

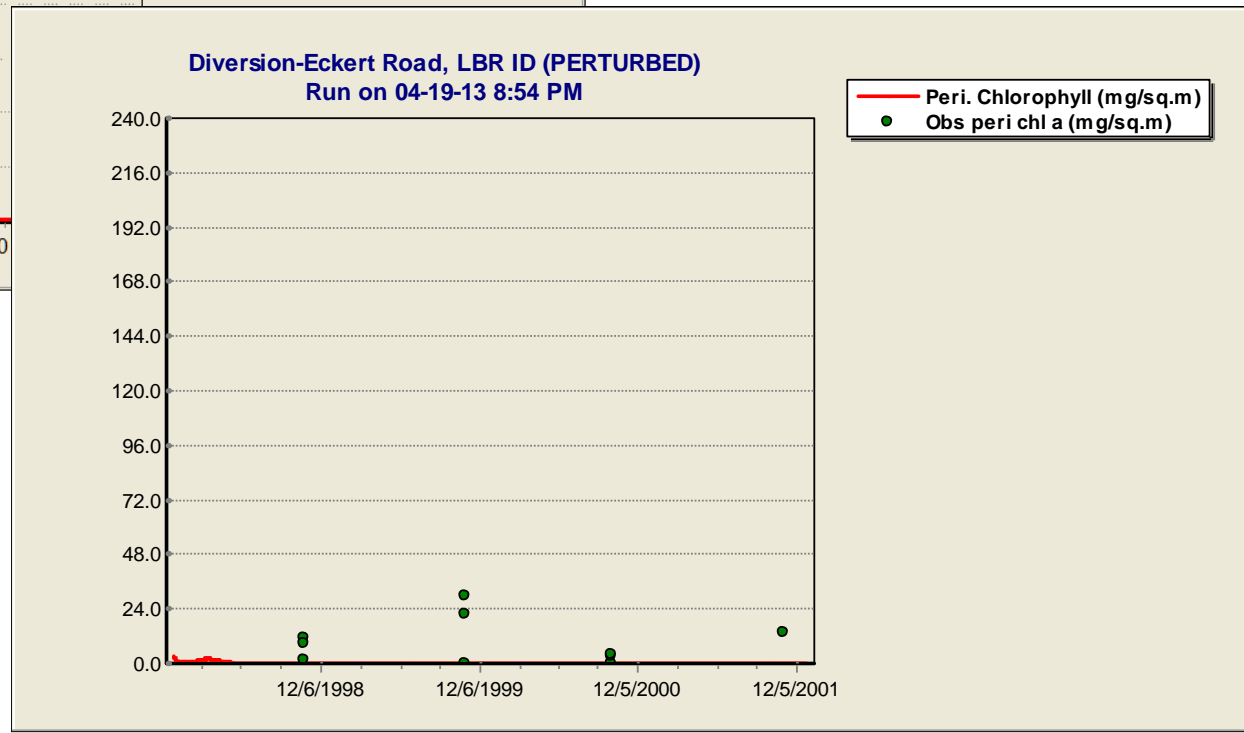
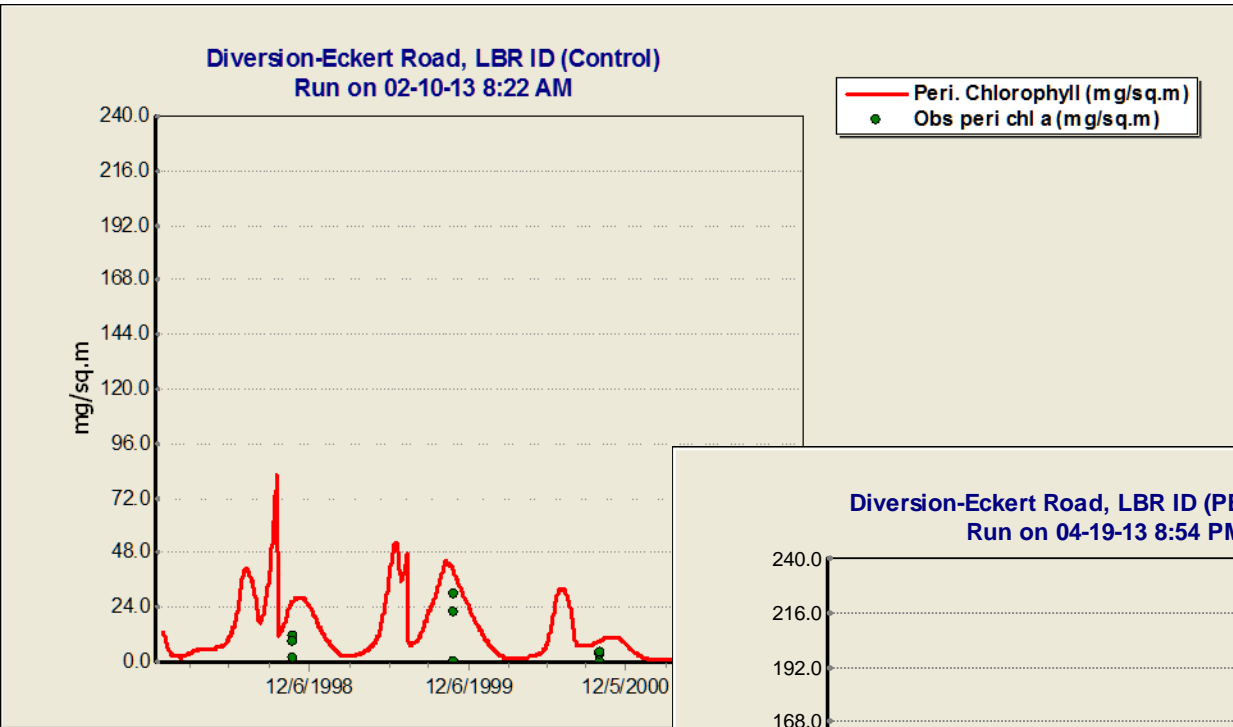
Modeling Algae with AQUATOX

Richard Park, 4/23/13

- An assemblage of algae with differing environmental requirements was calibrated with data from clear nutrient-poor, turbid nutrient-rich, and intermediate enriched and turbid MN wadeable rivers
- Same parameter set was applied to Lower Boise River without calibration *in this example*. Output exhibits very good fit to observed periphytic chlorophyll *a* over broad range of conditions (control simulations)
- Robust parameter set is important in modeling *change*
- **Can we decrease number of algal groups and maintain goodness of fit?**

