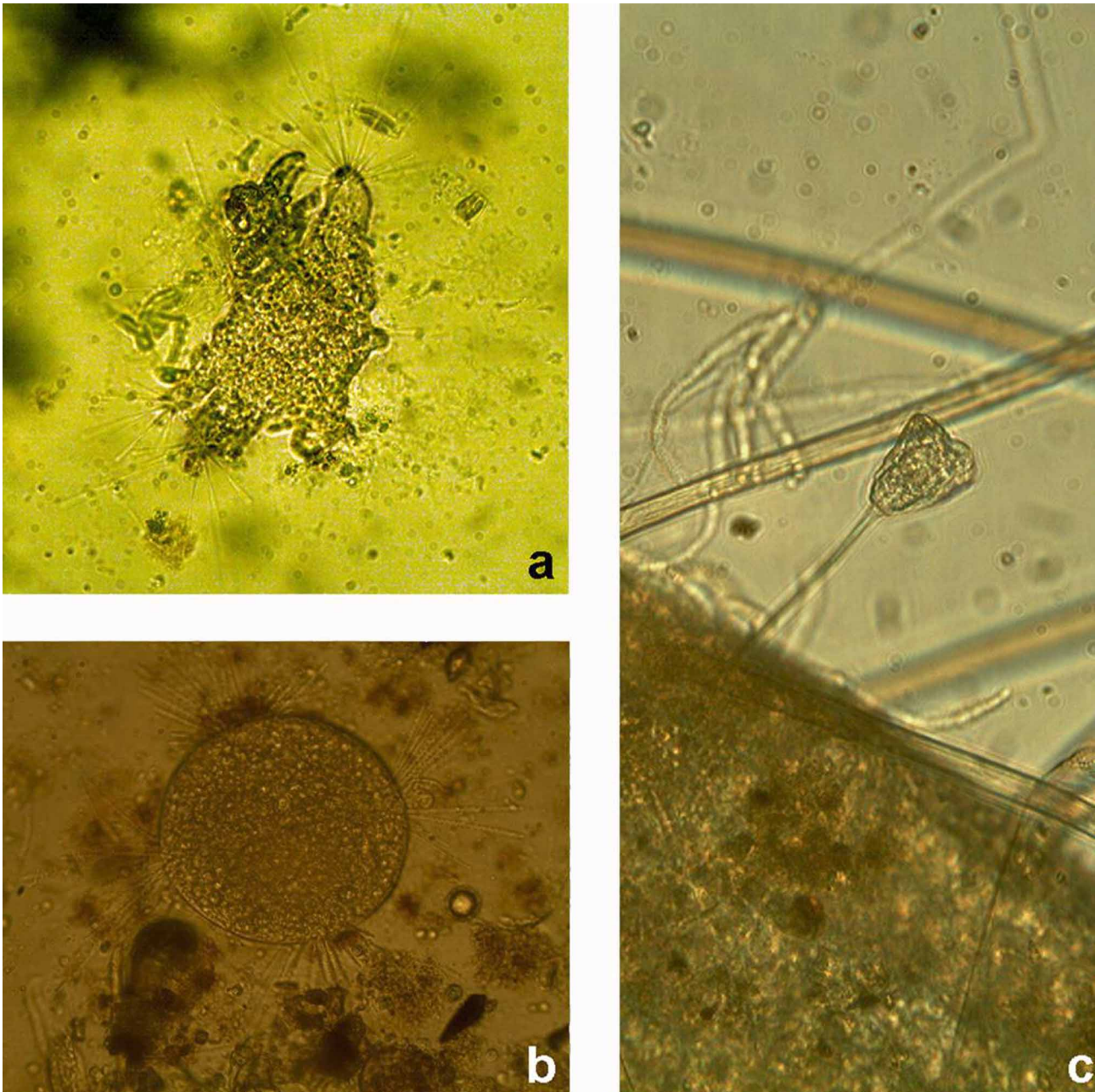


FIGURE 2. Some epibiotic suctorians of nepomorphans. **a.** *Dendrosoma radians* (Ukraine). **b.** *Cyclophrya magna* (Ukraine). **c.** *Tokophrya lemnarum* (Ukraine).

Family Manuelophryidae Dovgal

Manuelophrya hanna (Guhl, 1985)

Fig. 1a.

Cell is spherical with single, short, thick, rod-like tentacle by which this parasite of the peritrichs attaches to the host body. Lorica absent. Macronucleus spherical, centrally located. There are two contractile vacuoles, placed near the opposite site of the tentacular region of body. Reproduction by semi-circumvaginate budding.

