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NOTES ON THE GREGARINES (PROTOZOA: APICOMPLEXA: EUGREGARINORIDA) OF INSECTS IN SLOVENIA

Dušan DEVETAK
Department of Biology, Faculty of Natural Sciences and Mathematics, University of Maribor, SI-2000 Maribor, Koroška cesta 160, Slovenia
E-mail: dusan.devetak@guest.arnes.si

Manja OMERZU
SI-2000 Maribor, Borova vas 29, Slovenia

Richard E. CLOPTON
Department of Natural Science, Peru State College, Peru, Nebraska 68421, U.S.A.

ABSTRACT

Gregarines (Apicomplexa: Eugregarinorida) are relatively large protozoan parasites of the guts and body cavities of invertebrates including annelids, tunicates, sipunculids, and especially arthropods. The knowledge of their occurrence in insects is poor; gregarines have been reported from less than one percent of named insect species. Between August 2011 and October 2012 intestine of larvae and adults of insects originating from Slovenia were eviscerated and inspected for gregarines. Hosts of the following orders were infected: Dermaptera, Orthoptera, Blattaria, Psocoptera, Neuroptera and Coleoptera. During this preliminary study, 20 gregarine species were recorded belonging to the following taxa: Actinocephalus, Euspora, Gamocystis, Gregarina, Hirmocystis, Hyalospora *and* Leidyana.

Key words: Gregarines, Eugregarinorida, Apicomplexa, insects, parasites, Slovenia

NOTE SU GREGARINE (PROTOZOA: APICOMPLEXA: EUGREGARINORIDA) DI INSETTI IN SLOVENIA

SINTESI

Le gregarine (Apicomplexa: Eugregarinorida) sono protozoi relativamente grandi e parassiti del tratto digerente e delle cavità corporee di vari invertebrati, inclusi anellidi, tunicati, sipunculidi e specialmente artropodi. Molto poco è finora noto riguardo alla loro presenza negli insetti, visto che le gregarine sono state ritrovate in meno dell'un percento delle specie di insetti conosciute. La ricerca si è svolta nel periodo fra l'agosto del 2011 e l'ottobre del 2012, quando sono stati eviscerati ed ispezionati, alla ricerca di gregarine, i tratti digerenti di larve ed adulti di insetti provenienti dalla Slovenia. Individui dei seguenti ordini sono stati infettati: Dermaptera, Orthoptera, Blattaria, Psocoptera, Neuroptera e Coleoptera. Durante questo studio preliminare sono state riconosciute 20 specie di gregarine, appartenenti ai seguenti taxa: Actinocephalus, Euspora, Gamocystis, Gregarina, Hirmocystis, Hyalospora *e* Leidyana.

Parole chiave: Gregarine, Eugregarinorida, Apicomplexa, insetti, parassiti, Slovenia

INTRODUCTION

Gregarines (Protozoa: Apicomplexa) are obligate unicellular parasites infecting the intestines and other organs of invertebrates of terrestrial, freshwater, and marine habitats. The majority of eugregarine species are reported from insects (Clopton, 2002; Rueckert & Leander, 2008). The knowledge of their occurrence in insects is poor and is currently not given the attention they deserve. Therefore, most gregarine species remain unknown and undescribed.

Gregarines are divided into three major groups: eugregarines, archigregarines, and neogregarines (Grassé, 1953; Levine, 1971; Leander, 2008). Despite recent studies on the molecular level (see Clopton, 2009), our understanding and delineation of supra-specific taxa is incomplete because of our poor understanding of the actual diversity and phylogenetic relationships of gregarines (Rueckert & Leander, 2009).

Although taxonomic keys, figure drawings, or micrographs of many European gregarine species are given in the monographs of Lipa (1967) and Geus (1969), our knowledge of the diversity and distribution of the European gregarine fauna is still poor. In this study, gregarines from insects in Slovenia are addressed for the first time.

MATERIAL AND METHODS

Adult and larval insects collected in the area of Maribor (NE Slovenia) were eviscerated and their alimentary canals dissected in insect saline. Individuals of the following insect orders were inspected: Dermaptera, Orthoptera, Blattaria, Psocoptera, Neuroptera and Coleoptera. Their intestine was examined microscopically at 100, 200 and 400-times magnification. Gregarines were measured and photographed using a Nikon E 800 Microscope with a mounted digital camera Nikon DN100, and Eclipse Net version 1.16.3 software. The following standard gregarine trophozoite and gamont metrics (Lipa, 1967; Clopton,2004) are herein reported (in µm): total length, length of epimerite, length of protomerite, length of deuromerite, maximum width of protomerite, width of deutomerite at equatorial axis, and maximum width of deutomerite.

RESULTS AND DISCUSSION

One hundred twenty-two individual hosts' taxa within 6 insect orders were examined and twenty gregarine species were recorded and addressed herein.

Order Eugregarinorida Léger, 1900

Superfamily Gregarinoidea Chakaravarty, 1960 Emend. Clopton, 2009

Family Gregarinidae Labbé, 1899

Genus *Gregarina* Dufour, 1828 (Plates I, II)

***Gregarina ovata* Dufour, 1828** (Figs. 1, 2)

Material examined:

Host: *Forficula auricularia* (Linnaeus, 1758) (Dermaptera: Forficulidae)

Locality and prevalence: Maribor, 30.8.2011, 2/2 individuals infected; 9. 9.2011, 4/8 individuals infected.

Association biassociative, caudofrontal. Measurements of trophozoites and gamonts in association are presented in Table 1.

Clopton *et al*. (2008) reviewed morphometric data and nomenclatural status of previously described species of *Gregarina* infecting earwigs and recognized 8 valid species, two of which are reported from Slovenia. *G. ovata* was also reported from *F. auricularia* by Geus (1969).

Locality reports (summarized in Geus, 1969; Clopton *et al*., 2008): Africa (Cabo Verde Islands), Asia (Japan), Europe (France, Germany, Great Britain, Poland) and North America (USA).

***Gregarina chelidurella*e Geus, 1969** (Fig. 3)

Species inquirenda

Material examined:

Host: *Forficula auricularia* (Linnaeus, 1758) (Dermaptera: Forficulidae)

Locality and prevalence: Maribor, 9. 9.2011, 1/4 individuals infected.

Association biassociative, caudofrontal. Measurements of trophozoites and gamonts in association are given in Table 1.

G. chelidurellae is differentiated from *G. ovata* by differences in gamont size and shape. Geus (1969) provided only morphometric data and description for gamonts and associations but no oocyst description or data thus the taxon is considered species inquirenda (Clopton *et al*., 2008). *G. chelidurellae* was also reported from *Chelidura (=Chelidurella) acanthopygia* (Dermaptera) by Geus (1969).

Locality reports (summarized in Geus, 1969; Clopton *et al*., 2008): Europe (Germany).

***Gregarina acridiorum* (Léger, 1893)** (Fig. 4)

Material examined:

Host: *Decticus verrucivorus* (Linnaeus, 1758) (Orthoptera: Tettigoniidae)

Locality and prevalence: Maribor, 16.10.2012, 2/4 individuals infected.

Association biassociative, caudofrontal. Measurements of trophozoites and gamonts in association are given in Table 1.