Diversion-Eckert Road Site

control: all algae, perturbed: high-nutrient diatoms only

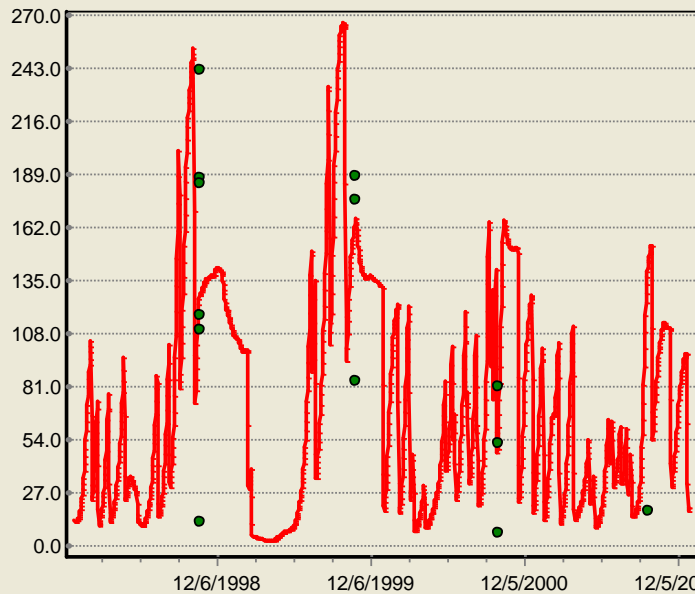


Data courtesy of Dorene MacCoy
normalized for pebbles

Glenwood Bridge Site

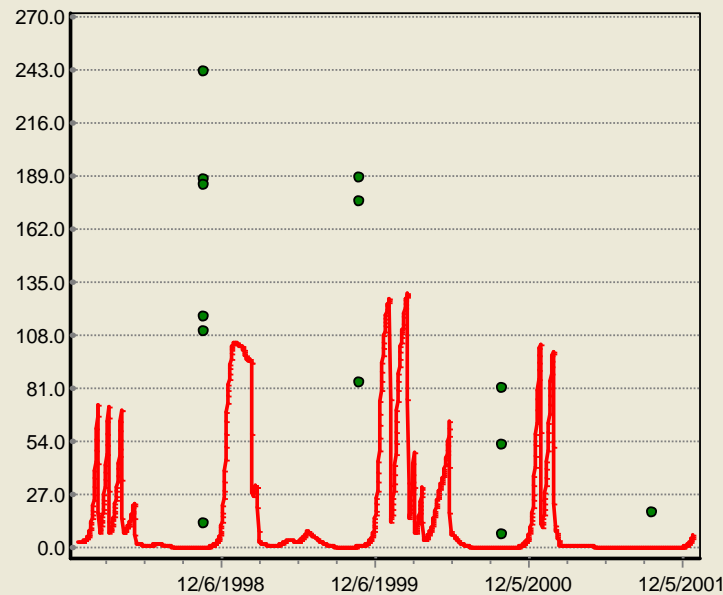
control: all algae, perturbed: high-nutrient diatoms only

Glenwood Br, LBR ID (Control)
Run on 02-10-13 7:40 AM



— Peri. Chlorophyll (mg/sq.m)
● Obs peri chl norm (mg/sq.m)

Glenwood Br, LBR ID (PERTURBED)
Run on 04-19-13 8:57 PM

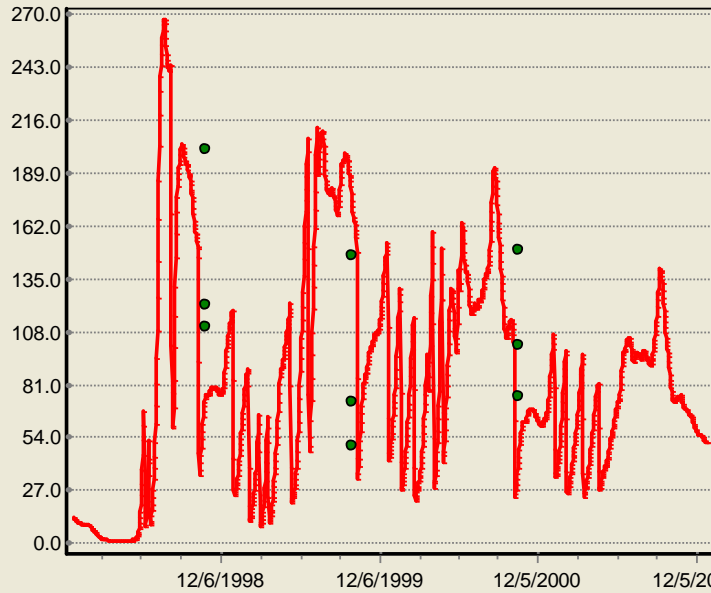


— Peri. Chlorophyll (mg/sq.m)
● Obs peri chl norm (mg/sq.m)

Middleton Site

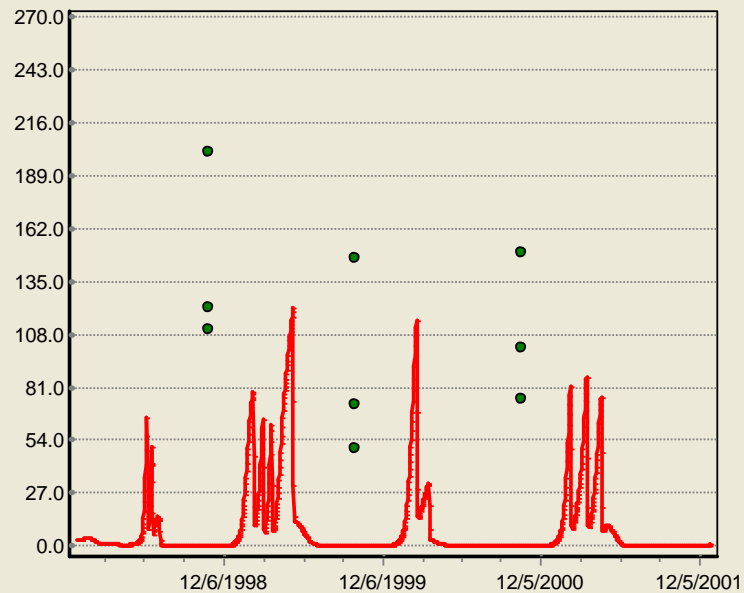
control: all algae, perturbed: high-nutrient diatoms only

Middleton, LBR ID (Control)
Run on 02-10-13 8:10 AM



— Peri. Chlorophyll (mg/sq.m)
● Obs peri chl a (mg/sq.m)

Middleton, LBR ID (PERTURBED)
Run on 04-19-13 8:58 PM

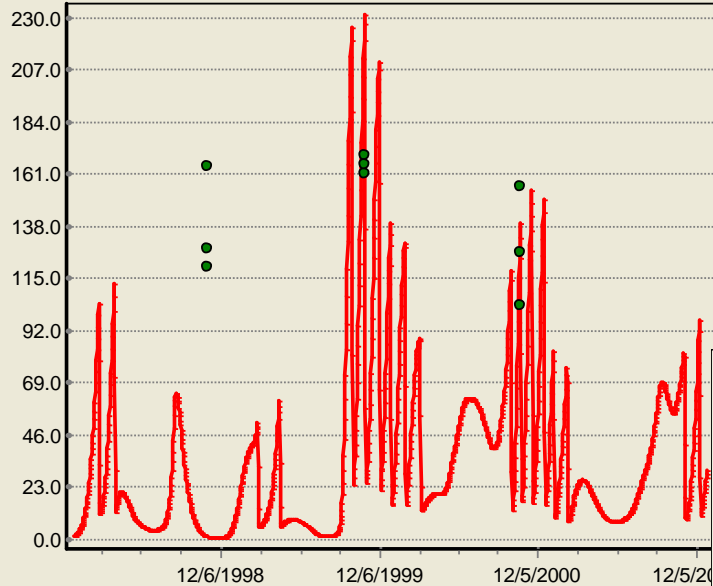


— Peri. Chlorophyll (mg/sq.m)
● Obs peri chl a (mg/sq.m)

Parma Site

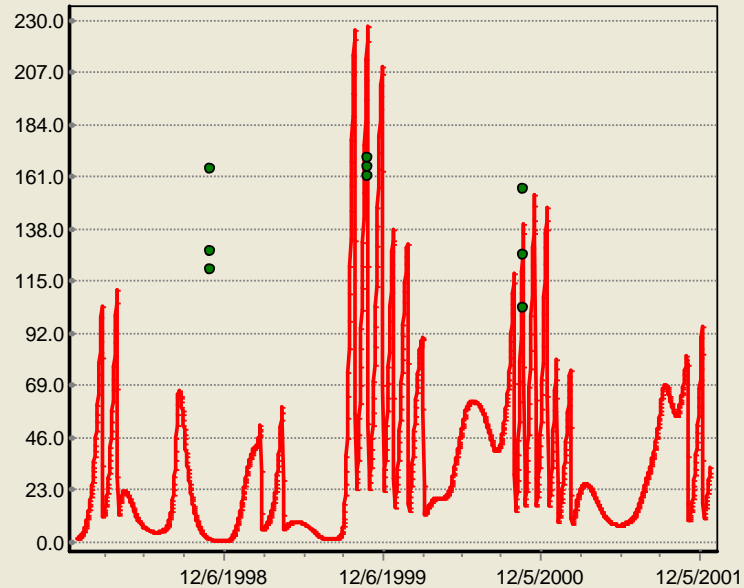
control: all algae, perturbed: high-nutrient diatoms only

