

This is Julie's (and my) 2003 data. The location is Foster Park and the graph shows TDN and Chla concentrations as the 2003 algal bloom waxed and waned - actually a double bloom since a second peak occurred in September. Chla was measured at approximately 2-week intervals, so the green data points represent variations in Chla that occurred over these time periods. Chla on the Matilija sites were measured by Kristie on June 3, at least 6 weeks after the peak of the bloom at these locations. Julie measured her Foster Park peak on June 1; it was $857 \mathrm{mg} / \mathrm{m} 2$ (given the measurement interval we don't know if this actually was the peak, but the probability is that the peak occurred within a week on either side of this date). Four weeks earlier it had been $49 \mathrm{mg} / \mathrm{m} 2$, and four weeks later it was $100 \mathrm{mg} / \mathrm{m} 2$.

Kristie's value for the Matilija above the dam was $11 \mathrm{mg} / \mathrm{m} 2$. My point here is that, at the height of the bloom, it could have been 100 or $200 \mathrm{mg} / \mathrm{m} 2$. We don't know. We'll never know. But we do know it was much greater than 11, and had the measurement been made closer to the peak of the bloom it, and the other upper-catchment values that define the lower end of the Chla vs. TN regression, would have given us a significantly different TN relationship. (We also know that in September, when Kristie made her second survey at this location, this time not long after the peak of a second, but smaller, bloom, she measured $58 \mathrm{mg} / \mathrm{m} 2$. So we can assume it was at least this high.)

If we wish to build a Chla/TN relationship without paying attention to where in the algal cycle measurements were made, or indeed by combining measurements at very different points in the cycle - both at different locations and multiple times at the same locations - we can go further with Julie's data.


We can assume, as I've done here, that all of the 2003 simultaneous measurements of Chla and nitrogen can be used to derive a relationship between Chla and TN. That's what this graph shows. Although each of the four surveyed locations is shown separately, the equation and regression line represents the entire dataset. The error bars represent the standard error of the mean Chla determination during each survey at individual sites.

Well, it turns out that the regression doesn't explain much, and it's only significant at the 0.2 level. OK, let's call it not significant. But I have a feeling that if only I had one more site to toss in, a site with lower values of TN, it probably would have been. I would point out the slope of the regression line: it's negative, i.e. increasing TN would give us even lower values of Chla.
However, even I'm not really sure we can be confident that locations with lower TN, i.e. more pristine locations, have greater algal problems. Note also that VR06, Foster Park, with lower TN than the other sites (all located below the treatment plant) generally had high Chla - and almost always had higher Chla than at Main Street (VR01).


Finally, I would point out that just because we observe a relationship in one year doesn't mean that it would hold true for other years. In fact we know it doesn't, because as aquatic plants replace algae below the treatment plant nitrogen levels typically increase. I've plotted Julie's data on Kristie's graph. The suspicion must be that we are dealing with a fundamentally different relationship. This is all the more reason for not placing too great an emphasis on the Chla/TN relationship in determining TMDL criteria.


Just to show I'm a fair-minded guy, I'll toss in another graph. This is the same one shown on the preceding page, except that I've separated Julie's data into two categories: (1) survey results dominated by filamentous algae (cladophora below the treatment plant, and what Julie identified as rhizoclonium at Foster Park), namely it includes most of the Foster Park points and those associated with bloom peaks at the other locations (yellow); and (2) survey results from when plants and diatoms were dominant on the lower river (red). Results dominated by filamentous algae fit in pretty well with Kristie's data on the upper end, but you can see that any regression utilizing these results would be rotated to a shallower slope - which has been my contention throughout this discussion. The red points, representing plant dominated/diatom conditions, appear to belong to an entirely different class - high nitrogen but much lower Chla.


Again, this is Julie's data, but I'm plotting Chla against TDP, not TN. What's interesting is that this regression is significant, at $\mathrm{p}<0.001$; and also that it appears to explain $25 \%$ of the Chla variation. It's also wrong - since it implies that lower amounts of algae result from increasing levels of total phosphorus.

What I think it does show is that as long as the data range extends over a couple orders-ofmagnitude we can be pretty sure of getting a valid regression. TDN differences in Julie's data only spanned a single order-of-magnitude: thus no valid relationship. But TDP spanned across two: and it's valid. Wrong, but valid.

Interestingly enough, individual regressions for Chla on TDP were also valid for Main Street and Foster Park, with r-squared values around 0.6. It appears that if only we could increase phosphorus at the latter location to $200 \mathrm{mg} / \mathrm{L}$ we'd never be bothered with algae again.