G. acridiorum is a common species occurring in locusts and grasshoppers (Orthoptera) (Geus, 1969; Lipa *et al*., 1996).

Locality reports (summarized in Geus, 1969; Lipa *et al*., 1996): Europe (France, Germany, Poland), Africa (Algeria) and Asia.

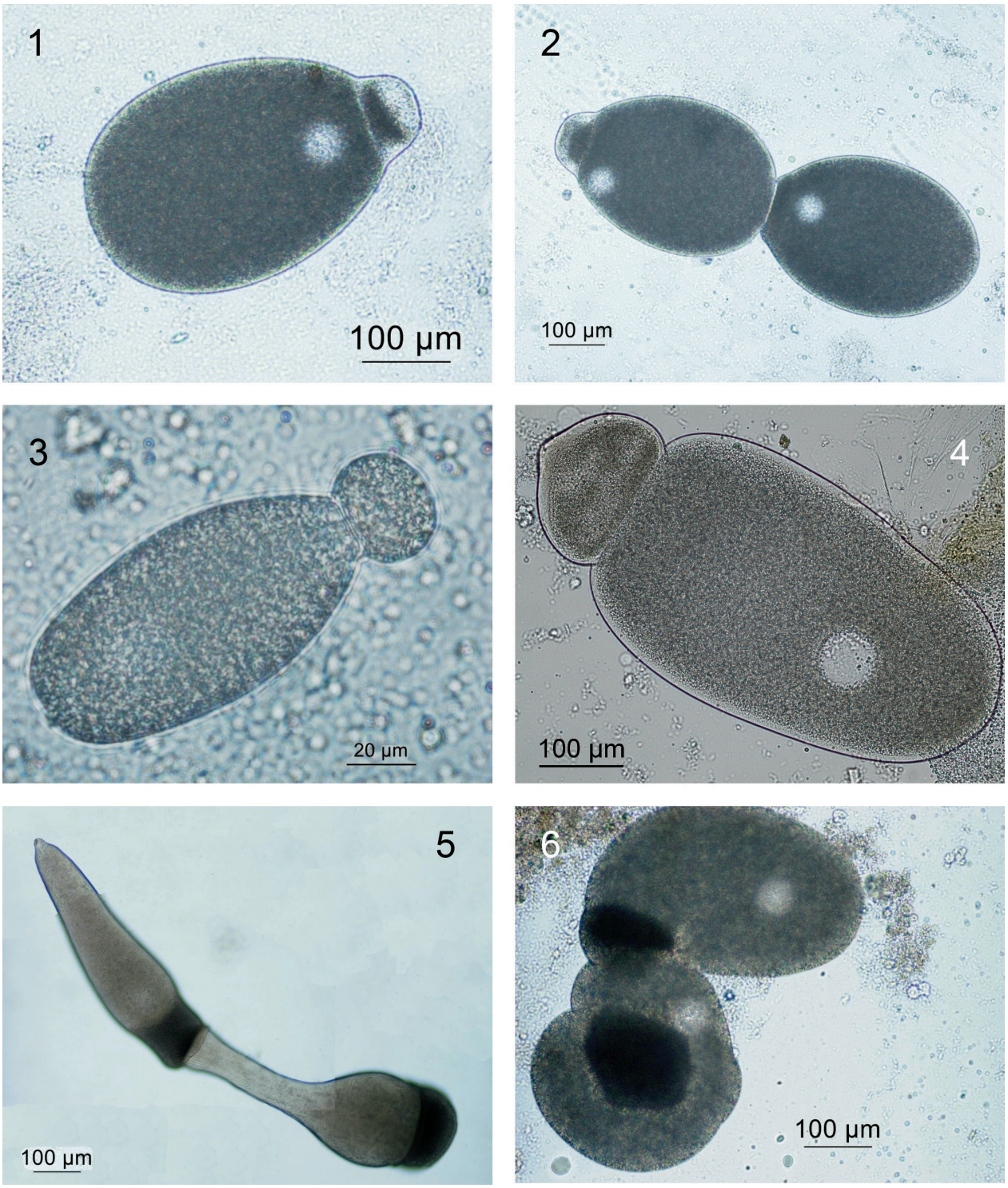

PLATE I: Genus *Gregarina*
Fig. 1: Solitary individual of *G. ovata*
Fig. 2: Associative pair of *G. ovata*
Fig. 3: Solitary individual of *G. chelidurellae*
Fig. 4: Solitary individual of *G. acridiorum*
Figs. 5, 6: *G. delmasi;* ***(Fig. 5) association and (Fig. 6) syzygy***

TABLA I: Rod *Gregarina*
Sl. 1: Solitarni osebek vrste *G. ovata*
Sl. 2: Ascociaciji vrste *G. ovata*
Sl. 3: Solitarni osebek vrste *G. chelidurellae*
Sl. 4: Solitarni osebek vrste *G. acridiorum*
Sl. 5, 6: *G. delmasi;* ***(Sl. 5) asociacija in (Sl. 6) sizigij***

***Gregarina delmasi* Tuzet et Rambier, 1953** (Figs. 5-8)
Material examined:
Host: *Decticus albifrons* (Fabricius, 1775) (Orthoptera: Ensifera: Tettigoniidae)
Locality and prevalence: Maribor, 5.9.2011, 17.10.2011, 2/2 individuals infected.
Gametocyst diameter 244-260 µm (n=4) (Fig. 7). Gamonts with characteristic longitudinally grooved pellicle (Fig. 8). Association biassociative, caudofrontal. Measurements of trophozoites and gamonts in association are given in Table 1.
G. delmasi was reported in locusts and grasshoppers (Orthoptera) by Geus (1969).
Locality reports (summarized in Geus, 1969): Africa (Congo) and Europe (France).

***Gregarina katherina* Watson, 1915** (Fig. 9)
Material examined:
Host: *Adalia bipunctata* (Linnaeus, 1758) (Coleoptera: Coccinellidae)
Locality and prevalence: Maribor: Piramida, 11.9.2011 2/2 individuals infected.
Associations composed of 2-3 individuals, caudofrontal. Measurements of gamonts in associations are given in Table 1.
G. katherina is reported from the following coccinelid species (Coleoptera: Coccinellidae) (Watson, 1915; Geus, 1969; Hoshide, 1980): *Coccinella septempunctata*, *Coccinula quatuordecimpustulata*, and *Coccinella novemnotata*.
Locality reports (summarized in Lipa, 1967; Geus, 1969; Hoshide, 1980): Asia (Japan), Europe (Germany, Poland) and North America (USA).

***Gregarina barbarara* Watson, 1915** (Fig. 10)
Material examined:
Host: *Adalia bipunctata* (Linnaeus, 1758) (Coleoptera: Coccinellidae)
Locality and prevalence: Maribor, Piramida, 28.9.2011, 2/6 individuals infected.
Association biassociative, caudofrontal. Measurements of trophozoites and gamonts in association are given in Table 1.
G. barbarara is reported from the following coccinellid species (Watson, 1915; Geus, 1969): *Adalia bipunctata*, *Coccinella* sp., *Brumus quadripustulatus* and *Tytthaspis sedecimpunctata*.
Locality reports (summarized in Geus, 1969): Europe (Germany) and North America (USA).

