

Algal Speciation Model and Calibration of Potomac Portion of Chesapeake Bay Water Quality Model

*Synthesis of Gunston Cove and Chesapeake Bay Program
Algal Speciation Data Analysis*

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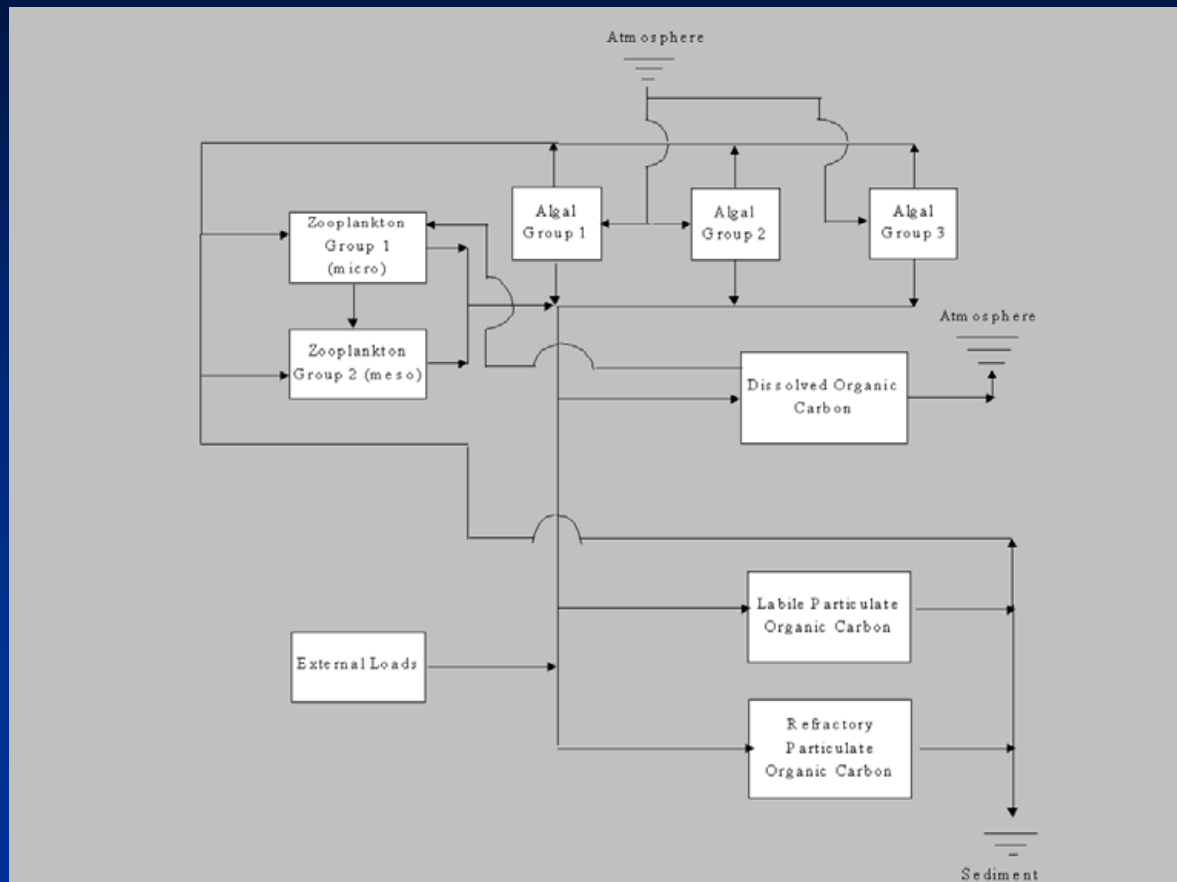
Study Objectives

- Refine and improve representation of dominant algal groups in the Potomac
- Calibrate the revised Potomac portion of the 57K Chesapeake Bay Water Quality Model (CBWQM)

Study Tasks

- **Literature Review**
 - Freshwater and marine phytoplankton species
 - Microcystis
 - Process representation and parameterization
- **Data Analysis**
 - CBP Living Resource Database
 - Data from 20-year Gunston Cove study (R. Christian Jones)
- **Development of New Algal Speciation Sub-Model**
 - How many algal groups?
 - How should they be characterized?
- **Calibration of Potomac Portion of CBWQM**
 - Stand-alone Potomac portion of 57K model
 - Will include revised pH-alkalinity sub-model
 - Period of simulation 1994-2000

Existing Algal Sub-Model



- Spring Diatoms
- Cyanobacteria (Blue-Greens)
- Other Green Algae

Model Design Considerations

- Nutrient requirements
- Salinity tolerance
- Temperature requirements
- Physiological parameters
 - Growth, death, metabolism, settling, etc.
- Susceptibility to grazing
- Water quality management issues
 - Microcystis blooms
- Model complexity
 - Difficult to model more than five groups
- Mass balance
 - Want to capture $\geq 95\%$ of algal biomass

