Appendix G

Guide to Electronic Appendix

An electronic appendix is provided with electronic files related to modeling aspects of this study described in sections 5.3, 5.3, and 5.5 of the report.

5.3 Building phytoplankton competitors into numerical model

For the models described in this section of the report, numerical integration of ordinary differential equations used a 4th-5th order Runge-Kutta algorithm, implemented in Fortran programs. Embedded comments in source code files explain the major variables and how the programmer can adjust their values to obtain the various kinds of output required to explore the model. Program output was stored in Excel files that are also provided, with internal commentary. All programs were compiled with the Absoft Fortran compiler v. 1.0.4 running on IBM PC computers and Windows XP. Several programs were also tested under older versions of the Digital Visual Fortran compiler and the open source G95 compiler, and found to run identically.

The following folders and files are provided:

Dynamic grazer models.doc – Documents construction of the model described in the report and several additional related models.
Dynamic grazer models sensitivity analysis and calibration.doc – Documents sensitivity analysis of the model described in the report, and its calibration to one year of observational data from Lake Granbury. Similar exercises for several related models are also documented.
Lake Granbury validation forcing data.xls – Documentation and calculations of the forcing data required for validation of the model as described in the report.
Lake Granbury Temperature.xls – Documentation and calculations of the temperature forcing data required for validation of the model as described in the report.
Lake Granbury TN.xls – Documentation and calculations of the nitrogen supply forcing data required for validation of the model as described in the report.
Lake Granbury TP.xls – Documentation and calculations of the phosphorus supply forcing data required for validation of the model as described in the report.
Lake Granbury Dilution.xls – Documentation and calculations of the hydraulic dilution forcing data required for validation of the model as described in the report.
Lake Granbury Light.xls – Documentation and calculations of the irradiance forcing data required for validation of the model as described in the report.
Lake Granbury Salinity.xls – Documentation and calculations of the salinity forcing data required for validation of the model as described in the report.
Lake Granbury P Parvum observations.xls – Documentation and calculations of the observational data on P. parvum density required for validation of the model as described in the report.
Folder\PP1A with grazers and toxin inhibition – Folder with program pp1agt.for, which drives one run of the model described in the report, for a number of years specified by the user. Several text files are provided with the necessary input
forcing data. Several Excel files are provided that document program output with the initially assigned parameter values, and the values assigned at different stages of the calibration described in the report.

Folder\PP1A with grazers and toxins sensitivity analysis – Folder with program pp1agtgs.for, which drives 50 runs of the model described in the report, each with a different value for a selected parameter. Several text files are provided with the necessary input forcing data. Several Excel files are provided that document program output when each parameter was varied in the first stage of the sensitivity analysis and calibration described in the report.

Folder\PP1A with grazers and toxins sensitivity analysis 2 – Folder with program pp1agtgs.for, which drives 50 runs of the model described in the report, each with a different value for a selected parameter. Several text files are provided with the necessary input forcing data. Several Excel files are provided that document program output when each parameter was varied in the second stage of the sensitivity analysis and calibration described in the report.

Folder\PP1A with grazers and toxins sensitivity analysis 3 – Folder with program pp1agtgs.for, which drives 50 runs of the model described in the report, each with a different value for a selected parameter. Several text files are provided with the necessary input forcing data. Several Excel files are provided that document program output when each parameter was varied in the third stage of the sensitivity analysis and calibration described in the report.

Folder\PP1A with grazers and toxins validation – Folder with program pp1agtvs.for, which runs the model described in the report for a period of about two years for the validation experiment. Several text files are provided with the necessary input forcing data. An Excel file is provided that documents program output.

5.4 Building *P. parvum* mixotrophy effects into numerical model from laboratory experiments

The models described in this section of the report were run as MATLAB scripts (under versions R2009a to R2010a), using the ode23s command to numerically integrate ordinary differential equations. The following files are provided:

Golden Algae Simulations.pdf – File has MATLAB scripts for the models referred to, and tables of the input data used.

5.5 Expanding “box” model into a 1-dimensional model

For the models described in this section of the report, numerical integration of partial differential equations used MacCormack algorithm, implemented in Fortran programs. Numerical integration of ordinary differential equations used a 4<sup>th</sup>-5<sup>th</sup> order Runge-Kutta algorithm, also implemented in Fortran programs. Embedded comments in source code files explain the major variables and how the programmer can adjust their values to obtain the various kinds of output required to explore the model. Program output was stored in Excel files that are also provided, with internal commentary. All programs were compiled with the Absoft Fortran compiler v. 1.0.4 running on IBM PC
computers and Windows XP. Several programs were also tested under older versions of the Digital Visual Fortran compiler, and found to run identically.

