

ALGAE COMMENSAL COMMUNITY IN *GENLISEA* TRAPSBARTOSZ JAN PŁACHNO¹, KONRAD WOŁOWSKI²

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ABSTRACT

The community of algae occurring in *Genlisea* traps and on the external traps surface in laboratory conditions were studied. A total of 29 taxa were found inside the traps, with abundant diatoms, green algae (Chlamydomphaceae) and four morphotypes of chrysophytes stomatocysts. One morphotype is described as new for science. There are two ways of algae getting into *Genlisea* traps. The majority of those recorded inside the traps, are mobile; swimming freely by flagella or moving exuding mucilage like diatoms being ablate to colonize the traps themselves. Another possibility is transport of algae by invertebrates such as mites and crustaceans. In any case algae in the *Genlisea* traps come from the surrounding environment. Two dominant groups of algae (*Chladymonas* div. and diatoms) in the trap environment, show ability to hydrolyze phosphomonoseters. We suggest that algae in carnivorous plant traps can compete with plant (host) for organic phosphate (phosphomonoseters). From the spectrum and ecological requirements of algal species found in the traps, environment inside the traps seems to be acidic. However, further studies are needed to test the relations between algae and carnivorous plants both in laboratory conditions and in the natural environment. All the reported taxa are described briefly and documented with 74 LM and SEM micrographs.

KEY WORDS: algae, carnivorous plants, *Genlisea*, commensalisms, phosphatase, phosphomonoseters, enzyme activity, ELF97 phosphate, phytotelmata, Lentibulariaceae, carnivorous syndrome, plant-microbe interaction.

INTRODUCTION

Carnivorous plants attract trap animals and finally utilize nutrients from their carcasses to supplement nutrition, but some of them are also phytotelmata (Juniper et al. 1989). The most complicated mutualistic interactions have evolved in those carnivorous plants which form large pitcher-type traps, mainly *Nepenthes* and *Sarracenia* (e.g., Juniper et al. 1989; Miller et al. 2002; Ellison et al. 2003; Gray et al. 2006). Moreover some provide an excellent environment for rich algae flora (Gebühr et al. 2006). The bladders of *Utricularia* forming tiny traps also support communities of several algae and microinvertebrates (e.g., Schumacher 1960; Botta 1976; Mosto 1979; Richards 2001; Adamec and Komárek 1999a, b). According to Juniper et al. (1989) *Genlisea* traps lack commensals. In contrast to *Utricularia*, there is only scarce information about algae in *Genlisea* traps (Goebel 1891, Tab. XV Fig. 5; Studnička 1996; Płachno et al. 2005a, b), none of which is detailed. The carnivorous rootless genus *Genlisea* (Lentibulariaceae),

with about 21 species, is restricted to South and Central America, Africa and Madagascar, and occurs in nutrient-poor habitats such as: ferricretes, inselbergs, savannas, swamps and wet meadows (Taylor 1991; Fischer et al. 2000). Similarly to other carnivorous plants, *Genlisea* ("corkscrew plant") has an additional source of nutrients by trapping and utilizing prey, small invertebrates e.g. rotifers, nematodes, crustaceans (Płachno et al. 2005) and protozoa (Barthlott et al. 1998). In order to achieve this, *Genlisea* forms eel/lobster-pot traps, which are submerged in wet soil. The single trap, which is a hollow utricle, consists of stalk, bulb, tubular channel (neck), and two helically twisted arms with openings (e.g., Lloyd 1942; Heslop-Harrison 1975; Reut 1993).

The main aim of this study was to determine algal species in *Genlisea* traps in laboratory conditions. Additionally, we detect enzyme production of algal commensals within trap environment using the ELF assay previously used for detection of phosphatase (phosphomonooesterase) activity in carnivorous plants (see Płachno et al. 2006) and

plankton (e.g. Nedoma et al. 2003; Štrojsová et al. 2003; Štrojsová and Vrba 2005; Cao et al. 2005).

MATERIAL AND METHODS

Plant material: *Genlisea hispidula* Stapf, *G. lobata* Fromm-Trinta, *G. violacea* St.-Hil. f. Giant, *G. pygmaea* St.-Hil., *G. repens* Benjamin and hybrid *Genlisea lobata* x *Genlisea violacea* f. Giant were cultivated in the Department of Plant Cytology and Embryology, Jagiellonian University. They were grown in pots in a mixture of wet peat and sand. The peat, which was brought from marshes, contained a natural community of small organisms.

In order to observe algae in situ inside the traps, samples were prepared for SEM according to procedures elsewhere (Płachno et al. 2005a, b). Samples for detailed taxonomic analysis were prepared and cleaned by standard techniques (Krammer and Lange-Bertalot 1986). Material was viewed with Hitachi S-4700 SEM (Scanning Microscopy Laboratory of Biological and Geological Sciences, Jagiellonian University).

For detection extracellular enzyme production of algal commensals we used ELF[®]97 phosphatase substrate (ELFP, Molecular Probes). The substrate is cleaved in the presence of phosphatases into ELF[®]97 alcohol, which has intensive, bright yellow-green fluorescence (Huang et al. 1992; Larison et al. 1995; see also Whitton et al. 2005). Briefly, the traps and soil samples were incubated in the substrate solution (c. 250 µM of ELFP in distilled water) at room temperature. For some samples DAPI was added to label DNA and make nucleus more visible. The traps were then screened for ELF (yellow-green), chlorophyll a (red) and DAPI (blue) fluorescence in an epifluorescence microscope (Nikon Eclipse E 400 with the UV-2A filter). Documentation was made on Sensia 100 slide films. Observations of chlorophyll fluorescence were also helpful in determining the shape and size of chloroplasts.

