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SCALED CHRYSOPHYCEAE AND SYNUROPHYCEAE FROM FLORIDA: IV. THE FLORA OF LOWER LAKE MYAKKA AND LAKE TARPON

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ABSTRACT: *Twenty-nine taxa of silica-scaled Chyrsophyceae and Synurophyceae are reported from the spring flora of two relatively eutrophic and humic stained lakes, Lower Lake Myakka and Lake Tarpon. Samples from 1986, 1987, 1989 and 1992 were analyzed. Twenty-seven and fifteen of the taxa were found in Lower Lake Myakka and Lake Tarpon, respectively. Affinities with tropical and temperate floras are noted in both lakes. This represents the first report of Synura petersenii f. truttae Siver and S. australiensis Playfair in Florida, and the second report of the latter taxon in the United States.*

EXCEPT for the work of Wujek and coworkers (Wujek, 1983, 1984; Wujek and Gardiner, 1985; Wujek and Bland, 1988, 1990) and Siver (1991), very little is known about the flora of silica-scale bearing Chrysophyceae and Synurophyceae from Florida. It is clear, however, based on the previous work, that a rich flora of Chysophyceae and Synurophyceae taxa does exist in Florida waterbodies. Wujek (1984) and Wujek and Bland (1990) reported over forty taxa of Chrysophyceae and Synurophyceae from localities in the central, southern and west coast regions. As many as nineteen taxa were found in a single sample from several waterbodies. The works of Wujek (1983), Wujek and Bland (1988), Wujek and Gardiner (1985) and Siver (1991) contain reports of newly described specific or subspecific taxa, again indicating the need for further investigation.

Recently, silica-scale bearing algae have become important as bioindicators of changes in the quality of lake water, especially from a paleolimnological perspective (Siver, 1993a; Smol, 1993 and references therein). Before scaled Chrysophyceae and Synurophyceae could be used as bioindicators in a similar manner in Florida, it is mandatory that the flora be adequately described.

This paper is the fourth in a series aimed at describing the flora of Chrysophyceae and Synurophyceae in Florida. The spring floras from two relatively eutrophic and humic stained lakes are described over a six-year period utilizing scanning electron microscopy. All previous work on scale-bearing algae from Florida, except for that of Siver (1991), had been done with transmission electron microscopy (TEM). One of our goals is to assemble a collection of SEM micrographs of the various taxa to complement previously published TEM micrographs.

METHODS AND MATERIALS—Plankton samples were collected from the two lakes during the month of March in 1986, 1987, 1989 and 1992. Collections from Lower Lake Mayakka were made from the center of the lake at a depth of 1 m. Collections from Lake Tarpon were made at the end of the walking

pier located in the community park along the western shore at a depth of 0.5 m. Both water samples and plankton net samples (10 μm mesh) were taken and fixed on site with Lugol's solution.

The water and plankton net samples were prepared for analysis with scanning electron microscopy according to Siver (1987). The relative proportions of each taxon were qualitatively estimated from the concentrated water samples and scored according to the following system. If taxa were among the most dominant species of algae in the sample they were scored as "abundant". Taxa that were sub-dominant, but still important components, were listed as "common". Taxa that were rare, but whole cells were observed, were listed as "rare". Taxa where only a few isolated scales were observed, were scored as "very rare".

RESULTS AND DISCUSSION—A total of 29 specific and subspecific taxa of Chrysophyceae and Synurophyceae were recorded from the two localities, including 17 taxa of *Mallomonas*, five of *Synura*, four of *Spiniferomonas*, two of *Paraphysomonas* and *Chyrsosphaerella brevispina* (Table 1). A total of 27 and 15 of the taxa were found in Lower Lake Myakka and Lake Tarpon, respectively.