The following folders and files are provided:

Folder\Riverine reservoir P-lim cylindro – Folder with programs, input data and record of results for the model of a riverine reservoir parameterized with P-limited cylindrospermopsis producers. Program adstor1.for runs the model with constant parameters for a length of simulated time specified by an adjustable variable. Program dil1.for runs the model with a time-variable hydraulic dilution rate for a number of simulated years specified by the user. All other parameters are constant. Program pe1.for runs the model with a time-variable hydraulic dilution rate for a number of simulated years specified by the user. Dispersion is proportional to the dilution rate, so that constant Pe number is maintained. Program tempd1.for runs the model with a time-variable hydraulic dilution rate and temperature for a number of simulated years specified by the user. Several biological parameters vary in relation to temperature as described in the report. Several text files provide the input forcing data used for model runs with variable parameter values. Several Excel files record the program output that was used to construct some of the figures in the report.

Folder\Riverine reservoir N-lim cylindro – Folder with programs, input data and record of results for the model of a riverine reservoir parameterized with N-limited cylindrospermopsis producers. Program adstor1a.for runs the model with constant parameters for a length of simulated time specified by an adjustable variable. Program dil1a.for runs the model with a time-variable hydraulic dilution rate for a number of simulated years specified by the user. All other parameters are constant. Program pe1a.for runs the model with a time-variable hydraulic dilution rate for a number of simulated years specified by the user. Dispersion is proportional to the dilution rate, so that constant Pe number is maintained. Program tempd1a.for runs the model with a time-variable hydraulic dilution rate and temperature for a number of simulated years specified by the user. Several biological parameters vary in relation to temperature as described in the report. Several text files provide the input forcing data used for model runs with variable parameter values. Several Excel files record the program output that was used to construct some of the figures in the report.

Folder\Riverine reservoir P-lim flagellates – Folder with programs, input data and record of results for the model of a riverine reservoir parameterized with P-limited flagellates. Program adstor2.for runs the model with constant parameters for a length of simulated time specified by an adjustable variable. Program dil2.for runs the model with a time-variable hydraulic dilution rate for a number of simulated years specified by the user. All other parameters are constant. Program pe2.for runs the model with a time-variable hydraulic dilution rate for a number of simulated years specified by the user. Dispersion is proportional to the dilution rate, so that constant Pe number is maintained. Program tempd2.for runs the model with a time-variable hydraulic dilution rate and temperature for a number of simulated years specified by the user. Several biological parameters vary in relation to temperature as described in the report. Several text files provide the
input forcing data used for model runs with variable parameter values. Several Excel files record the program output that was used to construct some of the figures in the report.

Folder Cove-lake P-lim cylindro – Folder with programs, input data and record of results for the model of a coupled cove and main lake parameterized with P-limited cylindrospermopsin producers. Program grad1.for runs the model with constant parameters for a length of simulated time specified by an adjustable variable. Program dil1.for runs the model with a time-variable hydraulic dilution rate for a number of simulated years specified by the user. All other parameters are constant. Program tempd1.for runs the model with a time-variable hydraulic dilution rate and temperature for a number of simulated years specified by the user. Several biological parameters vary in relation to temperature as described in the report. Several text files provide the input forcing data used for model runs with variable parameter values. Several Excel files record the program output that was used to construct some of the figures in the report.

Folder Cove-lake N-lim cylindro – Folder with programs, input data and record of results for the model of a coupled cove and main lake parameterized with N-limited cylindrospermopsin producers. Program grad1a.for runs the model with constant parameters for a length of simulated time specified by an adjustable variable. Program dil1a.for runs the model with a time-variable hydraulic dilution rate for a number of simulated years specified by the user. All other parameters are constant. Program tempd1a.for runs the model with a time-variable hydraulic dilution rate and temperature for a number of simulated years specified by the user. Several biological parameters vary in relation to temperature as described in the report. Several text files provide the input forcing data used for model runs with variable parameter values. Several Excel files record the program output that was used to construct some of the figures in the report.

Folder Cove-lake P-lim flagellates – Folder with programs, input data and record of results for the model of a coupled cove and main lake parameterized with P-limited flagellates. Program grad2.for runs the model with constant parameters for a length of simulated time specified by an adjustable variable. Program dil2.for runs the model with a time-variable hydraulic dilution rate for a number of simulated years specified by the user. All other parameters are constant. Program tempd2.for runs the model with a time-variable hydraulic dilution rate and temperature for a number of simulated years specified by the user. Several biological parameters vary in relation to temperature as described in the report. Several text files provide the input forcing data used for model runs with variable parameter values. Several Excel files record the program output that was used to construct some of the figures in the report.