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DATA TO KNOWLEDGE OF HUNGARIAN DINOPHYTA SPECIES III. CONTRIBUTION TO THE DINOPHYTA TAXA OF KÖRÖS AREA I.

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Abstract. Dinophyte species were investigated during this study from 28 sites in Körös area. Samples were taken from different oxbow-lakes, canals, and rivers. 30 taxa were identified, including 27 ones that were not previously reported from the Körös area and two from Hungary. New taxa for the Hungarian algal flora are *Cystodinedria inermis*, and *Peridiniopsis kevei* (*P. kevei* is a new freshwater species - Grigorszky *et al*. in print). The rare and valuable new species from Körös area are *Glenodiniopsis steinii, Gymnodinium fuscum, G. hiemale, Katodinium vorticella, Peridiniopsis cunningtonii, P. kevei, Peridinium volzii, Sphaerodinium cinctum, Woloszynskia pseudopalustris.* Four different forms of *Ceratium hirundinella* were recognized, including forma *furcoides,* forma *gracile,* forma *piburgense* and forma *robustum.*

Keyword: Dinophyta, Körös area, ***Ceratium, Glenodiniopsis, Gymnodinium, Katadinium, Peridiniopsis, Peridinium, Sphaerodinium, Woloszynskia****.*

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Introduction

Only a few paper were published about the algal flora of the Körös area, same on diatoms, some on desmids and chlorophytes (Koren 1883, Szalai 1942, Kol 1954, Uherkovich 1963, Vasas 1980a, 1980b, 1986). Three Dinophyta species were reported from thìs area: *Ceratium cornutum* (Uherkovich 1968), *Ceratium hirundinella* (Kol 1954) and *Glenodinium gymnodinium* (Szalai 1941). Concerning on this later species there is a doubt of identification, missing any drawing, micrograph or plate tabulation (unknown species name - perhaps missprint).

Dinophyta species are a distinctive group of unicellular protists recognized by their swimming pattern (spinning while advancing due to transverse and longìtudinal flagella), usually golden-brown pigmentation, centrally located nucleus with permanently condensed chromosomes and the lacking of histones. Dinophyta species can be divided into two groups:

(i) those with a cellulose wall composed by plates („armored”), and

(ii) those apparently lacking a rigid wall („naked”).

Determination of armored Dinophyta species must be confirmed by the tabulation of plates, the unarmored species are confirmed by inner structure and cell shape however, certain key features can be recognized in some species which aid in their identification. (Kofoid 1909, Lefévre 1932, Huber-Pestalozzi 1950, Bourrelly 1968, Starmach 1974, Spector 1984, Popovsky and Pfiester 1990). The objective of the present study is to report on Dinophyta species found in the Körös area and provide a short descriptions and a key, which can be useful to algologists working with phytoplankton samples (Table 1).

Materials and methods

Quantitative phytoplankton samples were taken by 1 l bottles and for qualitative analyses net samples — pore size 10 μm — from the open water of oxbow lakes, canals, rivers and squeezing from the submerse vegetation (sampling sites on Fig. 1). Most part of sampling were made between 1989 and 1994. One half of samples were preserved with Lugol's iodine and the other half were examined immediately upon return to the laboratory. Line drawings were based on sketches made during microscopic observations and from micrographs.