***Gregarina steini* Berndt, 1902** (Figs. 11, 12)
Material examined:
Host: *Tenebrio molitor* Linnaeus, 1758: larva (Coleoptera: Tenebrionidae)
Locality and prevalence: Maribor, from April to May 2012; 9/20 larvae infected.
Association biassociative, caudofrontal. Measurements of trophozoites and gamonts in association are given in Table 1.
Gregarines occurring in mealworm (*T. molitor*) larvae and adults are detailed by Clopton *et al*. (1991, 1992) and Clopton & Janovy (1993). *G. steini* is known only from *T. molitor*.
Locality reports (summarized in Geus, 1969; Lipa, 1967): Europe and North America (USA).

***Gregarina cuneata* Stein, 1848** (Figs. 13-15)
Material examined:
Host: *Tenebrio molitor* Linnaeus, 1758: larva (Coleoptera: Tenebrionidae)
Locality and prevalence: Maribor, from April to May 2012; 4/20 larvae infected.
Association biassociative, caudofrontal. Triassociative associations occurred rarely (Fig. 14). Measurements of trophozoites and gamonts in association are given in Table 1.
G. cuneata is reported from the following tenebrionid beetles (Coleoptera: Tenebrionidae) (Geus, 1969): *Alphitobius ovatus, Ceropria anthracina, Ceropria romandi, Chiroscelis digitata, Stenosis angustata, Strongylium buettneri, T. molitor, Tenebrio nitidulus, Tenebrio obscurus* and *Tribolium ferrugineum*.
Locality reports (summarized in Geus, 1969; Lipa, 1967): Africa, Asia (Turkey, Japan), Europe, North and South America.

***Gregarina polymorpha* (Hammerschmidt, 1838)** (Fig. 16)
Material examined:
Host: *Tenebrio molitor* Linnaeus, 1758: larva (Coleoptera: Tenebrionidae)
Locality and prevalence: Maribor, from April to May 2012; 14/20 larvae infected.
Association biassociative, caudofrontal. Measurements of trophozoites and gamonts in association are given in Table 1.
G. polymorpha is reported from the following tenebrionid beetles (Coleoptera: Tenebrionidae) (Geus, 1969): *Gonocephalum* sp., *Gonocnemis* sp., *Pelloides senegalensis*, *Taraxides punctatus*, *T. molitor* and *Tenebrio guineensis*.
Locality reports (summarized in Geus, 1969; Lipa, 1967): Africa (Congo), Asia (Japan), Europe, North and South America.

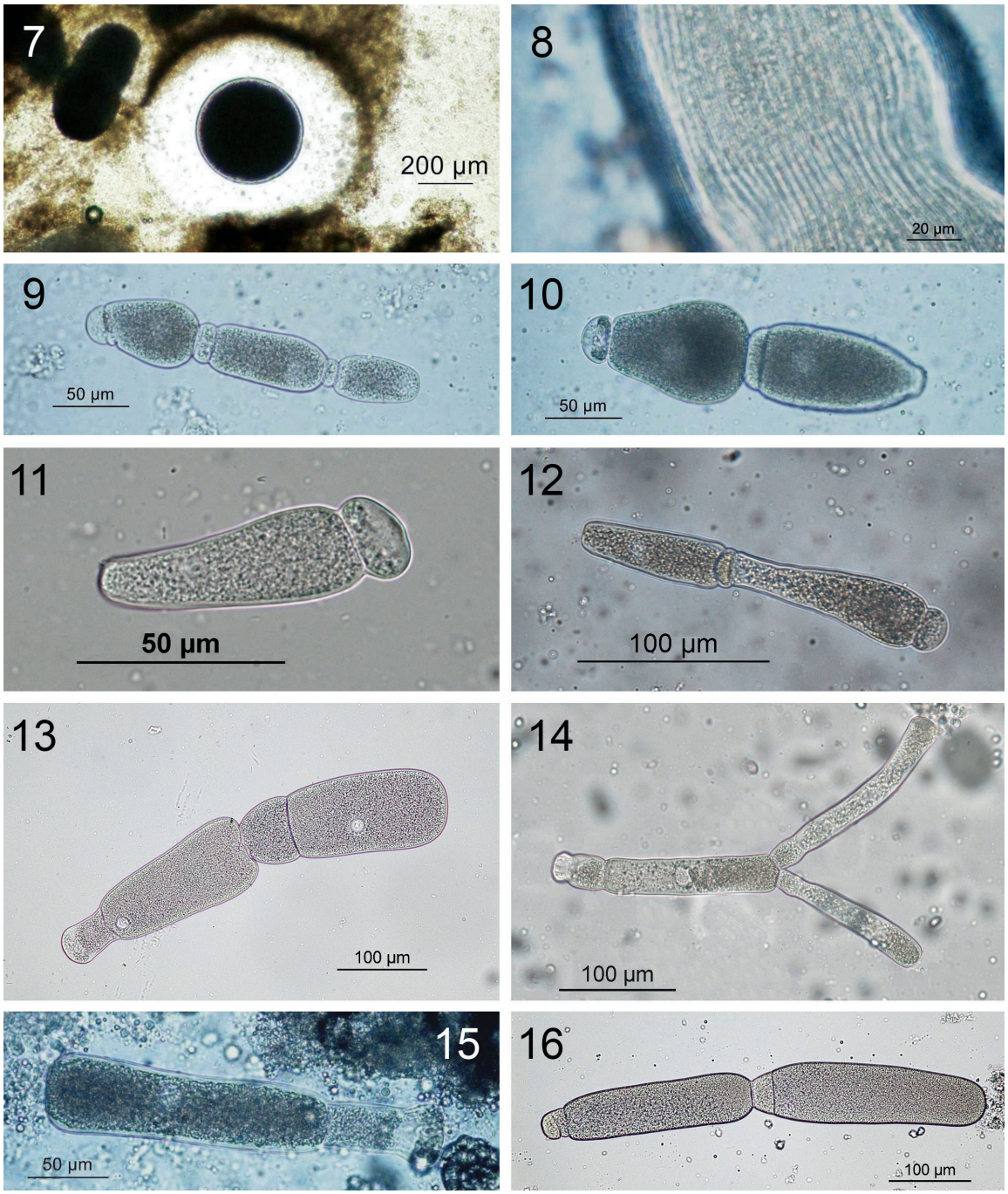

PLATE II: Genus *Gregarina*
Figs. 7, 8: *G. delmasi****; (Fig. 7) gametocyst and (Fig. 8) detail of the pellicle of a primate***
Fig. 9: Association of *G. katherina*
Fig. 10: Association of *G.a barbarara*
Figs. 11, 12: Solitary individual and association of *G. steini*
Figs. 13-15: *G. cuneata****; (Fig. 13) biassociative association, (Fig. 14) triassociative association and (Fig. 15) solitary individual***
Fig. 16: Association of *G. polymorpha*

TABLA II: Rod *Gregarina*
Sl. 7, 8: *G. delmasi****; (Sl. 7) gametocista in (Sl. 8) detajl pelikule primita***
Sl. 9: Asociacija vrste *G. katherina*
Sl. 10: Asociacija vrste *G. barbarara*
Sl. 11, 12: Solitarni osebek in asociacija vrste of *G. steini*
Sl. 13-15: *G. cuneata****; (Sl. 13) biasociativna asociacija, (Sl. 14) triasociativna asociacija in (Sl. 15) solitarni osebek***
Sl. 16: Asociacija vrste *G. polymorpha*

***Gregarina curvata* (Hammerschmidt, 1838)** (Fig. 17)

Material examined:

Host: *Cetonia* sp. (Coleoptera: Scarabaeidae)

Locality and prevalence: Maribor, 14.10.2011, 1/6 individuals infected.