RESULTS

Algae occur both inside the traps and also on the external trap surface. They were found in all the trap parts: arm, neck and bulb. In the neck, the algae frequently accumulated along the rows of secretory hairs. The external trap surface provides a solid substratum for epiphytic algae, especially the arms of the giant traps in *G. pygmaea* and *G. repens*, which grow on the surface of peat and have access to light. In this case algae were commonly observed in close proximity to the external secretory hairs.

Cyanophyta (=Cyanobacteria)

Synechocystis aquatilis Sauvageau Figs 1 and 2

Cells globular to widely ovoid, solitary or two together (3.7)-6.0-7.1(8.0) µm in diameter. Only few specimens were observed. This organism, which occurs in stagnant or slow-flowing water bodies, is probably common, but rarely reported from Europe (Starmach 1966; Komarek and Anagnostidis 1998). Widespread, common.

Planktothrix conf. *agardhii* Gomont Fig. 3

Filaments light-blue-green, cells ca. 2.5 µm long, ca. 4.7 µm wide, with small granulation at the cross wall. Only few filaments were observed in the trap. Cosmopolitan, widespread.

Heterokontophyta

Chrysophyceae

Chromulina conf. *bicocca* Schiller Figs 9 and 10

Cells broadly ovoid, irregular, periplast covered with small papilla, 10-12.0 µm in diameter, chloroplast yellow-green. Palmelloid aggregates were observed. Several specimens were observed in the traps. Not common, reported from Neusiedlersee Austria. **Note:** Our specimens were smaller than those described by Schiller (after Starmach 1985: 12-22 µm long, 12-18 wide).

Mallomonas conf. *globosa* Schiller Figs 27 and 28

Cells circular, ca. 10 µm in diameter, covered by smooth scales with long bristles. Only few specimens were observed in and outside on the external of the trap surface. Not common, reported from plankton of old river bed in Austria. **Note:** Our specimens were a little smaller than those described by Schiller (after Starmach 1985: 12-13 µm in diameters. It can only be stomatocyst of *Mallomonas globosa* still attached by scales.

Stomatocyst 183 Brown & Smol in Brown et al. (1994)

Fig. 29

Cyst spherical, smooth, 5.23 µm in diameter; collar cylindrical 1.5 in diameter, 0.5-0.7 high, surrounding a regular pore, 0.3 in diameter. Single specimen was observed inside the trap. Common.

Stomatocyst unidentified Wołowski & Płachno Fig. 30

Cyst spherical, 5.7 µm in diameter, ornamented, ornamentations consist of regularly scattered echinate spine pattern. Only single specimen was observed. **Note:** Because the details of the collar and apical pore were not visible we cannot identify observed stomatocyst.

Stomatocyst 1 Cabała 2002 Figs 31 and 32

Cyst spherical 13-15 µm in diameter, covered with 5-7-9 spines, slightly wider at the base, straight; collar with flat planar annulus 2.3-3 µm in diameter, ca. 0.5-1 µm high, apical pore 1.2-1.3 µm in diameter. Many specimens were observed. Probably common. **Note:** Dimension of the stomatocyst is a little bigger than Stomatocyst 1 Cabała 2002. but the rest of the features are the same.

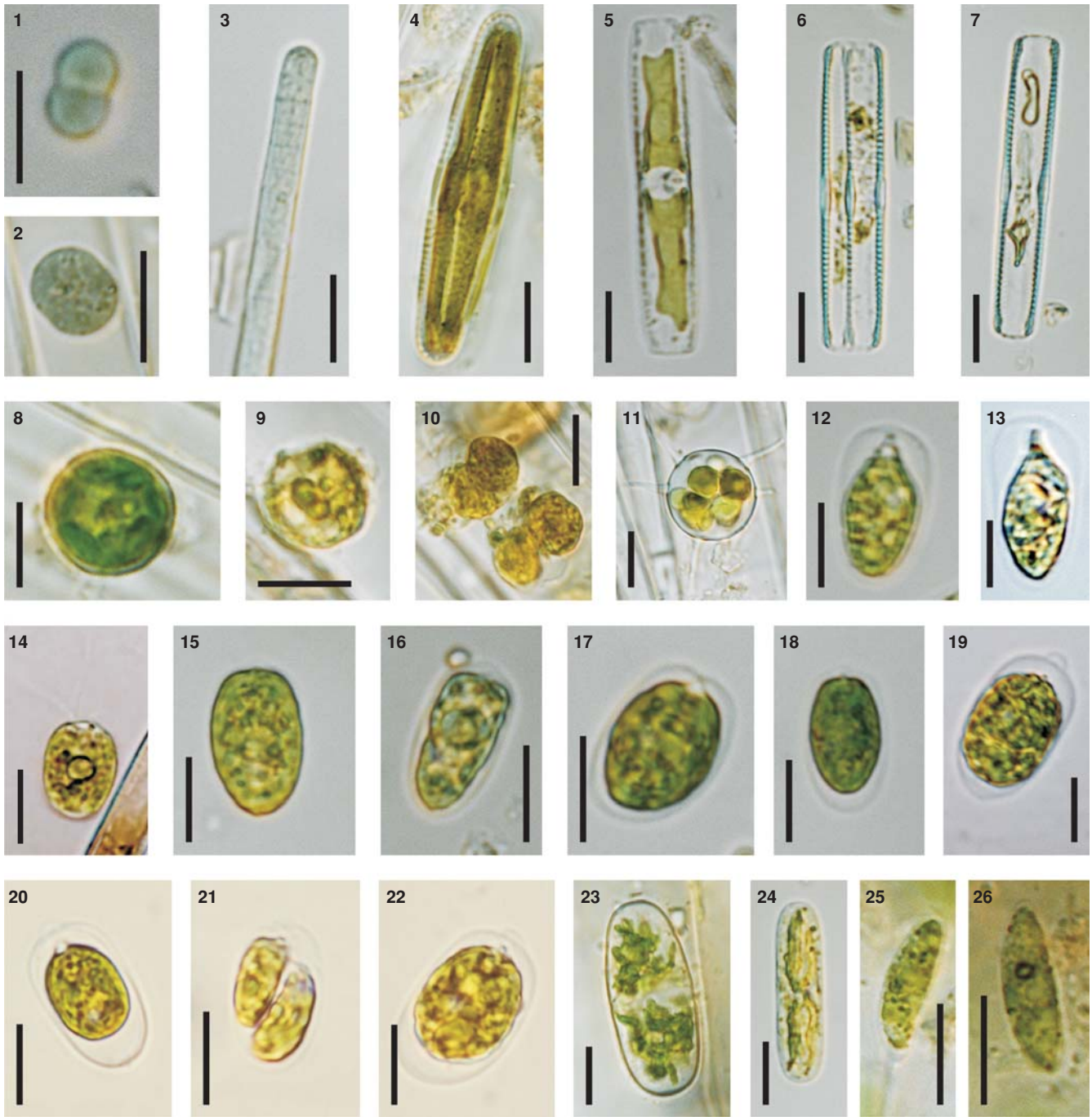
Stomatocyst 1 Wołowski & Płachno (this paper)

