Northeast Aquatic Plant Management Society
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Chester, NJ 07930

Dear NEAPMS officers,

Enclosed is a summary of my 2006 Lake Sunapee *Gloeotrichia echinulata* research. Thank you again for your support! I have acknowledged my Northeast Aquatic Plant Management Society's grant in all manuscripts and will send reprints when they are finally accepted.

The aim of this past summer's research was to 1) conduct routine monitoring of *G. echinulata*'s recruitment and surface abundance, and Lake Sunapee's sediment total dissolved phosphorus (TDP) concentrations to compare to 2005 data, 2) more definitively describe the role of sediment TDP in *G. echinulata*'s life cycle, and 3) survey other oligotrophic lakes in New England that have recently exhibited *G. echinulata* blooms.

Routine monitoring data:

In 2006, I chose Herrick Cove to be the main focus of my *G. echinulata* monitoring. As the 2005 data demonstrated that *G. echinulata* recruitment has similar patterns throughout the lake, I wanted to work at the site of highest recruitment in 2005. I used 3 sites in the cove for routine sampling: off the Eliassen's dock (site name Midge), off the Cates' boathouse (site name Cates), and off the Rosenfield's dock (site name Rosen). At each site, I measured *G. echinulata* recruitment with 3 traps, *G. echinulata* surface abundance with plankton hauls, and sediment TDP with sediment samples twice every week from 26 June 2006 to 18 September 2006. I conducted all fieldwork and laboratory analyses of TDP myself.

The data I present here concentrate specifically on Cates and Midge, as I have both 2005 and 2006 data from these sites. Figure 1 displays the surface abundance of *G. echinulata* at sites Midge and Cates from Julian day 180 to 268 (29 June to 25 September) in 2005 and 2006. It is evident that *G. echinulata* surface abundance (measured in colonies L^{-1}) was slightly higher in 2006, with more distinct pulses. However, no prolonged surface scums were observed in Herrick Cove in 2006, unlike in September 2005.

Figure 2 displays four panels of recruitment and sediment TDP at sites Midge and Cates in 2005 and 2006. At both sites in 2005, sediment TDP peaks on day 230, and after a 3.5-week lag, *G. echinulata* recruitment peaks on day 255 (12 September). A 3 to 3.5-week lag corresponds to the exact amount of time *G. echinulata* colonies on the sediment need to develop into planktonic colonies and enter the water column. Site Midge in 2006 exhibits a similar pattern to both 2005 sites, with the highest recruitment occurring in early September. At site Midge in 2006, two 3-week lags are evident with peaks of sediment TDP on days 180 and 236, and peaks of *G. echinulata* recruitment on days 198 and 255, respectively. These graphs indicate that sediment TDP may be an important part of *G. echinulata*'s life cycle. At site Cates in 2006, however, there is no distinct pulse of recruitment, which may be due to the high level of disturbance that occurred at this site in spring 2006. The Cates site is located near a culvert draining a wetland, and received a high amount of overflow throughout the extremely high rains of May-June 2006. During this time, it is possible that the top sediment layer that contains *G. echinulata* akinetes was washed out into the lake, which would account for the low recruitment levels throughout the summer. In addition, a dense macrophyte community was established in early August at the site, decreasing the amount of light available to germinating akinetes on the sediment. Overall, there are two important differences between 2005 and 2006. *G. echinulata* recruitment was higher in 2005, and sediment TDP concentrations were much higher (~20 $\mu g\ L^{-1}$) in 2006.

Sediment TDP experiment:

In early August 2006, I conducted an experiment to definitively test the effect of TDP pulses on *G. echinulata* recruitment in situ. I placed tiles enriched with phosphorus directly on the lake sediment and measured the response of *G. echinulata* recruitment over a 30 day period, with 8 replicates. Recruitment traps were placed immediately adjacent to enriched tiles (referred to as the 10 cm treatment), and 1 m away from the tiles (referred to as the 1 m treatment). The data from this experiment are displayed in Figure 3. In the 10 cm treatment, *G. echinulata* recruitment significantly increases after a 22-day lag, and in the 1 m treatment, *G. echinulata* recruitment significantly increases after a 26-day lag. The 4 day difference in *G. echinulata* increases approximately matches the amount of time needed for phosphorus to diffuse 1 m in the sediment. This experiment demonstrates that increases in sediment TDP significantly trigger *G. echinulata* recruitment. This finding indicates that the most effective way to reduce *G. echinulata* blooms is to limit the amount of phosphorus entering the sediment, particularly phosphorus that enters the lake in pulses.