Measurements of trophozoites are given in Table 1.

Gregarina curvata is reported from the following scarabaeid beetles (Coleoptera: Scarabaeidae) (Geus, 1969): *Cetonia* sp., *Cetonia aurata, Protaetia cupraea (= Potosia cuprea)* and *Osmoderma eremita*.

Locality reports (summarized in Geus, 1969): Europe (France, Germany).

Genus *Gamocystis* Schneider, 1875 (Plate III)

***Gamocystis tenax* Schneider, 1875** (Fig. 18)

Material examined:

Host: *Ectobius lapponicus* (Linnaeus, 1758) (Blattaria: Blatellidae)

Locality and prevalence: Maribor, 5.9.2011, 19.9.2011; 4/8 individuals infected.

Association biassociative, caudofrontal. Only in younger trophozoites was the gregarine divided into a distinct protomerite and deutomerite. Measurements of trophozoites and gamonts in association are given in Table 1.

Gregarines occurring in tropical and subtropical Blattaria are comprehensively presented in a series of papers of Clopton (1995, 2010, 2011, 2012a, 2012b), Clopton & Gold (1996) and Clopton & Hays (2006). Little is known about gregarines infecting Holarctic cockroaches.

G. tenax is reported from the following cockroach species (Geus, 1969): *Ectobius lapponicus, Ectobius livens* and *Ectobius sylvestris*.

Locality reports (summarized in Geus, 1969): Europe (France, Germany).

***Gamocystis fimetarii* Cordua, 1953** (Fig. 19)

Material examined:

Host: *Ectobius lapponicus* (Linnaeus, 1758) (Blattaria: Blatellidae)

Locality and prevalence: Maribor, 27.9.2011; 2/4 individuals infected.

Association biassociative. The primite is clearly divided into protomerite and deutomerite, however, there is no such division of the satellite. Measurements of trophozoites and gamonts in association are given in Table 1.

G. fimetarii was originally reported from an aphodiid beetle *Aphodius fimetarius* (Coleoptera: Aphodiidae) (Geus, 1969), so it is unusual that it is found in cockroaches.

Locality reports (summarized in Geus, 1969): Europe (Germany).

Family Hirmocystidae Grassé, 1953

Genus *Hirmocystis* Labbé, 1899 (Plate III)

***Hirmocystis polymorpha* (Léger, 1892)** (Figs. 20, 21)

Material examined:

Host: *Adalia bipunctata* (Linnaeus, 1758) (Coleoptera: Coccinellidae)

Locality and prevalence: Maribor: Piramida, 12.9.2011; 2/4 individuals infected.

Associations caudofrontal, composed of 6-7 individuals. Measurements of gamonts in associations are given in Table 1.

H. polymorpha is reported from larvae of a lucanid beetle *Platycerus caraboides* (Coleoptera: Lucanidae) and from larvae of dipterans *Erioptera* sp., *Limonia* sp. and *Symplecta* sp. (Geus, 1969). This is the first report of *H. polymorpha* from a coccinellid host.

Locality reports (summarized in Geus, 1969): Europe (Germany).

Genus *Hyalospora* Schneider, 1875 (Plate III)

***Hyalospora hemerobii* Geus, 1969** (Figs. 22, 23)

Material examined:

Host: *Hemerobius humulinus* Linnaeus, 1758 (Neuroptera: Hemerobiidae)

Locality and prevalence: Maribor, Piramida; 8.9.2011, 16.9.2011; 9/10 individuals infected.

Gametocyst diameter 83-95 µm (n=4) (Fig. 23). Some trophozoites with epimerite. Association biassociative, caudofrontal. Measurements of trophozoites and gamonts in association are given in Table 1.

H. hemerobii is also reported from the brown lacewing species *Hemerobius pini* (Neuroptera: Hemerobiidae) (Geus, 1969).

Locality reports (summarized in Geus, 1969): Europe (Germany).

***Hyalospora psocorum* (Siebold, 1839)** (Fig. 24)

Material examined:

Host: *Graphopsocus cruciatus* (Linnaeus, 1768) (Psocoptera: Stenopsocidae)

Locality and prevalence: Maribor: Piramida; 14.10.2012, 23.10.2012; 7/12 individuals infected.

Measurements of trophozoites are given in Table 1.

H. psocorum is reported from the following psocopteran species: *Amphigerontia bifasciata, Graphopsocus cruciatus, Mesopsocus unipunctatus, Psocus longicornis, Stenopsocus immaculatus, Lachesilla quercus* and *Valenzula flavidus* (Lipa, 1967; Geus, 1969).

Locality reports (summarized in Lipa, 1967; Geus, 1969): Germany (Poland).