Figs 33-38

Negative number: P5-21 Figs: 33-38, from traps of *Genlisea* plants cultivated in Department of Plant Cytology and Embryology Jagiellonian University,

Number of specimens: 5

SEM descriptions: Stomatocyst spherical 14-15.3 µm in diameter, covered with 6-7 spines µm long, slightly wider at the base, bifurcate at the ends, distributed over the surface; regular pore 0.7-1 µm in diameter with flat planar annulus, (Fig. 33), obconical collar, 1.7 µm high, sometimes with well visible siliceous plug (Fig. 34), collar margin is irregularly folded and turned-down, 4.5-5.7 in diameter at



Figs 1-2. *Synechocystis aquatilis*, cell in various focus. **Fig. 3.** *Planktothrix* conf. *agardhii*, apical part of trichome. **Figs 4-7.** *Pinnularia permicrostauron*; Fig. 4 – cell in front view; Fig. 5 – cell in lateral; Figs 6-7 – valves in lateral views. **Fig. 8.** Chlorococcal form of cell. **Figs 9-10.** *Chromulina bicocca*; Fig. 9 – single cell; Fig. 10 – cells during division. **Fig. 11.** Stomatocyst 183 Brown & Smol with well visible chloroplasts and drops of chrysolaminarına. **Figs 12-13.** *Sphaerolopsis alpine*. **Figs 14-15.** *Chlamydomonas* sp. 1. **Figs 16-18.** *Chlamydomonas* sp. 2. **Figs 19-22.** *Chlamydomonas* sp. 3; Fig. 21 – cells after division. **Figs 23-24.** *Actinotaenium cruciferum*; Fig. 23 – cell in front view; Fig. 24 – cell in lateral view. **Figs 25-26.** *Chlorogonum* conf. *fusiforme* – cells without flagella. Scale bar = 10 μ m.

the apex (Figs 35-36). **Note:** similar to stomatocyst 80 Hansen 2001, but our specimens were bigger and had larger margin surrounding apical and regular pore, and to the stomatocyst 42 Piątek 2007, but our cyst had regular pore with planar pseudoannulus. Morphologically comparable with stomatocyst reported previously by Buczkó and Wojtal (2005, p. 37, Fig. 69) from Hungarian peat bogs, but wrongly described as stomatocyst S062 Pla 2001, which has different collar and ornamentation.