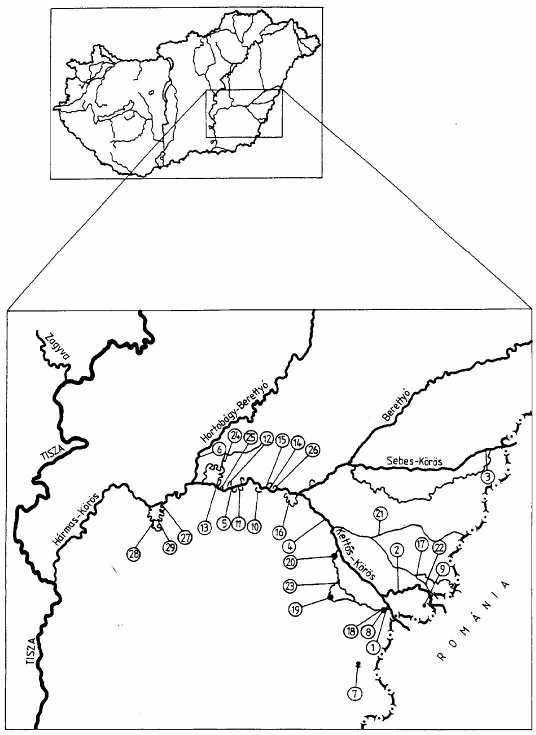

Fig. 1. Sketch map of sampling sites. 1. Fehér-Körös, 2. Fekete-Körös, 3. Sebes-Körös, 4. Kettôs-Körös, 5. Hármas-Körös, 6. Hortobágy-Berettyó main canal, 7. Kétegyházi inland water reservoire, 8. Gyula inner lake, 9. Dénesmajori lake, 10. Torzsási-backwater, 11. Gyoma inner backwater, 12. Templom-Bónom-Socózugi backwater, 13. Peresi-backwater, 14 Siratói-backwater, 15. Siratói-backwater (end of the oxbow), 16 Félhalmi-backwater, 17. Gyepeses-canal, 18. Élôvíz-canal (Gyula), 19. Élôvíz-canal (Békéscsaba), 20. Élôvíz-canal (Békés), 21. Határér, 22. Kopolya (Sarkad), 23. Gerlai-backwater, 24. Malomzugi-backwater, 25. Kecskészugi-backwater, 26. Kecsegészugi-backwater, 27. Szarvasi-backwater(Szivornya), 28 Szarvasi-backwater (HAKI halrács), 29. Szarvasi-backwater (Anna-liget)

The description of different oxbows and backwaters were found in book of Pálfi (1995). For identification the books of Starmach (1974) and Popovsky and Pfiester (1990) were first of all used.

Results

Dinophyte cells are considered to have a typical ventral and dorsal view. The mid-cell cingulum divides the cell into an upper part (epitheca, epicone) and lower part (hypotheca, hypocone). Thus, the cell may be viewed from four directions: ventral, dorsal, apical and antapical. Thecate (armored) Dinophyta species have a cellulose wall divided into plates and their taxonomy is based on the number and arrangement of the plates. Kofoid (1909) proposed a code system for the plate arrangement, socalled tabulation. Plates are often in concentric rows above and below the cingulum. The ventral plate in series is the first plate and plates are numbered counterclockwise on epitheca and anticlockwise on hypotheca.

The series of plates closest to the apex is designated apical and has a single prime (') mark after the number. Precingular plates have two prime following the number, postcingular three prime, and antapical four prime. Plates between the apical and precingular series are anterior intercalary (a), and plates between postcingular and antapical series are posterior intercalary (p).

Plate tabulations are always included in species descriptions (e.g., 4', 3a, 7'', 5''', 2'''' for *Peridinium cinctum).* Non-thecate (naked) Dinophyta species lack a well developed cellulose wall and their taxonomy is based on cell shape, pigmentation, presence of an eyespot (stigma), and motility. During this study 30 taxa were identified: 24 armored, and 6 naked, of which 27 are new records for the Körös area, two new species for Hungary (Fig. 2). Most of the taxa recorded here have distinctive features which facilitate their identification.

We present here a key based on the species of Dinophyta species found by the author and does include all previously reported species. (Table 1.)

Ceratium Shrank 1793

Ceratium hirundinella is characterized by one apical, one antapical, and one or two postcingular horns. *C. hirundinella* as having recognized different forms (Huber-Pestalozzi 1950) varying number of postcingular horns. The *Ceratium* cells are golden yellow with thick plates displaying reticulate ornamentation. Plate plate-tabulation is 4', 5'', 5''', 2''''. Length 188- 322 μm. Distinctive phytoplankton and the most commonly reported freshwater Dinophyta species. This species is distinguished from C. *cornutum* by the straight position of the apical horns. (Fig. 2/1, 5).

(i) Cells with 3 horns under optimal conditions:

Ceratium hirundinella forma *furcoides* (Levander) Schoeder 1920 (Fig. 2/1) Cells are relatively narrow — up to 60 µm — and long — 180-350 µm — with 3 horns under optimal conditions. The apical horn is in the same angle as the antapical horn. The species was found: 25. collecting site. (The numbers sign the sampling sites on Fig.1.)