Mallomonas caudata (Fig. 1) and *Synura petersenii* f. *truttae* (Fig. 2-3) were the most common taxa found in Lower Lake Myakka during the study. *Mallomonas caudata* was abundant during each of the four years, while *S. petersenii* f. *truttae* was either common or abundant. *Mallomonas matvienkoae* v. *myakkana* (Fig. 4-5) was observed to be common in 1987, 1989 and 1992. Four additional species, *Mallomonas portae-ferreae* (Fig. 6-7), *M. corymbosa* (Fig. 8-9), *Synura uvella* and *Paraphysomonas vestita* (Fig. 10) were also found to be common or abundant in Lower Lake Myakka during at least one of the years. All other taxa from Lower Lake Myakka were rare or very rare (Table 1). Taxa in this category, but found during at least two of the years included *Mallomonas mangofera* f. *foveata* (Fig. 11), *M. tonsurata* (Fig. 12), *M. striata* v. *serrata* (Fig. 13), *M. pseudocoronata* (Fig. 14), *M. heterospina*, *Synura petersenii* f. *petersenii*, *S. australiensis* (Fig. 15) and *Spiniferomonas coronacircumspina*. Other rare taxa found in Lower Lake Myakka and pictured in this paper include *M. akrokomos* (Fig. 16), *M. annulata* (Fig. 17), *M. peronoides* (Fig. 18), *M. bronchartiana* (Fig. 19), *M. cyathellata* v. *cyathellata* (Fig. 20) and *M. papillosa* (Fig. 21).

The most common taxa in Lake Tarpon were similar to those recorded in Lower Lake Myakka (Table 1). In addition, all but two of the taxa observed in Lake Tarpon were also found in Lower Lake Myakka, indicating the similarities in the two floras. *Mallomonas caudata*, *M. corymbosa* and *M. tonsurata* were the most common species in Lake Tarpon over the study period. *Synura petersenii* f. *truttae* and *Paraphysomonas vestita* were also observed to be at least common during one of the years. Six additional taxa, *Mallomonas annulata*, *M. pseudocoronata*, *M. matvienkoae* v. *myakkana* and v. *matvienkoae*, *Synura petersenii* and *Spiniferomonas coronacircumspina* were also found during more than one year (Table 1).

A note needs to be made concerning *Mallomonas matvienkoae* v. *myakkana*, described by Siver (1991) from Lake Myakka. We recognize that this taxon may be the same as *M. matvienkoae* v. *grandis* Dürrschmidt & Cronberg described from Sri Lanka (Dürrschmidt and Cronberg, 1989). Scales of v. *myakkana* differ from the type in possessing a cluster of three to five pores in the posterior region and a dense covering of papillae over the distal area. According to the original description of v. *grandis*, it differs from the type in possessing several (three to five) large subcircular

TABLE 1. The occurrence and relative abundance of 29 taxa of scaled Synurophyceae and Chrysophyceae in Lower Lake Mayakka and Lake Tarpon during March of 1986, 1987, 1989 and 1992. "A" = abundant; "C" = common; "R" = rare; "VR" = very rare.

Taxon	*Mayakka*				*Tarpon*			
	86	87	89	92	86	87	89	92
Mallomonas								
M. akrokomos Ruttner	R							
M. annulata (Bradley) Harris	R				R	VR		
M. bronchartiana Compere		R						
M. caudata Krieger	A	A	A	A	A		C	A
M. corymbosa Asmund & Hilliard	A	R	R	R	A		C	C
M. cyathellata v. *cyathellata* Wujek & Asmund		R			R			
M. heterospina Lund		R	VR					
M. mangofera f. *foveata* Dürrschmidt	R	R	R					
M. matvienkoae v. *matvienkoae* (Matvienko) Asmund & Kristiansen					R		R	
M. matvienkoae v. *myakkana* Siver		C	C	C		R	R	R
M. papillosa Harris & Bradley				R				
M. peronoides (Harris) Momeu & Péterfi	VR							
M. portae-ferreae v. *reticulata* Gretz, Sommerfeld & Wujek	A		R	C				
M. pseudocoronata Prescott		R	R		R	R		
M. striata v. *serrata* Harris & Bradley		R	R					
M. tonsurata Teiling emend. Krieger		R	R	R	A	C		R
M. transsylvanica Péterfi & Momeu		VR						
Synura								
S. australiensis Playfair	R			R				
S. curtispina (Petersen & Hansen) Asmund				VR				
S. petersenii f. *petersenii* Korshikov		R	R	R	R		R	
S. petersenii f. *truttae* Siver	C	C	C	A			R	C
S. uvella Stein		A						
Spiniferomonas								
S. alata Takahashi						VR		
S. bourrellyi Takahashi		R						
S. coronacircumspina (Wujek & Kristiansen) Nicholls		R	R		R	R		
S. trioralis Takahashi	R				R			

