

Bloom Producing Algae in Virginia Waters

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Phytoplankton Monitoring Programs (ODU Phytoplankton Analysis Lab Data Base)

Virginia Department of Environmental Quality: 1985 to present:

- a. Monthly collections taken at 7 Chesapeake Bay stations, and at 7 stations within 4 Virginia rivers March through October.
- b. Additional collections during major blooms, fish kill events, shellfish contamination, and presence of harmful algal species.
- c). Includes total algal composition, identification and abundances.

Virginia Department of Health: 1997 to present:

- a). From February through September, analysis of phytoplankton composition and abundance from ca. 50+ Virginia shellfish harvesting locations. Approximately 450 samples annually.
- b). Emphasis on bloom producers and HAB presence.
- c). Additional sampling for presence of HABs in Virginia lakes in 2010.

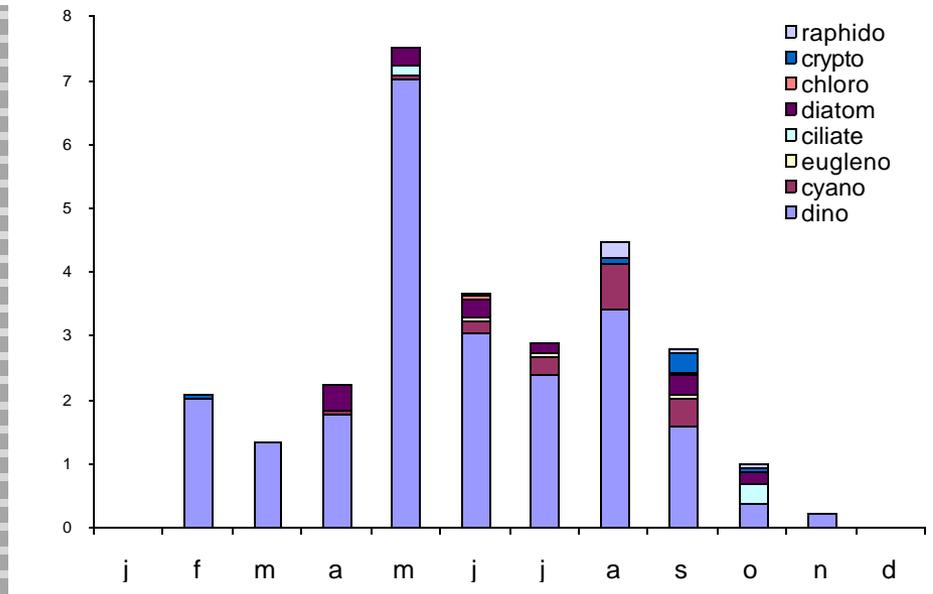
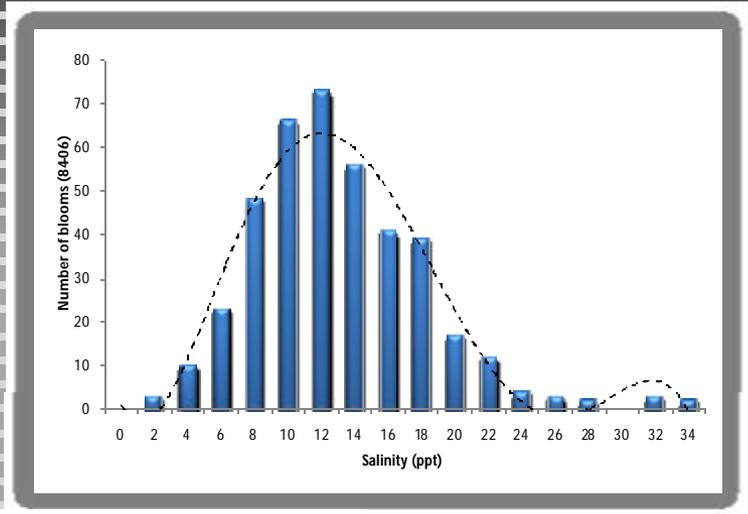
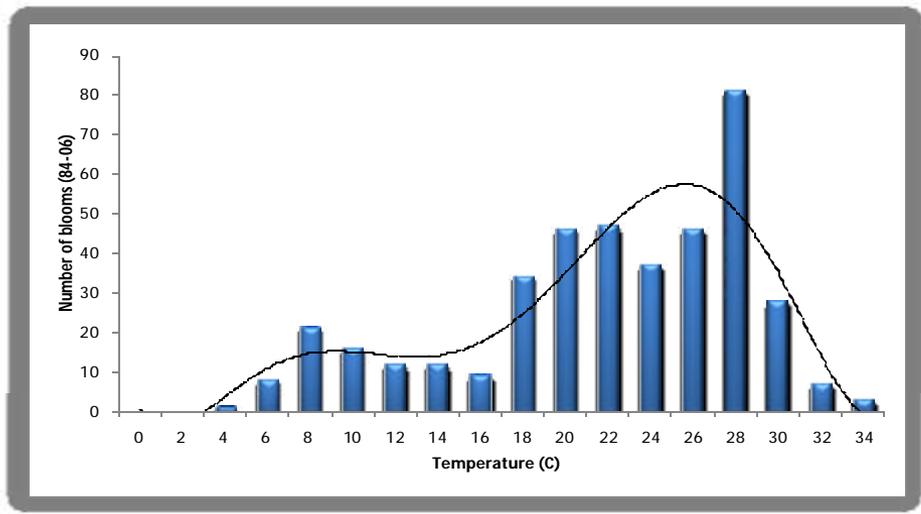
Analysis Protocol