(ii) Cells with 4 horns under optimal conditions:

C. hirundinella forma *robustum* (Amberg) Bachmann 1911 (Fig. 2/2) has a smaller body volume than the *Ceratium hirundinella* forma *hirundinella* form. The antapical horn is long and slightly divergent, the postcingular horns are half in length of the antapical one. The length of the cells is 168-320 µm. The species was found in 21., 22. collecting sites.

Ceratium hirundinella forma *gracile* Bachmann 1911 (Fig. 2/3) The cell has one or two downward pointing postcingular horns. It is similar to forma *hirundinella,* differing in the direction of horns. The length of the cells is 147-238 µm. The species was found in 24. collecting site.

Ceratium hirudinella forma *piburgense* (Zederbauer) Bachmann 1911 (Fig. 2/4) The outer antapical horn and the postcingular horns are divergent. The cells are 163-210 µm long and 40- 52 µm wide. The species was found in 8., 14., 15. collecting sites.

Ceratium cornutum (Ehrenbergh) Claparede and Lachmann 1858 (Fig. 2/5) has a relatively short, wide and curved apical horn. The apical horn directed an angle from the longitudinal axis. On the hypotheca two unequal horns are visible, the smaller one can be reduced or the lacking of it sometimes typical at low temperature conditions. The cells are 97-150 µm long and 48-75 µm wide. The species was found in 8., 9., 16., 29. collecting sites.

Cystodinedria Pascher 1944

The *Cystodinedria* species has two main life cycle stages: (i) gymnoid phase and (ii) cystodinedroid stage. The species can be identified only in cystodinedroid stage. In this stage the cells are oval in shape and attached to a substrate. The substrate are mainly filamentous Cyanobacteria or Chlorophyta. Sometimes numerous spines are visible on the surface of the cell. The chloroplasts are mainly discoid but sometimes absent.

Cystodinedria inernis (Geitler) Pascher 1944 (Fig. 2/6) is a parasitic taxon, approximately oval except for flattening where it is appressed to a host cell. It may be recognized by its golden coloration and large nucleus. The species were found on filaments of *Cladophora* sp. The cells are 40-48 µm long and 33-36 µm wide. The species was found in 9. collecting site.

Glenodiniopsis Woloszynska 1916

Cells are oval without apical pore. The chloroplasts are numerous and parietally situated. Cells six to eight postcingular plates on hypotheca. There are no stigma. Numerous red corpuscles can be present within the cytoplasm. The cingulum is deep and spirals to the left.

Glenodiniopsis steinii (Lemmermann) Woloszynska 1916 (Fig. 2/7). The cells are somewhat oval and flattened dorso-ventrally. The apical pore is absent. The plate arrangement is asymmetric. The plate formula is 4’, 4a, 8’’, (6-8)’’’, 2’’’’. The cells are 36-48 µm long and 32-46 µm wide. The species was found in 28. collecting site.

Gymnodinium Stein 1878

Gymnodinium is a genus of naked Dinophyta species with the cingulum in a median position. They must be examined and sketched while alive and swimming, because upon death they form featureless spheres (the only way to distinguish *Gymnodinium* from thin walled *Glenodiniopsis, Peridiniopsis* and *Woloszynskia).* The species are differentiated by the shape of the epicone and hypocone, details of the sulcus, presence a stigma, and the color of chloroplasts. Species can be photosynthetic with yellow-gold or blue-green chloroplasts, or they can be non-photosynthetic and colorless, or they may have accumulation bodies of various colors (yellow, orange, red).

Gymnodinium fuscum (Ehrenbergh) Stein 1878 (Fig. 2/8). The epicone is dome-shaped and the hypocone forming an inverted cone a slightly produced tip. The numerous chloroplasts are radially arranged. The cells are 53-75 µm long and 43-56 µm wide. The species was found in 9. collecting site.

Gymnodinium hiemale (Schiller) Popovsky 1984 (Fig. 2/9) is a non-photosynthetic species, its sulcus extends to antapex, the nucleus is in the hypocone, and there can be red inclusion bodies. The specimens from the Körös area are are larger (average length 21 µm) than those described in the literature (16 µm). The cells are 18-25 µm long and 12-26 µm wide. The species was found in 9. collecting site.