Dimensions: cell body diameter 30–35; length of tentacles 15–20; diameter of macronucleus 8–12. Previous measurements: cell body diameter 30–35.

Material examined. Found as ectoparasite of epibiont peritrich species from *Lethocerus* sp. **Mexico.** Near Grutas de la Estrella, Ixtapan de la Sal. State of Mexico. 1550 m.a.s.l. (18° 43' 30.7" N; 99° 35' 59.1 W). 18.09.2005.

Additional records. Ectoparasite of peritrich *Haplocaulus walteri* Precht (Matthes *et al.* 1988).

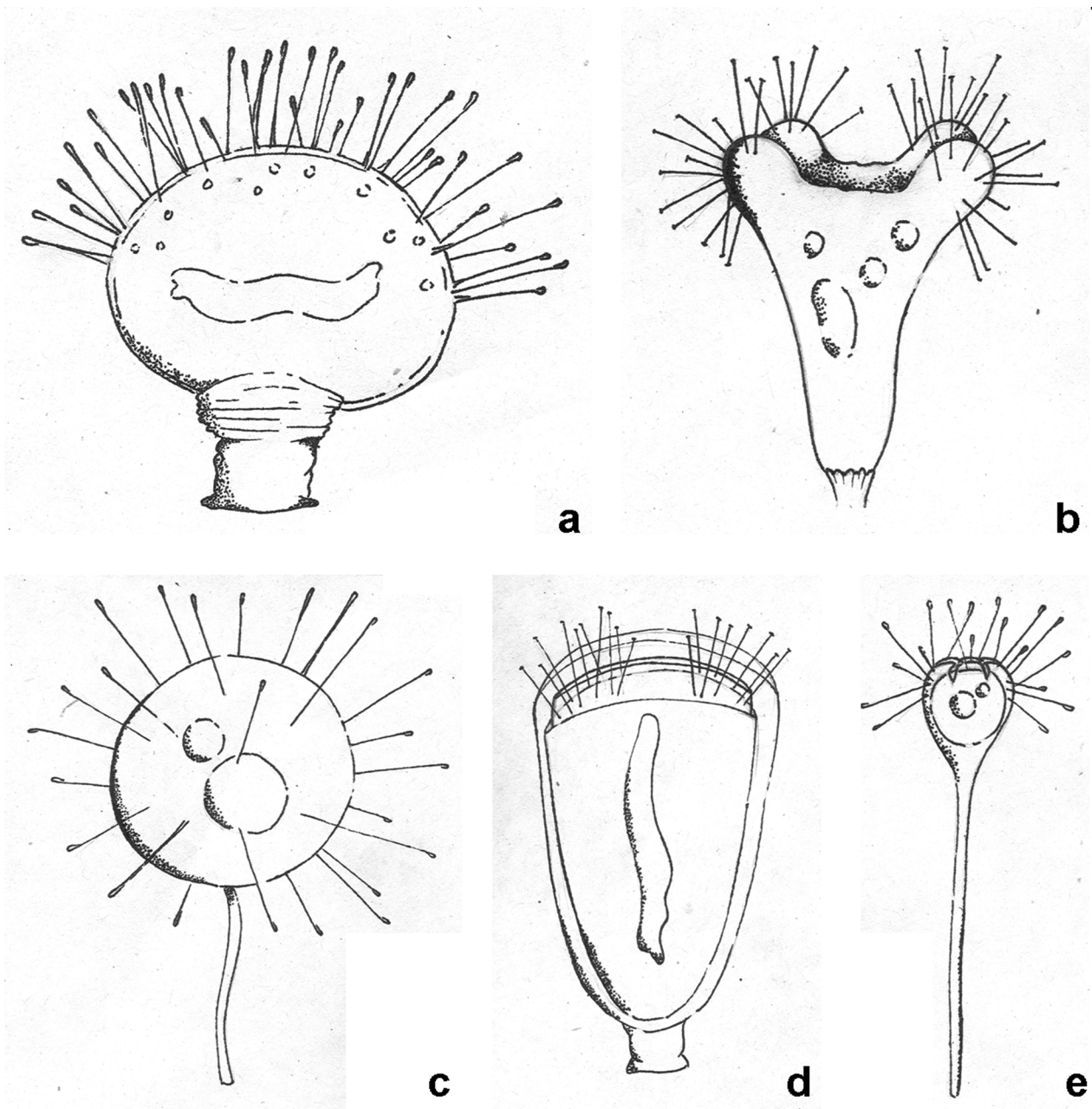


FIGURE 3. Some epibiotic suctorians of nepomorphans. **a.** *Discophrya ochtebii*. **b.** *Tokophrya quadripartita* from *Lethocerus* sp. (Mexico). **c.** *Podophrya fixa*. **d.** *Kormosia linguifera*. **e.** *Metacineta longipes*.