1. Water samples (250-1000 ml) are initially prepared for standard light microscopic analysis (300X, 600X) conducted with inverted plankton microscopes for species identification and concentrations.
2. Microcystin analysis (ELISA) is performed during *Microcystis* bloom events.
3. Routine PCR analysis is conducted throughout the sampling regarding *Karlodinium* and *Pfiesteria* taxa.
4. Supplementary analysis may include use of epifluorescent or electron microscopy in rare cases.

General Historical Results

- Our bloom records in Virginia tidal tributaries and Chesapeake Bay since 1985 indicate:
 - A broad diversity among bloom producing algae, with 43 taxa identified as past bloom producers.
 - The most common bloom producers were dinoflagellates responsible for 82 % of these blooms.
 - Between 1998 and 2008, ca. 15.3 % of 4,467 water samples taken at monitored stations (ca.78) contained bloom concentrations. Algal blooms are common events in Virginia waters.
 - The majority of these bloom producers are not HABs, but they may impact the regional ecosystem and growth conditions for HABs, or by their own presence degrade water quality.

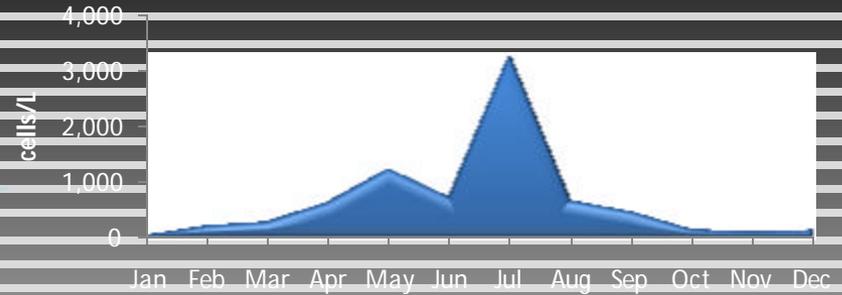
General Occurrences of Regional Blooms to Temperature and Salinity