Parma, LBR ID (Control)
Run on 02-10-13 7:54 AM



— Peri. Chlorophyll (mg/sq.m)
● Obs peri chl a (mg/sq.m)

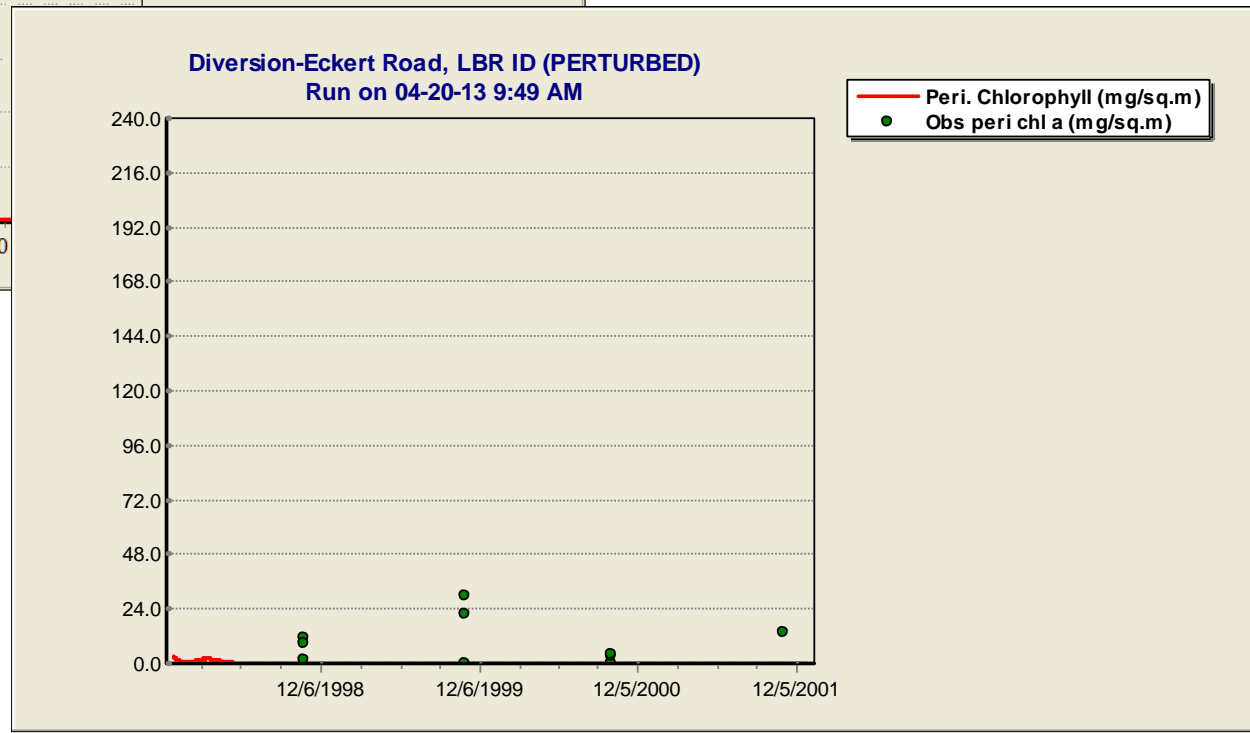
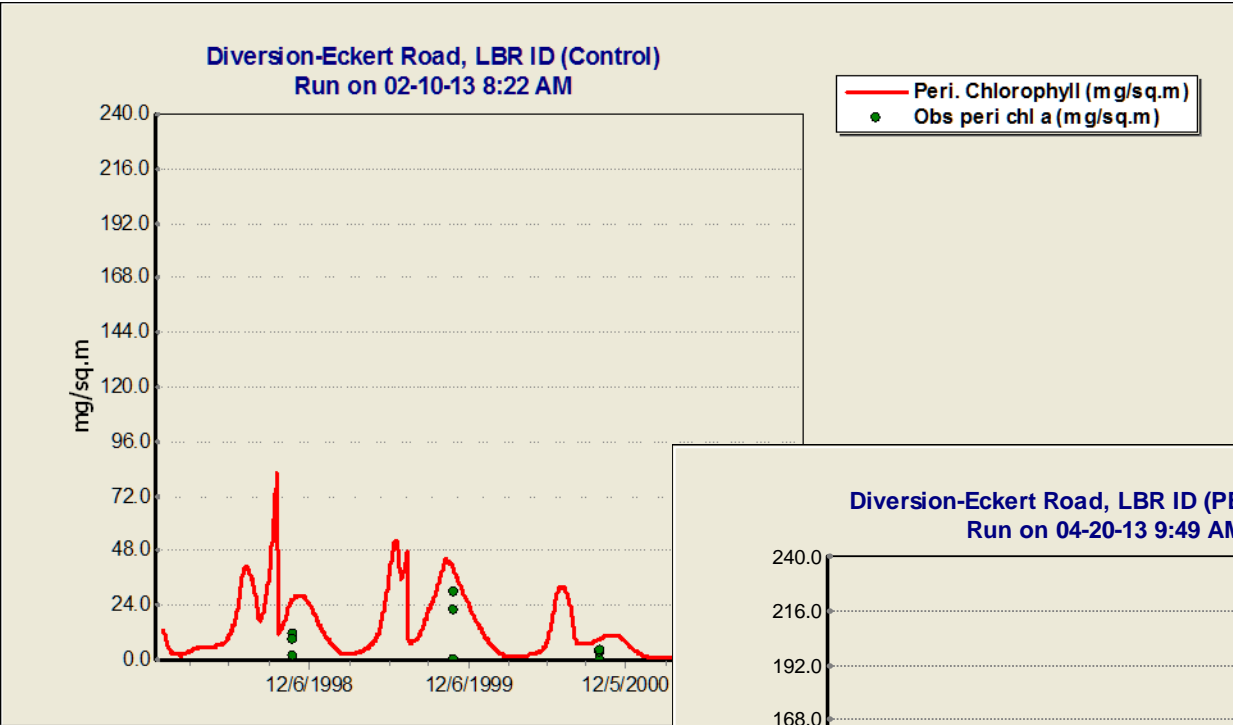
Parma, LBR ID (PERTURBED)
Run on 04-19-13 8:58 PM



— Peri. Chlorophyll (mg/sq.m)
● Obs peri chl a (mg/sq.m)

Diversion-Eckert Road Site

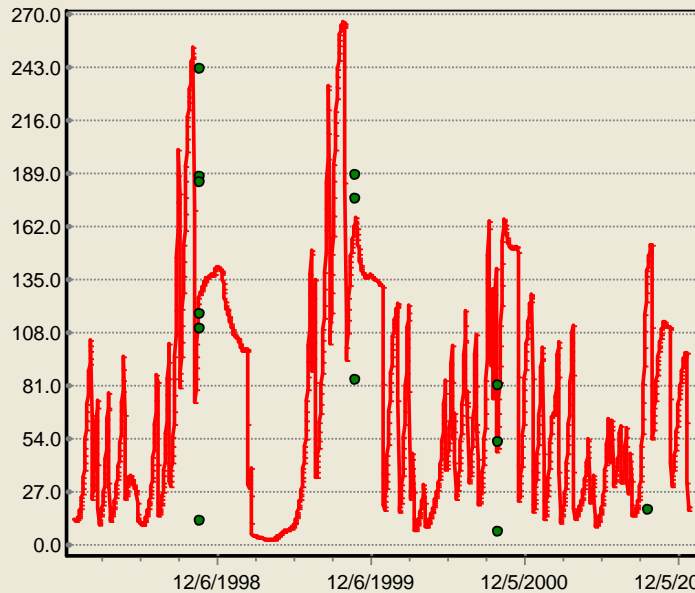
control: all algae, perturbed: high-nutrient diatoms & greens