Gymnodinium palustre Schilling 1891 (Fig. 2/10) is an autotrophic, holophytic species. The epicone can be twice in lenght of the hypocone. Numerous chloroplasts are parietally arranged. The cells are 36-48 µm long and 20-31 µm wide. The species was found in 9. collecting site.

Gymnodinium uberrimum (Allman) Kofoid and Swezy 192 l (Fig. 2/11). The cells are broadly sphaerical and little flattened dorso-ventrally. The epicone is rounded or bell-shaped. The hypocone is highly variable in size and form. Numerous chloroplasts are radially arranged. The cells are 38-52 μm long and 30-40 μm wide. The species was found in 5., 6., 8., 16., 25. collecting sites.

Katodinium Fott 1957

Cells are spherical, ova1 or mushroom shaped. The cingulum is anteriorly placed and slightly spiral. The cell wall thin and colorless. The species mainly colorless. Fott (1957) placed from the *Massartia* Conrad 1926 genus to *Katodinium* genus.

Katodinium vorticella (Fig. 2/12) are usually colorless species, if chloroplasts present there are less than 10, which are relatively small and green or grey. Numerous reddish droplets can be present in the cytoplasm. If the shape of these droplets oval, it is a sign of the saprotrophic nutrition. If number of red droplets one or two and the shape is rectangular the cell is in sexual reproduction process. The cells are 18.5-33 μm long and 18-30 μm wide. This is a common species in different peat bogs, ponds and pools. The species was found in 8., 23. collecting sites.

Peridiniopsis Lemmermann 1904

Bourrelly (1968) transferred one part of *Glenodinium* species with known plate tabulations into the genus *Peridiniopsis;* it remains a highly variable genus (3-5’, 0-la, 6-7’’, 5’’’, 2’’’’).

Peridiniopsis cunningtonii Lemmermann 1907 (Fig. 2/13). Cells are elongated. From two to six spines are on the hypntheca. Chloroplasts are numerous and oval. The plate formula is 4’, la, 6’’, 5’’’, 2’’’’, or 5’, Oa, 6’’, 5’’’, 2’’’’. The cells are 32-48 μm long and 27-46 μm wide. The species was found in 2., 21., 26., 28. collecting sites.

Peridinopsis elpatiewskyi (Ostenfeld) Bourelly 1968 (Fig. 2/14). Cells are pentangular. Several spines or teeth-like projection may be present on the hypotheca. There are numerous chloroplasts. The plate formula is 4’, Oa, 7’’, 5’’’, 2’’’’. The cells are 29-44 μm long and 27-42 μm wide. The species was found in 13., 16. collecting sites.

Peridiniopsis kevei Grigorszky, Vasas F. et Klee 1997 (Fig. 2/15). The plate tabulation : 3’, 1 a, 6’’, 5’’’, 2’’’’ ; the species is unicellular; theca and plate arrangement of glenoid and young cell not visible with light microscope; the average lenght is 35 μm, 37 μm width; epitheca vary in shape from acute to a little blunt from; cingulum median and deep, narrower than sulcus; sulcus is deep, and is not reach to epitheca; some short spines (cristae) are on the edge of the sulcus, transverse flagellum as long as cingulum; longitudinal flagellum trailing body by less than one cell length; cells with numerous golden-brown chloroplasts generally located peripherally, their shape vary from ovoid to elongate; stigma sometimes present; nucleus large, with conspicuous chromosomes, usually located in hypotheca; pore exist at the apical end; 1’’’’ antapical plate has a relatively long tapering spines; some short spines (cristae) are on the edges of antapical plates. The species was found in 1., 2., 3., 4., 5., 6., 10., 11., 14., 15., 17., 18., 19., 20. collecting sites.

Peridiniopsis polonicum (Woloszynska) Bourrelly 1968 (Fig. 2/16) can be recognized by its conical epitheca, rounded hypotheca, and squared shape 1a plate. The plate pattern is 4’, 2a, 7’’, 5’’’, 2’’’’. The cells are 41-52 μm long and 37-39 μm wide. The species was found in 13., 16. collecting sites.

