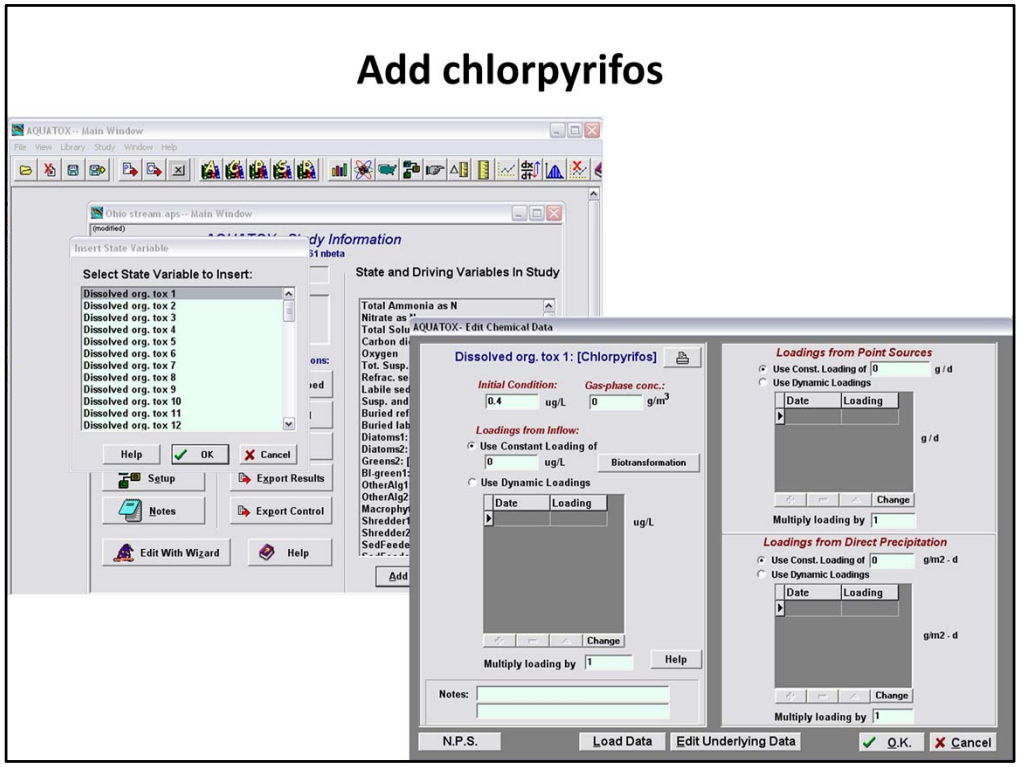
Lab 7: Risk Assessment of Insecticide in Ohio Stream