Glenwood Bridge Site

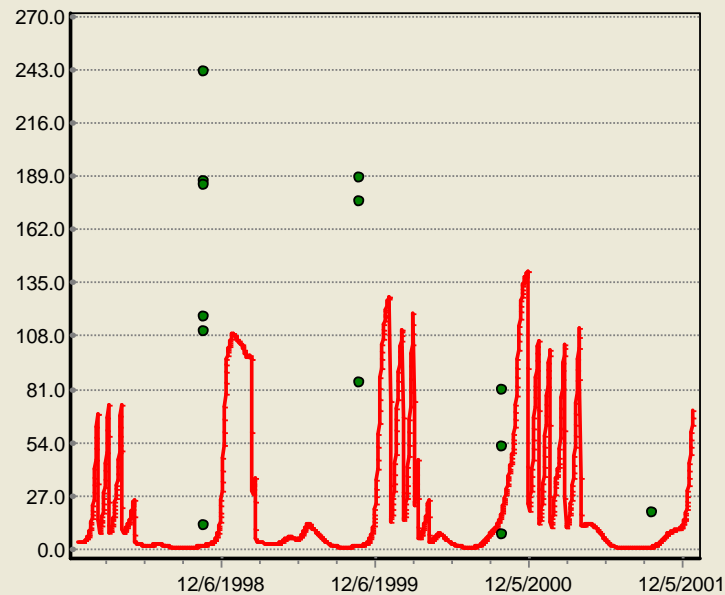
control: all algae, perturbed: high-nutrient diatoms & greens

Glenwood Br, LBR ID (Control)
Run on 02-10-13 7:40 AM



— Peri. Chlorophyll (mg/sq.m)
● Obs peri chl norm (mg/sq.m)

Glenwood Br, LBR ID (PERTURBED)
Run on 04-20-13 9:53 AM

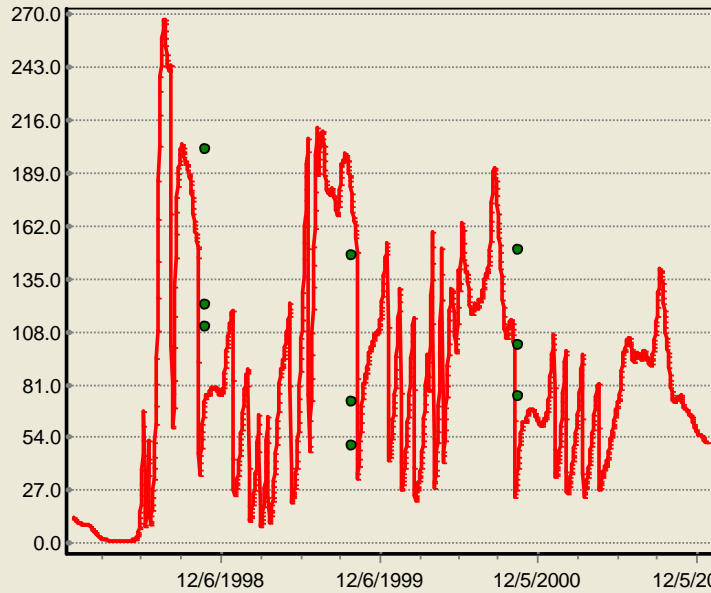


— Peri. Chlorophyll (mg/sq.m)
● Obs peri chl norm (mg/sq.m)

Middleton Site

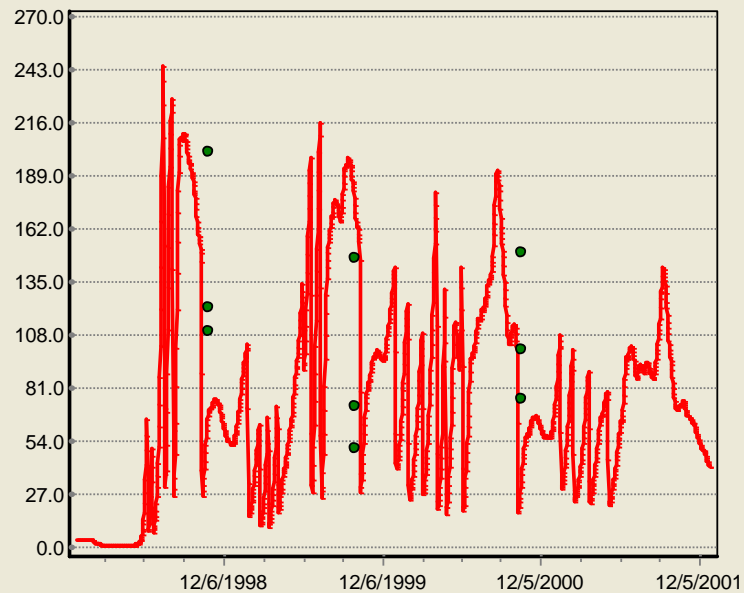
control: all algae, perturbed: high-nutrient diatoms & greens

Middleton, LBR ID (Control)
Run on 02-10-13 8:10 AM



— Peri. Chlorophyll (mg/sq.m)
● Obs peri chl a (mg/sq.m)

Middleton, LBR ID (PERTURBED)
Run on 04-20-13 9:54 AM

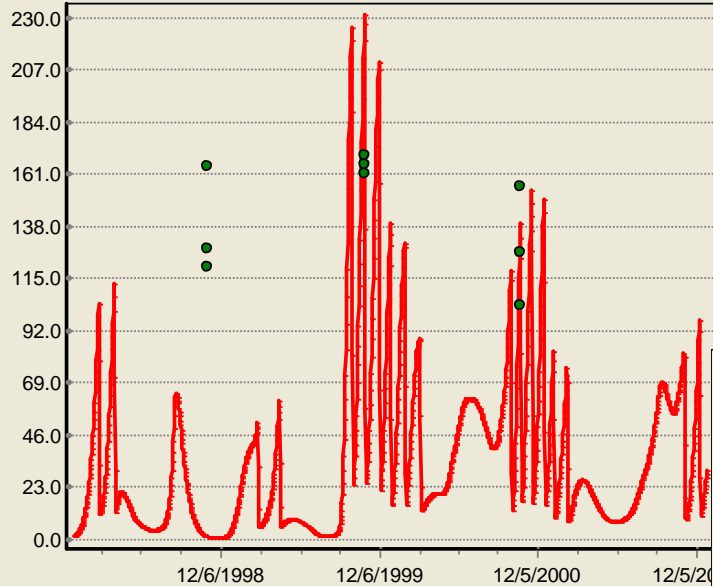


— Peri. Chlorophyll (mg/sq.m)
● Obs peri chl a (mg/sq.m)