Bacillariophyceae

Navicula minima Grunow

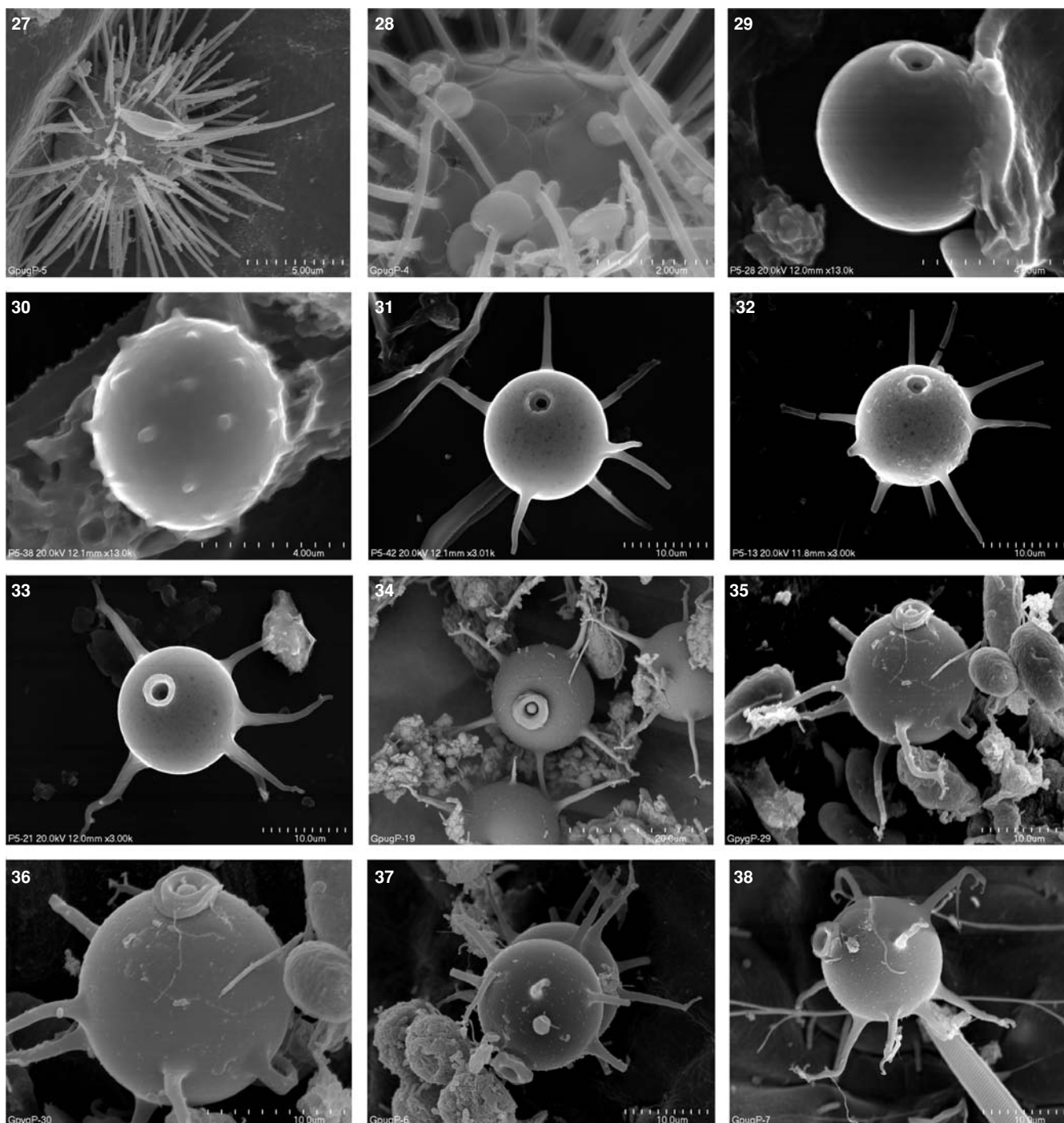
Fig. 39

Valves small, elliptical with rounded apices, 10 μ m long, 3.23 μ m wide, striae density 10-14/10 μ m. Single specimen was observed inside the traps. Cosmopolitan, widespread.

Navicula festiva Kraske

Fig. 40.

(= *Frustulia vitrea* Östrup, *Navicula vitrea* (Östrup) Hustedt)



Figs 27-28. *Mallomonas* conf. *globosa*; Fig. 27 – general view of cell; Fig. 28 – detail view of bristles and scales. **Fig. 29.** Stomatocyst 183 Brown & Smol. **Fig. 30.** Stomatocyst unidentified Wołowski & Plachno. **Figs 31-32.** Stomatocyst 1 Cabala 2002. **Figs 33-38.** Stomatocyst 1 Wołowski & Plachno; Fig. 33 – cyst without plug; Figs 34-38 – stomatocysts in various view (SEM).

Valve elliptical to linear lanceolate with rounded apices, ca. 13.8 μm long, 4.6 μm wide, striae density 24/10. Several specimens were observed inside the traps. Cosmopolitan.

***Frustulia crassinervia* (Bréb) Lange-Bertalot**

& Krammer Figs 41 and 42

Valve broadly lanceolate with slightly rostrate, 45 μm long, 11.2 μm wide, striae density: 34/10 μm , more or less parallel; axial area straight with a pair of thick and parallel ribs around the raphe. Several specimens were observed. Cosmopolitan.

***Eunotia bilunaris* (Her.) Mills**

Fig. 43

Valve slightly dorsi-ventral, with rounded and unmodified apices, ca. 20 μm long, ca. 4 μm wide, striae density 17/10 μm parallel. Few specimens were observed inside the traps. Common.

***Eunotia exigua* (Brébisson ex Kützing) Rabenhorst**

Fig. 44

Valves dorsi-ventral, 10.5-13.5 μm long, 3.7-4.1 μm wide, slightly narrowing towards the ends; striae parallel and slightly denser near the apices, striae density ca. 26/10 μm . Several specimens were observed in the traps. Acidobiotic, common.