Peridinium Ehrenberg 1830

Peridinium is defined by its plate tabulation: 4’, 2-3a, 7’’, 5’’’, 2’’’’. Species differ from each other in the number of intercalary plates, apical symmetry, and the presence or absence of an apical pore. Most species are found as minor components of the phytoplankton although occasionally one species can be completely dominated in a pond or lake.

Peridinium achromatium Levander 1932 (Fig. 2/17). Cells are rhomboidal and flattened dorsi-ventrally. The plate formula is 4’, 3a, 7’’, 5’’’, 2’’’’. Chloroplasts are absent. The cells are 40-53 μm long and 36-49 μm wide. The species was found in 15. collecting site.

Peridinium aciculiferum Lemmermann 1900 (Fig. 2/18). The cells are elongated. Usually spines are found on the hypotheca. The plate formula is 4’, 3a, 7’’, 5’’’, 2’’’’. The apical pore is present. The sulcus reaches the epitheca. The cells are 32-45 μm long and 20-40 μm wide. The species was found in 13., 14., 15., 28. collecting sites.

Peridinium bipes Stein 1883 (Fig. 2/19) has an apical pore, its cingulum is offset a cingulum width, and it is ventrally concave. Its plate pattern is 4’, 3a, 7’’, 5’’’, 2’’’’. The cells are 45-67 μm long and 41-64 μm wide. Our specimens lack the typical paired antapical flanges. It looks like a *P. willei* with an apical pore. The species was found in 6., 9., 11., 17. collecting sites.

Peridinium cinctum Ehrenbergh 1838 (Fig. 2/20). The cells are sphaerical. The cingulum extends further into the epitheca. Chloroplasts are numerous and parietally arranged. Plates are thick. Plate formula is 4’, 3a, 7’’, 5’’’, 2’’’’. The cells are 43-59 μm long and 42-53 μm wide. This species widespread in oxbows and canals in summer months. The species was found in 10., 26. collecting sites.

Peridinium inconspicuum Lemmermann 1899 (Fig. 2/21) is a small, approximately pentagonal cell with an apical pore, yellow-gold chloroplasts, and an approximately equatorial cingulum. Cells may have hypothecal spines. Plate pattern is 4', 2a, 7'', 5''', 2''''. The cells are 18-22 μm long and 15-19 μm wide. The species was found in 1., 2., 3., 6., 10., 11., 17., 18., 19., 20., 21., 27., 28., 29. collecting sites.

Peridinium goslaviense Woloszynska 1916 (Fig. 2/22). The cells are egg or pear-shaped. One large spine present on the hypotheca. The plate formula is 4', 2a, 7'', 5''', 2''''. The cells are 28- 34 μm long and 22-32 μm wide. The species was found in 9. collecting site.

Peridinium palatinum Lauterborn 1896 (Fig. 2/23). The cells are ovoid. The absence of pore and the plate formula: 4', 2a, 7'', 5''', 2'''' are tipical for this species. The plate arrangement is asymmetrical. Sutures are concave. The cells are 37-43 μm long and 24-39 μm wide. This species an common winter species in Körös area. The species was found in 8., 14., 15., 28. collecting sites.

Peridinium umbonatum (Fig. 2/24) is a golden to dark brown cell, it is round in apical or antapical view (i.e., no dorsoventral compression), and wider than long. Some cells have red accumulation bodies. Its apical and intercalary plates are in an symmetrical arrangement and there is apical pore. Plate pattern is 4', 2a, 7'', 5''', 2''''. The cells are 28-37 μm long and 32-45 μm wide. It was common in the studied area, sometimes found in bloom condition. The species was found in 5., 11., 12., 17., 18., 19., 20., 23., 24., 29. collecting sites.

Peridinium volzii Lemmermann 1906 (Fig. 2/25) has a plate pattern similar to P. *willei* with apical intercalary plates in a symmetrical arrangement, but the cell is less compressed, and the 1' plate smaller than 7''. The cells are round in ventral view, somewhat dorsoventrally compressed, with a defined sulcus reaching the antapex, and thick plates with reticulate ornamentation; plate pattern is 4', 3a, 7'', 5''', 2''''. The cells are 42-50 μm long and 35-44 μm wide. The species was found in 11., 12., 27. collecting sites.