Objective: analyze direct and indirect ecotoxicological effects with model

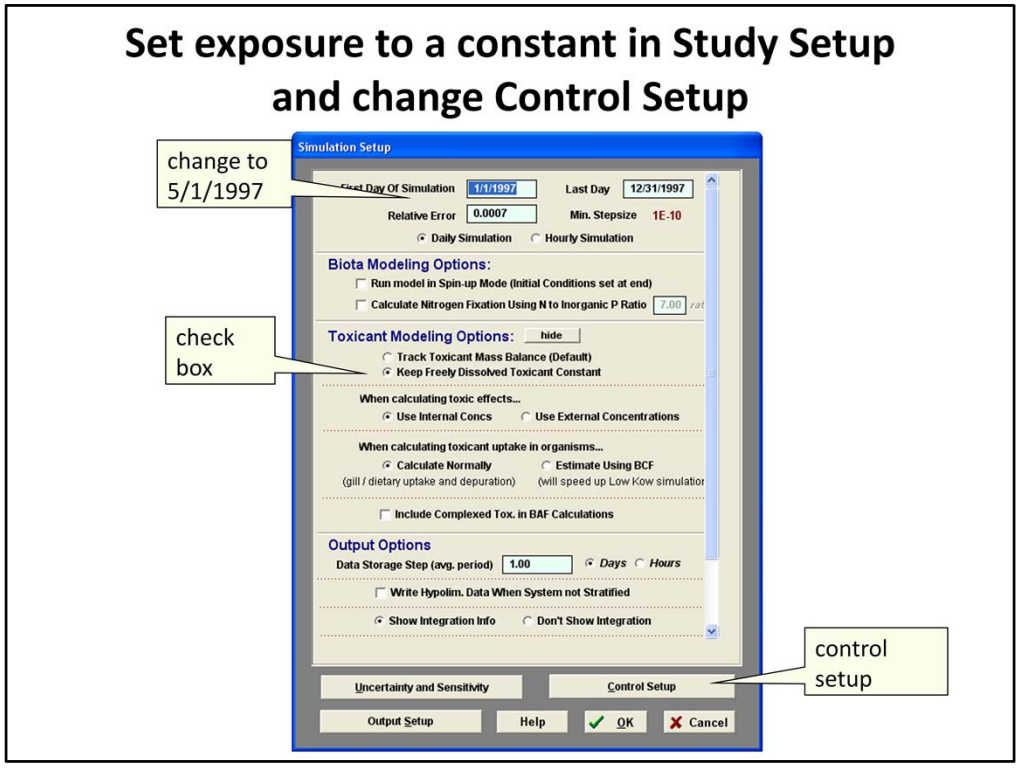
- Assessment of chlorpyrifos in a generic stream
  - small stream in corn belt
  - drain tiles
- Open Ohio Stream.aps,
- Add chlorpyrifos, save as Ohio Stream chlor.aps
- Run, plot, analyze control/perturbed/ %difference
- Compare constant exposure vs. single dose

We will use a constant level of 0.4 ug/L chlorpyrifos in a generic small stream for purposes of risk assessment. This concentration is based on the worst-case value chosen by US EPA for risk assessment of chlorpyrifos. We will start the simulation on May 1, the start of the growing season.
The second simulation will compare a constant dose against a single, initial dose of the same magnitude.