Parma Site

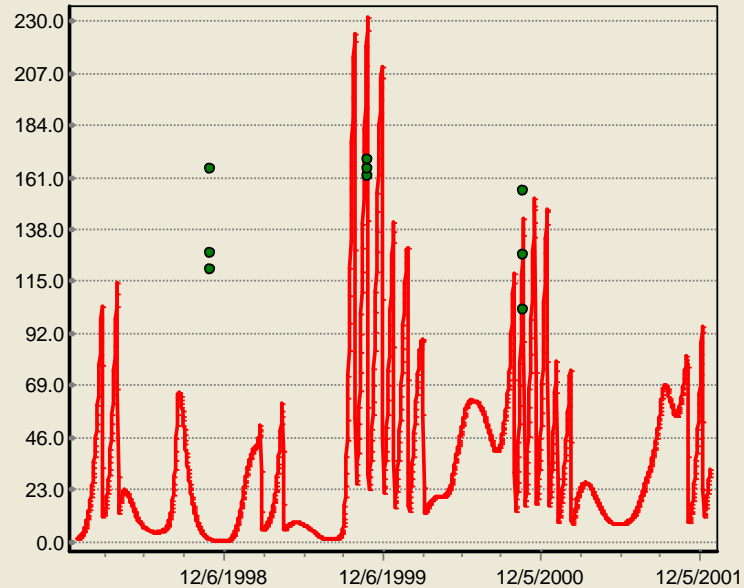
control: all algae, perturbed: high-nutrient diatoms & greens

Parma, LBR ID (Control)
Run on 02-10-13 7:54 AM



— Peri. Chlorophyll (mg/sq.m)
● Obs peri chl a (mg/sq.m)

Parma, LBR ID (PERTURBED)
Run on 04-20-13 9:53 AM

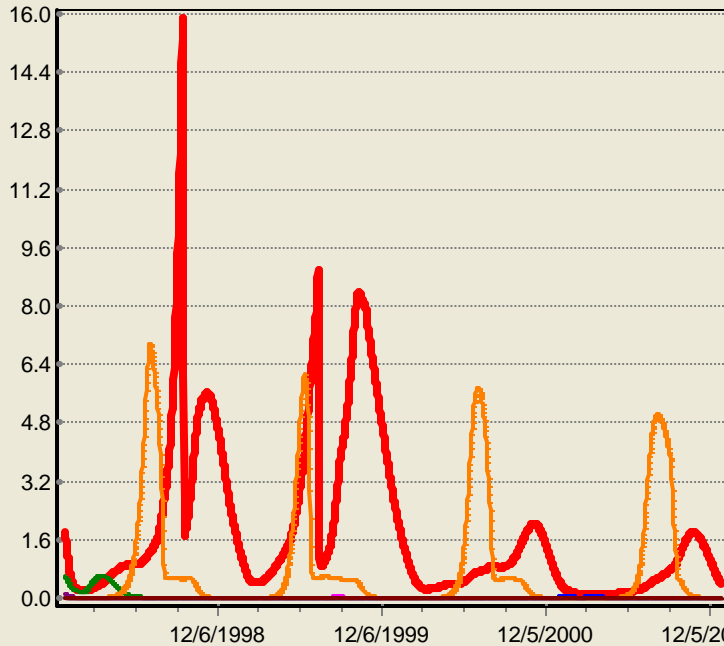


— Peri. Chlorophyll (mg/sq.m)
● Obs peri chl a (mg/sq.m)

Diversion-Eckert Road & Glenwood Br Sites

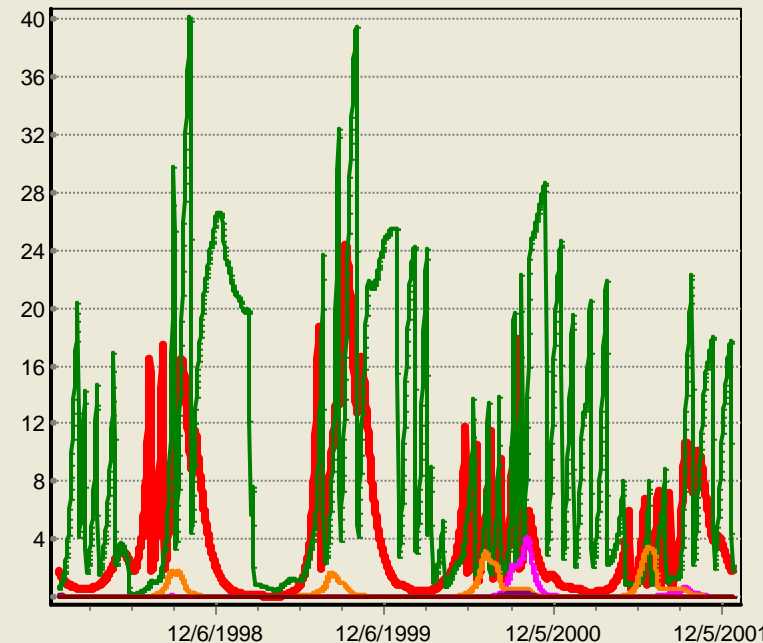
what additional group is needed? (*Cladophora* was observed)

Diversion-Eckert Road, LBR ID (Control)
Run on 02-10-13 8:22 AM



- Peri Low-Nut Diatom (g/m2 dry)
- Peri High-Nut Diatom (g/m2 dry)
- Peri, Navicula (g/m2 dry)
- Peri, Nitzschia (g/m2 dry)
- Cladophora (g/m2 dry)
- Peri, Green (g/m2 dry)
- Peri, Blue-Greens (g/m2 dry)
- Fontinalis (g/m2 dry)

Glenwood Br, LBR ID (Control)
Run on 02-10-13 7:40 AM



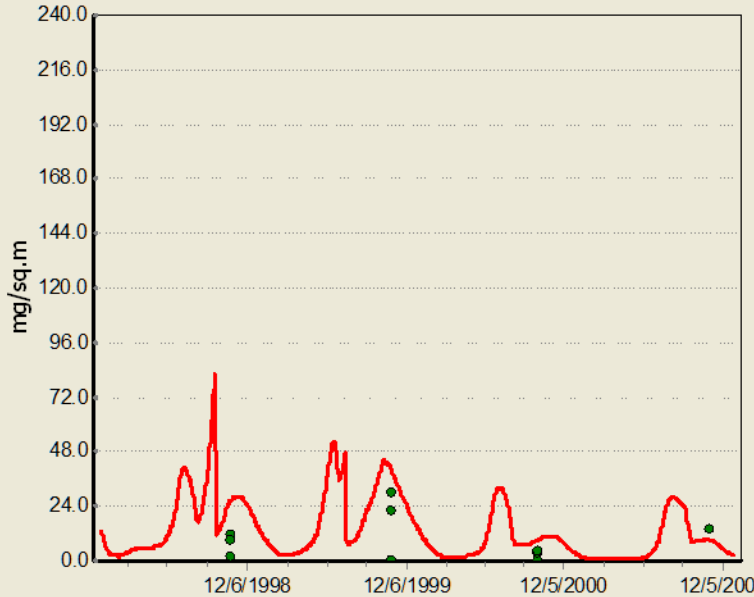
- Peri Low-Nut Diatom (g/m2 dry)
- Peri High-Nut Diatom (g/m2 dry)
- Peri, Navicula (g/m2 dry)
- Peri, Nitzschia (g/m2 dry)
- Cladophora (g/m2 dry)
- Peri, Green (g/m2 dry)
- Peri, Blue-Greens (g/m2 dry)
- Fontinalis (g/m2 dry)

low-nutrient diatoms are lacking
so add them (+ *Cladophora*?)