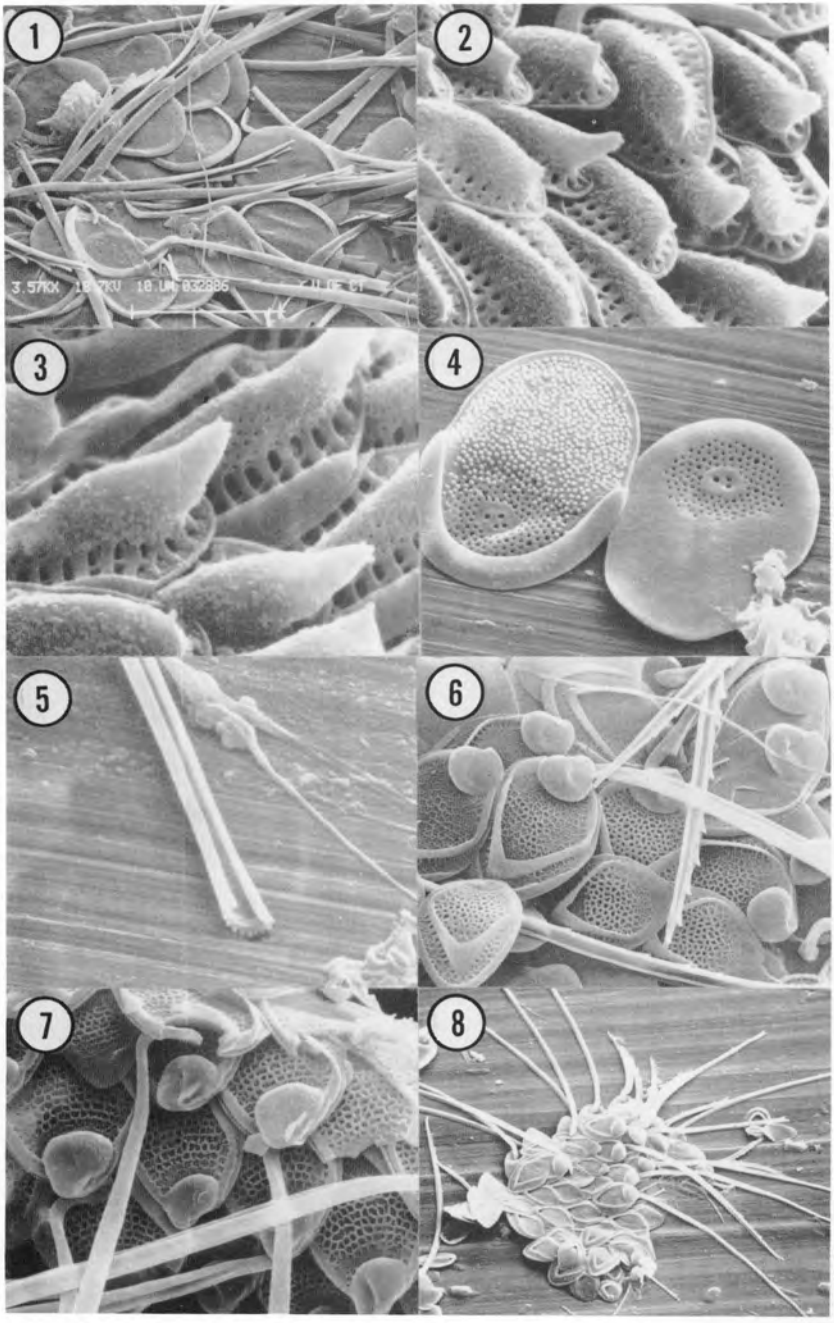
TABLE 1. CONTINUED

Taxon	*Mayakka*				*Tarpon*			
	86	87	89	92	86	87	89	92
Paraphysomonas								
P. takahashi Cronberg & Kristiansen		R				R		
P. vestita (Stokes) de Saedeleer	C	A	R		R	R		C
Chrysosphaerella								
C. brevispina Korschikov em. Harris & Bradley		VR						

