Algal and *Lemna* populations continue to fluctuate seasonally and basin-to-basin in the Olentangy River wetlands

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Introduction

Population densities and species composition of the photosynthesizing components of the two research Wetlands continued to be in a state of seasonally dynamic change during 2000 — just as has been the case each year since the Olentangy River Wetland Research Park began operation in 1994. As noted in the two most recent of our annual reports, *Lemna minor*, 'duckweed', appears to have become an important determinant in how much filamentous algae (herein referred to as 'macroalgae' and 'mat algae') is present in the summer and early fall in the surface water of the basins and shallows of both Wetlands. However, this influence does not appear to always be the same when comparing Wetland 1 (originally planted with vascular plants) and Wetland 2 (originally unplanted). In other words, environmental factors, some apparent, some not, influence populations of both the macroalgae and duckweed, but not necessarily in the same way for each.

Interaction between duckweed and mat-forming algae can be much better documented by visual observation of each of the three basins in each of the two experimental Wetlands than by microscopic analysis of small samples from each basin. Consequently this approach to the algal survey was given added emphasis in 2000. Detailed visual observations were made on the extent of algal mat and duckweed coverage on seven dates (Apr. 1, May 13, July 16, Aug. 25, Sept. 19, Oct. 13 and Oct. 20) during the growing season. Samples for microscopic determination of generic composition and analysis of microalgal diversity and abundance were collected on four of those dates (Apr. 1, May 13, July 16 and, Oct. 20). Naturally, more observational and sample collection events would have been better, but this was not possible because of our distance from the site and the increasing primary workload.

Methods

Observational data was obtained by carefully looking over the surface of each of the three basins and the two shallow areas separating those deeper basins in each of Wetland 1 (W1) and Wetland 2 (W2). The density and extent of coverage of each component – *Lemna*, *Potamegeton* (pondweed), and the genera of macroalgae that can be determined by appearance, texture and feel, (*Cladophora*, *Hydrodictyon* and *Spirogyra*, in particular) – were estimated. These observations are condensed below under the heading 'Visual Observations'.

The methods of sampling, microscopic analysis and rating for abundance on the survey microscope slides of algal populations in the Wetlands have been outlined several times in previous annual reports (see 'Summer mat macroalgae largely replaced by duckweed, Lemna minor, in 1999 in two Olentangy River experimental wetlands' in the 1999 edition of this publication) so will not be repeated here.

Statistical analyses (t-test) of the seasonal mean abundance in W1 vs. W2 in 2000 of four common genera, *Chlamydomonas*, *Cladophora*, *Spirogyra*, (Chlorophyta) and *Oscillatoria* (Cyanobacteria) were made on each of the abundance ratings (scale) determined from the four sets of samples analyzed microscopically. Also, the abundance ratings for all of the genera of each of the algal Divisions Chlorophyta, Chrysophyta, Euglenophyta, and Cryptophyta, and the Cyanobacteria that were identified and rated for abundance in W1 and W2 were compared for each of the years 1995 – 2000. Additionally, the abundance ratings of all algal and Cyanobacterial genera were combined and compared en-mass, W1 vs. W2 for each of the same years.

Results and Discussion

Visual Observations Supplemented with Microscopic Details

Apr. 1, 2000: On this date there was no floating algal mat in any of the Wetland basins. Because of the high, muddy water in the Wetlands it was not possible to locate and collect any of the small, floating clumps of filamentous algae such as had been seen in early spring in most previous years. For the same reason surveying for any bottom algae was impossible. As a consequence of these conditions only plankton net samples were collected. The colonial alga Tetraspora, which in 1999 was found in samples for the first time since the study began in 1994 (in both Wetlands 1 and 2) was present in the samples from inlet, mid and outlet basins of W1 but was not found in any of the samples from W2.

May 13, 2000: By this date algal mat coverage in both Wetlands was visible, but in distinctly differing amounts. Both Wetlands had limited amounts of floating, filamentous algae in their inlet basins (estimated at less than 10% coverage in each), but the mid basin of W1 was about 65%

covered with a mat composed primarily of Cladophora and Rhizoclonium whereas the same portion of W2 had only small floating clumps of the same genera; these clumps only covered an estimated three percent of the basin. There was a small amount of Hydrodictyon visible in the outlet basins of both Wetlands and a small amount of Tetraspora was still present in the outlet area of Wetland 1. Duckweed was evident in light to moderate densities, especially in the areas close to the shores of the basins and in and adjacent to the shallow areas lying between the basins of both Wetlands.

July 16, 2000: Prior to this collecting date there had been a high-water event that left dried algae hanging from the support posts of the boardwalks and cattails of the shallows. Surface coverage of all basins was heavy and consisted of a mélange of mat algae (mostly Cladophora), growing intermingled in portions of inlet and outlet basins with the tops of *Potamegeton* and overlain by a top layer of *Lemna*. Small patches of other vascular plants were present here and there. In both mid and outlet basins there were scattered areas of a thin, green surface film; later microscopic examination revealed that this was composed entirely of *Euglena*. Microscopic examination of the mat samples revealed typically high summer-time diversity of algal genera, this was especially true of those samples from the outlet basins where as many as 18 genera of the Chlorophyta were found under a single 22mm^2 coverslip. Strong outflow from the flooding apparently flushed most of the filamentous algae out of the upper portion of the drainage swale; collection from the spillway wall was all that was possible. Microscopic examination later identified *Cladophora*, *Rhizoctonia* and *Oedogonium* as the filamentous components.