Family Acinetidae Ehrenberg

Acineta fluviatilis Stokes, 1885

Medium sized, freshwater, loricate species that is pyriform to triangular in outline, strongly compressed laterally. The apical aperture is slit-like through which the two fascicle born upon lobe-like actinophores protrude. Actinophores independently contractile. Stalk of variable length, joining with lorica without any collar or cup-like region.

With centrally located spherical macronucleus and apical contractile vacuole. Reproduction by monogemmic endogenous budding (Curds, 1985a).

Dimensions: width of lorica 24–60; length of stalk 58–68; stalk diameter 5–7; macronucleus 10–14 x 15–45; length of the tentacles 18–30, diameter of contractile vacuole 6–8. Previous measurements: length 65; length of stalk 20–90.

Material examined. Found as epibiont of: *Ranatra linearis*. **Ukraine.** Small lake in high-water bed of Dnieper river (left bank) near Kiev, Ukraine. 08.01.1986. Horn of river Severskyi Donets near village Cherkasskyj Bishkin', Kharkov region. 10.08.1989. *Naucoris cimicoides*. **Ukraine.** Pond at left bank of river Southern Bug near village Selyscshe, Vinnitca region. 19.08.1988.

Additional records. On *Vallisneria spiralis* Linnaeus (Curds, 1985a).

Family Tokophryidae Jankowski

Tokophrya quadripartita (Claparède et Lachmann, 1859)

Fig. 3b.

Species medium to large, freshwater whose body shape is pyramidal and approximately square in cross section. There are 4 lobe-like prominent actinophores, one at each corner of the apical surface, each bearing a fascicle of capitate tentacles. Lorica absent. Stalk of variable length present. Number of contractile vacuoles varies from 1 to 3. Macronucleus spherical to ovoid, centrally placed. There is one contractile vacuole. Endogenous budding results in an ovoid larval form with variable numbers of ciliary rows and formations (Curds, 1985b).

Dimensions: body length 50–138; body width 20–70; macronucleus 7–16 x 28–58; length of tentacles 20–50; length of stalk 80–220; stalk diameter 4–7. Previous measurements: body length 60–175, body width 18–75, length of tentacles until 90.

Material examined. Found as epibiont of: *Lethocerus* sp. **Mexico.** Near Grutas de la Estrella, Ixtapan de la Sal. State of Mexico. 1550 m.a.s.l. (18° 43' 30.7" N; 99° 35' 59.1 W). 18.09.2005.

Additional records. On aquatic plants, copepods, over stalk of *Epistylis plicatilis* Ehrenberg, on *Asellus* Geoffroy, *Triturus* sp. Rafinesque (Matthes *et al.* 1988); on *Paludina* Lamarck, *Cyclops* Müller, *Chrysemys picta belli* (Gray) (Curds, 1985b); on *Cambarellus patzcuarensis* Villalobos (Aladro-Lubel *et al.* 2006; Fernandez-Leborans, 2009). On *Cyclops*, *Limnocalanus macrurus* Sars, *Epischura lacustris* Forbes, *Eucyclops agilis* (Koch & Sars), *Cyclops bicuspidatus* Claus, *Astacus leptodactylus* Eschscholtz (Fernandez-Leborans & Tato-Porto, 2000). On *Limnocalanus macrurus*, *Epischura lacustris* and *Asellus intermedius* Forbes (Morado & Small, 1995).

Tokophrya lemnarum (Stein, 1859)

Fig. 2c.

Freshwater species whose body shape is pyriform to pyramidal. Lorica absent. Fascicles of capitate tentacles mounted on 2 actinophores. Stalk longitudinally striated, of variable length, but usually at least as long as body. There are usually 2 anterior-lateral contractile vacuoles. Macronucleus ovoid to elongate with several micronuclei. Reproduction by endogenous budding producing buds with 4 ciliary girdles (Curds, 1985b).

Dimensions: body length 30–48; body width 24–35; length of the tentacles 35–50; macronucleus diameter 9–12; stalk length 60–250; stalk diameter 3–7. Previous measurements: body length 18–127; body width 12–82; stalk length 54–170.

Material examined. Found as epibiont of: *Nepa cinerea*. **Ukraine.** Pond near village Begun', Zhytomir region. 25.09.1984. *Naucoris cimicoides*. **Ukraine.** Small lake in high-water bed of river Western Bug near village Kamenka Bugskaya, Lvov region. 06.09.1985.