Regional *G. echinulata* survey:

During 24-27 July 2006, I sampled 14 oligotrophic lakes throughout southern and central Maine that have recently exhibited *G. echinulata* blooms. The goal of this survey was to measure sediment TDP and *G. echinulata* surface abundance in each lake for comparison to Lake Sunapee. Figures 4 and 5 display *G. echinulata* surface abundance and sediment TDP across the continuum of lakes, respectively. Note that these data are only a snapshot of an entire summer, and may not accurately affect peak bloom conditions. Lake Sunapee has the 3rd highest *G. echinulata* surface abundance of these lakes and is in the lower half of lake sediment TDP concentrations.

My 2005 and 2006 research are currently being prepared into 3 manuscripts; roughly divided into *G. echinulata* toxicity, the role of sediment TDP in *G. echinulata*'s recruitment, and the regional *G. echinulata* issue and recruitment patterns in a representative oligotrophic lake (Sunapee). The toxicity manuscript was submitted to the journal *Environmental Toxicology* on 9 October 2006, and the other two are in preparation.

Sincerely,
Cayelan Carey

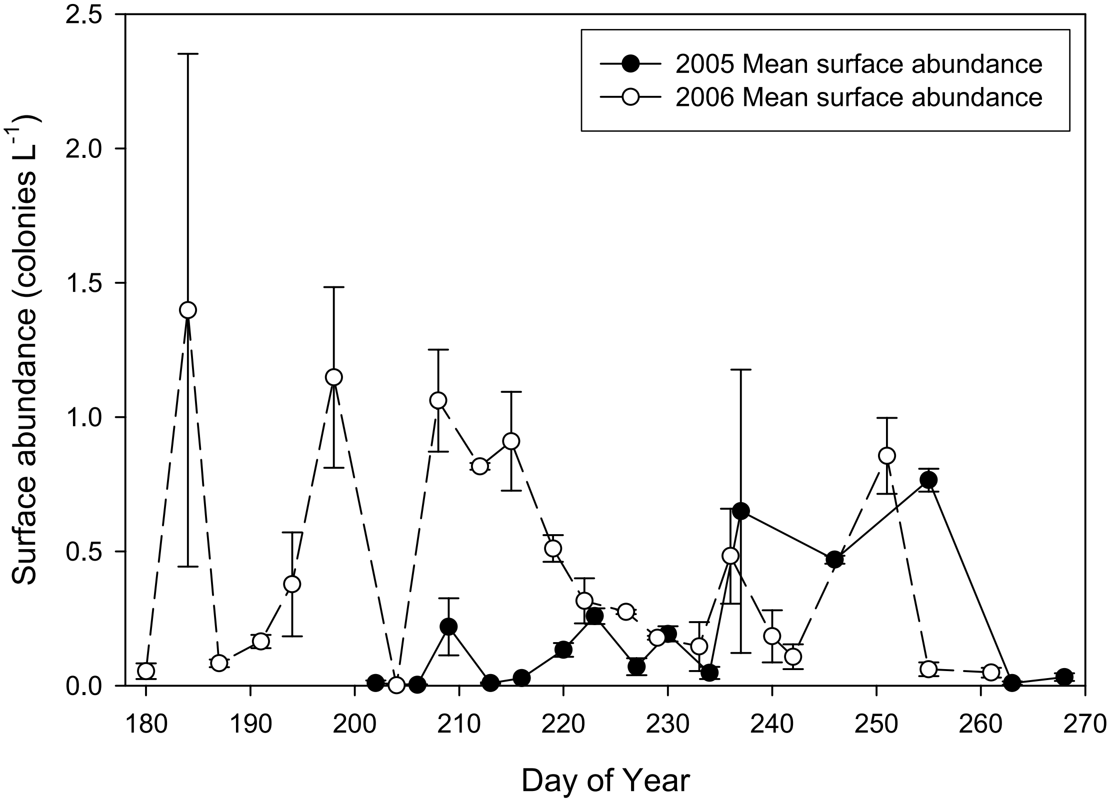

Figure 1. The mean surface abundance of *G. echinulata* at the Midge and Cates shallow sites in 2005 and 2006. Error bars demarcate 1 standard error.