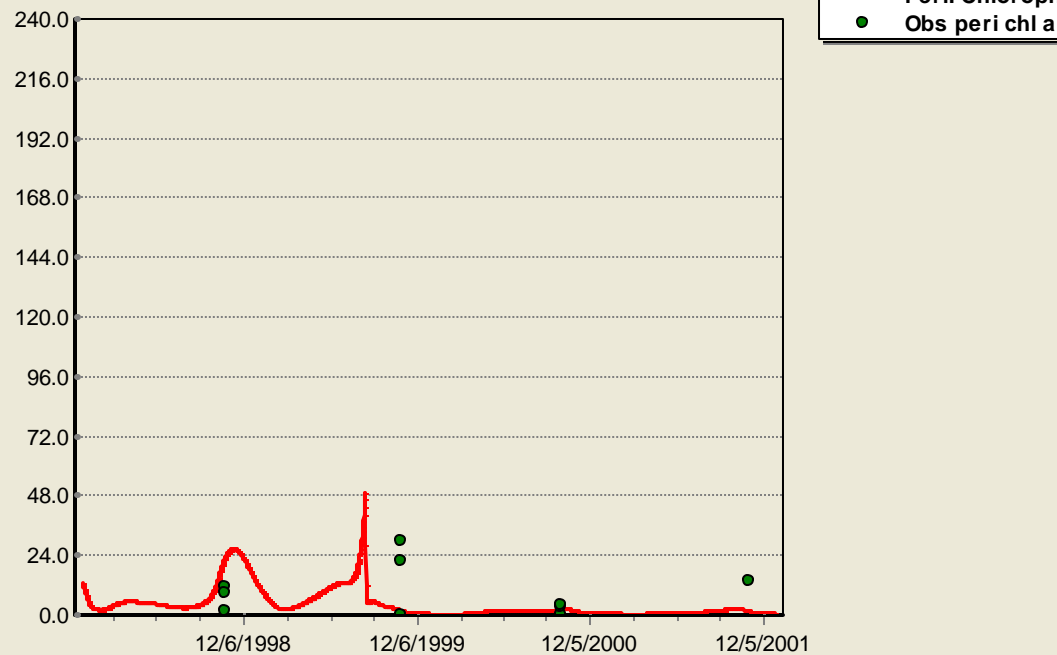
Diversion-Eckert Road Site

control: all algae, perturbed: high & low-nutrient diatoms & greens

Diversion-Eckert Road, LBR ID (Control)
Run on 02-10-13 8:22 AM



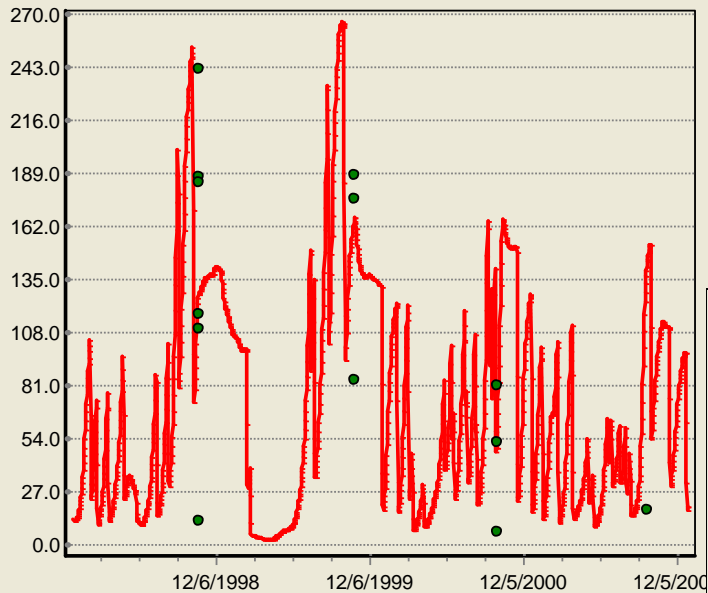
Diversion-Eckert Road, LBR ID (PERTURBED)
Run on 04-21-13 5:58 AM



Glenwood Bridge Site

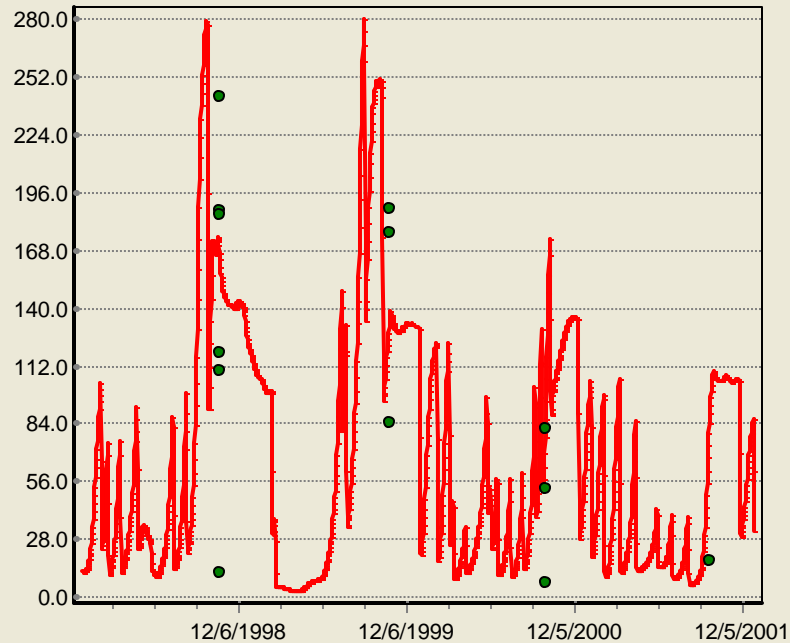
control: all algae, perturbed: high & low-nutrient diatoms & greens

Glenwood Br, LBR ID (Control)
Run on 02-10-13 7:40 AM



— Peri. Chlorophyll (mg/sq.m)
● Obs peri chl norm (mg/sq.m)

Glenwood Br, LBR ID (PERTURBED)
Run on 04-21-13 6:02 AM



— Peri. Chlorophyll (mg/sq.m)
● Obs peri chl norm (mg/sq.m)

Caveat: almost no cyanobacteria in simulation cyanobacteria (and *Cladophora*) important in 2007 data

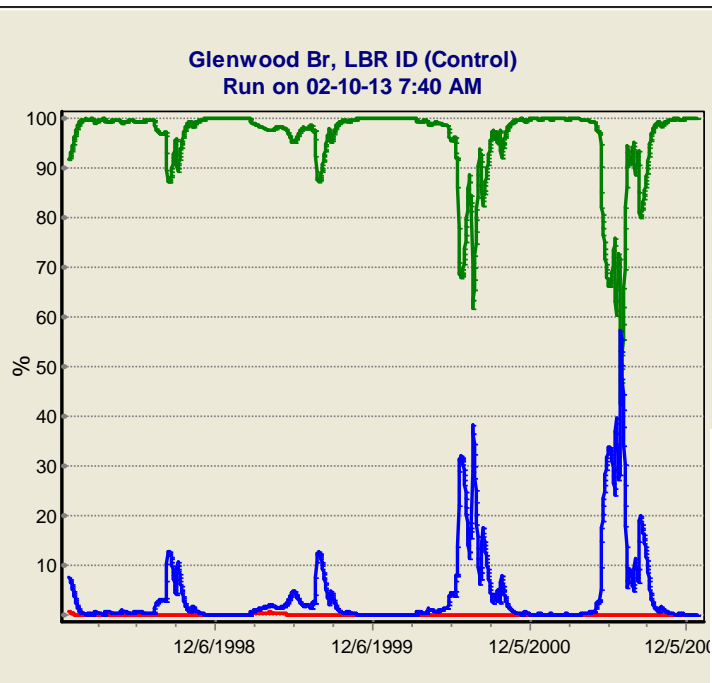
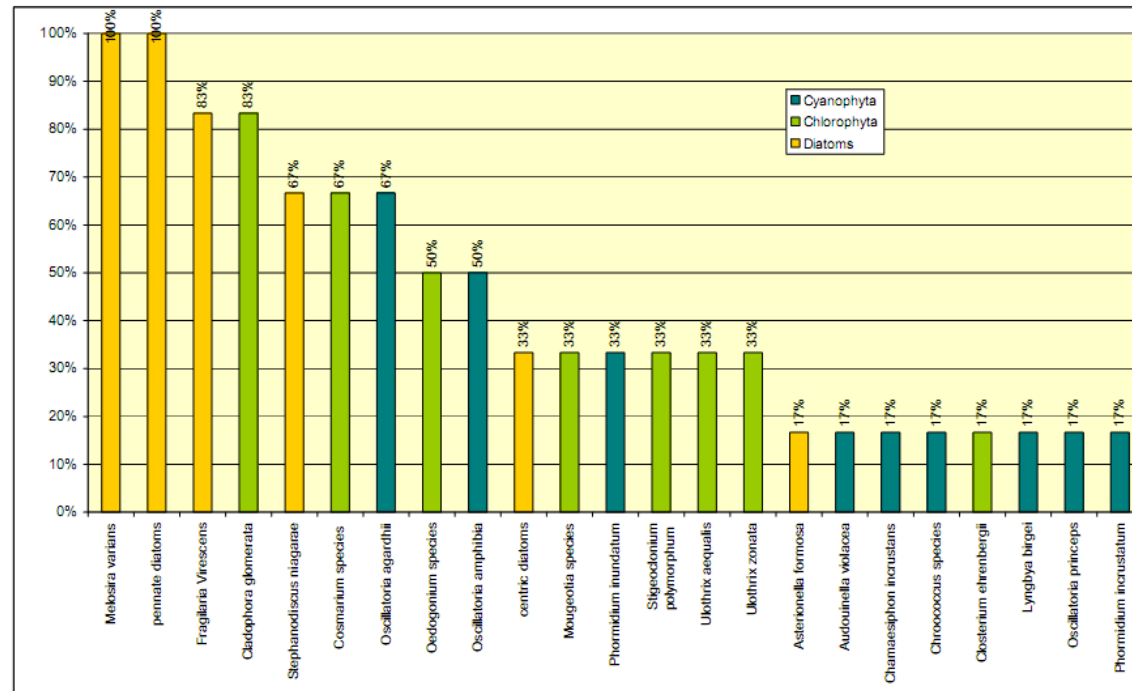


