# Summer mat macroalgae largely replaced by duckweed, *Lemna minor*, in 1999 in two Olentangy River experimental wetlands

Robert Deal and John A. Kantz

*Department of Natural Sciences*
*Shawnee State University, Portsmouth, Ohio*

## Introduction

In the first five years (1994 – 98) of operation the experimental wetlands at The Ohio State University were more or less dominated, in terms of surface producers, by mats of macroalgae that included in varying abundance the genera *Hydrodictyon, Cladophora, Rhizoclonium,* and *Spirogyra*. In 1998 the duckweed, *Lemna minor,* became more abundant and by mid-summer 1999 was the visible dominant on the surface of both wetlands, especially in the inlet and mid basins. Duckweed also developed heavy populations among the stems of *Typha* and *Schoenoplectus* that are the dominant emergent vegetation of the shallower portions of the wetlands. The mat of duckweed became so thick in the inlet basins by early August that it was difficult to find filamentous algae except on the support posts of the boardwalks.

Data from the 1999 algal survey indicate, as in the past, that diversity and population densities of algae (genera) are in dynamic flux, both within a growing season and season-to-season. With experience from six years of study at the wetlands changes in relative abundance of the dominant genera of macroalgae have become recognizable more readily from visual observation than from the standardized sampling and microscopic study that was established in 1994 for both of the wetlands. Microscopic analysis and identification remains vital, of course, to determining diversity and abundance of all microalgae.

## Methods

Samples of macroalgae ('mat samples') were collected from inlet, mid and outlet basins of Wetlands 1 and 2 and the outlet swale. Whenever there was open water a plankton net was three times tossed to the end of a 20' line and pulled in; after the basins became covered with algae and/or duckweed several holes were opened in the mat and the plankton net dipped up and down several times in each hole to obtain a composite sample for each basin. At each time of collection (March 20, April 24, May 18, June 24, August 6, September 10, and November 12) visual observations were made and data recorded on the identifiable genera of macroalgae, their abundance as estimated percent coverage of each basin, and the general status of the water environment. Samples were iced for transport to Portsmouth and refrigerated until read.

As in past years each sample was sub-sampled by preparing three slides using square 22 mm coverslips. The area under each coverslip was surveyed at 100x magnification in a top to bottom, back and forth pattern and all algae observed were identified to genus. When necessary higher magnification was used. Following the survey of each coverslip, each identified unicellular, colonial and coenobial genus was ranked according to a scale: rare = less than five; infrequent = 5 to 10; common = 11 to 20; and abundant = more than 20 individuals per coverslip area. Filamentous genera were ranked on a similar scale, but the ranking included subjective consideration of comparative abundance relative to other filamentous genera on the slide. Small, difficult to identify diatoms were simply ranked for abundance without regard for specific identification.

## Results and Discussion

### *Visual Observations*

March 20, 1999: In Wetland 1(W1) only the outlet basin exhibited any significant coverage (about 50%) by floating mat; this was a mix of small 'pads' of dense Cyanobacteria (later found to consist primarily of *Oscillatoria*) and larger mats of *Spirogyra* and *Zygnema*. In the inlet and mid basins the Chlorophyte *Tetraspora* was found as small isolated colonies; 1999 was the first year that this alga was identified in the Wetlands. In Wetland 2 (W2) the mid and outlet basins had about 35% and 40%, respectively, coverage with clumps of *Spirogyra*. Scattered among these, and in the Inlet basin as well, were small pads of dense Cyanobacteria similar to those seen in Wetland 1.

April 24, 1999: By this date both *Rhizoclonium* and *Cladophora* had become components of the floating clumps and mats in both Wetlands and, based upon microscopic study, were most abundant in the inlet and mid basins of W1 and outlet basin of W2. *Spirogyra* was still common in both outlet basins. Even more colonies of *Tetraspora* were seen in inlet and mid basins of Wetland 1 as well as in the shallow water between these two areas of deeper water.