Data Analysis

- **Data Sources**

- GCEMP, Chris Jones (GMU)
- CBP Data Hub, Living Resources Database

- **Spatial Scale**

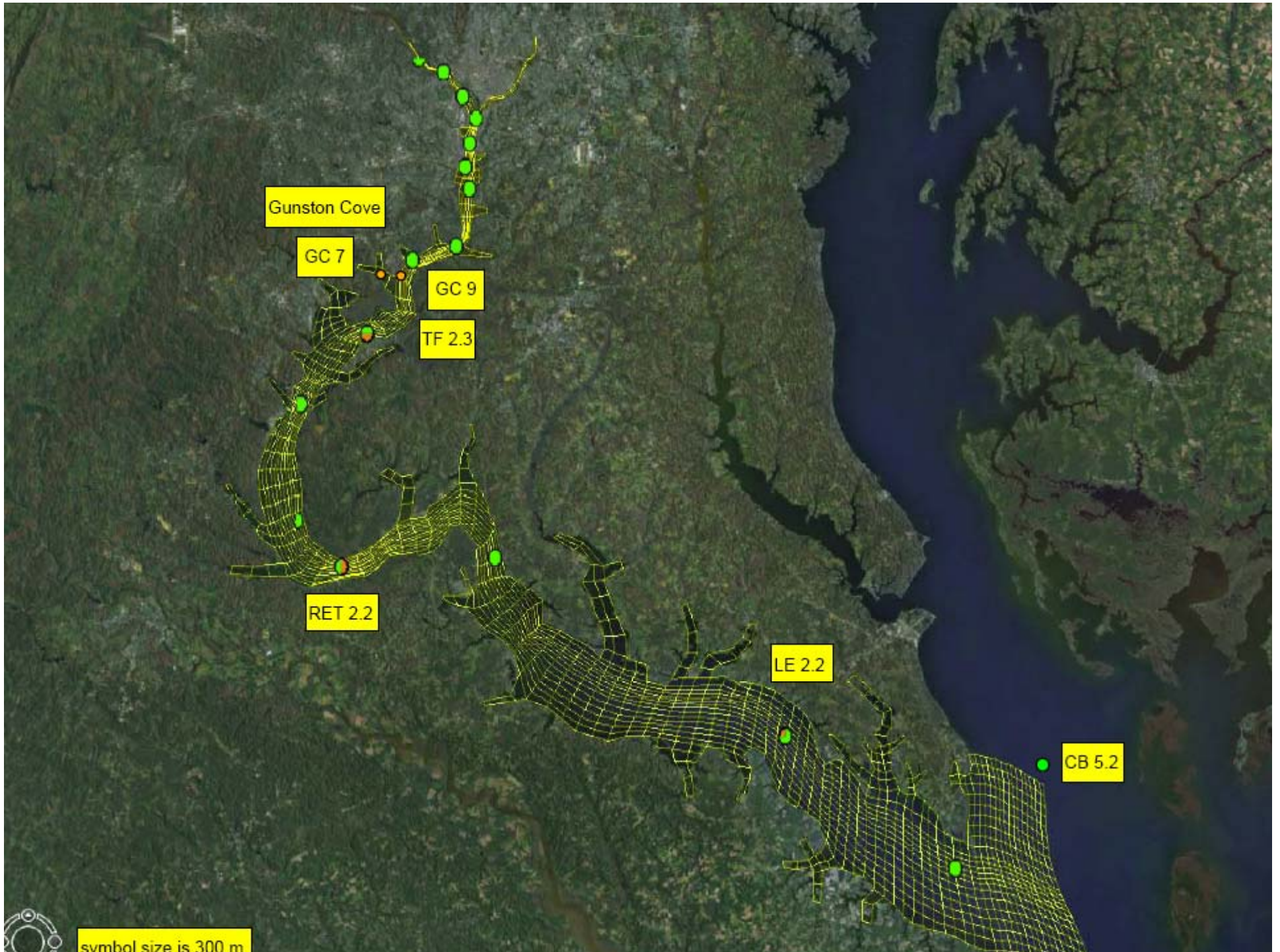
- Gunston Cove (GC7)
- Tidal fresh (GC9)
- Tidal fresh (TF2.3)
- River-estuary transition zone (RET2.2)
- Lower estuary (LE2.2)


- **Temporal Domain**

- 1984-2006

- **Parameters**

- Phytoplankton biomass, abundance, cell size
- Temperature, salinity, light attenuation, nutrients