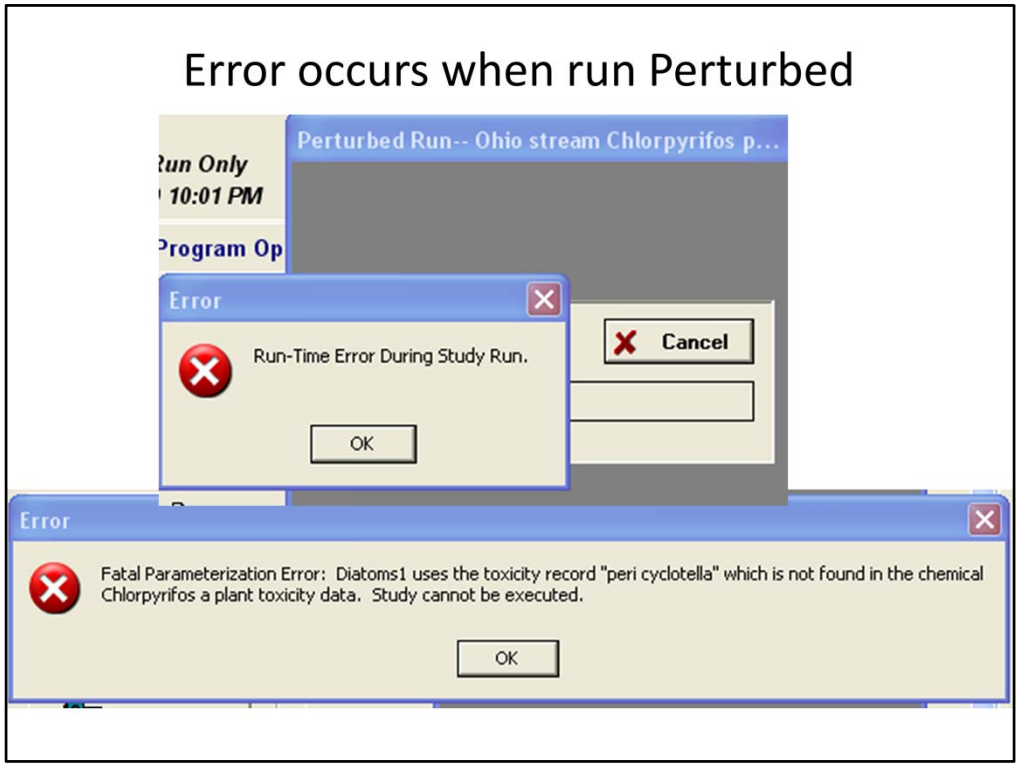
Add chlorpyrifos



Add Dissolved org. tox 1 as statevariable
Choose **chlorpyrifos**
Double-click on **Dissolved org. tox 1 [chlorpyrifos]** in the state variable list
Set the initial condition to 0.4 ug/L
Click on **OK** to exit
Save as **Ohio stream chlorpyrifos.aps**

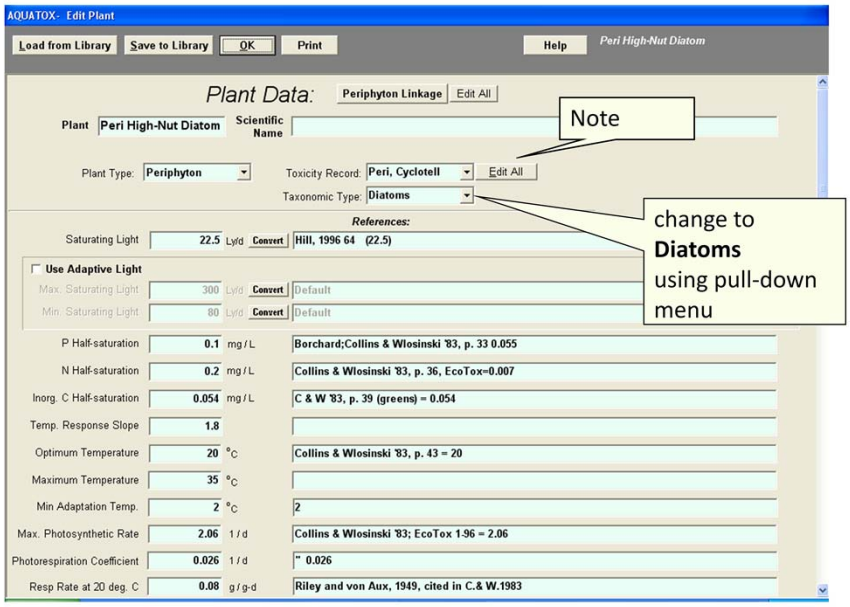


In Main Screen click on **Study Setup**
Check box **Keep Freely Dissolved Contaminant Constant**
Change start date to **5/1/1997** (to speed up simulation)
In **Control Setup** check **All Organic Toxicants** boxes (so Control will not have chlorpyrifos)



Run the perturbed simulation. We have purposefully included an error! Organisms must be linked to a valid toxicity record for the toxicant being modeled. The disconnect occurs when organisms are parameterized for one toxicant and then used for another toxicant with different available toxicity data.