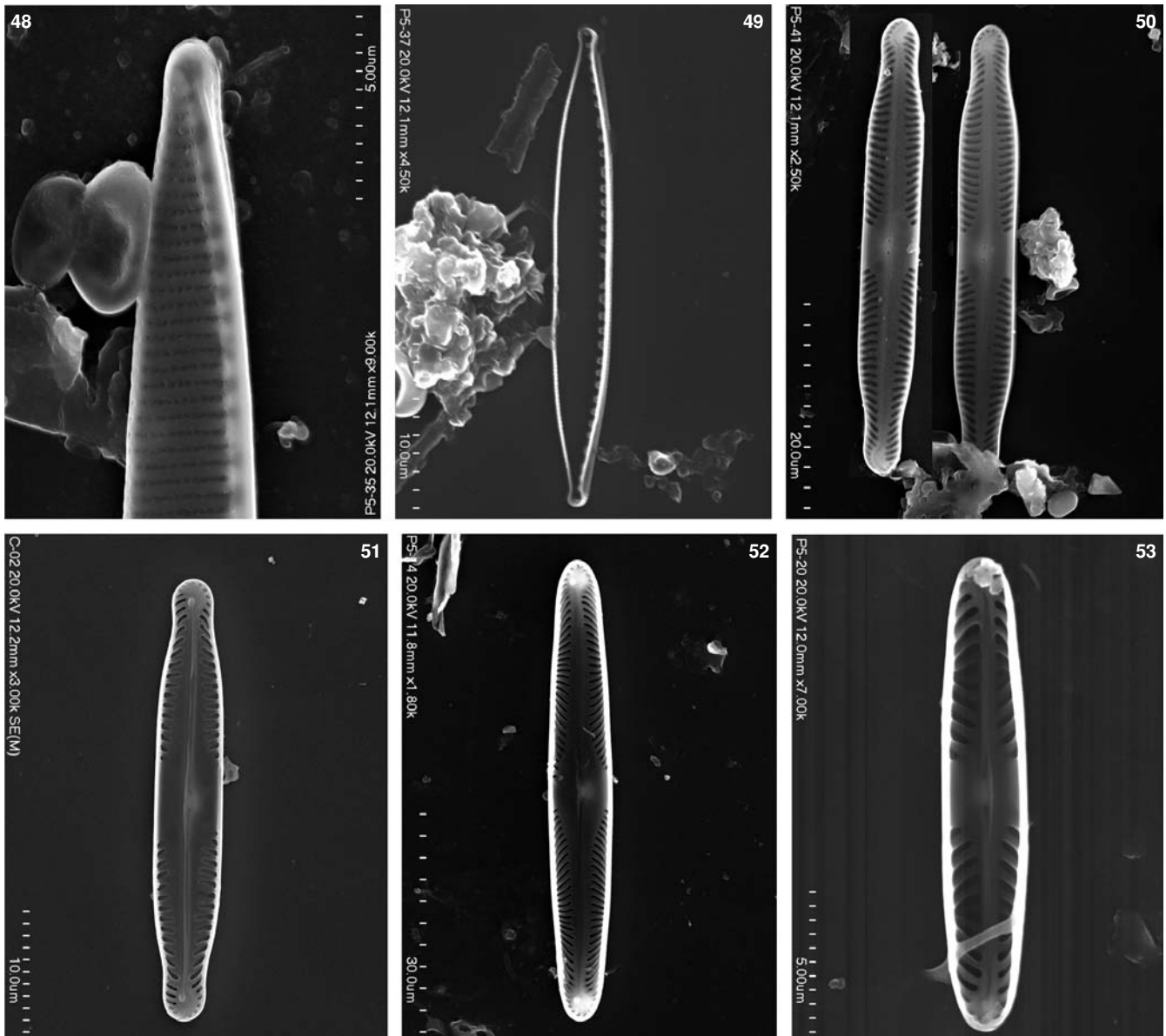


Fig. 48. *Nitzschia linearis*, detail of valve structure at the apical part. **Fig. 49.** *Nitzschia capittelata* with well visible short fibulae of keel. **Figs 50-51.** *Pinnularia subcapitata*; Fig. 50 – external view of two valves; Fig. 51 – detail structure from the internal view of valve. **Fig. 52.** *Pinnularia* conf. *permicrostauron*, internal view of valve. **Fig. 53.** *Pinnularia acidophila*, internal view of valve (SEM).

Pinnularia conf. *permicrostauron*

Cramer & Metzeltin Figs 52, 72, 73

Valve linear with almost parallel sides, ends long broadly truncate protracted, 44.5-63.0 μm long, 8.8-9.4 μm wide, striae density: 11/10 μm , radiate in the middle, convergent at the ends. Only ventral valve was observed (Fig. 52).

Pinnularia acidophila Hofmann & Krammer Fig. 53

Valve linear-lanceolate ca. 16.8 μm long, ca. 3.0 μm wide, with straight to weakly convex sides, rounded at the apices, raphe branches filiform, striae density: 14-16/10, radiate in the middle part of valve becoming strongly convergent at the ends. Few specimens were observed inside the traps. Acidobiontic, common.

Euglenophyta

Euglenophyceae

Euglena mutabilis Schmitz

Cells narrowly-cylindrical, slightly narrowed at the anterior end, strongly flexible in shape, 60-65 μm long, 5-7

μm wide. Many specimens were observed inside one trap. Acidobiontic, common (Wołowski & Hindak 2005).