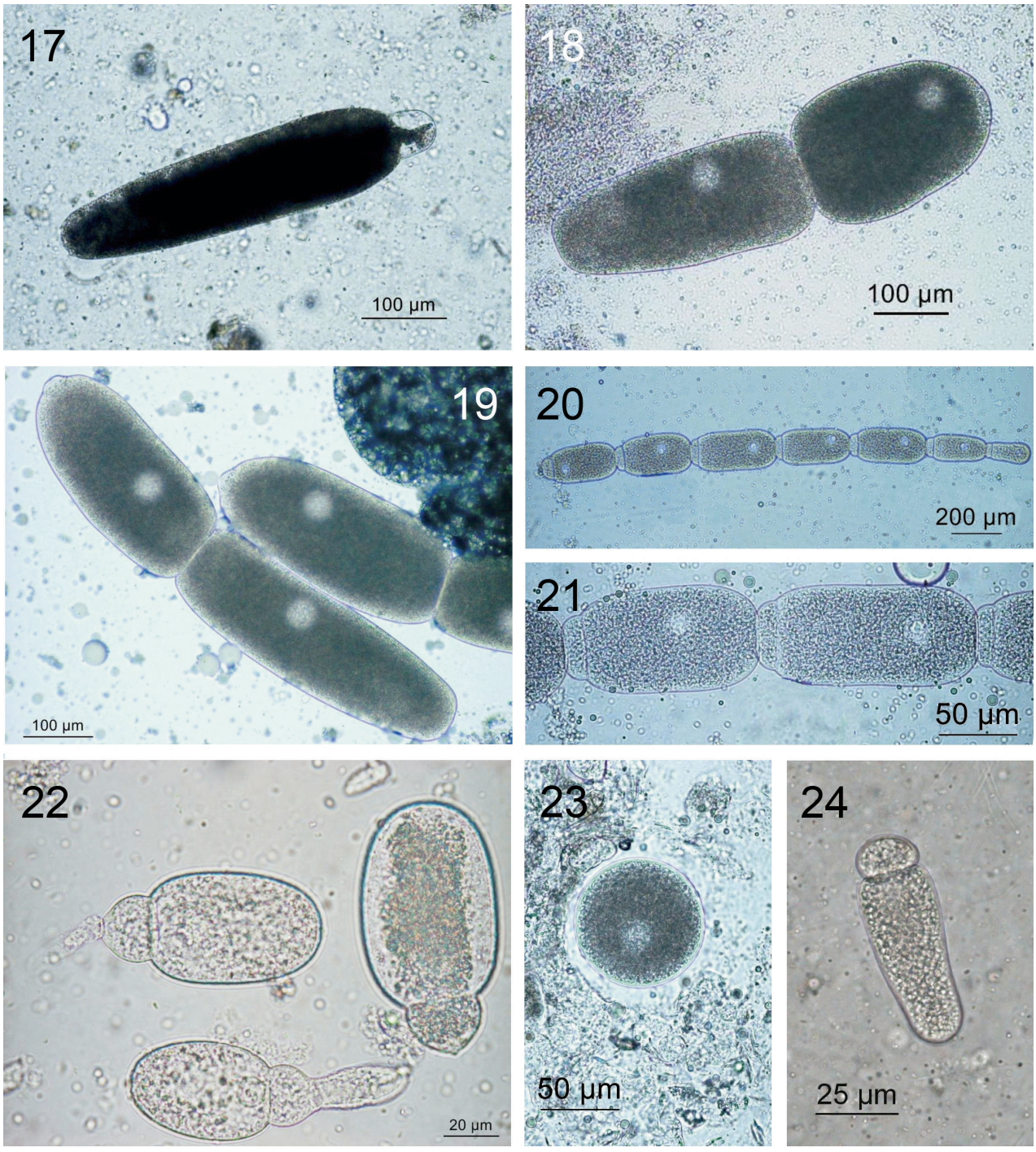

PLATE III: Genera *Gregarina, Gamocystis, Hirmocystis* ***and*** *Hyalospora*
Fig. 17: Solitary individual of *Gregarina curvata*
Fig. 18: Association of *Gamocystis tenax*
Fig. 19: Associations of *Gamocystis fimetarii*
Figs. 20, 21: Association of *Hirmocystis polymorpha*
Figs. 22, 23: *Hyalospora hemerobii****; (Fig. 22) solitary individuals and (Fig. 23) gametocyst***
Fig. 24: Solitary individual of *Hyalospora psocorum*

TABLA III: Rodovi *Gregarina, Gamocystis, Hirmocystis* ***in*** *Hyalospora*
Sl. 17: Solitarni osebek vrste *Gregarina curvata*
Sl. 18: Asociacija vrste *Gamocystis tenax*
Sl. 19: Asociacija vrste *Gamocystis fimetarii*
Sl. 20, 21: Asociacija vrste *Hirmocystis polymorpha*
Sl. 22, 23: *Hyalospora hemerobii****; (Sl. 22) solitarni osebki in (Sl. 23) gametocista***
Sl. 24: Solitarni osebek vrste *Hyalospora psocorum*

Genus *Euspora* Schneider, 1875 (Plate IV)

***Euspora fallax* Schneider, 1875** (Figs. 25, 26)

Material examined:

Host: *Melolontha* sp., larva (Coleoptera: Scarabaeidae)

Locality and prevalence: Maribor, 3.5.2012; 2/4 individuals infected.

Association biassociative, caudofrontal. Measurements of associations are given in Table 1.

E. fallax is reported from the following beetles (Coleoptera) (Geus, 1969): Tenebrionidae: *Allecula* sp., *Asida* sp., *Monomma giganteum*; larval Melolonthidae: *Melolontha melolontha*, *Melolontha* sp., *Rhizotrogus aestivus* and *Rhizotrogus* sp.

Locality reports (summarized in Geus, 1969): Europe (Germany, France) and Africa (Congo).

Superfamily Stenophoroidae Levine, 1984 Emend. Clopton, 2009

Family Leidyanidae Kudo, 1954

Genus *Leidyana* Watson, 1915 (Plate IV)

***Leidyana gryllorum* (Cuenot, 1897)**

= *Leidyana erratica* (Crawley, 1907) (Figs. 27, 28)

Material examined:

Host: *Gryllus campestris* Linnaeus, 1758 (Orthoptera: Gryllidae)

Locality and prevalence: Kamnica, Koblarjev zaliv; 7.9.2011; 2/2 individuals infected.

Gametocyst diameter 95-115 µm (n=6) (Fig. 28). Measurements of trophozoites are given in Table 1.

L. gryllorum is reported from the following cricket species (Orthoptera: Gryllidae) (Geus, 1969): *Acheta domesticus, Gryllus campestris, Gryllus assimilis, Nemobius fasciatus, Nemobius sylvestris, Phaeophilacris pilipennis* and *Phaeophilacris* sp.

Locality reports (summarized in Geus, 1969): Europe (France, Germany), USA, Asia (India) and Africa (Congo).

***Leidyana oblonga* (Dufour, 1837)** (Fig. 29)

Material examined:

Host: *Acheta domesticus* (Linnaeus, 1758) (Orthoptera: Gryllidae)

Locality and prevalence: Maribor, a stock; 7.9.2011; 5/10 individuals infected.

Measurements of trophozoites are given in Table 1.

L. oblonga is reported from the following orthopteran species (Orthoptera) (Geus, 1969): Gryllidae: *G. campestris, N. sylvestris*; Acrididae: *Locusta migratoria*, *Psophus stridulus*.

Locality reports (summarized in Geus, 1969): Europe (France, Germany) and North America (USA).

Family Actinocephalidae Léger, 1892

Subfamily Actinocephalinae Léger, 1899

Genus *Actinocephalus* Stein, 1848 (Plate IV)

***Actinocephalus permagnus* Wellmer, 1911** (Figs. 30-32)

Material examined:

Host: *Carabus coriaceus* Linnaeus, 1758 (Coleoptera: Carabidae)

Locality and prevalence: Maribor, 23.9.2011; 2/4 individuals infected.

Protomerite cylindrical or conical (Figs. 31, 32). Measurements of trophozoites are given in Table 1.

A. permagnus is reported from the following carabid species (Coleoptera: Carabidae) (Geus, 1969; Sienkiewicz & Lipa, 2009): *Carabus cancellatus*, *C. catenulatus*, *C. coriaceus*, *C. granulatus*, *C. hortensis*, *C. nemoralis*, *Carabus (Cathoplius) asperatus* and *Ceutosphodrus oblongus*.

Locality reports (summarized in Geus, 1969; Sienkiewicz & Lipa, 2009): Europe (France, Germany, Poland) and Africa (Morocco).

***Actinocephalus conicus* (Dofour, 1837)** (Figs. 33-35)

Material examined:

Host: *Dorcus parallelipipedus* (Linnaeus, 1785) (Coleoptera: Lucanidae)

Locality and prevalence: Maribor, 10.6.2012, 31.8.2012; 1/4 individuals infected.

Measurements of individuals are given in Table 1. Some trophozoites with epimerite.