 symbol size is 300 m

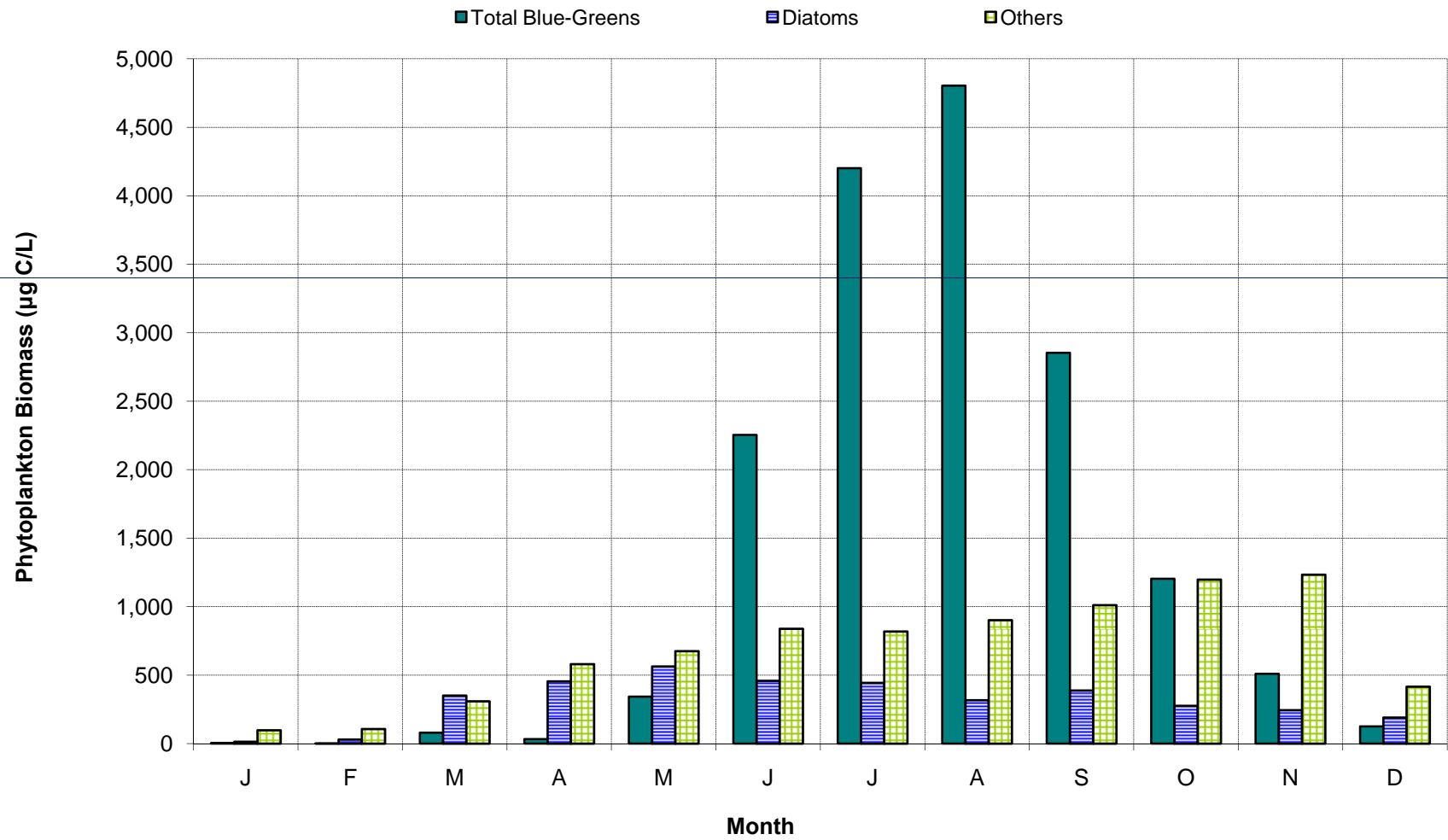
Proposed Model Algal Groups

- Tidal Freshwater Diatoms (Freshwater?)
- Lower Estuary Diatoms (Marine?)
- Dinoflagellates
- Greens
- Total Blue-Greens