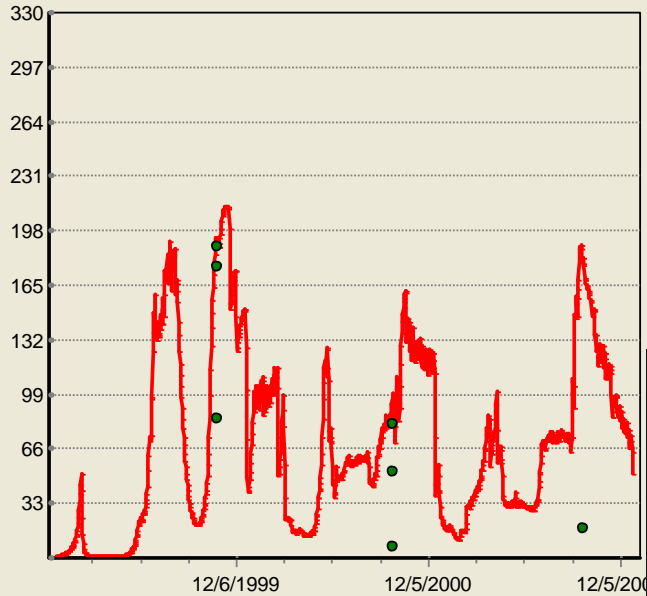
Figure 1. Occurrence of taxon in periphyton samples from Boise River collected in March, 2007.



Glenwood Bridge Site

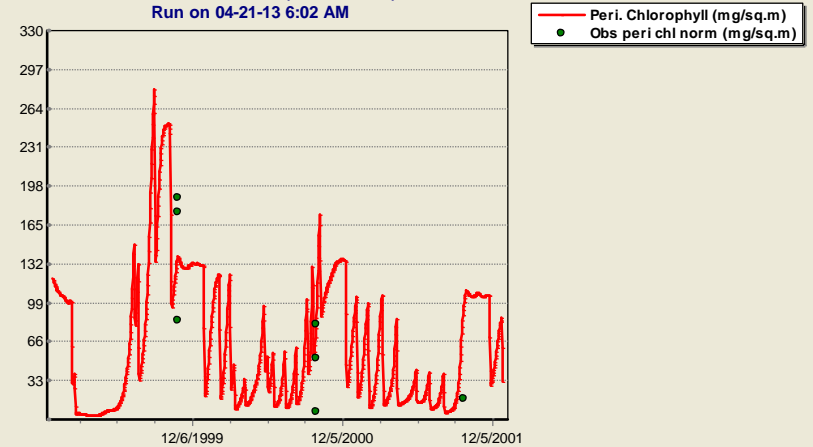
control: old linked calibration, perturbed: present 3 periphyton groups

Glenwood (Control)
Run on 08-8-12 11:03 AM



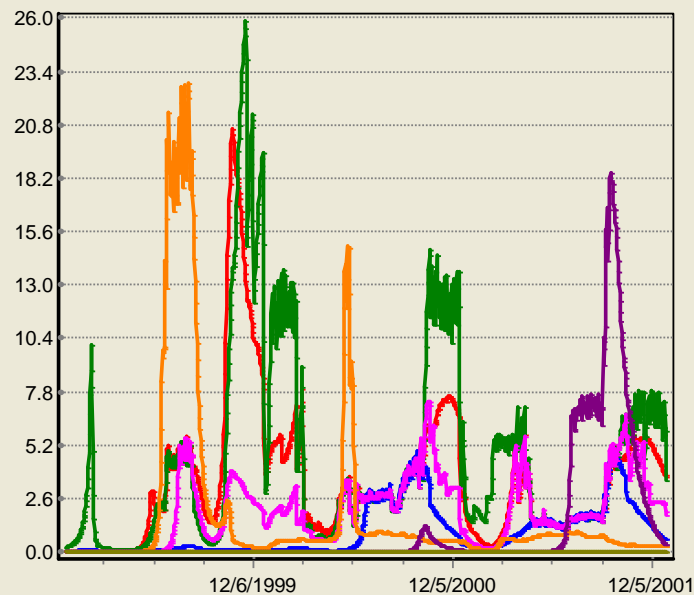
— Peri. Chlorophyll (mg/sq.m)
● Peri Chl a at Glenwood (mg/sq.m)

Glenwood Br, LBR ID (PERTURBED)
Run on 04-21-13 6:02 AM



— Peri. Chlorophyll (mg/sq.m)
● Obs peri chl norm (mg/sq.m)