Trachelomonas hispida (Perty) Stein var. *hispida*

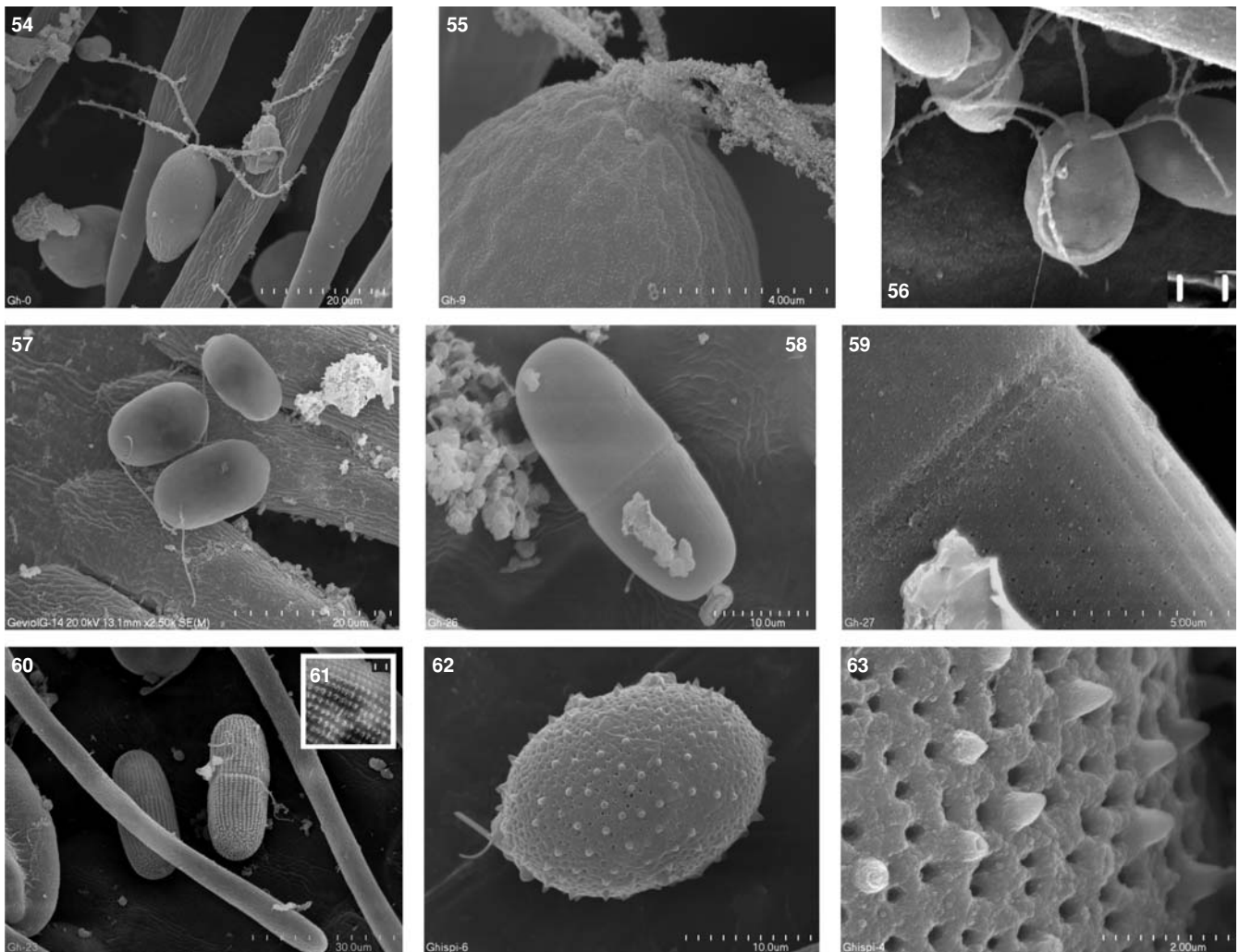
Figs 62 and 63

Lorica elliptic, punctate and covered with short spines, 22.7 long, 15 μm wide. Two specimens were observed inside the traps. Cosmopolitan, widespread (Wołowski 1998).

Chlorophyta

Sphaerellopsis alpina Pascher Figs 12 and 13

Cells elliptic-cylindrical, 14.5-23 μm long, 9.5-10 μm wide with two flagella (which are not presented on our micrographs), cell wall gentle, in the apical part of cell extended from protoplast, at the posterior end only slightly or not extended. Several specimens were observed inside the traps. Not common, reported from Austria (Ettl 1983).



Figs 54-55. *Carteria* conf. *quadrilobulata*; Fig. 54 – cells with for flagella lying on the hairs inside *Genlisea hispida* trap; Fig. 55 – papilla with flagella in high magnification. **Figs 56-57.** *Carteria* conf. *geminata*. Fig. 56 – cell with four flagella; Fig. 57 – cells with damaged flagella lying on the hairs inside *Genlisea violacea* trap. **Figs 58-59.** *Actinotaenium cruciferum*; Fig. 58 – general view of cell; Fig. 59 – detail view of wall structure around the shallow sinus. **Figs 60-61.** *Penium cylindrus*; Fig. 60 – general view of cell with well visible shallow sinus; Fig. 61 – detail wall structure; *Trachelomonas hispida*. **Fig. 62.** general view of lorica. **Fig. 63.** Detail view of lorica wall structure (SEM).

***Chlamydomonas* sp. 1.**

Figs 14, 15, 64-65

Cell broadly ellipsoidal 12-16-20 μm long, 9-10-13 μm wide, with small prominent papilla, chloroplast with centrally placed pyrenoid. **Note:** Because the details of cell organelle were not visible we cannot determinate the observed specimens. Occurred in mass inside the traps.

***Chlamydomonas* sp. 2**

Figs 16-18, 66-67

Cells ovoid to broadly elliptical 12.5-14-16-18.5-21.8 μm long, 6.5-13.5 μm wide, with small conical papilla, protoplast more or less detached from cell wall. **Note:** Because the details of cell organelle were not visible we cannot determinate the observed specimens. Occurred in mass inside the traps.

***Chlamydomonas* sp. 3**

Figs 19-22

Cells broadly elliptical 13.5-19.0 μm long (together with protoplast) 9.1-13.3 μm wide, with small conical papilla, protoplast evidently detached from cell wall at the anterior and posterior parts **Note:** Because the details of cell organelle were not visible we cannot determinate the observed specimens. Occurred in mass inside the traps.

***Carteria* conf. *quadrilobulata* Skuja** Figs 54 and 55

Cells ellipsoidal, ca. 20.0 μm long, 10.9 μm wide, papilla flat at the top, with four flagella rising from the side wall of papilla, located opposite, occurred abundantly, was observed inside the traps. **Note:** We did not see the details of cells in LM but in SEM.