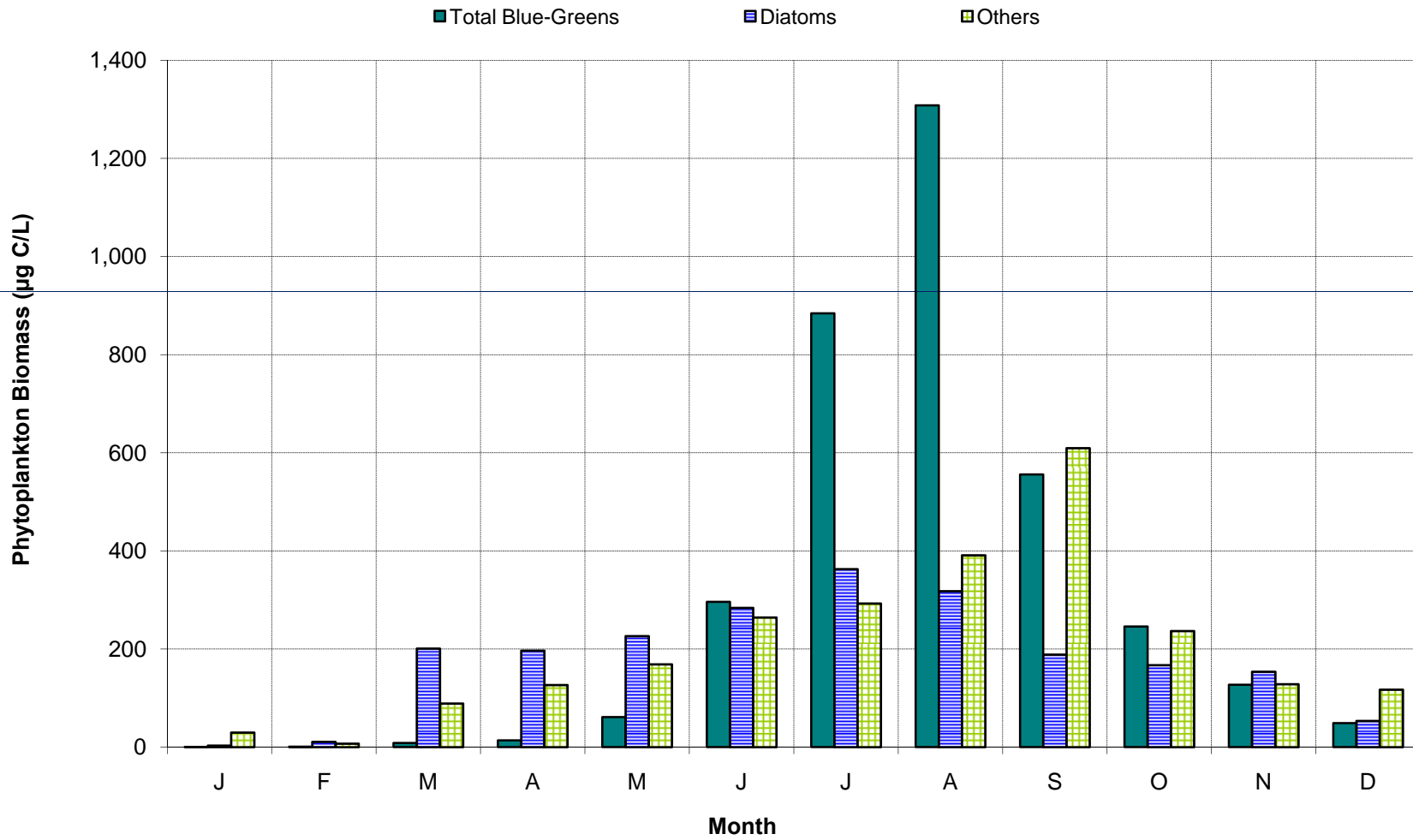
Measures of Phytoplankton Composition

*What groups contribute most of the
biomass as carbon?*

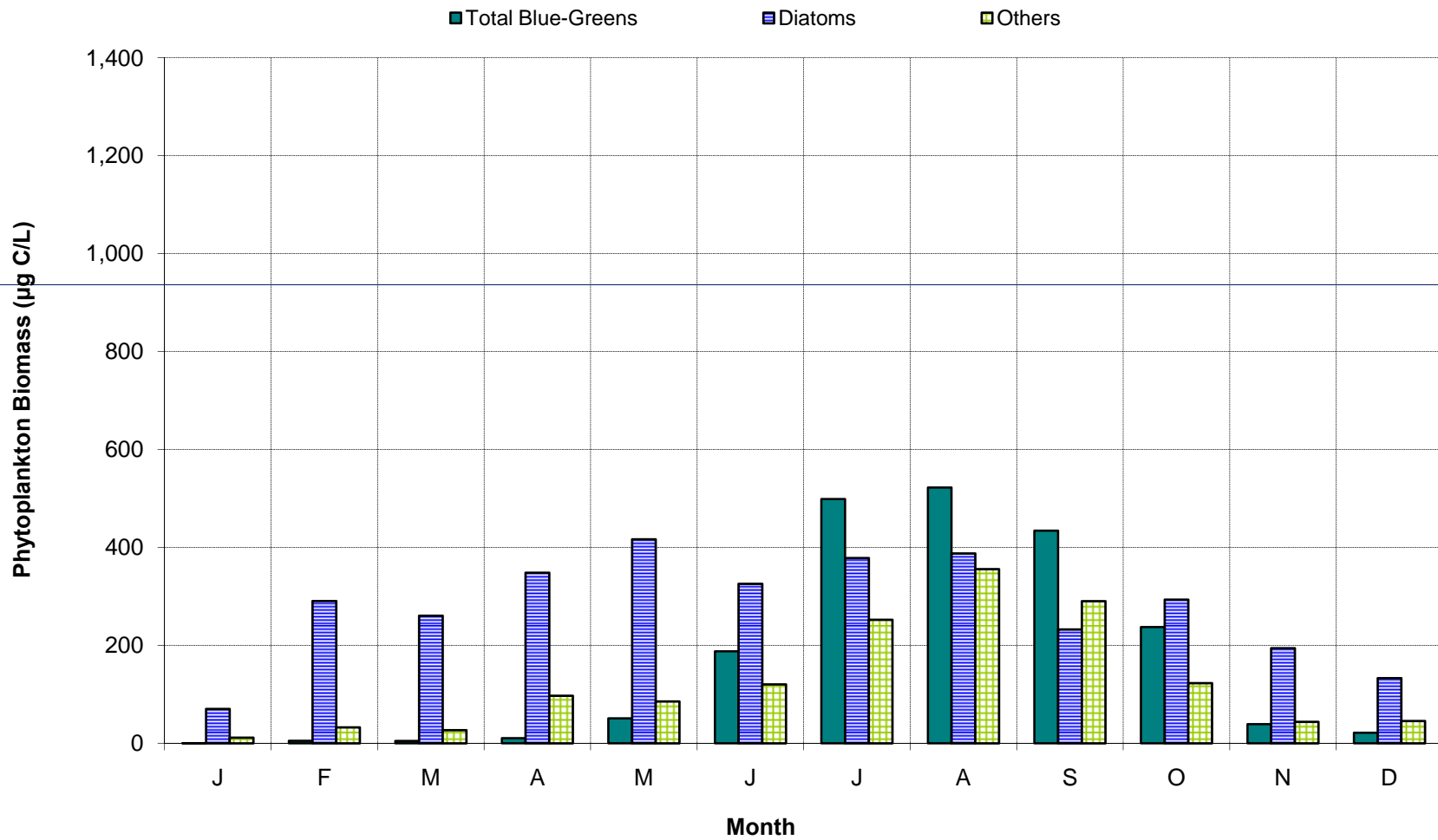