Common non-HAB Bloom Producers

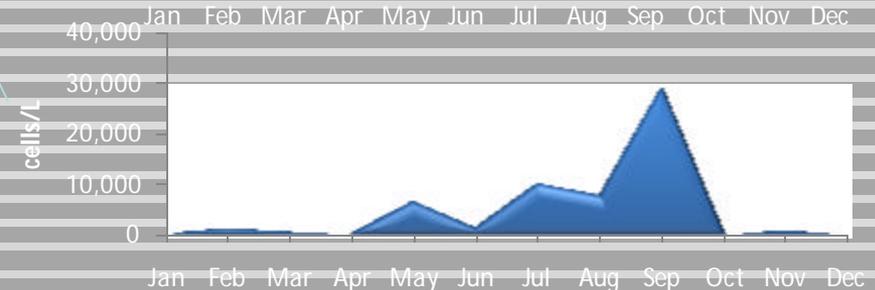
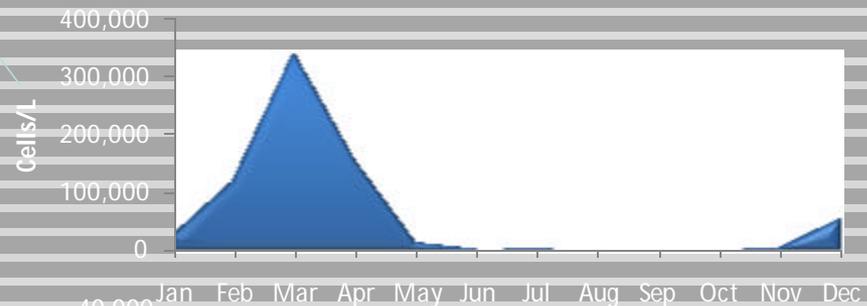
Dinoflagellates:

- *Akashiwo sanguinea*
- *Heterocapsa rotundata*
- *Heterocapsa triquetra*
- *Scrippsiella trochoidea*



Ciliate:

- *Myrionecta rubra*:
a sporadic bloom producer
in local rivers and the Bay



Harmful Algae in Virginia Tidal Waters and Chesapeake Bay

- We have identified over 1,400 algal species within our regional waters. Originally 38 species (ca. 2.7%) were considered potentially harmful (HABs). Some were regionally common, and others rare, or not widely distributed.
- These HABs were represented by : 14 dinoflagellates, 5 diatoms, 3 raphidophytes, and 16 cyanaobacteria.
- This list will increase with continued investigations of existing flora, and with other invasive species entering the ecosystem.

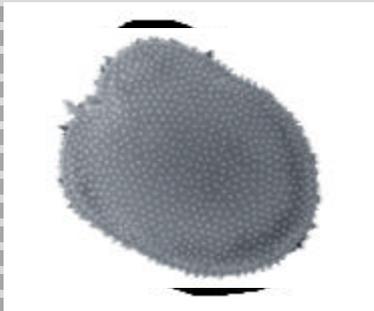
Harmful Bloom Species of Major Concern in Virginia Waters