Glenwood (Control)
Run on 08-8-12 11:03 AM



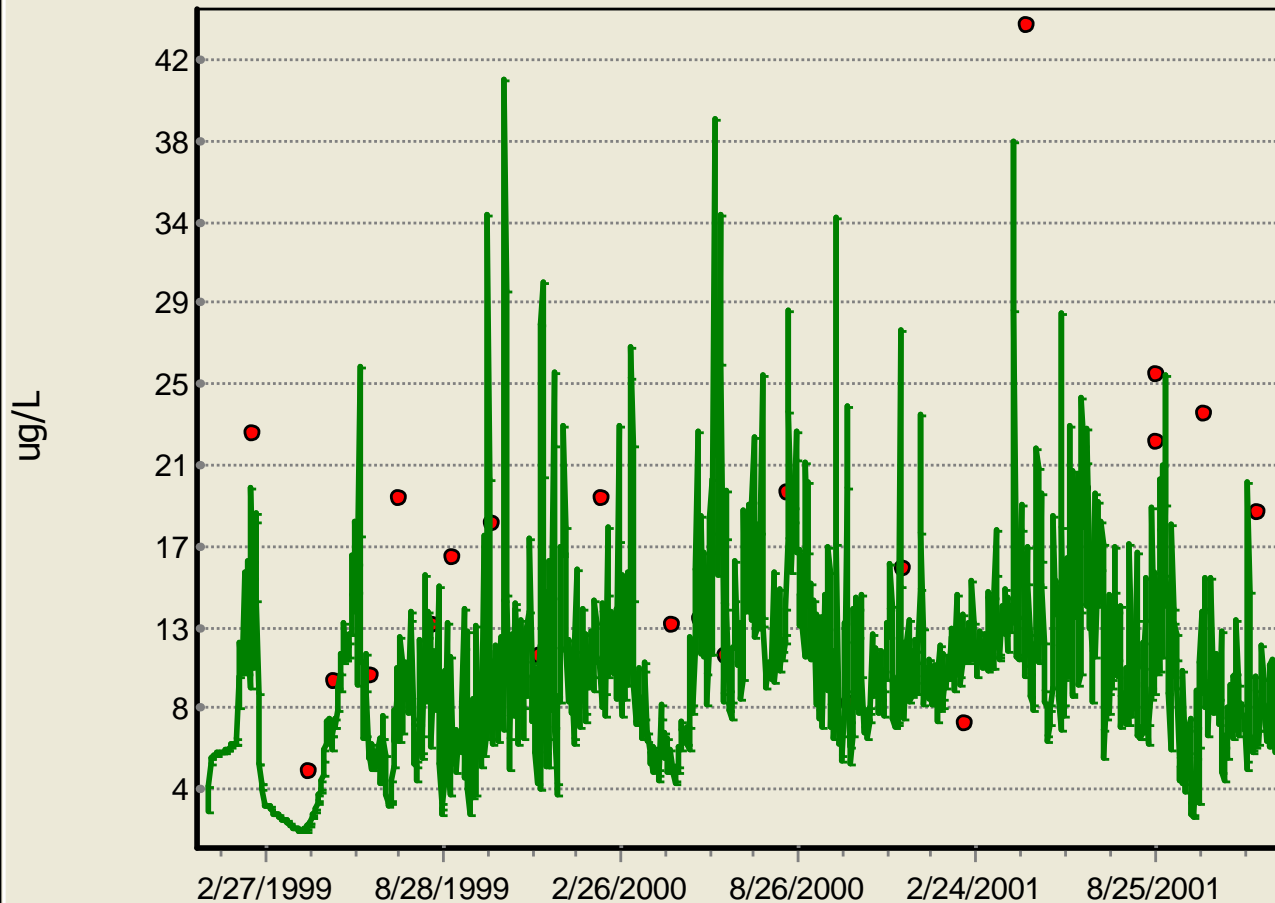
— Peri Low-Nut Diatom (g/m² dry)
— Peri High-Nut Diatom (g/m² dry)
— Peri, Navicula (g/m² dry)
— Peri, Nitzschia (g/m² dry)
— Cladophora (g/m² dry)
— Peri, Green (g/m² dry)
— Peri, Blue-Greens (g/m² dry)

Implications for Phytoplankton

- Periodically periphyton slough or are scoured, forming sestonic algae; sestonic algae-phytoplankton may settle to the bottom, contributing to periphyton downstream
- If sestonic chlorophyll *a* is a target endpoint, additional calibration may be required because of sensitivity to site-specific conditions such as variable retention times
- Linked stream segments *must* be used to accurately model phytoplankton

Parma is especially sensitive to upstream processes such as scour of periphyton and agricultural drainage with nutrients and turbidity

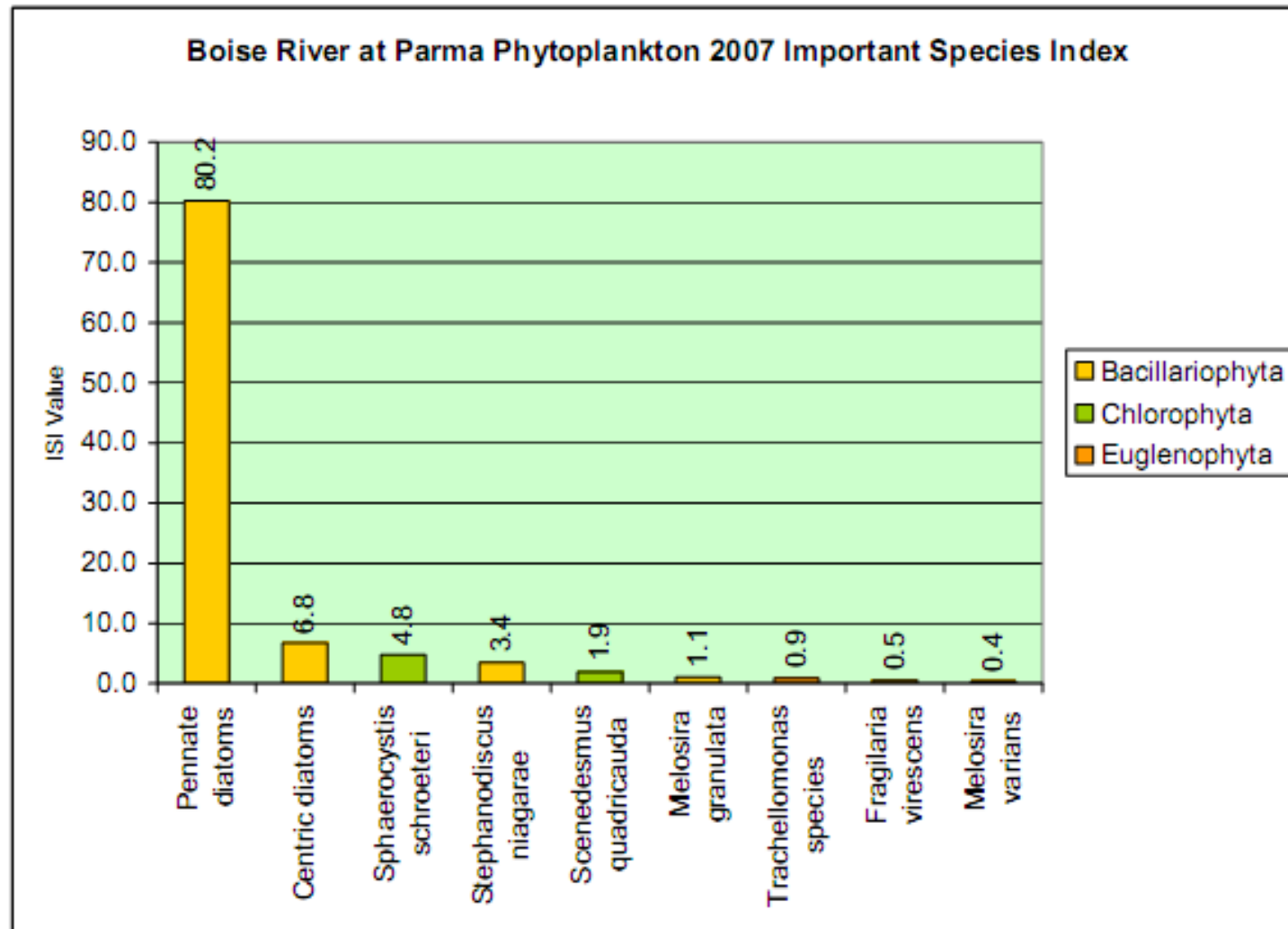
Parma (PERTURBED)
Run on 10-24-07 10:37 PM



● Obs Chla at Parma (ug/L)
— Phyto. Chlorophyll (ug/L)

Linked segment
mean retention = 0.2 d

March 2007 phytoplankton sample at Parma similar to Caldwell periphyton



Caldwell periphyton:

Algal biomass comprised primarily of Pennate diatoms, which are abundant and diverse. Filamentous blue-green algae present as well as rare filamentous green algae.

In Conclusion

- Can probably limit simulation of LBR algae to low- and high-nutrient diatoms and to greens
- Should link periphyton and phytoplankton (sestonic algae)
- In addition to representing complex hydrology and cumulative effects of multiple sources of nutrients, it is advisable to use linked segments because of impact of transport of sestonic algae from upstream