Phytoplankton "Group" Biomass - Gunston Cove (GC7) (1984-2005)



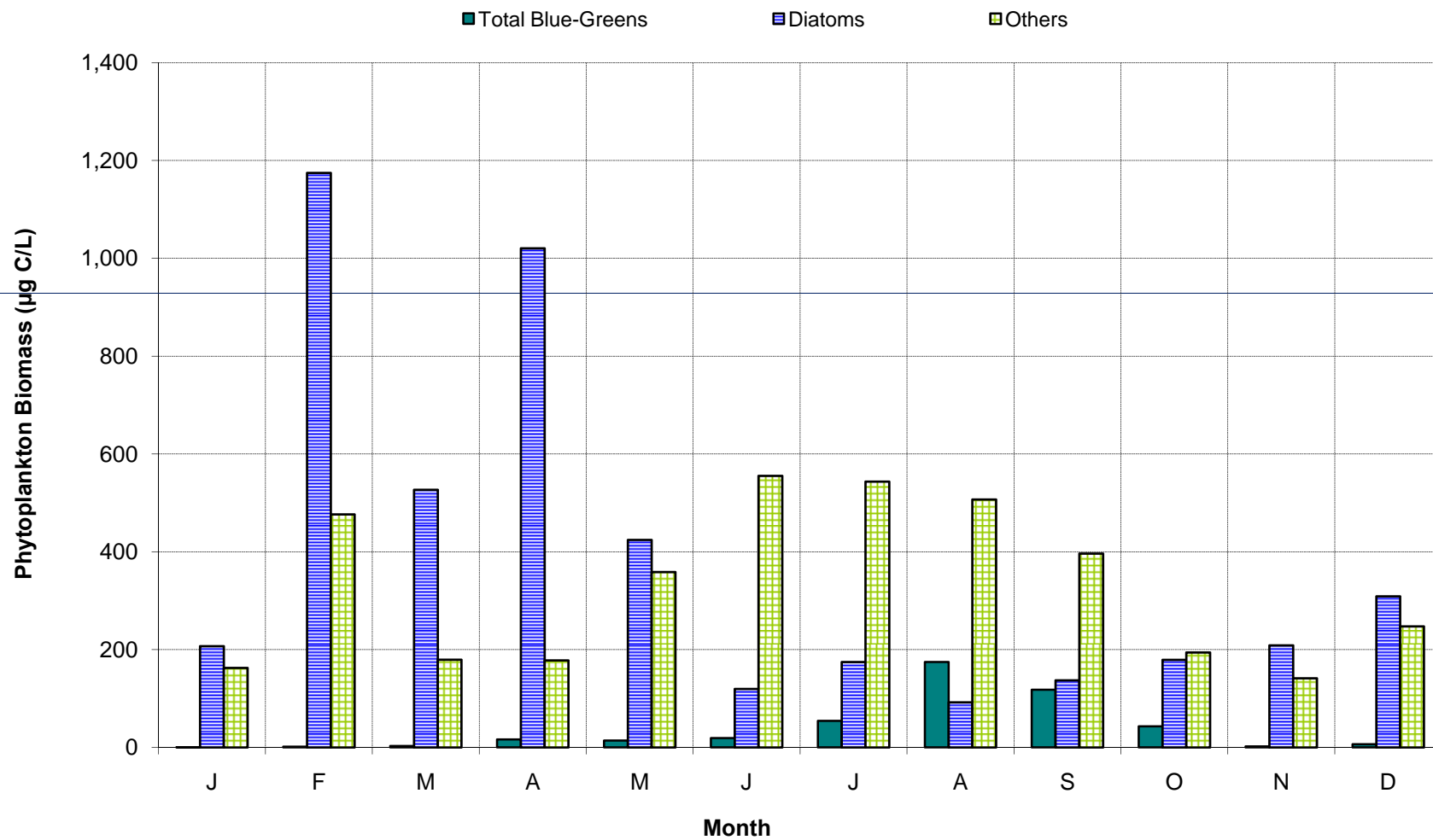
Phytoplankton "Group" Biomass - Tidal Fresh (GC9) (1984-2005)