* Note that Dürrschmidt and Cronberg (1989) recently combined *M. bangladeshica* with *M. peronoides*.

pores in the proximal region of the scale; all other features of the scales are similar to the type (Dürrschmidt and Cronberg, 1989). Since Dürrschmidt and Cronberg (1989) did not state whether scales of v. *grandis* possessed the dense covering of papillae as do those of v. *myakkana* we have decided at this point to recognize both taxa. In addition, scales of v. *myakkana* (6.5 µm to 7.5 µm in length) are slightly larger than those of the type, but smaller than those listed for v. *grandis* (8 µm to 9 µm; see Dürrschmidt and Cronberg, 1989). Further work will be needed in order to determine if indeed both taxa should remain separate or whether a combination is in order. Regardless, it is important to note that both taxa have only been reported from warm tropical or subtropical localities (Dürrschmidt and Cronberg, 1989; Cronberg, 1989; Saha and Wujek, 1990; Siver, 1991).

Siver (1991) discussed the difficulties with the identification of taxa in the genus *Mallomonas* contained within the Series Tonsuratae, especially *M. tonsurata* and *M. corymbosa*. Several of the cells found in the study lakes proved to be difficult to identify because they had characteristics of both *M. tonsurata* and *M. corymbosa*. Because clear differences between the two species are not always present, we believe that further work is warranted in determining the status of these two taxa. *Synura petersenii* f. *petersenii* is often reported to be the most common taxon of *Synura* (e.g. Wee et al., 1976; Wujek et al., 