Peridinium willei Huitfeld-Kaas 1900 (Fig. 2/26) is a fairly large, golden brown species with distinctive flanges extending from apical plate boundaries, cingulum, and posterior borders, no stigma, concave ventral surface, and the 1st apical plate (1') is large. Its apical and intercalary plates are in a symmetrical arrangement and there is no apical pore. Plate pattern is 4', 3a, 7'', 5''', 2''''. The cells are 48-58 μm long and 49-52 μm wide. It was found fairly commonly throughout the Körös area. The species was found in 13., 23., 24. collecting sites.

Sphaerodinium Woloszynska 1916

Sphaerodinium cirnctum (Ehrenbergh) Woloszynska 1916 (Fig. 2/27). The cells are oval. The epitheca and hypotheca are equal in size. Plate formula: 4', 4a, 7'', 6''', 2''''. Apical pore is present. The cells are 28-34 μm long and 22-30 μm wide. The species was found in 29. collecting site.

Woloszynskia genus Thompson 1950

The cell wall is composed of very fine, numerous platelets, which are usually hardly or not seen during ligh microscopic (LM) investigations. Many species have been described, but it is only possible to unambigouously determine 5-7 species.

Woloszynskia ordinata (Skuja) Thompson 1950 (Fig. 2/28). The cells contain less than five, big chloroplasts. The size of platelets is the bigest one among the *Woloszynskia* species. The cingulum is broad and deep. The cells are 15-20 μm long and 13-18 μm wide. The species was found in 14., 15. collecting sites.

Woloszynskia pascheri (Suchlandt) v. Stoch 1973 (Fig. 2/29). The cells is varied in shape and in size. Regular hexagonal platelets cover the cell. The cells are 15-42 μm long and 24-39 μm. The species was found in 12. collecting site.

Woloszynskia pseudopalustris (Woloszynska) Kiselev 1954 (Fig. 2/30). The hypovalva is „excavated”. The morphology and arrangement of platelets are not well documented. Chloroplasts are numerous and are in parietal position. The cell are 34-45 μm long and 34-42 μm wide. The species was found in 11. collecting site.

Discussion

The presence of Dinophyta species, other than that of *Ceratium hirundinella*, is probably under-reported in the literature because of both the inherent difficulty in determination of genera and species, and an old and scattered literature. Armored Dinophyta species require elucidation of the plate pattern and comparison to reponed patterns. Naked Dinophyta species require immediate examination. During this study a few taxa with thin thecae were found but not identified because of insufficient material and lack of definitive characteristics. During our investigation 30 species were found in Körös area and two of them are new species for Hungary: *Peridiniopsis kevei, Cystodinedria inermis*. Up to now 32 freshwater Dinophyta species were known form Hungary and only three species were known from this area. In our

Table 1. Key to the Dinophyta species of Körös area.