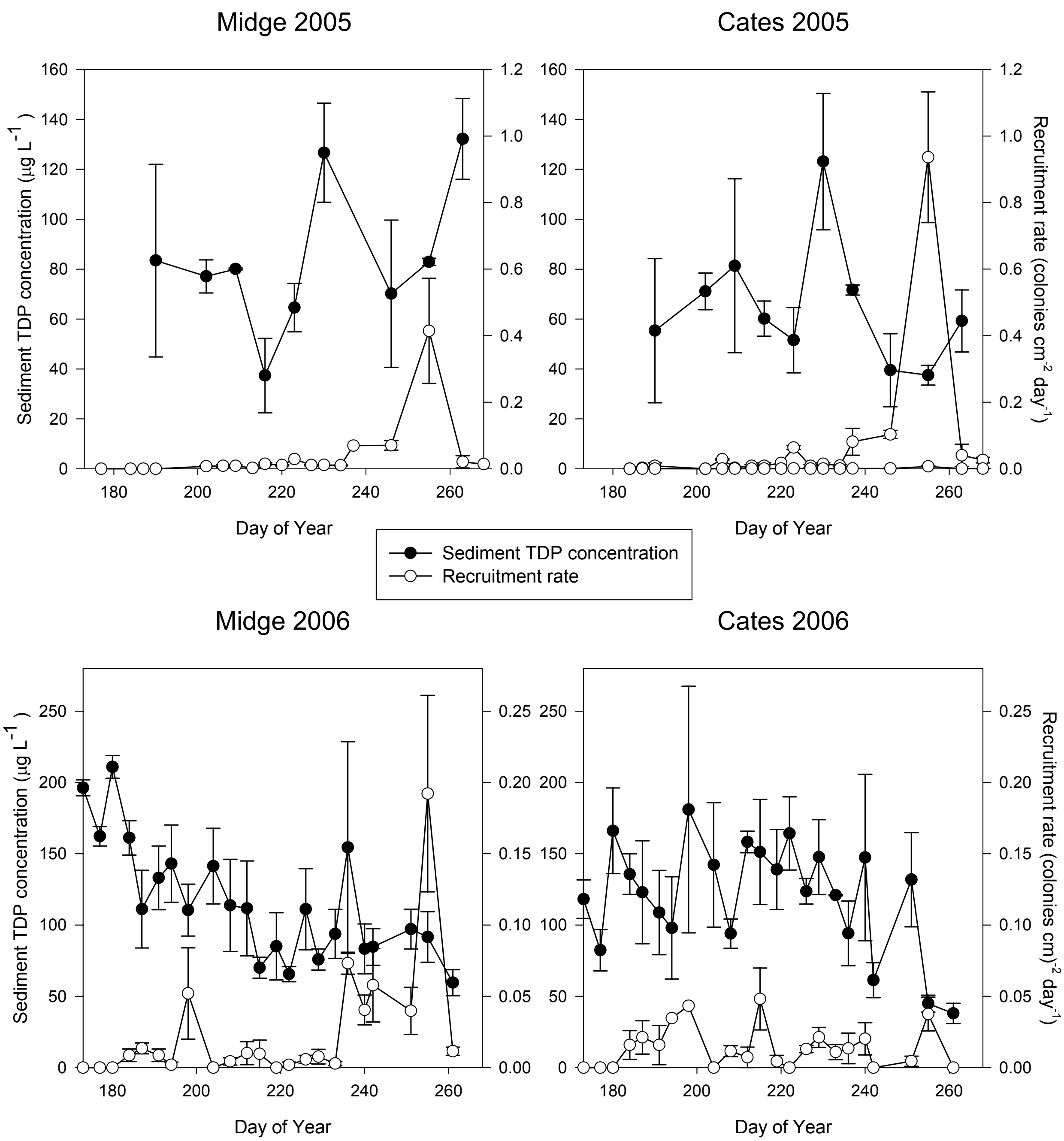

Figure 2. Mean sediment total dissolved phosphorus (TDP) and mean *G. echinulata* recruitment rate at sites Midge and Cates during June-September 2005 and 2006. The error bars demarcate 1 standard error. Note the difference in scale in recruitment rate and sediment TDP between 2005 and 2006.