Actinocephalus conicus is reported from the following beetle (Coleoptera) species: *Dorcus parallelipipedus* (Lucanidae); *Elater ferrugineus* (larvae) (Elateridae).

Locality reports (summarized in Geus, 1969): Europe (France, Germany).

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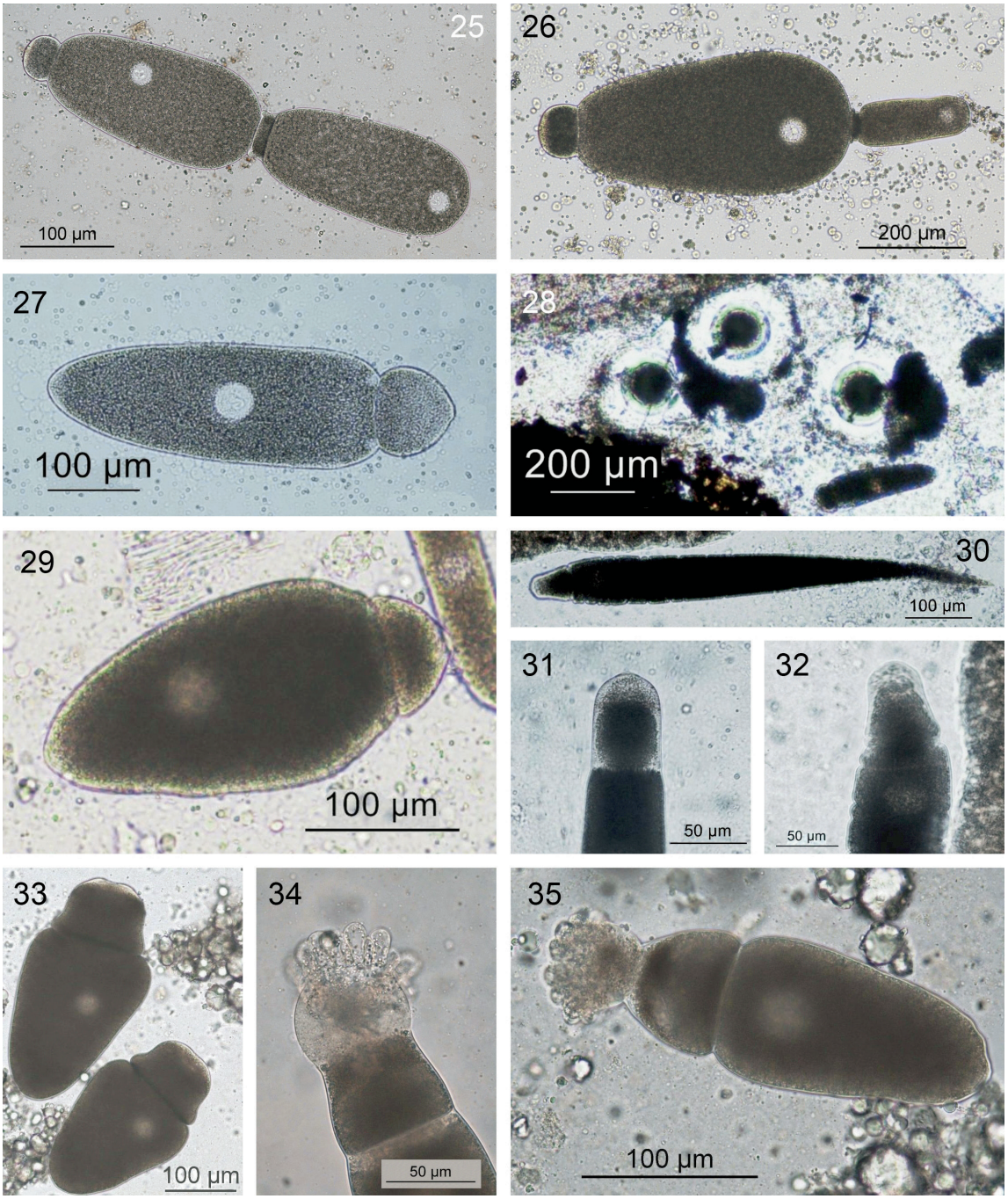

***PLATE IV: Genera** Euspora, Leidyana **and** Actinocephalus*
***Figs. 25, 26: Associations of** E. fallax*
Figs. 27, 28:** L. gryllorum**; (Fig. 27) solitary individual and (Fig. 28) gametocyst
***Fig. 29: Solitary individual of** L. oblonga*
Figs. 30-32:** A. permagnus**; (Fig. 30) solitary individual and (Figs. 31, 32) protomerites
Figs. 33-35:** A. conicus**; (Fig. 33) individuals without epimerite and (Figs. 34, 35) individuals with epimerite

***TABLA IV: Rodovi** Euspora, Leidyana **in** Actinocephalus*
***Sl. 25, 26: Asociacija vrste** E. fallax*
Sl. 27, 28:** L. gryllorum**; (Sl. 27) solitani osebek in (Sl. 28) gametocista
***Sl. 29: Solitarni osebek vrste** L. oblonga*
Sl. 30-32:** A. permagnus**; (Sl. 30) solitarni osebek in (Sl. 31, 32) protomeriti
Sl. 33-35:** A. conicus**; (Sl. 33) osebki brez epimerita in (Sl. 34, 35) osebki z epimeritom

K POZNAVANJU GREGARIN (PROTOZOA: APICOMPLEXA: EUGREGARINORIDA) IZ ŽUŽELK V SLOVENIJI

Dušan DEVETAK
Oddelek za biologijo, Fakulteta za naravoslovje in matematiko, Univerza v Mariboru, SI-2000 Maribor, Koroška cesta 160
E-mail: dusan.devetak@guest.arnes.si

Manja OMERZU
SI-2000 Maribor, Borova vas 29

Richard E. CLOPTON
Department of Natural Science, Peru State College, Peru, Nebraska 68421, ZDA

POVZETEK

Gregarine (Protozoa: Apicomplexa: Eugregarinorida) so razmeroma velike praživali, ki zajedajo v kopenskih, sladkovodnih in morskih nevretenčarjih. So obligatni paraziti v prebavilih in telesnih votlinah kolobarnikov, plaščarjev, pršivcev in členonožcev. Čeprav so iz žuželk opisali največ vrst gregarin, so za prisotnost teh parazitov preiskali le manj kot odstotek znanih vrst žuželk, zato pričakujemo še veliko novih najdb. Kljub bogati tradiciji v preteklosti so te praživali v Evropi še vedno razmeroma slabo preiskane. V prispevku so za Slovenijo gregarine prvič navedene. Med avgustom 2011 in oktobrom 2013 smo odkrili gregarine v prebavilih naslednjih redov žuželk: Dermaptera, Orthoptera, Blattaria, Psocoptera, Neuroptera in Coleoptera. Zabeležili smo dvajset vrst gregarin, ki jih uvrščamo v naslednje rodove: Actinocephalus, Euspora, Gamocystis, Gregarina, Hirmocystis, Hyalospora *in* Leidyana.