1a. Vegetative cells free-swimming ... 2
1b. Vegetative cells attached on filamentous algae or submerse vegetation ... *Cystodinedria inermis*
2a. Cells unarmored ... 3
2b. Cells armored ... 7
3a. Cingulum is equatorial ... 4
3b. Cingulum is not equatorial. ... *Katodinium* vorticella
4a. Sulcus extends into the epicone more than 1/3 of length of epicone ... *Gymnodinium uberrimum*
4b. Sulcus does not extend into the epicone ... 5
5a. Cells are spherical ... *Gymnodinium hiemale*
5b. Cells are not spherical ... 6
6a. Chloroplasts are parietally arranged ... *Gymnodinium palustre*
6b. Chloroplasts are radially arranged ... *Gymnodinium fuscum*
7a. The cells have numerous, small, similar size plates ... 8
7b. Plates not numerous, and dissimilar in size ... 10
8a. Less then five, big chloroplats are present. ... Woloszynskia *ordinata*
8b. Numerous small chloroplasts are present ... 9
9a. The hypovalva is „excavated" ... *Woloszynskia pseudopalustris*
9b. The hypovalva is rounded ... *Woloszynskia pascheri*
10a. Cells with one apical and 1-3 antapical horns ... 11
10b Cells without homs ... 15
11a. Apical horn straight compared with the longitudinal axis ... 12
11b. Apical horn directed at an angle from the longitudinal axis ... Ceratium cornutum
12a. Cells with 3 horns ... *Ceratium hirundinella f. furcoides*
12b. Cells with 4 horns ... 13
13a. Antapical horn and postcingular horn are not divergent ... *Ceratium hirundinella f. gracile*
13b. Antapical horns or postcingular horns are divergent ... 14
14a. Antapical horn is parallel with the apical horn, but the postangular horns are divergent... ... *Ceratium hirundinella f. robustum*
14b. Antapical horn is not parallel with the apical horn ... *Ceratium hirundinella f. piburgense*
15a. Five postcingular plates (5''') ... 17
15b. Six or seven postcingular plates (6''' or 7''') ... 16
16a. Apical pore present ... *Sphaerodinium cinctum*
16b. Apical pore absent ... *Glenodiniopsis stenii*
17a. Cells have zero or one intercalary plate ... 27
17b. Cells have two or three intercalary plates ... 18
18a. Apical pore present ... 22
18b. Apical pore absent ... 19
19a. Cells have two intercalary plates ... *Peridinium palatinum*
19b. Cells have three intercalary plates ... 20
20a. 3a intercalary plate does not reach the 4'' precingular plate ... 21
20b. 3a intercalary plate reaches the 4'' precingular plate ... *Peridinium cinctum*
21a. 1' apical plate is pentangular ... *Peridinium volzii*
21b. 1' apical plate is quadangular ... *Peridinium willei*
22a. Cells have two intercalary plates ... 23
22b. Cells have three intercalary plates ... 25
23a. Cells have one spine on the hypotheca ... *Peridinium goslaviense*
23b. Cells without spines or have lots of spines on the hypotheca ... 24
24a. The cells longer than wider ... *.Peridinium umbonatum*
24b. The cells approximately as long as wide or little wider ... *Peridinium inconspicuum*
25a. Chloroplasts are present ... 26
25b. Chloroplasts are absent ... *Peridinium achromatium*
26a. 3a - intercalary plate - does not reach 4'', precingular plate ... *Peridinium bipes*
26b. 3a - intercalary plate - reaches 4'', precingular plate ... *Peridinium aciculiferum*
27a. Cells with 7'', precingular plates ... 28
27b. Cells with 6'', precingular plates ... 29

28a. Cells with 0a, intercalary plate .... *Peridiniopsis elpatiewskyi*
28b. Cells with 1a, intercalary plate.. *Peridiniopsis polonicum*
29a. Cells with 3', apical plates .... *Peridiniopsis kevei*
29b. Cells with 4' or 5'' apical plates .... *Peridiniopsis cunningtonii*

opinion although the Körös area is full of interesting and wonderful waters (rivers, canals, oxbow-lakes, dead-arms) from algological point of view, but it is not a unique place in Hungary in that point of view, as well. The lack of investigations resulted that this area was „poor" in Dinophyta species. Probably this is true for other part of Hungary. The authors hope that this work will be useful to algologists working with phytoplankton samples, find and want to identify or to know more about these species.