1981; Siver, 1987; Nicholls and Gerrath, 1985). Kristiansen (1986) stated that *S. petersenii* may be the most widespread and common taxon of scaled chrysophyte in the world. The form found to be most common in both of the study lakes, *Synura petersenii* f. *truttae*, was only recently described from a shallow humic stained locality in Connecticut (Siver, 1987). To date, it has been found in only a few localities (Siver, 1987). Thus, it is interesting that this form of *S. petersenii* was so common in both Lower Lake Myakka and Lake Tarpon. It is also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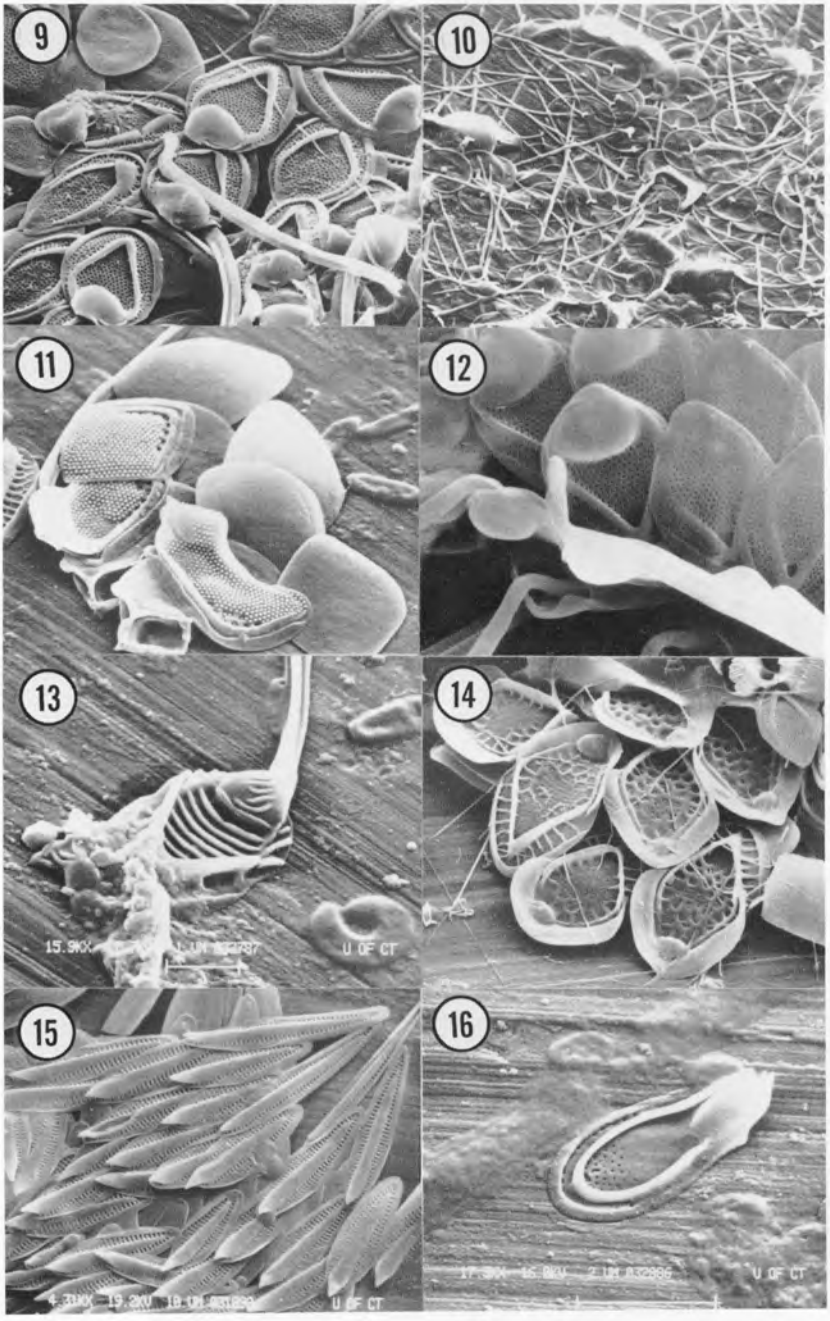
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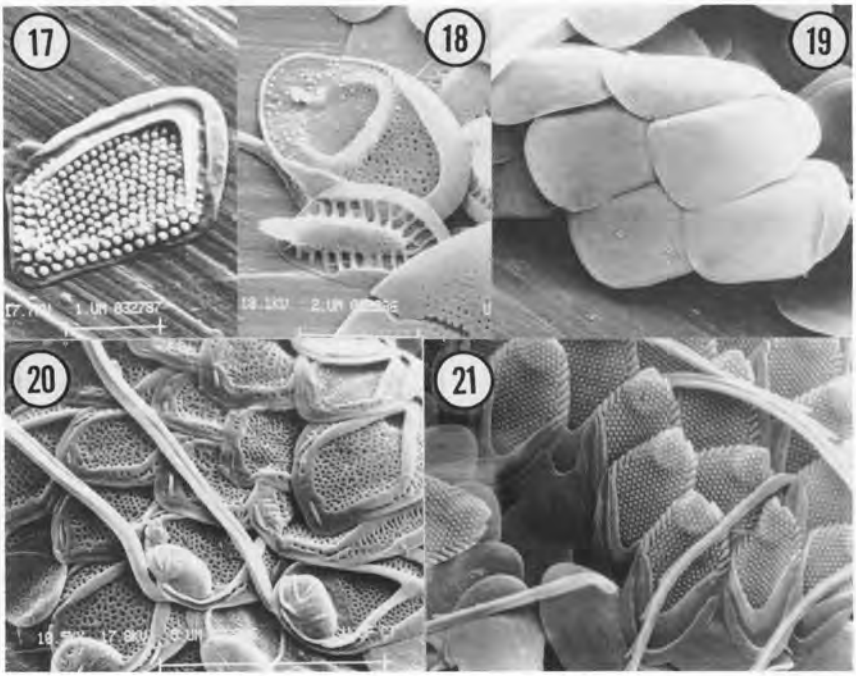

Figure Legends

FIG. 1-8. FIG. 1. *Mallomonas caudata*. Scales and bristles. 1,960X. FIG. 2-3. *Synura petersenii* f. *truttae*. Note that some scales have toothed spines, some pointed spines and others rounded central ridges. Also note the network of struts and ribs forming a series of pores. 10,200X and 14,600X, respectively. FIG. 4-5. *Mallomonas matvienkoae* f. *myakkana*. Fig. 4. Interior and exterior views of body scales. Note the series of papillae covering the anterior 2/3 of the scale. 6,000X. FIG. 5. Morphology of bristle tip. 7,980X. FIG. 6-7. *Mallomonas portae-ferreae*. Features of scales and bristles. Note the scales in Fig. 6 that appear to lack the secondary rib pattern. 3,740X and 4,440X, respectively. FIG. 8. *Mallomonas corymbosa*. Whole cell. Specimen closely related to *M. tonsurata*, but the bristle pattern is that of *M. corymbosa* (see text). 1,500X.