Aug. 25, 2000: Only visual observations were made on this date (no algal collections). Both inlet basins were almost completely covered with a thick layer of *Lemna*; no filamentous algae could be found except for that attached to the boardwalk support posts (previous microscopic examinations have shown that *Oedogonium* is the typical dominant in this microhabitat). There was a noticeable difference in the coverage of the mid basins. W1 had about 25% coverage by *Lemna* whereas W2 had about 70% such coverage. *Cladophora*-dominated mat covered about 60% of mid W1, but only about 20% of mid W2. In both of these basins the algae was overlain by a light to moderate density of *Lemna*. In the limited surface area (W1 ca 15%, W2 ca 10%) of more or less open water there were small clumps of floating Cyanobacteria intermingled with scattered *Lemna* plants. There was also a noticeable difference in the surface coverage of the outlet basins. W1 had about 50% essentially open water with small, scattered clumps of Cyanobacteria and thinly scattered Lemna. Also visible here were some bottom clumps of Spirogyra. The balance of this basin was dominated by intermingled *Potamegeton* and filamentous algae; this was estimated to consist of about 80% *Cladophora*/ 20% *Spirogyra*. In contrast, outlet W2 had only about 5% open water, 75% coverage by a *Cladophora*-dominated mat overlain by moderately dense stand of *Lemna*, and about 20% of its area occupied by small-medium (2-10 cm) clumps of Cyanobacteria. None of the film of Euglena observed on 7/16 was observed.

Sept. 19, 2000: The amount of Lemna was less in both inlet basins than was observed on July 25 and it was possible to again locate filamentous algae. Both mid basins were observed to still have considerable duckweed coverage. The difference in abundance of mat algae and other surface biota seen in August between mid and outlet basins, W1 as compared to W2, had persisted (see above) with the most noticeable difference being a significant increase in the density of duckweed in the outlet area of W2. The swale stream had an abundance of *Lemna* along its edges and very limited amounts of filamentous algae. As in August visual observations were made with no samples for microscopic observation being taken.

Oct. 13, 2000: Inlet W1 still had a heavy covering of duckweed over a portion of the basin whereas the inlet of W2 had only a generally light covering; some of this difference was due to the obvious difference in surface winds over the two basins as these were influenced by differences in the stands of vascular plants around the perimeter of the two basins. In the mid basin of W2 the duckweed was so heavy that no filamentous algae could be seen; the algal mat that had been prominent in mid W1 in the previous three months appeared to be disintegrating as most of the filaments of *Cladophora* appeared to be senescent or dead. The *Cladophora* that was observed in the outlet basins was also in a deteriorated state. The density of duckweed in these basins was noticeably lower than in the previous month. The swale channel was essentially open with minimal amounts of filamentous algae and duckweed along its edges. As for the previous three dates (above) no samples were collected.

Oct. 20, 2000: Observations were made and samples taken this date.

Duckweed, though still abundant in places, appeared to be deteriorating and there were many bleached plants in any collection of this vascular plant. In the areas of open water it was possible to see patches of the former algal mat resting on the bottom; in other places *Spirogyra* appeared to be increasing, as compared to the week before, in numbers of 'clumps' on the bottom of open water areas, this replicated an aspect of algal life seen in previous years.

2000 Microscopic Survey

Sixty-nine genera of algae and Cyanobacteria were identified microscopically from the four sets of samples; 59 were found in W1, 60 in W2 and 31 in the swale (Table 1). The total of 69 genera derived from four sampling dates in 2000 compares with the 76 genera identified in seven sets of samples taken in 2001. Three genera, *Crucigenia* and *Chaetosphaeridium* (Chlorophyta) and *Synechocystis* (Cyanobacteria), were identified for the first time in the Wetlands; this brings to 143 the total number of genera of algae and Cyanobacteria that have been identified in the

two Wetlands and drainage swale since the survey began in 1994.

The statistical analyses demonstrate that on a seasonal basis there were no significant differences in the abundance of the common genera *Chlamydomonas*, *Cladophora*, *Spirogyra* and *Oscillatoria*. Such 'pooling' of the abundance ratings derived from microscopic survey based upon small samples all taken from the wetland board walks ignores the larger picture that specimens of a macroalgal genus can be seen at a location in a wetland basin but not be reachable for sampling or that the random (scattered) small samples that are taken may simply miss an alga that is present.

The comparison of the seasonal abundance of the genera of each of the four Divisions of algae and the Cyanobacteria indicated that on a Division–by-Division basis there are only small differences, none significant, in the overall abundance of algae surveyed season-to-season in W1 as compared to W2, 1995-2000. This information does more to indicate that there is internal consistency in the sampling and microscopic survey procedure than it says anything about the noticeable differences that can be seen visually and microscopically when comparing one basin with another, both intra- and inter-wetland. With our increasing experience in surveying the Wetlands it appears, as said above, that the big differences are better documented by careful visual survey of each basin of each wetland. The microscopic survey provides the information on the presence/absence and abundance of the many genera of microalgae that appear (and disappear) in the wetlands.