Change the linkage to toxicity record

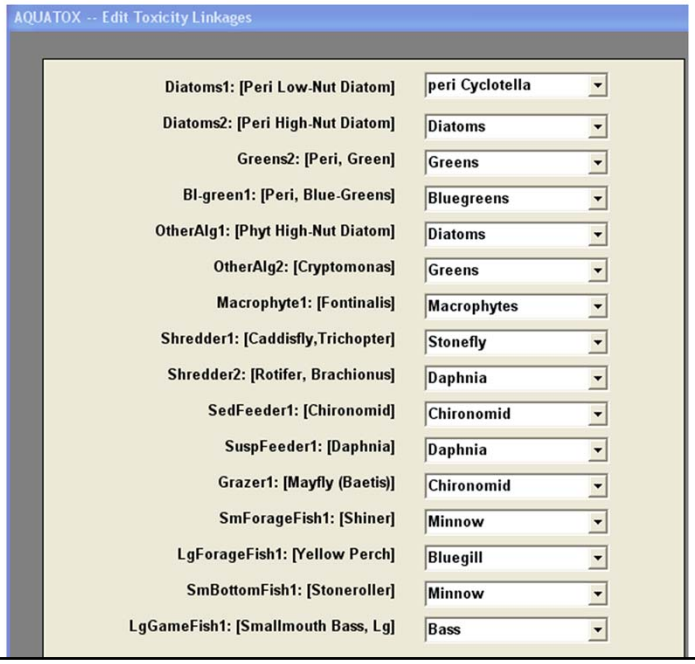


The pull-down menu for the Toxicity Record lists the available state-variable linkages for the toxicant. As you have seen, if you miss an assignment the program will return an error and tell you which state variable is unassigned.

If you need to make more than one toxicity assignment, click on **Edit All** next to the pull-down menu.

In order to fix this simulation, double-click on Diatoms1:[Peri Low-Nut Diatom], click on Edit Underlying Data, and click Edit All…

Can edit all toxicity linkages

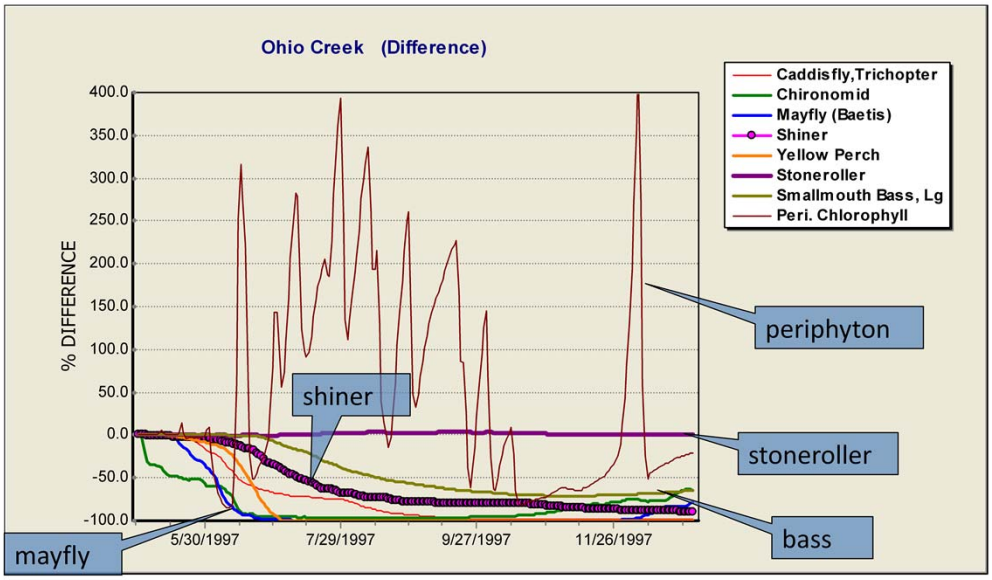


By clicking on **Edit All** next to the toxicity assignment you can assign all linkages in one screen.

Change the toxicity linkage for Diatoms1:[Peri Low-Nut Diatom] from peri Cyclotella to Diatoms.

Run both the control and perturbed simulations.