FIG. 9-16. FIG. 9. *Mallomonas corymbosa*. Note domed and domeless scales. 4,800X. FIG. 10. *Paraphysomonas vestita*. Remains of a whole cell. 3,930X. FIG. 11. *Mallomonas mangofera* f. *foveata*. Note anterior collar and body scales. 5,670X. FIG. 12. *Mallomonas tonsurata*. Portion of a whole cell showing domed and domeless scales. 5,900X. FIG. 13. Single scale of *Mallomonas striata* v. *serrata*. 8,745X. FIG. 14. *Mallomonas pseudocoronata*. Note winged body scales. 3,050X. FIG. 15. *Synura australiensis*. Portion of a cell showing long and slender scales. 2,370X. FIG. 16. *Mallomonas akrokomos*. Isolated apical scale. 9,515X.

FIG. 17-21. FIG. 17. Isolated scale of *Mallomonas annulata*. 11,160X. FIG. 18. Isolated scale of *Mallomonas peronoides* (larger scale). 8,200X. FIG. 19. *Mallomonas bronchartiana*. Body scales. 3,040X. FIG. 20. *Mallomonas cyathellata* v. *cyathellata*. Domed and domeless scales. 5,780X. FIG. 21. *Mallomonas papillosa*. Body scales. 6,650X.

of interest that both of the Florida localities are humic stained, similar to the waterbody where f. *truttae* was first described. Preliminary data from other localities in Florida indicate that it is quite widespread and much more common than in more northern climates (Siver, unpub. data).

Many of the taxa found in both study lakes are relatively rare in more northern climates, but are common in tropical waters. In a survey of work done in tropical localities, Cronberg (1989) concluded that many of the species of scaled Chrysophyceae and Synurophyceae can be grouped into three categories. First, a group of organisms, including *M. matvienkoae* v. *grandis*, taxa in the *Peronoides* group, *M. bronchartiana* and *M. mangofera* f. *reticulata* Cronberg, appear to be primarily restricted to tropical localities. The second group, including *M. portae-ferreae*, *M. guttata* Wujek and *Synura australiensis*, had a wider distribution, but were primarily found in tropical regions. Third, a number of the more common taxa found in the tropics, including *Mallomonas tonsurata*, *M. crassisquama*, *M. striata* v. *striata*, *Paraphysomonas vestita*, *Synura petersenii* f. *petersenii* and *S. echinulata*, are cosmopolitan in nature. Many of the taxa listed in these three groups were found in the study lakes (Table 1). *Mallomonas cyathellata* v. *cyathellata*, found in both study lakes, is also commonly found in tropical waterbodies (Cronberg, 1989; Saha and Wujek, 1990), and more temperate areas during warm periods (Wujek and Asmund, 1979). *Mallomonas striata* v. *serrata* (Cronberg, 1989) and *M. annulata* (Dürrschmidt and Croome, 1985; Dürrschmidt and Cronberg, 1989) have also been reported as common taxa in tropical waters. We conclude that the flora of Lower Lake Myakka and Lake Tarpon has a definite tropical element.

There were a number of rare or very rare species, including *Mallomonas heterospina*, *M. transsylvanica*, and *Chrysosphaerella brevispina*, found in the study lakes that are often associated with more northern climates and coldwater conditions. Each of these taxa are consistently found under low temperatures, often less than 10°C, and have also been reported from either eutrophic and/or humic localities (Siver, 1991; 1993b). Thus, it appears that there is also a temperate element of the floras from the study lakes; we believe that cells of these taxa were residual from the winter. Since all of the samples in this study were taken during March it makes sense that both winter and summer organisms would be found. More work to include differences between seasons is warranted. In addition, more work needs to be done in order to determine the distributions of species along environmental gradients in Florida waterbodies.

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