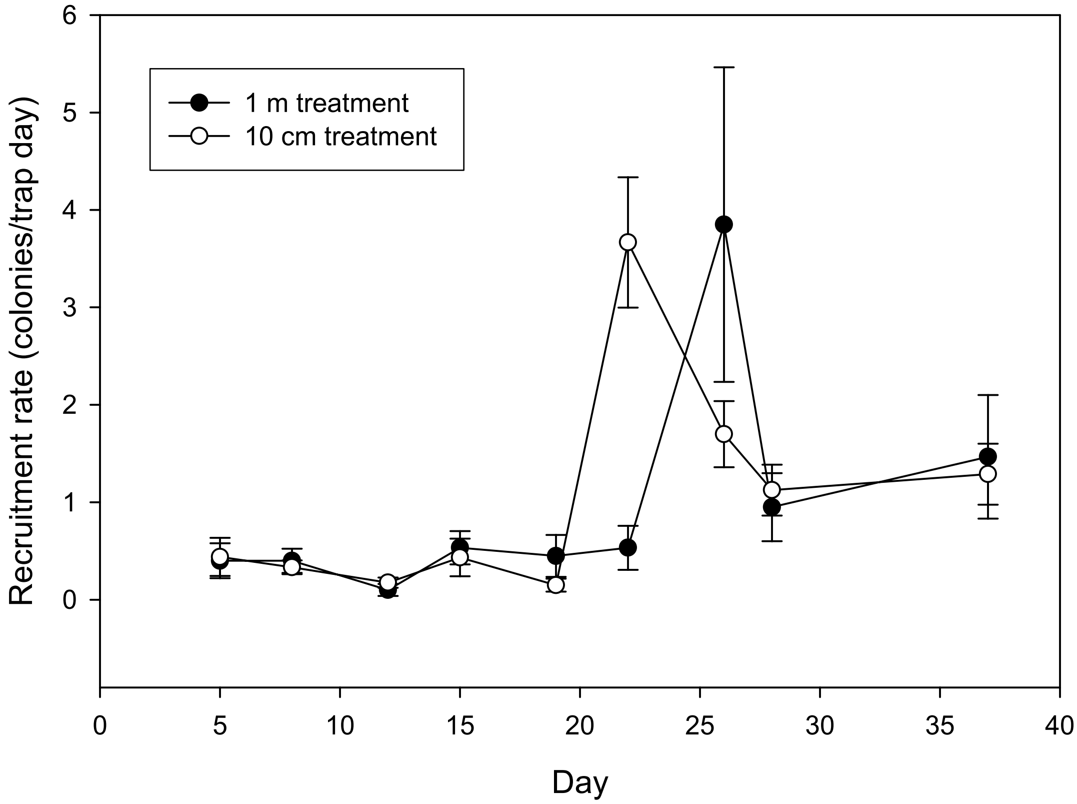

Figure 3. Mean *G. echinulata* recruitment rate from sediment enriched by phosphorus-coated agar tiles placed 10 cm away (10 cm treatment) and 1 m away (1 m treatment) in Lake Sunapee. The error bars demarcate 1 standard error.