Additional records. On *Lemna* (Curds, 1985b); on aquatic plants, *Asellus aquaticus* (Linnaeus), *Astacus leptodactylus*, gammarids from Baikal lake (Curds, 1985b; Matthes *et al.* 1988); on *Gammarus* Fabricius, *Astacus leptodactylus* (Morado & Small, 1995); on *Cordylophora caspia* Pallas (Aladro-Lubel *et al.* 2006).

Family Dendrosomatidae Bütschli***Dendrosoma radians* Ehrenberg, 1838**

Fig. 2a.

Suctorian ciliate with very large (up to 5 mm) branched body. Several fascicles of tentacles placed at the numerous actinophores which are elevated over the substrate. Single macronucleus branched reaching the actinophores. Micronuclei are numerous. The shape of body is extremely variable depending on the type of substrate. Thus at the more or less flat substrate the individuals (especially young), have irregularly shaped flattened body with short, unramified actinophores, whereas on complex surfaces, i.e. aquatic invertebrates, the body might be dendritic with long branched actinophores. Reproduction by multiple endogenous budding.

Dimensions of individuals: body width 150–380; actinophore length 30–140; length of tentacles 10–30. Previous measurements: vertical length until 550; length of tentacles 75–90.

Material examined. Found as epibiont of: *Ranatra linearis*. **Ukraine.** Lake Lyubyaz' near village Lyubyaz' (high-water bed of Pripyat' river), Volyn' region, 08.06.1986. *Aphelocheirus aestivalis*. **Ukraine.** Psel river near village Kamennoe. 17.07.1988.

Additional records. On artificial substrate (Jones, 1974; Coats & Clamp, 2009). On aquatic plants, *Ceratophyllum*, *Callitriche* Linnaeus, *Elodea* Michaux, *Myriophyllum* Ponted, algae, *Cordylophora* Allman, *Phragmites* Adanson, *Polygonum* Linnaeus, gammarids from Baikal lake (Matthes *et al.* 1988); on *Brandtia latissima* (Gerstfeldt), *Odontogammarus pulcherrimus* Dorogostaisky, *Pallasea cancellus* (Pallas), *Echinogammarus maacki* Stebbing, *Hyalellopsis czyrniankii* Stebbing (Fernandez-Leborans & Tato-Porto, 2000).

Family Pseudogemmidae Jankowski***Pseudogemma pachystyla* Collin, 1912**

Fig 1b.

Ectoparasitic species with sacciform loricate body. There is single, short, thick, rod-like tentacle by which the parasite attaches to the apical part of the host (suctorian ciliates) body. The tentacle as a rule completely dipped into host cell body. Reproduction by endogenous budding.

Dimensions: body length 18–24; body width 16–20. Previous measurements: body length 20–30; body width 12–25.

Material examined. Found as ectoparasite of *Periacineta buckei*, epibiont of: *Ranatra* sp. 1. **Mexico.** Tecocomulco lake. State of Hidalgo. 2530 m.a.s.l. (19° 52' 30.5" N; 98° 23' 41.2" W). 15.09.2007.

Additional records. Brackish water from Béziers and the channel of the port of Cette; ectoparasite of *Acineta tuberosa* (Matthes *et al.* 1988).

Family Discophryidae Collin***Discophrya elongata* (Claparède et Lachmann, 1859)**

Fig. 1c.

Freshwater species whose body shape is elongate and flattened. Clavate tentacles are arranged in apical fascicle; with or without 2–5 lateral fascicles, or solitary lateral tentacles. Macronucleus varies from spherical to elongate. Stalk often longitudinal or transversal striated, and occasionally with apical cup-like broadening. There are from 3 to 6 contractile vacuoles. Reproduction by inversogemmatic budding.

Dimensions: body length 17–101; body width 8.4–46; macronucleus 3–62 x 3–13; length of the tentacles 6–51; contractile vacuole diameter 3–7; length of stalk 8–102; diameter of stalk 4–12. Previous measurements: body length 26–132; body width 17–48.