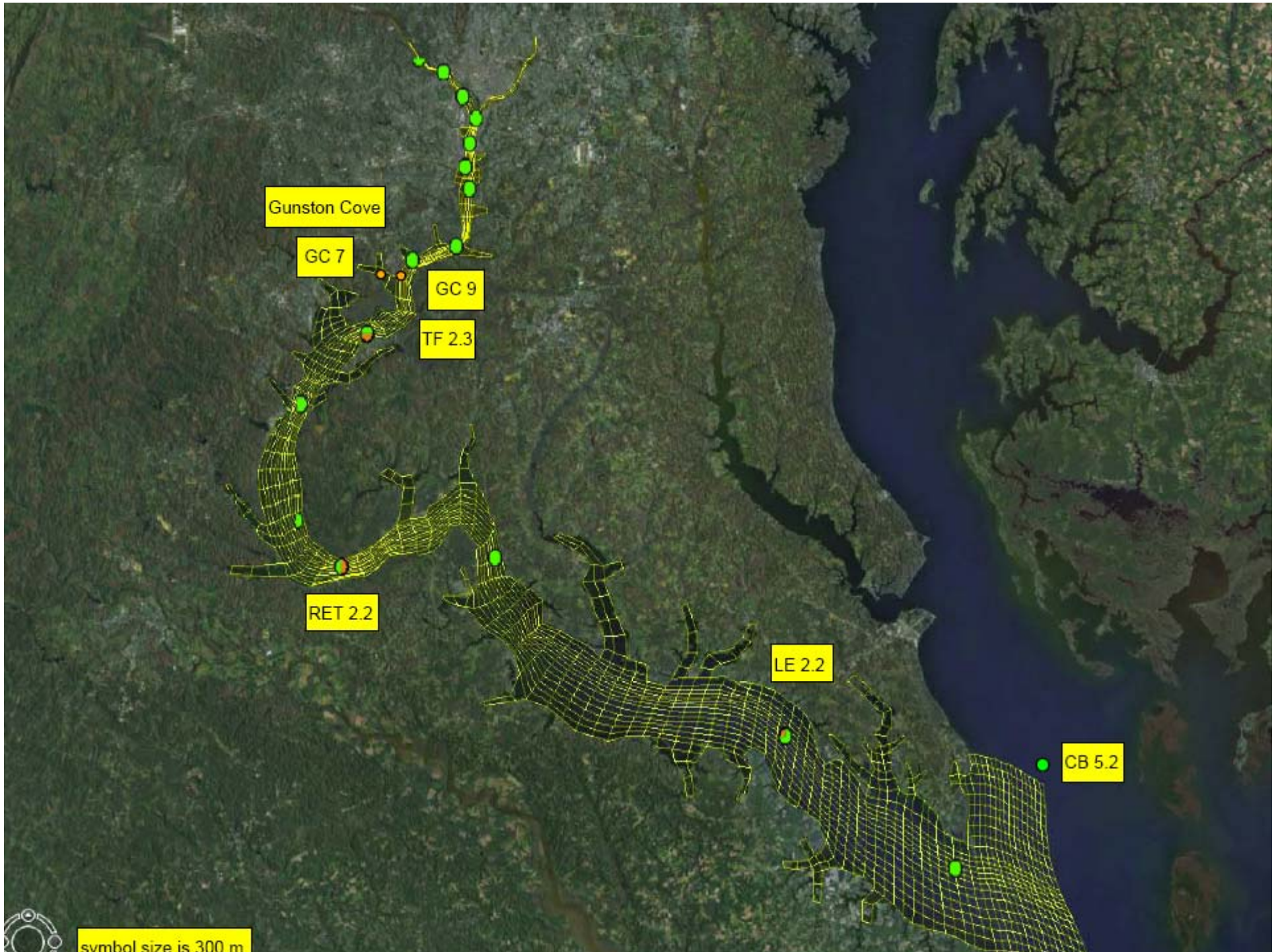


Phytoplankton "Group" Biomass - Station TF2.3 (1984-2006)



Phytoplankton "Group" Biomass - Station LE2.2 (1984-2006)