Ključne besede: gregarine, Eugregarinorida, Apicomplexa, žuželke, paraziti, Slovenija

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Tab. 1: Measurements of gregarines. Abbreviations: TL – total length; EL – epimerite length; PL – length of protomerite; PL* - length of protomerite without epimerite; DL – length of deutomerite; PWM – maximum width of protomerite; DWE – width of deutomerite at equatorial axis; DWM – maximum width of deutomerite; Pr – primite; Sat – satellite; Assoc – association

Tab. 1: Meritve gregarin. Okrajšave: TL – celotna dolžina; EL – dolžina epimerita; PL – dolžina protomerita; PL* – dolžina protomerita brez epimerita; DL – dolžina devtomerita; PWM – največja širina protomerita; DWE – širina devtomerita na ekvatorialni ravnini; DWM – največja širina devtomerita; Pr – primit; Sat – satelit; Assoc – asociacija

***Gregarina ovata* Dufour, 1828**												
Solitary individuals												
Individual	TL		PL		DL		PWM		DWE		DWM	
1	392		62		330		105		244		248	
2	248		45		203		64		117		117	
Gamonts in association												
	Pr						Sat					
Assoc	TL	PL	DL	PWM	DWE	DWM	TL	PL	DL	PWM	DWE	DWM
1	39	60	330	100	250	260	370	40	330	130	250	255
2	400	50	350	120	265	270	377	27	350	140	270	275
3	200	35	165	50	100	110	196	24	172	50	95	96
4	400	56	344	119	271	273	386	29	357	135	279	279
5	392	46	346	112	270	272	381	27	354	136	274	274

***Gregarina chelidurellae* Geus, 1969**												
Solitary individuals												
Individual	TL		PL		DL		PWM		DWE		DWM	
1	127		26		101		32		53		53	
2	201		35		166		44		71		72	
3	156		34		122		35		62		62	
4	172		36		136		35.5		66		66	
5	252.5		42.5		210		61.5		98		100	
Gamonts in association												
	Pr						Sat					
Assoc	TL	PL	DL	PWM	DWE	DWM	TL	PL	DL	PWM	DWE	DWM
1	212	38	174	41	62	63	228	36	192	53	69	69
2	211	38	173	42	65	65	227	37	190	52	69	70

***Gregarina acridiorum* (Léger, 1893)**												
Solitary individuals												
Individual	TL		PL		DL		PWM		DWE		DWM	
1	419		89		330		115		158		158	
2	450		96		354		128		158		159	
3	622		129		493		186		292		302	
4	397		100		297		127		181		198	
5	382		79		303		113		172		187	
Gamonts in association												
	Pr						Sat					
Assoc	TL	PL	DL	PWM	DWE	DWM	TL	PL	DL	PWM	DWE	DWM
1	307	62	245	84.5	123	123	297	35	262	80	113	120
2	626	130	496	170	253	259	609	65	544	172	238	260
2	649	132	517	172	241	253	465	77	388	137	169	175

***Gregarina delmasi* Tuzet et Rambier, 1953**						
Solitary individuals						
Individual	TL	PL	DL	PWM	DWE	DWM
1	471	71	400	156	113	137
2	517	63	454	129	78	148
3	435	125	310	206	109	172
4	485	98	387	129	111	119

Gamonts in association												
	Pr						Sat					
Assoc	TL	PL	DL	PWM	DWE	DWM	TL	PL	DL	PWM	DWE	DWM
1	607	69	538	185	124	188	526	49	477	148	127	183
2	604	82	522	173	79	200	591	92	499	127	114	255
3	578	93	485	181	88	215	589	100	489	133	117	155

***Gregarina katherina* Watson, 1915**												
Gamonts in association												
	Pr						Sat					
Assoc	TL	PL	DL	PWM	DWE	DWM	TL	PL	DL	PWM	DWE	DWM
1	104	20	84	28	40	44	111	11	100	30	39	40
2	109	19	90	31	59	60	115	12	103	37	48	49
3	72	12.5	59.5	23	30	32.5	75.5	11	64.5	26.5	33	33
3*							59	8.5	50.5	19	25	25.5

*Data for secondary satellite in association 3

***Gregarina barbarara* Watson, 1915**						
Solitary individuals						
Individual	TL	PL	DL	PWM	DWE	DWM
1	112.5	17.5	95	29.5	66	69

Gamonts in association												
	Pr						Sat					
Assoc	TL	PL	DL	PWM	DWE	DWM	TL	PL	DL	PWM	DWE	DWM
1	108.5	18.5	90	31.5	61	66.5	117	11	106	41	51	53
2	93	19	74	27.5	47	52	97.5	7	90.5	34.5	42	46
3	98	22	76	26.5	50.5	53	98.5	7.5	91	35	40	47

***Gregarina steini* Berndt, 1902**						
Solitary individuals						
Individual	TL	PL	DL	PWM	DWE	DWM
1	103.5	15.5	88	19	26.5	30.5
2	93.5	11	82.5	17	21	26
3	61.5	9	52.5	13	15.5	17
4	128	15.5	112.5	22.5	28	32
5	134	20	114	31	33	39

Gamonts in association												
	Pr						Sat					
Assoc	TL	PL	DL	PWM	DWE	DWM	TL	PL	DL	PWM	DWE	DWM
1	148	23	125	33.5	35	46	135	12	123	33.5	37.5	41
2	141	16.5	124.5	30	35	40	132.5	17.5	115	30	34	40.5
3	147	18	129	31	38.5	43	134	14.5	119.5	32.5	35	39.5
4	150.5	21.5	129	32	39.5	41	108	12	96	26	29	32
5	147	20	127	29	30	37	102	10	92	22.5	27.5	30
6	140	14	126	30	32	44	111	12	99	26.5	28.5	38

***Gregarina cuneata* Stein, 1848**						
Solitary individuals						
Individual	TL	PL	DL	PWM	DWE	DWM
1	248	70	178	38.5	43	47.5
2	158	48.5	109.5	35	42	43
3	57	14	43	16	17	18

Gamonts in association

	Pr						Sat					
Assoc	TL	PL	DL	PWM	DWE	DWM	TL	PL	DL	PWM	DWE	DWM
1	231	54.5	176.5	42	73	85	229	53	176	73	87	88
2	174	52	122	42	68	75	140	14	126	43	56	58
3	296.5	62.5	234	44	48	60	408	64	346	53	55	55
4	249	57	192	35	37.5	49	233	39	194	31	32	37
5	207	45.5	161.5	37	36	45	270	44	226	35	40	46

***Gregarina polymorpha* (Hammerschmidt, 1838)**						
Solitary individuals						
Individual	TL	PL	DL	PWM	DWE	DWM
1	183	32	151	31.5	43	44
2	178	28	150	32	41	44
3	263	40	223	43	55.5	61
4	278	35	243	47	69	73
5	269	24	245	39	61	66

Gamonts in association

	Pr						Sat					
Assoc	TL	PL	DL	PWM	DWE	DWM	TL	PL	DL	PWM	DWE	DWM
1	256	33	223	41	57	59.5	292.5	25.5	267	51	60	65
2	292	34	258	42	64.5	74.5	309	27	282	55	71	78
3	212	28	184	39	50	53	223.5	25.5	198	43	52	56
4	245	30	215	41	55	60	247	23	224	42	53.5	60
5	351	28	323	43	70	72.5	354	29	325	51	75	77.5