Material examined. Found as epibiont of: *Ranatra* sp. 1. **Mexico.** Tecocomulco lake. State of Hidalgo. 2530 m.a.s.l. (19° 52' 30.5" N; 98° 23' 41.2" W). 15.09.2007. *Ranatra* sp. 2. **Mexico.** Near Grutas de la Estrella, Ixtapan

de la Sal. State of Mexico. 1550 m.a.s.l. (18° 43' 30.7" N; 99° 35' 59.1 W). 18.09.2005. *Ranatra linearis*. **Ukraine**. Small lake in high-water bed of Snov river near city Sednev, Chernigov region. 15.06.1991. Small lake in high-water bed of river Goryn' near village Zbuzh, Rovno region. 06.07.1985. Small lake in high-water bed of Dnieper river (left bank) near Kiev. 08.01.1986. Lake Lyubyaz' near village Lyubyaz' (high-water bed of Pripyat' river), Volyn' region. 08.06.1986. Small lake in high-water bed of river Teterev near village Charitonovka, Zhytomir region. 21.08.1986. Small lake in high-water bed of Dnieper river near village Liplavo, Cherkassy region. 13.06.1998. Small lake in Kanev reserve, Cherkassy region. 10.06.1998. **Belarus**. Small lake in high-water bed of river Pripyat' near village Khojno, 14.06.1986. *Ambrysus* sp. 1. **Mexico**. Near Santo Domingo de Morelos. State of Oaxaca. 309 m.a.s.l. (15° 52' 24.7" N; 96° 37' 49.6" W). 16.01.2009. *Notonecta unifasciata*. **Mexico**. Tecomatlán pond. State of Hidalgo. 2256 m.a.s.l. (20° 10' 55.6" N; 99° 00' 41.6" W). 02,03,04,05,07.2005. Tecocomulco lake. State of Hidalgo. 2530 m.a.s.l. (19° 52' 30.5" N; 98° 23' 41.2" W). 10.2006, 03,09,12.2007, 03.2008. *Hesperocorixa laevigata*. **Mexico**. Tecocomulco lake. State of Hidalgo. 2530 m.a.s.l. (19° 52' 30.5" N; 98° 23' 41.2" W). 15.09.2007. *Corixa* sp. **Ukraine**. Goryn' river near village Duksin, Rovno region. 30.06.1985.

Additional records. On aquatic plants, *Lymnaea* Lamarck, *Planorbis* Mueller, *Paludina*, *Nepa*, *Ranatra*, *Belostoma*, *Hydrous* Thunberg, *Dysticus* Linnaeus, *Cybister* Curtis, *Berosus* Leach, and *Tropisternus* Solier (Matthes *et al.* 1988).

Discophrya gessneri Matthes, 1954

Fig. 1d.

Freshwater species with flattened asymmetrical body. Stalk short, cup-like apically covering about a quarter of body. Clavate tentacles not arranged in fascicles, evenly distributed over apical body surface and each one beginning from small projections of the cortex. Macronucleus spherical, centrally located. Reproduction has not been observed.

Dimensions: body length 20–42; width 17–36; length of the tentacles about 60. Previous measurements: body length 18–38; body width 18–38; length of tentacles until 60.

Material examined. Found as epibiont of: *Aphelocheirus aestivalis*. **Ukraine**. Psel river near village Kamennoe. 17.07.1988. Psel river near village Malyj Perevoz, Poltava region. 24.07.1988. **Belarus**. Ubort' river between villages Kopishche (Zhytomir region, Ukraine) and Milashevichi (Gomel' region, Belarus) 12.08.1983.

Additional records. *Aphelocheirus aestivalis* (Matthes *et al.* 1988).

Discophrya lichteinsteinii (Claparède et Lachmann, 1859)

Fig. 1e.

Suctorian ciliate with flattened, disc-shaped or elongate body. Macronucleus ovoid, centrally located. Contractile clavate tentacles evenly distributed over all edge of body, but in some cases only at apical part. Stalk cup-shaped or elongate, with different length (Dovgal & Kochin, 1997), uniformly expanding upwards, with transversal folds. There are up to three contractile vacuoles. Reproduction by inversogemmlic budding.

Dimensions: body length 25–180; body width 15–160; macronucleus 5–7 x 12–16, stalk length 17–192; stalk diameter 4–7; length of the tentacles 6–28. Previous measurements: body length 29–180; body width 36–130.

Material examined. Found as epibiont of: *Ranatra linearis*. **Ukraine**. Small lake in high-water bed of Goryn' river near village Velyky Tceptcevichi, Rovno region. 11.07.1985. Small lake in high-water bed of river Goryn' near village Zbuzh, Rovno region. 06.07.1985. *Plea leachi*. **Ukraine**. River Unava near Fastov city, Kiev Region. 30.05.2004. *Ambrysus* sp. 2. **Mexico**. River Cuichat. State of Puebla. 980 m.a.s.l. (20° 00' 32" N; 97° 30' 46" W). 19.03.2010.