Gunston Cove

GC 7

GC 9

TF 2.3

RET 2.2

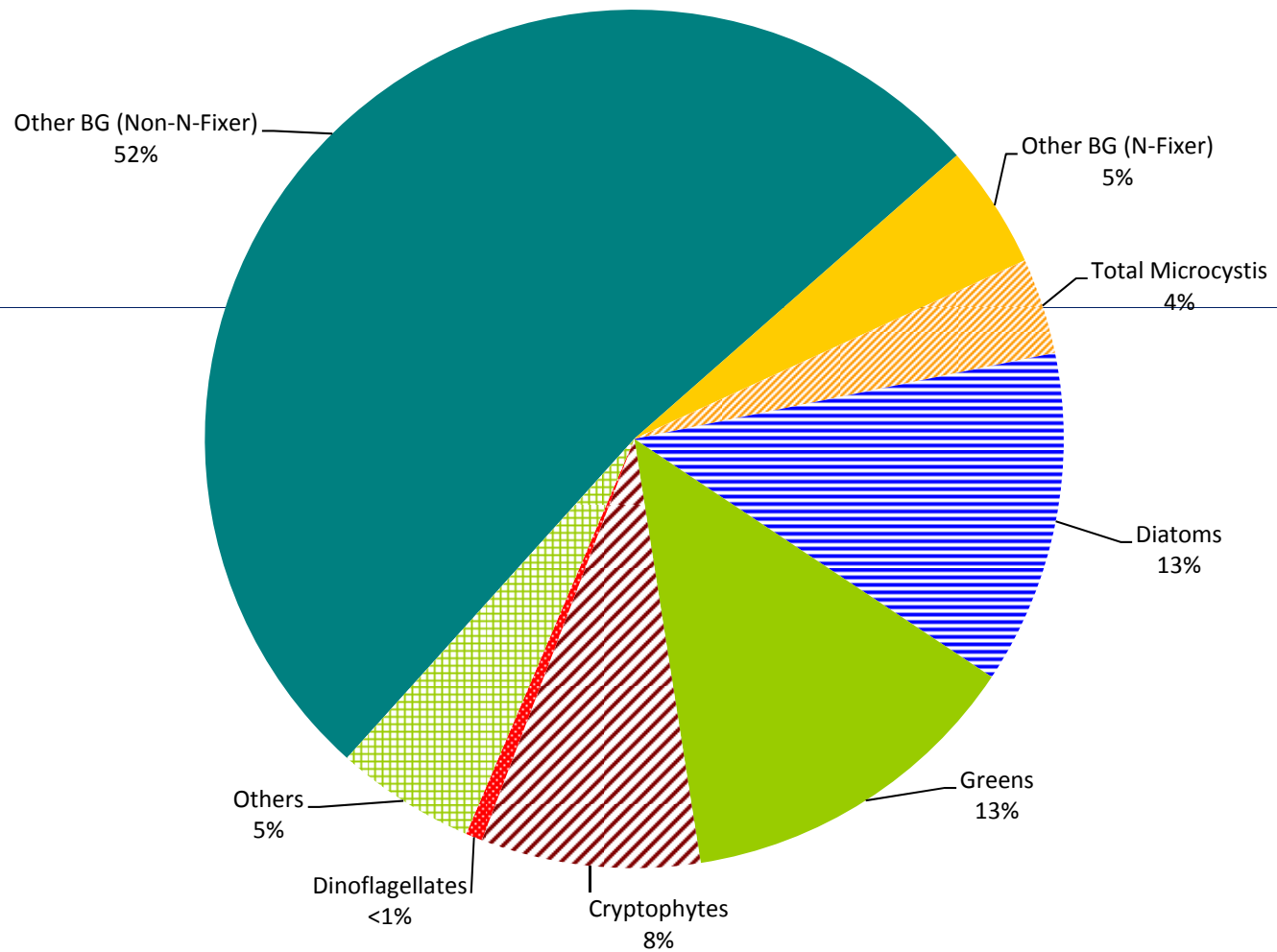
LE 2.2

CB 5.2

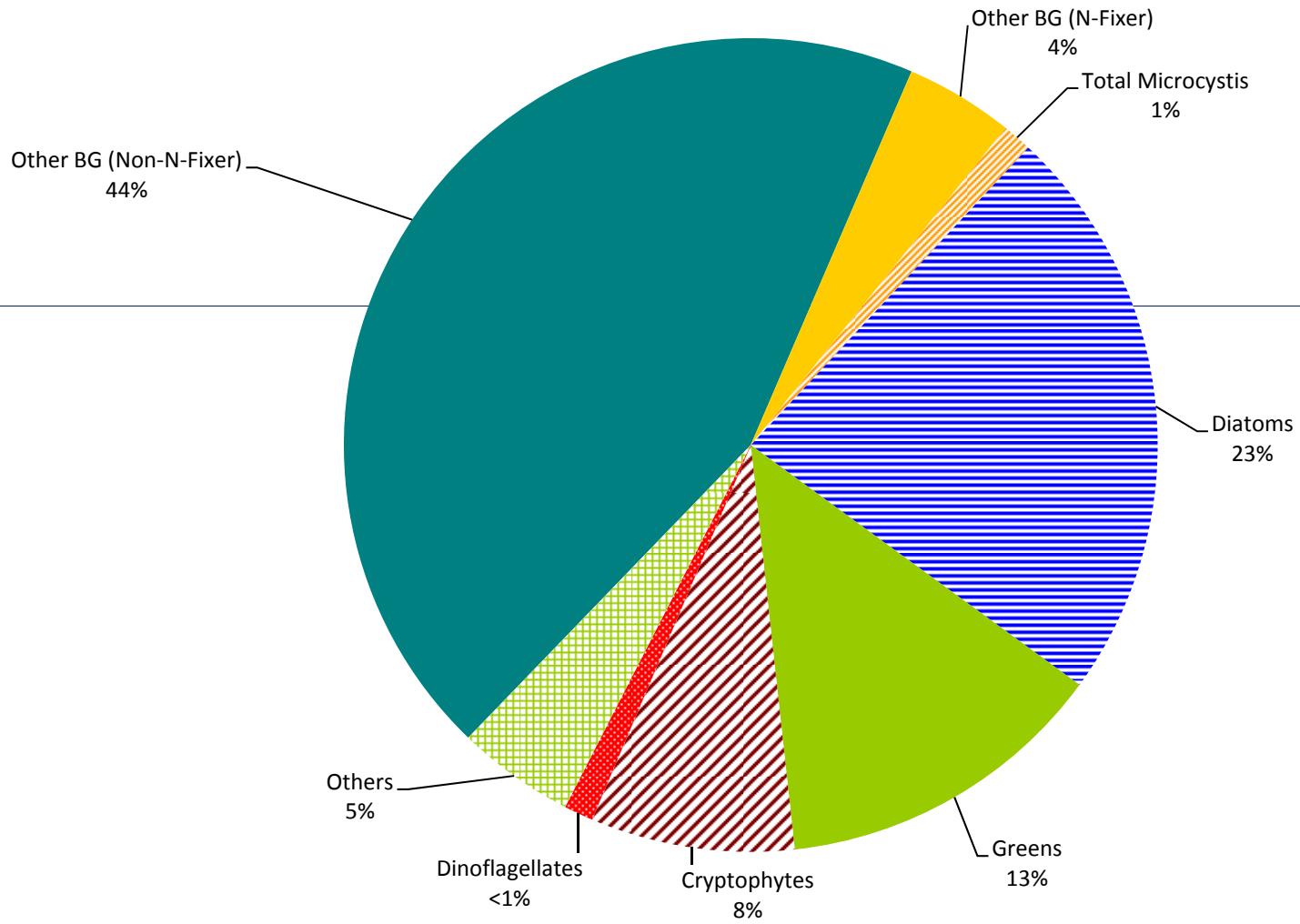


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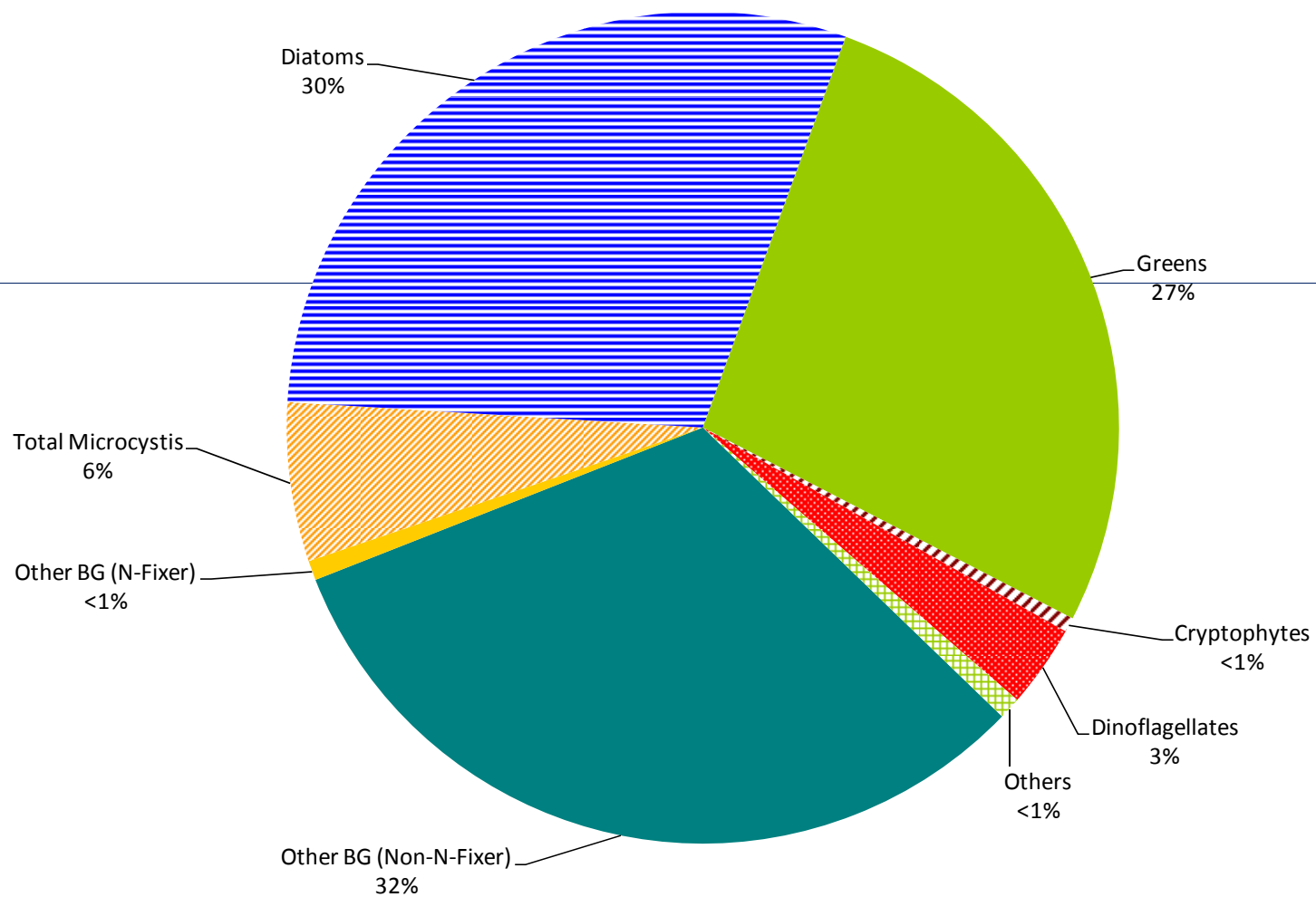
**Percent Composition of Phytoplankton "Group" Biomass
Gunston Cove (GC7), 1994-2000**