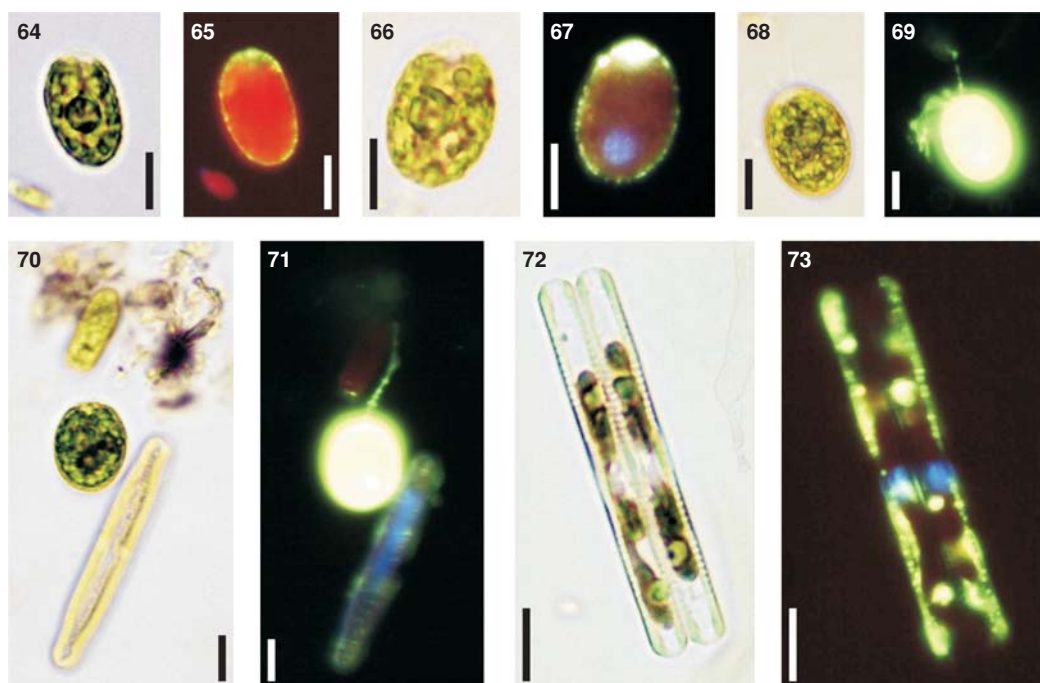
***Carteria* conf. *geminata* Ettl** Figs 56 and 57, 68-71

Cells ovoid to egg shaped, ca. 17.6-18 μm long, 12.5-13 μm wide, without papilla, four opposite flagella, placed lower the top of cell. Occurred abundantly inside the traps together with *Carteria* conf. *quadrilobulata*. **Note:** We did not observe the details of cells in LM but only in SEM specimens were observed. Our specimens were a little bigger than those described by Ettl (1964): 10-16 long, 6-12 wide; taxa also similar to *C. ellipsoidalis* Bold which is decidedly broadly-ellipsoidal in shape.

***Chlorogonium* conf. *fusiforme* Matwienko**

Figs 25 and 26

Cells spindle form 12.5-15.5 μm long, 4-4.2 μm wide, chloroplast parietal, cell with single approximately median pyrenoid. **Note:** Because we observed only specimens



Figs 64-65. *Chlamydomonas* sp. 1; Fig. 64 – cell with well visible pyrenoid; Fig. 65 – the same cell as in Fig. 64, phosphomonoesterase activity (yellow-green fluorescence) seen as small dots. **Figs 66-67.** *Chlamydomonas* sp. 2; Fig. 66 – general view of cell; Fig. 67 – cell with well visible nucleus (blue fluorescence) and intensive phosphomonoesterase activity (yellow-green fluorescence) in apical part of the cell. **Figs 68-69.** *Carteria* conf. *geminata*; Fig. 68 – general view of cell; Fig. 69 – whole monad together with flagella has intensive phosphomonoesterase activity (yellow fluorescence). **Figs 70-71.** *Carteria* conf. *geminata* and *Pinnularia subcapitata*; Fig. 70 – general view of the cells; Fig. 71 – phosphomonoesterase activity, more intensive enzyme activity occurs in *Carteria* than *Pinnularia*. **Figs 72-73.** *Pinnularia permicrostauron*; Fig. 72 – general view of the cells; Fig. 73 – phosphomonoesterase activity, some ELF alcohol precipitates there are seen inside the cells (yellow-green fluorescence), also nuclei are visible (blue fluorescence). Scale bar = 10 μm

without flagella, and stigma we cannot identify them. Many specimens were observed on the external trap wall surface.

Chlorococcal form div. Fig. 8

Cell 15.3 μm in diameter, with cape shaped chloroplast.

Note: We did not observe the detailed cell morphology.

Zygnematophyceae

Actinotaenium cruciferum (De Bary) Teiling

Figs 23, 24, 58, 59

(=*Cosmarium cruciferum* De Bary, *Disphinctium cruciferum* (De Bary) Hansgirg; after Croasdale & Flint 1988).

Cells ca. 25 μm long 12.2 μm wide, guitar shaped with shallow sinus, apex rounded, wall gently punctuate, chloroplast stellate. Several specimens were observed inside the traps, Common, widespread, acidophilic (Croasdale and Flint 1988).

Penium cylindrus (Ehrenberg) Brebison in Ralfs Figs 60 and 61

(=*Closterium cylindrus* Ehrenberg, *Disphinctium cylindrus* (Ehr.) Nägeli, after Croasdale & Flint 1986).

Cells cylindrical, slightly constricted, with rounded apices, wall with coarse granules regularly dispersed, 30.5-35.0 μm long, 12.2-15.0 μm wide. Several specimens were observed inside the traps. Common, widespread, acidophilic (Croasdale and Flint 1986).