Additional records. On *Cybister*, *Dysticus*, *Graphoderes* Thomson, *Haliplus* Latreille, *Peltodytes* Régimbart, *Brychius* Thomson, *Graptodytes pictus* Fabricius, *Hyphydrus ovatus* Linnaeus, *Coelambus impressopunctatus* (Schaller), *Hyphydrus* Illiger, and *Potamonectes elegans* (Panzer) (Matthes *et al.* 1988). Aquatic coleopterans (families Dysticidae, Haliplidae) (Matthes *et al.* 1988). On *Astacus* Fabricius (Morado & Small, 1995).

***Discophrya ochthebii* Matthes, 1954**

Fig. 3a.

Suctorian ciliate with flattened disk-like body, and cone-shaped short stalk with transversal ridges. Numerous long, clavate, contractile tentacles distributed over edge of body. Macronucleus spherical or ovoid, centrally located. A group (12–29) of contractile vacuoles placed near edges of body, or (when their number is greatest) thorough the body is characteristic. Reproduction by inversogemmlic budding.

Dimensions: body length 26–50; body width 43–69; macronucleus 4–9 x 21–32; contractile vacuole diameter 3–4; length of tentacles 23–26; width of apical part of stalk 26–31. Previous measurements: body length 40–91; body width 43–124; length of stalk 9–45.

Material examined. Found as epibiont of: *Plea leachi*. **Ukraine.** Small lake in high-water bed of Psel river near mouth of Ol'shanka river. 16.07.1988. Former river-bed of Goryn' river near village Stavok, Rovno region. 04.07.1985. Small lake in high-water bed of Dnieper river (left bank) near Kiev. 07.08.1985. River Oster near city Nezbyn, Chernigov region. 17.09.1985. Small lake in high-water bed of Dnieper river (left bank) near Kiev. 24.11.1985. Lake Lyubyaz' near village Lyubyaz' (high-water bed of Pripyat' river), Volyn' region. 08.06.1986. Small lake in high-water bed of Pripyat' river near village Kopachi, (zone of Chernobyl' accident). 11.06.1987. Former river-bed of Psel river near village Vorozhba, Sumy region. 13.07.1988. Former river-bed of Psel river near village Sary, Poltava region. 21.07.1988. Small lake in high-water bed of Psel river near villages Perevoz and Savintcy Poltava region. 22.07.1988. Small lake in high-water bed of Severskij Donets river near village Cherkasskij Bishkin', Kharkov region. 10.08.1989. Small lake in high-water bed of Severskij Donets river near village Morozovka, Kharkov region. 11.08.1992. Small lake in high-water bed of Vorskla river near village Luchki, Poltava region. 07.07.1997. Small lake in high-water bed of Psel river near village Borovoe, Sumy region. 11.07.1988.

Additional records. On aquatic coleopteran *Ochthebius* sp. Thomson (Matthes *et al.* 1988).

Family Periacinetidae Jankowski***Periacineta buckei* (Kent, 1882)**

Figs. 1g–i.

Polymorphic suctorian with trapeziform, flattened, loricate body. Lorica smooth, without transversal ribbons, and with slit-like aperture, the stalk is short. Macronucleus spheroidal or elongate. Tentacles are clavate, and capable to contract into body, and are arranged in two apical fascicles. Actinophores absent. There are from 1 to 4 contractile vacuoles. Reproduction by inversogemmlic budding.

Dimensions: body length 16–120; width 19–59; macronucleus 13–38 x 4–7; contractile vacuoles diameter 2–4; length of the tentacles 8–75; stalk length 6–24; stalk diameter 3–10. Previous measurements: body length 24–450; body width 13–121; length of tentacles until 88.