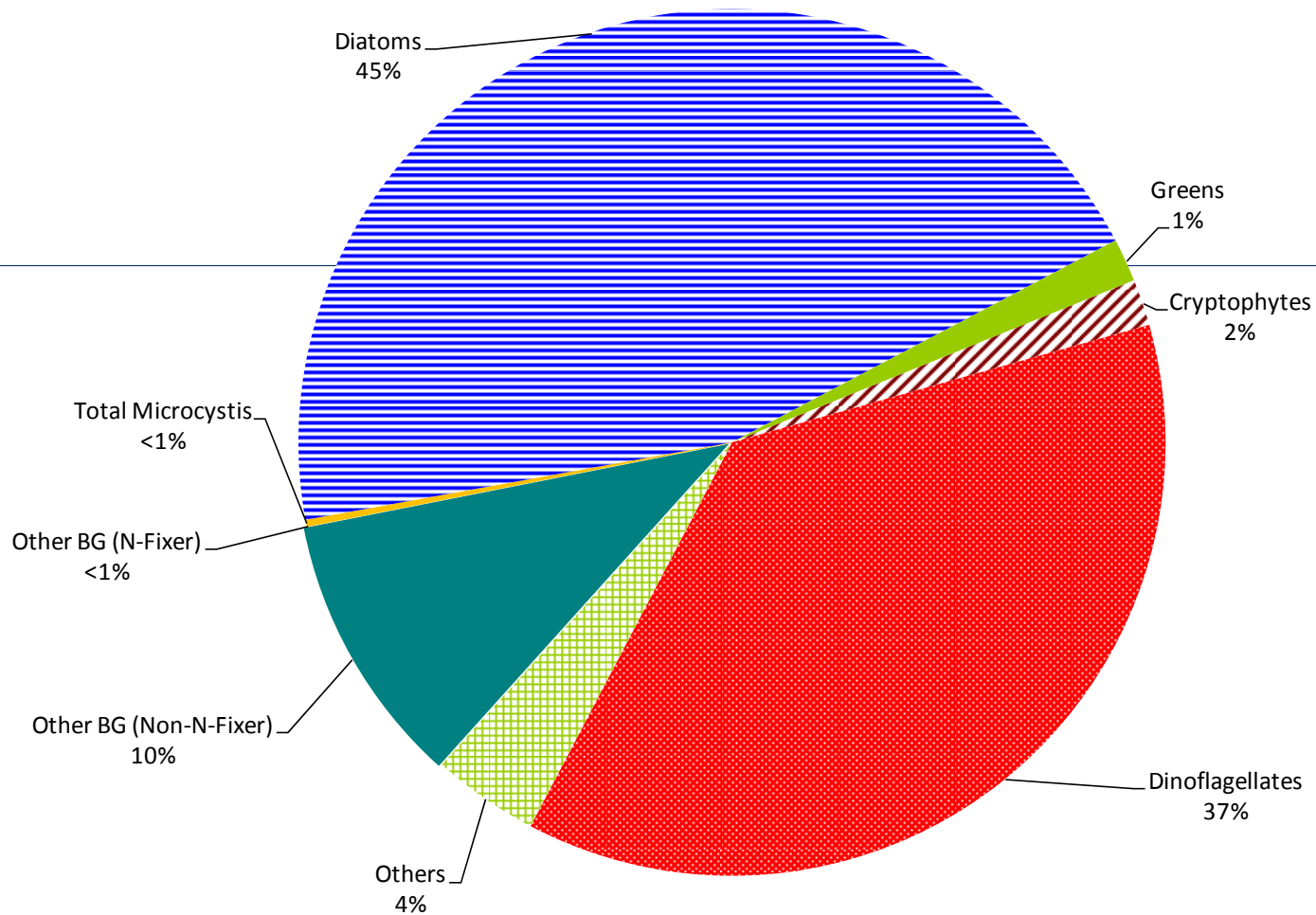
**Percent Composition of Phytoplankton "Group" Biomass
Tidal Fresh (GC9), 1994-2000**



**Percent Composition of Phytoplankton "Group" Biomass
Station TF2.3, 1994-2000**



**Percent Composition of Phytoplankton "Group" Biomass
Station LE2.2, 1994-2000**



Refined Model Algal Groups?

- Tidal Freshwater Diatoms (Freshwater?)
- Lower Estuary Diatoms (Marine?)
- Dinoflagellates
- Greens + *Cryptophytes*
- Total Blue-Greens

Parameterization of Model Groups

- **Salinity**
 - Low salinity tolerance
 - ◆ Tidal Freshwater Diatoms
 - ◆ Greens + Cryptophytes
 - ◆ Total Blue-Greens
 - High salinity tolerance
 - ◆ Lower Estuary Diatoms
 - ◆ Dinoflagellates
- **Physiological parameters**
 - Stoichiometry, growth, death, metabolism, settling, etc.
- **Ecological parameters**
 - Predation
- **Nitrogen fixation**
 - Function of DIN concentration

Model Calibration Issues

- How to parameterize tidal freshwater and lower estuary diatom groups and compare with observations?
- How to handle residual biomass from “Others” ?
- How to represent potential nitrogen-fixation under conditions of low dissolved inorganic nitrogen concentration?

Proposed Model-Data Comparisons

Computed	Observed
Tidal Freshwater Diatoms + Lower Estuary Diatoms	Total Diatoms
Greens + Cryptophytes	Greens + Cryptophytes ¹ Others
Dinoflagellates	Dinoflagellates
Total Blue-Greens	Total Blue-Greens

¹Mass balance check

Next Steps

- **Develop model calibration targets**
- **Develop upstream boundary conditions**
 - Translate chlorophyll concentrations into algal carbon and apportion among five model algal groups
- **Develop downstream boundary conditions**
 - Calculate biomass from algal speciation abundance data from station CB5.2
 - Determine how to handle the 1996-1997 data gap
- **Develop carbon:chlorophyll conversion factors**
 - Compare computed vs observed chlorophyll as consistency check
 - Compare computed chlorophyll to results from Potomac portion of whole bay model
- **Set up model post-processing algorithms**
- **Begin preliminary calibration runs**