May 18, 1999: In the 24 days from the preceding observations *Hydrodictyon* developed dense, thick mats in Inlet and Mid basins of Wetland 1 (covering 90-95% of their surface areas) and in Mid and Outlet basins of Wetland 2 (95% and 75% estimated coverage, respectively). In both Inlet basins *Spirogyra* was growing heavily entangled among leaves and stems of the stands of *Potamegeton* spp. The *Spirogyra* that had been so abundant in the drainage swale in March and April appeared to be gone (an observation supported by microscopic data). Duckweed was becoming conspicuous around the edges of the basins, especially so in Inlet 1; this at a time when *Typha* was near full growth, *Schoenoplectus* about one third full height and burreed, *Sparganium eurycarpum*, in flower.

June 24, 1999: In the intervening period following May 18, duckweed proliferated to the extent of covering essentially 100% of both inlet basins (except for leaves of emergent vascular plants), about 95 % of mid W 2 (but here mixed with still abundant coenobia of *Hydrodictyon*), and about 35% of mid 1 along with about 60% coverage by mats of *Cladophora*. Outlet 1 had about 25% coverage by mats of *Cladophora*. Outlet 2 had about 45% *Hydrodictyon, 45% Cladophora* mat cover and the remaining open water contained numerous tiny (young) coenobia of *Hydrodictyon*. *Cladophora* was the dominant alga in the swale.

August 6, 1999: Both inlet basins were covered with very dense stands of duckweed. The only observable filamentous algae was in a ring at the perimeter of the small area of open water around the inlet standpipes; in W 1 this was a mix of *Cladophora* and *Rhizoclonium*, in W 2, *Cladophora, Rhizoclonium* and *Spirogyra*. Mid 1 had about 92% coverage of a mix of duckweed, *Cladophora,* and *Rhizoclonium*; mid 2 with about the same percent coverage of duckweed but with *Hydrodictyon* as the algal partner. Outlet 1 was almost devoid of filamentous algae, but there were a moderate number of small pads of *Oscillatoria* and *Anabaena*. Outlet 2 had more numerous and larger clumps of *Oscillatoria*; microscopic analysis indicated a lesser amount of *Anabaena*, however.

September 10, 1999: Observation on this day indicated the heaviest coverage of the season by duckweed. The vascular plant was essentially solid over both inlet and mid basins; it was almost impossible to find any macroalgae. Outlet 1 had almost no duckweed, some *Hydrodictyon*, and a few small clumps of bottom-setting *Spirogyra*. Duckweed was noticeably more abundant in outlet basin 2 than in 1. In this basin there were numerous small clumps of dead and decaying mat algae, but very little living macroalgae could be found.

November 12, 1999: Duckweed was almost gone from open water basins but still moderately abundant among the stems of *Typha* and *Schoenoplectus* in the shallower between-basin waters. The water was murky and very little Chlorophyte macroalgae could be seen. All three basins of Wetland 2 had noticeably more floating pads of *Oscillatoria* and *Anabaena* (determined by microscopic analysis) than did Wetland 1. No macroalgae were found in the swale.

## *1999 Microscopic Survey*

Nine genera of algae were identified from the Wetlands for the first time in 1999; three of the genera (*Raciborskiella, Phacotus,* and *Tetraspora*) are Chlorophytes, one (*Colacium*) is a Euglenophyte, two (*Stichochrysis* and *Mallomonas*) are representatives of the Chrysophyceae, and three (*Diatomella, Frustulia,* and *Rhizosolenia*) are diatoms. *Tetraspora*, as mentioned above, was the only one of these that appeared in any abundance (as determined from both visual observation and microscopic analysis).

With these findings the total number of genera of algae and Cyanobacteria found in the Wetlands and drainage swale since the survey began in the summer of 1994 is 140.

Altogether in 1999, specimens of 67 genera of algae/ Cyanobacteria were identified in Wetland 1, 64 genera from Wetland 2 and 41 genera from the outlet swale. Of the total genera found, 53 were identified from both Wetlands, 11 only from Wetland 1, nine only from Wetland 2; and three only from the outlet swale (see Table 1). This data has to be interpreted with caution because so many of the genera appear in the samples so infrequently; i.e., are so rare in the Wetlands, that finding them at all is an improbable event.