Material examined. Found as epibiont of: *Belostoma* sp. 1. **Mexico.** Tecocomulco lake. State of Hidalgo. 2530 m.a.s.l. (19° 52' 30.5" N; 98° 23' 41.2" W). 15.09.2007. *Belostoma* sp. 2. **Mexico.** Near Santo Domingo de Morelos. State of Oaxaca. 309 m.a.s.l. (15° 52' 24.7" N; 96° 37' 49.6" W). 16.01.2009. *Belostoma* sp. 3. **Mexico.** Near Grutas de la Estrella, Ixtapan de la Sal. State of Mexico. 1550 m.a.s.l. (18° 43' 30.7" N; 99° 35' 59.1 W). 18.09.2005. *Lethocerus* sp. **Mexico.** Near Grutas de la Estrella, Ixtapan de la Sal. State of Mexico. 1550 m.a.s.l. (18° 43' 30.7" N; 99° 35' 59.1 W). 18.09.2005. *Ranatra* sp. 1. **Mexico.** Tecocomulco lake. State of Hidalgo. 2530 m.a.s.l. (19° 52' 30.5" N; 98° 23' 41.2" W). 15.09.2007. *Ranatra* sp. 2. **Mexico.** Near Grutas de la Estrella, Ixtapan de la Sal. State of Mexico. 1550 m.a.s.l. (18° 43' 30.7" N; 99° 35' 59.1 W). 18.09.2005. *Ranatra linearis*. **Ukraine.** Lake Lyubyaz' near village Lyubyaz' (high-water bed of Pripyat' river), Volyn' region. 08.06.1986. Small lake in high-water bed of Snov river near Sednev, Chernigov region. 15.06.1991. Small lake in high-water bed of river Goryn' near village Zbuzh, Rovno region. 06.07.1985. River Goryn' near village Stepan', 08.07.1985. Former river-bed of Desna river near city Oster, Chernigov region. 21.09.1985. Small lake in high-water bed of Dnieper river (left bank) near Kiev, Ukraine. 08.01.1986. **Belarus.** Small lake in high-water bed of river Pripyat' near village Khojno, 14.06.1986. *Nepa cinerea*. **Ukraine.** River Snov near Village Gorsk, Chernigov region. 14.06.1991. River Zamglaj near village Kiselevka, Chernigov region. 10.07.1990. River Severskij Donets near village Cher-

vonaya Gorka, Kharkov region. 11.08.1989. Turya river near village Khoteshov, Volyn' region, 31.05.1986. Lake Svyatoe near village Zalukhov, Volyn' region. 04.06.1986. *Ambrysus* sp. 1. **Mexico**. Near Santo Domingo de Morelos. State of Oaxaca. 309 m.a.s.l. (15° 52' 24.7" N; 96° 37' 49.6" W). 16.01.2009. *Naucoris cimicoides*. **Ukraine**. Small lake in high-water bed of Psel river near village Staronovo. 12.07.1988.

Additional records. On artificial substrate (Jones, 1974; Coats & Clamp, 2009). On *Nepa*, *Ranatra*, *Naucoris*, *Hydrous*, *Helophorus* Fabricius, *Hydraena* Kugelann, *Argyroneta aquatica* Clerck, and *Planorbis* (Matthes *et al.* 1988).

***Periacineta notonectae* (Claparède et Lachmann, 1859)**

Fig. 1f.

Loricata suctoriana species. Lorica stalked, slightly flattened, nearly conical, softly curved with wide apical aperture that have oblique cutted edge. Cell body fills up all lorica. Stalk very short and conical. Clavate tentacles are in two apical bundles. Actinophores absent. Macronucleus spherical. Reproduction by inversogemmnic budding.

Dimensions: lorica length 113–137; width 45–52; macronucleus diameter 12–15; length of tentacles 30–42; length of stalk 12–18; stalk diameter 9–12. Previous measurements: body length 55–154; body width 29–74.

Material examined. Found as epibiont of: *Hesperocorixa laevigata*. **Mexico**. Tecocomulco lake. State of Hidalgo. 2530 m.a.s.l. (19° 52' 30.5" N; 98° 23' 41.2" W). 15.09.07. *Corixa* sp. **Ukraine**. Irpen' river near village Irpen', Kiev region. 07.11.1998. Small lake in high-water bed of Psel river near mouth of Ol'shanka river. 16.07.1988. Pripyat' river near village Shchetyn', Volyn' region. 05.06.1986. Pripyat' river near village Pochapy, Volyn' region. 02.06.1986. River Zulnya near village Grushovka, Rovno region. 09.07.1985. Small lake in high-water bed of river Goryn' near village Zbuzh, Rovno region. 06.07.1985. River Zamchysko near mouth. 05.07.1985. Goryn' river near village Stavok, Rovno region. 07.07.1985. River Zarnovka near village Zhobryn, Rovno region. 30.06.1985. Goryn' river near village Duksin, Rovno region. 30.06.1985. Slovechna river near village Tkhorin, Zhytomir region. 30.09.1984. Pond near village Begun', Zhytomir region. 25.09.1984. Pripyat' river near village Bol'shye Soroki, Kiev region. 07.09.1984.

Additional records. On *Notonecta*, *Corixa* and *Sigara* (Matthes *et al.* 1988).

***Kormosia linguifera* (Claparède et Lachmann, 1859)**

Fig. 3d.

Suctoriana with triangular flattened body, with stylotheca provided by short stalk-like protuberance. There are two apical fascicles of contractile clavate tentacles. Macronucleus central and elongated. From 1 to 4 contractile vacuoles. Body attached to the lorica edges near aperture. Reproduction by inversogemmnic budding.