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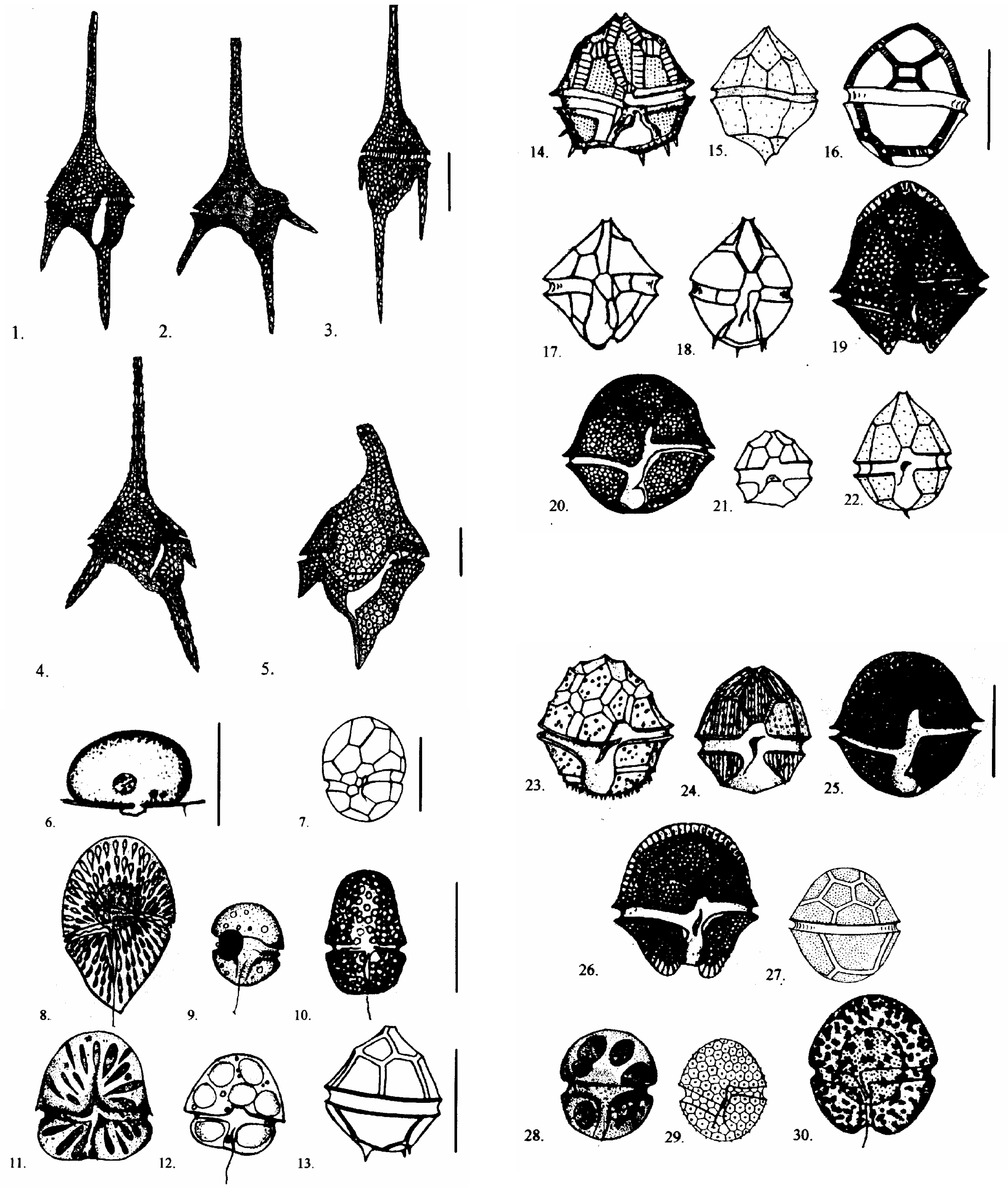

Fig. 2. Dinophyta species from Körös area. Bars beside figures correspond 30 µm. 1.: Ceratium hirundinella f. furcoides. 2.: Ceratium hirundinella f. robustum. 3.: Ceratium hirundinella f. gracile. 4.: Ceratium hirundinella f. piburgense. 5.: Ceratium cornutum. 6.: Cystodinedria inermis. 7.: Glenodiniopsis stenii. 8.: Gymnodinium fuscum.. 9.: Gymnodinium hiemale. 10.: Gymnodinium palustre. 11.: Gymnodinium uberrimum. 12.: Katodinium vorticella. 13.: Peridiniopsis cunningtonii. 14.: Peridiniopsis elpatiewskyi. 15.: Peridiniopsis kevei. 16.: Peridiniopsis polonicum. 17.: Peridinium achromatium. 18.: Peridinium aciculiferum. 19.: Peridinium bipes. 20.: Peridinium cinctum. 21.: Peridinium inconspicuum. 22.: Peridinium goslaviense. 23.: Peridinium palatinum. 24.: Peridinium umbonatum. 25.: Peridinium volzii. 26.: Peridinium willei. 27.: Sphaerodinium cinctum. 28.: Woloszynskia ordinata. 29.: Woloszynskia pascheri. 30.: Woloszynskia pseudopalustris.