Enzyme activity

We detected surface phosphomonoesterases production in two dominant groups of algae (Bacillariophyceae and in Chlamydomonadaceae), in trap environment. Moreover, algae which live in external trap environment, in wet peat, also

have surface bound activity of phosphomonoesterases. There are characteristic patterns of phosphomonoesterase activity (ELF alcohol precipitates) of the cell surface (a surface phosphomonoesterase enzymes) and in the cells of the mentioned groups of algae (intracellular enzyme activity). In Chlamydomonaceae ELF alcohol precipitates form dots (Figs 65 and 67), in some monads intensive phosphomonoesterase activity occurs in apical part cell near flagella (Figs 69 and 70). But also whole monad together with flagella can show intensive phosphomonoesterase activity (Fig. 67). In diatoms intensive phosphomonoesterase activity occurs in furrows, and also some ELF alcohol precipitates are seen inside the cells (Fig. 72). It should be mentioned that not all algae cells in both populations inside the traps and in external environment, show phosphomonoesterase activity.

DISCUSSION

The algal flora of *Genlisea* traps, with the exception of the newly described stomatocyst, consists of common cyanobacteria and algae. Among the cyanobacteria we recognize only two taxa *Synechocystis aquatilis* and *Planktothrix* conf. *agardhii* which occurred singly. The algal communities were represented totally by 27 taxa, including representatives of Chrysophyceae such as *Chromulina bicocca*, which occurred singly and a few specimens of *Malomonas* conf. *globosa* in and outside the traps. There were four morphotypes of stomatocysts, one of which is new for science. The most frequent was stomatocyst 1 Cabała covered with several spines and the newly described one which is similar to stomatocyst 1 Cabała.

We recognized 10 diatom taxa, with *Frustulia bilnearis*, *Pinnularia subcapitata* and *Eunotia exigua*, the most frequent. Green algae were represented by *Chlamydomonas* spp. and two taxa of *Carteria* inside the trap. We recognized only three different vegetative forms of *Chlamydomonas*, which could not be identified to known taxa. The Zygnematophyceae were represented by few specimens of *Actinotaenium* and *Penium*. Among Euglenophyceae there were only *Euglena mutabilis* and *Trachelomonas hispida*. The most interesting species found in the traps was *Sphaerellopsis alpina* Pascher, which was described from small water bodies by Ettl 1983, but rarely reported otherwise. The majority of the reported taxa are very common and widespread. Some are classified as acidophilic: *Euglena mutabilis*, *Pinnularia acidophila*, *Eunotia exigua*, *Actinotaenium cruciferum*, and *Penium cylindrus*. The occurrence of these taxa is strictly connected with the peat which was brought from marshes to cultivate *Genlisea*. From the spectrum and ecological requirements of algal species found in the traps, environment inside the traps seems to be acidic.

As mentioned earlier, previous information about algae in *Genlisea* is scarce. Goebel (1891), showed on Table XV, Fig. 5, part of a desmid cell in the trap of *G. aurea* (*G. ornata*), which we identified as *Euastrum* sp. Later Studnička (1996, p. 15), wrote that he observed "single-cell algae (Bacillariophyceae and Desmidiaceae)" in the trap of *Genlisea pygmaea*. Płachno et al. (2005a, b) in general reported diatoms and flagellates inside the *Genlisea* traps and diatoms and other algae in mucilage on the leaves of *G. aurea*.

There are two ways of algae getting into *Genlisea* traps. The majority of those recorded inside the traps, are mobile; swimming freely by flagella or moving by exuding mucilage like diatoms and can colonize the traps themselves. Another possibility is transport of algae by invertebrates such as mites and crustaceans. In the case of *Utricularia* algae are mainly suctioned to the bladders, though, as in *Genlisea* some algae may be transported by animals. In any case algae in the traps of both *Genlisea* and *Utricularia* come from the surrounding environment. Gebühr et al. (2006) suggested that in *Sarracenia purpurea*, algae in colonize pitchers originated from air, rain and trapped insects, but not from surrounding wetland. What is the role of algae in the *Genlisea* traps? Are they prey? It is suggested that algae in this special environment occur in good conditions. What is more, it was observed that they can reproduce. Similarly and Hegner (1926) observed that the flagellates, *Euglena* sp., *Heteronema acus* and *Phacus longicauda* not only survive in *Utricularia* traps, but also may reproduce there. Moreover, we think that plant – host may also use nutrients, which are left by trap inhabitants and which are freed during cell lysis caused by either cell age or other reasons. Also Gebühr et al. (2006) think that in European allochthonous populations of carnivorous *Sarracenia purpurea*, algal biomass may be used as another source of nitrogen and phosphorus for the plants. On the other hand, it cannot be ruled out that algae in carnivorous plant traps compete with plant-host for nutrients from prey digestion (Adamec and Komárek 1999a; Jobson et al. 2000; Sirová et al. 2003). Two dominant groups of algae, in the *Genlisea* trap environment, show ability to hydrolyze phosphomonoesters. The *Genlisea* hairs have surface bound activity of phosphomonoesterase and ability to hydrolyze phosphomonoesters (Płachno et al. 2006), that we suggest,

that algae in carnivorous plant traps can compete with plant-host for organic phosphate (phosphomonoesters). However, for proof this competition the biomass of algae in the trap calculation is needed. Probably all phototrophs can utilize inorganic phosphate, but some of them can also mobilize organic phosphate through surface phosphatase activity, this occurs in most cyanobacteria, algae and mosses (for detail review, see Whitton et al. 2005). In contrast to all the mentioned results, Mette et al. (2000) report, that in some aquatic *Utricularia* species, autotrophic organisms are also part of food spectrum; are digested as a prey. For these reasons, further studies are needed to test the relations between algae and carnivorous plants both in laboratory conditions and in natural environment.

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