Of the genera identified microscopically in 1999 only six were found in samples from all seven collection dates; these were *Chlamydomonas, Spirogyra, Euglena, Synedra, Navicula,* and *Oscillatoria*. Six more, *Scenedesmus, Closterium, Phacus, Fragilaria, Gomphonema,* and *Anabaena* were found in six of the seven sets of samples.

Table 1. Breakdown by taxonomic Division of genera of algae/Cyanobacteria identified in microscopic sampling of Olentangy experimental wetlands in 1999.

| Taxonomic Division: | Genera Shared: | Wetland 1 Only | Wetland 2 Only | Swale Only |
|---|---|---|---|---|
| Chlorophyta | 22 | 7 | 3 | 2 |
| Euglenophyta | 4 | 1 | 0 | 0 |
| Chrysophyta | 20 | 2 | 3 | 1 |
| Cryptophyta | 1 | 0 | 1 | 0 |
| Cyanobacteria | 6 | 1 | 2 | 1 |
| Totals: | 53 | 11 | 9 | 3 |

## *Long-term Trends*

In 1994, in the first year of operation, water was first pumped into the Wetlands in early spring; by mid-June *Hydrodictyon* ('water net') was visible as numerous floating clumps of coenobia. By late July this alga formed heavy mats over the basins of both Wetlands and these persisted as mats of *Rhizoclonium* developed intermingled with the *Hydrodictyon*. By the end of 1997 it appeared that *Hydrodictyon* was disappearing as a significant component of the macroalgae in the Wetlands (see Table 2), however in 1998 the alga was obviously more abundant, both from visual observations and from microscopic analysis. It formed even denser mats in the spring and summer, as described above, in 1999. This is not reflected so strongly in the microscopic study (see Table 2); however, because there were more early spring samplings than in previous years – at a time when *Hydrodictyon* does not appear – thus reducing the percentage frequency in the data.

The Cyanobacteria are a group of organisms that, based upon microscopic records, appear to have reached their greatest diversity in 1996 with the finding of organisms in 13 different genera, prior to that and since, no more than nine genera have shown representatives (see Table 3). However, the volume of Cyanobacteria, as floating small 'pads' and mats of *Oscillatoria* and, to a lesser extent, *Anabaena,* appears to be on a decided upswing; this has been especially noticeable in early spring observations this year. On April 1, 2000 small to moderately large, floating masses of *Oscillatoria* comprised the vast bulk of non-vascular photosynthetic biomass on each basin and in shallows of both wetlands. This increase appears to be correlated with increasing deposition of duck and goose droppings in the water.

Table 2. Identification of *Hydrodictyon* in microscope-analyzed samples from Wetland 1 and 2 expressed as percent of six collections per Wetland (two each inlet, mid and outlet basins) each collecting date (variable four to seven/year).

| Wetland: | 1994* | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|
| W1 | 60 ± | 6 | 27 | 4 | 17 | 26 |
| W2 | 60 ± | 46 | 17 | 4 | 29 | 26 |

*Estimate based on records from visual observations

Table 3. Long-term trends in generic diversity in Cyanobacteria in Wetlands 1 and 2 and drainage swale at Olentangy River Wetland Research Park. Data determined from microscopic analysis of six samples from each Wetland and two from swale/each collection date.

| Habitat: | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|
| W1 | 6 | 13 | 6 | 8 | 6 |
| W2 | 8 | 9 | 7 | 9 | 8 |
| Swale | 3 | 10 | 4 | 7 | 5 |

## Conclusions

If duckweed, *Lemna minor*, proliferates each summer in the future as it did in 1999, algae (excluding Cyanobacteria) will, because of greatly reduced abundance, play a much less noticeable role in providing significant biomass and photosynthetic productivity in the wetlands. In past years the greatest algal diversity has occurred in mid- and late summer and early fall; with dominance by duckweed at that time of the year, a detectable drop in this diversity could become apparent by summer 2000.