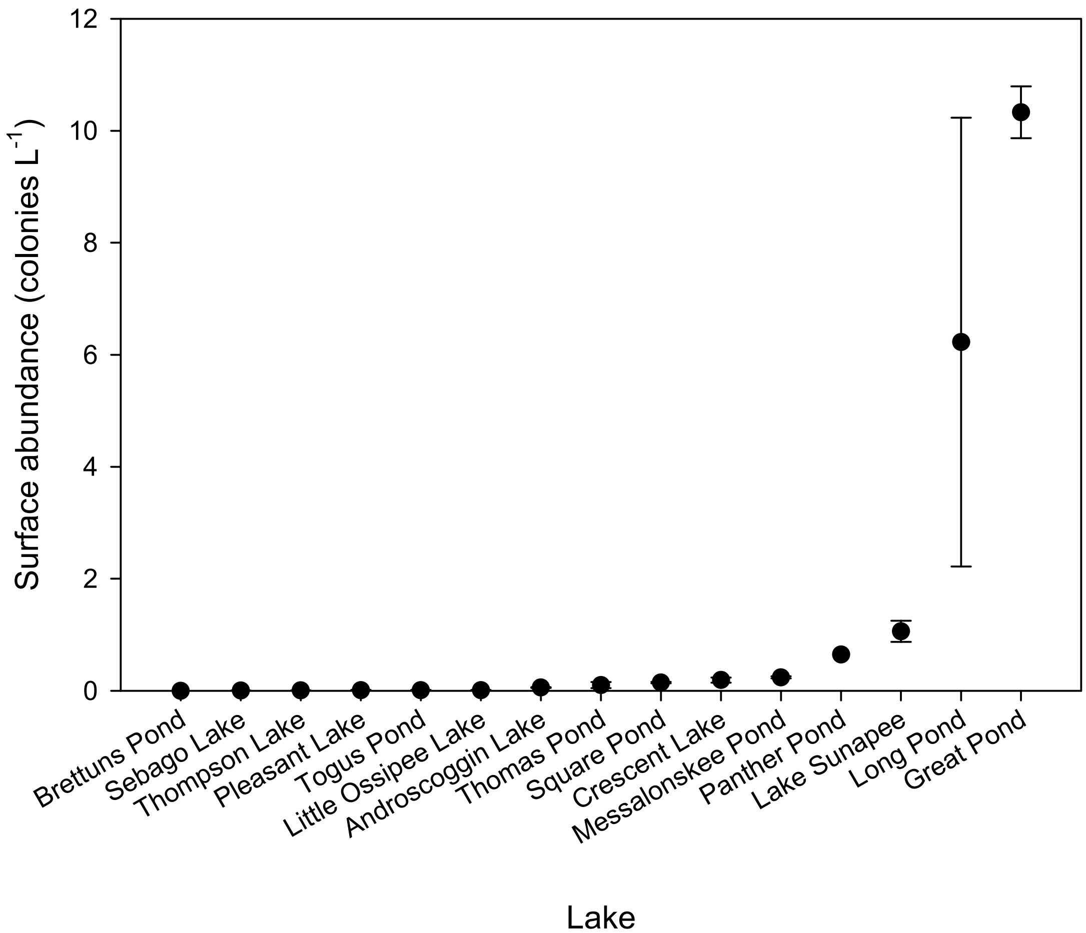

Figure 4. The mean surface abundance of *G. echinulata* in 15 oligotrophic lakes in Maine and New Hampshire, sampled between 24 July 2006 - 27 July 2006.

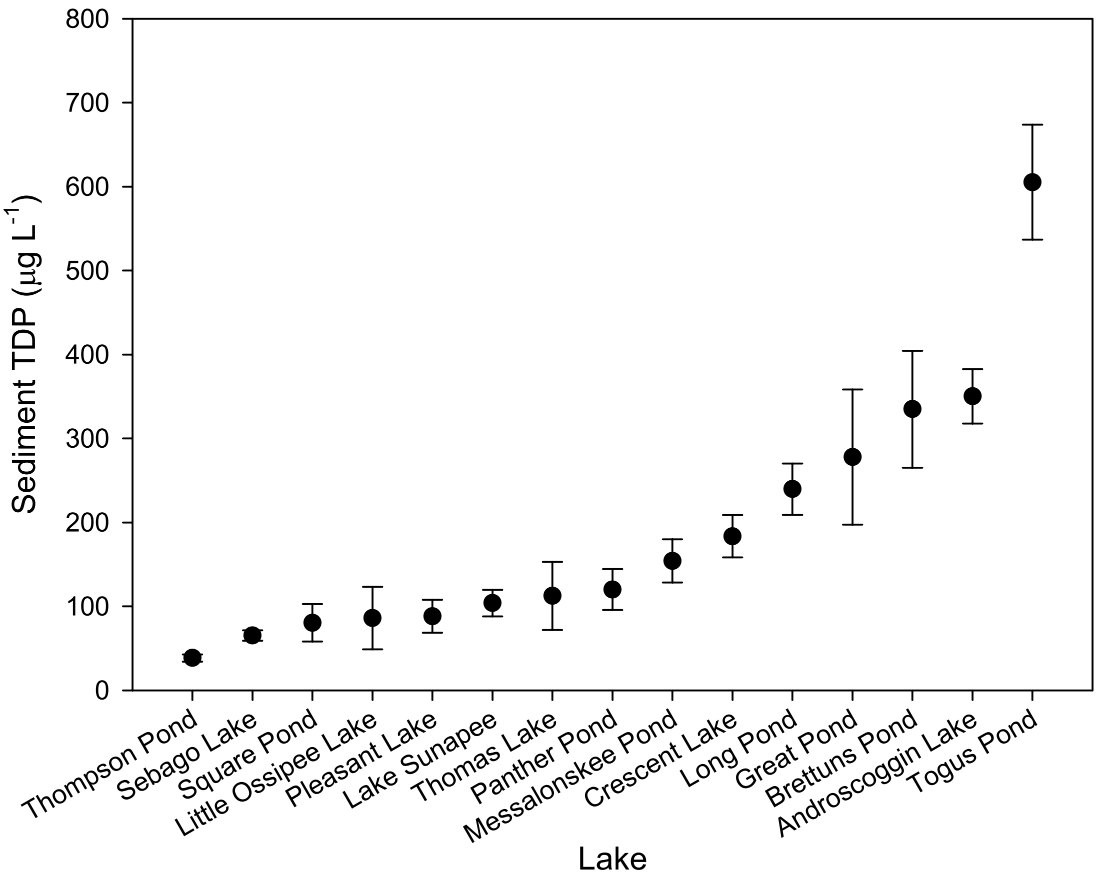

Figure 5. The mean sediment total dissolved phosphorus concentration in 15 oligotrophic lakes in Maine and New Hampshire, sampled between 24 and 27 July 2006.