***Gregarina curvata* (Hammerschmidt, 1838)**						
Solitary individuals						
Individual	TL	PL	DL	PWM	DWE	DWM
1	456	49	407	53	99	106
2	458	49.5	408.5	58	100	107

***Gamocystis tenax* Schneider, 1875**						
Solitary individuals						
Individual	TL	PL	DL	PWM	DWE	DWM
1*	289	-	-	-	150	162
2*	284	-	-	-	136	142
3	287	8	279	36.5	206	206
4	296	8	288	35	214	214
5	325	9	316	40	197	197

Gamonts in association

	Pr						Sat					
Assoc	TL	PL	DL	PWM	DWE	DWM	TL	PL	DL	PWM	DWE	DWM
1	303.5	8.5	295	40	227	227	345*	-	-	-	178	191
2	261.5	7.5	254	38	164	164	285*	-	-	-	142	151
3	276	7	269	21	143	144	239*	-	-	-	122	122
4	263*	-	-	-	182	187	339*	-	-	-	148	152
5	259*	-	-	-	207	220	345*	-	-	-	169	172

*The cell was not divided into protomerite and deutomerite

***Gamocystis fimetarii* Cordua, 1953**						
Solitary individuals						
Individual	TL	PL	DL	PWM	DWE	DWM
1	293	1.5	291.5	14.5	73	73
2	291	1.5	289.5	25.5	90	90
3	324	2	322	19	93.5	95
4	286	2	284	15.5	97	97
5*	275	-	-	-	81	82

Gamonts in association												
	Pr						Sat					
Assoc	TL	PL	DL	PWM	DWE	DWM	TL	PL	DL	PWM	DWE	DWM
1	315	7	308	37.5	150	154	431*	-	-	-	133	137
2	342	8.5	333.5	33	118	119	384*	-	-	-	105	114
3	318	8	310	38	113	113	425*	-	-	-	106.5	107
4	246*	-	-	-	87	88	235*	-	-	-	57	71
5	295	7	288	35	92	93	309*	-	-	-	78	78

*The cell was not divided into protomerite and deutomerite

***Hirmocystis polymorpha* (Léger, 1892)**						
	Parameter					
Assoc 1	TL	PL	DL	PWM	DWE	DWM
Primite	115	22.5	92.5	33	52	56
Satellite 1	122	11	111	39	55	56
Satellite 2	116.5	14	102.5	34	49	51
Satellite 3	108.5	12	96.5	31	44	44
Satellite 4	118	15	103	32	45	45
Satellite 5	86.5	10.5	76	29	38.5	38.5
	Parameter					
Assoc 2	TL	PL	DL	PWM	DWE	DWM
Primite	297	48	249	88	144	148
Satellite 1	305	34.5	270.5	97	163	163
Satellite 2	342	33	309	109	155	155
Satellite 3	300	29.5	270.5	97	139.5	139.5
Satellite 4	307	35	272	89	136	138
Satellite 5	237	30	207	76	105	105
Satellite 6	178	23.5	154.5	59	76.5	85
	Parameter					
Assoc 3	TL	PL	DL	PWM	DWE	DWM
Primite	102.5	16	86.5	28	48	51
Satellite 1	102	11	91	33	52	52
Satellite 2	117.5	12.5	105	34.5	49	49.5
Satellite 3	104	12	92	31	44	44
Satellite 4	108.5	14.5	94	31	44.5	44.5
Satellite 5	82	11	71	26	35	35
Satellite 6	67	8	59	22	28.5	28.5

***Hyalospora hemerobii* Geus, 1969**							
Solitary individuals with epimerite							
Individual	TL	EL	PL*	DL	PWM	DWE	DWM
1	120	29	20	71	33	70	70
2	101	26.5	20	54.5	27	50	50
3	103	33	16	54	26	49	49
4	87.5	31.5	17	39	19.5	36.5	36.5
5	137	31	26	80	35	83	83

Solitary individuals without epimerite						
Individual	TL	PL	DL	PWM	DWE	DWM
1	104	26	78	37	69.5	71
2	98.5	26.5	72	36	65.5	65.5
3	86	22	64	34.5	59	59
4	266	32	234	60	182	182
5	102.5	25.5	77	37	69	70

Gamonts in association												
	Pr						Sat					
Assoc	TL	PL	DL	PWM	DWE	DWM	TL	PL	DL	PWM	DWE	DWM
1	82	20	62	26.5	47	47	78	14.5	63.5	22	31	32
2	99	24	75	28	60	60	89	13.5	75.5	35	70	70
3	72	19	53	26.5	51	51	83	16	67	25	43	43

***Hyalospora psocorum* (Siebold, 1839)**						
Solitary individuals						
Individual	TL	PL	DL	PWM	DWE	DWM
1	48.5	13	35.5	21	22.5	24
2	49	11.5	37.5	21	16.5	20.5
3	49	12.5	36.5	20	18.5	19.5
4	64.5	12	52.5	18.5	20	23.5
5	69	10.5	58.5	19.5	20.5	24

***Euspora fallax* Schneider, 1875**												
Gamonts in association												
	Pr						Sat					
Assoc	TL	PL	DL	PWM	DWE	DWM	TL	PL	DL	PWM	DWE	DWM
1	492	64	428	92	209	217	454	29	425	102	198	203
2	299	42	257	64	113	128	308	23.5	284.5	71	114	119
3	486	69	417	93.5	236	256	474	39	435	100	260	265
4	513	28	485	100	251	269	222	14.5	207.5	64	80	83.5
5	618	82	536	113	277	293	553	34	519	122	276	276

***Leidyana gryllorum* (Cuenot, 1897)**						
Solitary individuals						
Individual	TL	PL	DL	PWM	DWE	DWM
1	357	53	304	82.5	69.5	95
2	371	48	323	69	55	75
3	441	85	356	96.5	126	129
4	361	62	299	69	60.5	70
5	375	68.5	306.5	68.5	72.5	82

***Leidyana oblonga* (Dufour, 1837)**						
Solitary individuals						
Individual	TL	PL	DL	PWM	DWE	DWM
1	274	40.5	233.5	79.5	120	132
2	287	51	236	71	98	107

***Actinocephalus permagnus* Wellmer, 1911**						
Solitary individuals						
Individual	TL	PL	DL	PWM	DWE	DWM
1	356	48	308	49.5	49	60
2	979	74	905	54	54.5	69
3	754	69	685	56	56.5	78.5
4	470	44.5	425.5	58	62	71.5
5	859	61	798	52	64.5	77

***Actinocephalus conicus* (Dofour, 1837)**							
Solitary individuals with epimerite							
Individual	TL	EL	PL*	DL	PWM	DWE	DWM
1	314	62	55	197	88	97	112.5
2	274	69	54	151	67.5	75.5	79
3	448	98	69	281	148	171	194
4	259	51	50	158	73	75.5	84
5	266	53.5	55.5	157	68	73	81
Solitary individuals without epimerite							
Individual	TL	PL	DL	PWM	DWE	DWM	
1	679	154	525	232	204	257.5	
2	317	77.5	239.5	129	150	159	
3	791	181.5	609.5	239.5	222	285	
4	762	127	635	165	234	291	
5	321	86	235	130	142	174	