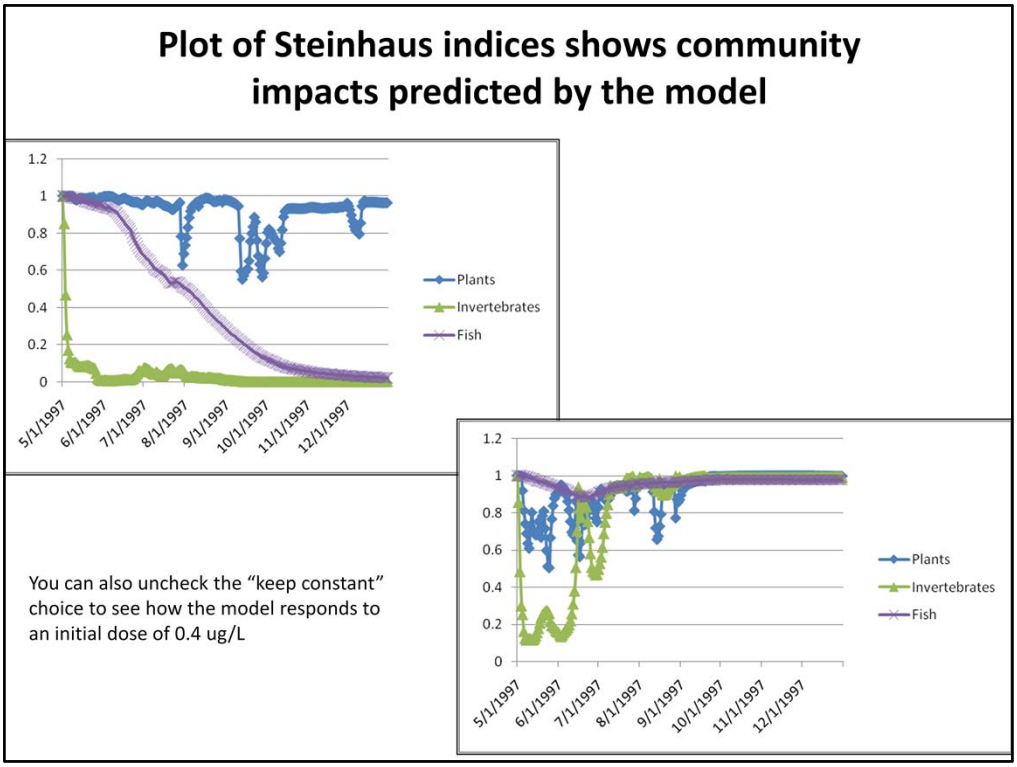
Impacts of constant chlorpyrifos on animals are dramatic, algae increase



The best indication of the impacts are to be seen in a **Difference** graph that compares the perturbed with the control. To get this you have to run the simulations for the same period. Note that most of the invertebrates disappear quickly, followed by the fish. Shiners and stonerollers share the same toxicity record (Minnow), so the relative decline of shiners is due to loss of invertebrate food base and not direct toxicity whereas stonerollers, which graze periphyton, are unaffected.

What is the impact of an initial (rather than constant) exposure to 0.4 ug/L chlorpyrifos on May 1?

Within a week the chironomids are reduced by > 99%, in 2 weeks Mayfly numbers are reduced by more than 95%, in one month Caddisflies are reduced by almost 94%. In about 2 months the yellow perch population is < 1% its starting amount and in 3 months the Smallmouth Bass population is reduced to half its original number. By the end of 1997, the Shiner population in >99% lost. Conversely, the stoneroller population decreases by no more than 10% before rebounding and periphyton experience some blooms and smaller die-offs.



The chronic exposure to 0.4 ug/L chlorpyrifos is predicted to lead to the rapid disappearance of invertebrates followed by fish. Periphyton are also affected due to release of herbivory.

An acute exposure of 0.4 ug/L is predicted to result in a significant change in the animals (about 80% dissimilarity for invertebrates compared to the control). However, complete recovery is predicted in about 5 months.

The output files with graphs are in the Data directory as **Ohio stream Chlorpyrifos constant_Stein.xlsx** and **Ohio stream Chlorpyrifos pulse_Stein.xls.**