Dimensions: lorica length 95–118; width 35–118; body length 67–84; macronucleus 13–17 x 31–38; length of tentacles 6–22. Previous measurements: body length 50–245; body width 40–130.

Material examined. Found as epibiont of: *Ranatra linearis*. **Ukraine**. Small lake in high-water bed of Goryn' river near village Velyky Tceptcevichi, Rovno region. 11.07.1985.

Additional records. Aquatic coleopterans (*Coelambus* Thomson, *Hygrotus* Stephens, *Hydroporus* Schellenberg, *Graptodytes* Seidlitz, *Colymbetes* Schellenberg, *Berosus* and *Belostoma* (Matthes *et al.* 1988).

Family Heliophryidae Corliss

***Cyclophrya magna* Gonnert, 1935**

Fig. 2b.

Suctoriana with large, flattened disc-shaped body. Macronucleus ribbon-like, convoluted, ramified. There are four (rarely five) bundles of long, contractile, clavate tentacles near the edge of body. There are from 4 to 8 contractile vacuoles. Reproduction by inversogemmnic budding.

Dimensions: diameter of body 90–108; length of tentacles 14–40. Previous measurements: diameter of body until 190; length of tentacles until 500.

Material examined. Found as epibiont of: *Nepa cinerea*. **Ukraine.** Snov river near village Gorsk, Chernigov region. 14.06.1991.

Additional records. Flowing water, slides (Matthes *et al.* 1988).

Discussion

The epibiotic relationship between suctorians and aquatic true bugs is poorly understood. There is little evidence of the degree of specificity in the epibiont-basibiont system. According to Hebsgaard *et al.* (2004), members of the infraorder Nepomorpha are well supported as a monophyletic group, with the Nepoidea (Belostomatidae and Nepidae) placed as the first branch clade. The next node corresponds to Corixidae as sister group of Tripartita (the rest of the families), whose relationship differs according to the analysis employed (morphological, molecular, combined) (Hebsgaard *et al.* 2004). According to previous and present data, the members of the superfamily Nepoidea present a higher diversity of epibiotic suctorians, with 11 species, nevertheless all the species of suctorians recorded in this subfamily have been previously found in substrates other than nepomorphans (i.e. aquatic coleopterans, crustaceans, and aquatic plants).

In contrast, in the most derived branches (Corixidae and Tripartita), the suctorian *Discophrya gessneri* has been recorded only as epibiont of *Aphelocheirus aestivalis*, and *Periacineta notonectae* has been found only as epibiont of members of the family Corixidae (*Hesperocorixa laevigata*, *Sigara* and *Corixa* sp.), and from only one genus of notonectid (*Notonecta*) (Claparède et Lachmann, 1859). However, after careful revision through years of thousands of specimens of notonectids and corixids, we observed *P. notonectae* only in corixids, for which we consider this last record as a misidentification of the host. For these reasons we can catalogue this suctorian with a high specificity degree to corixids. Recently Mariño-Pérez *et al.* (2010) found a high specific suctorian (*Periacineta mexicana* Mariño-Pérez, Mayén-Estrada & Dovgal) on species of the genus *Buenoa* Kirkaldy (Notonectidae). Nevertheless, we also recorded several species of non specific suctorians (i.e. *P. buckei* and *D. elongata*) in Corixidae and Tripartita.

Certain morphological and physiological features of the aquatic true bugs could rule the presence, specific richness, and or degree of specificity of epibionts over their body surface. For example, within the Nepoidea (Belostomatidae and Nepidae) there is a siphon for breathing air. Individuals are greater in comparison to the members of other families, but we do not find epibiotic ciliates species-specific (Schuh & Slater, 1995). Species belonging to the family Notonectidae usually control their buoyancy capacity and use their abdominal setae to collect an air bubble; these actions reduce their movements through water column until they surface to obtain oxygen (Schuh & Slater, 1995). Members of two families of aquatic true bugs, Naucoridae and Aphelocheiridae could use the plastron for oxygen uptake, so they can spend all the time submerged (Schuh & Slater, 1995). In both cases, these actions probably favor the attachment of epibionts. Species of the family Corixidae are detritivorous and depend of active migrations through water column, for oxygen and food uptake. The rest of the families limit their displacement to prey capture due to predator habits. These behavior patterns could explain the high degree of specificity of *Discophrya gessneri* to be found upon *Aphelocheirus aestivalis*, *Periacineta notonectae* on corixids, and *Periacineta mexicana* on *Buenoa* spp. (Notonectidae).

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