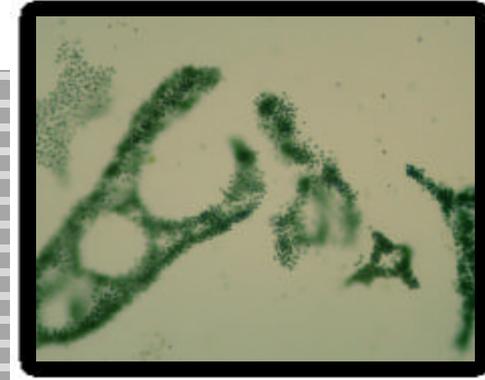
Cochlodinium polykrikoide



Karlodinium veneficum



Microcystis aeruginosa



Prorocentrum minimum

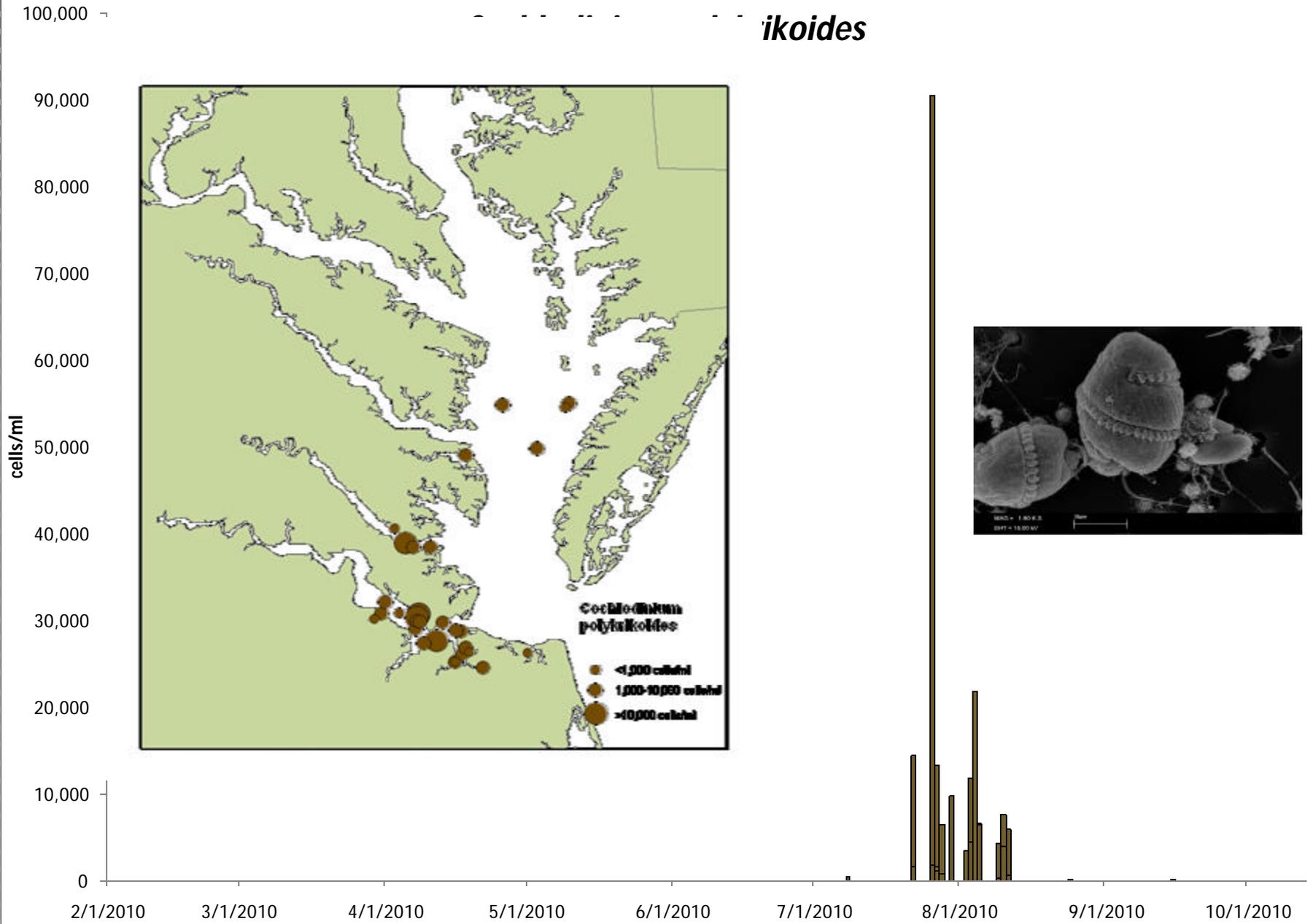
- Several associated with toxin production.
- Each may reduce oxygen levels and water quality conditions.
- Impact to local fisheries, local resources, and economic relationships.
- Several expanding their range and degree of impact regionally and locally,

Major Algal Blooms

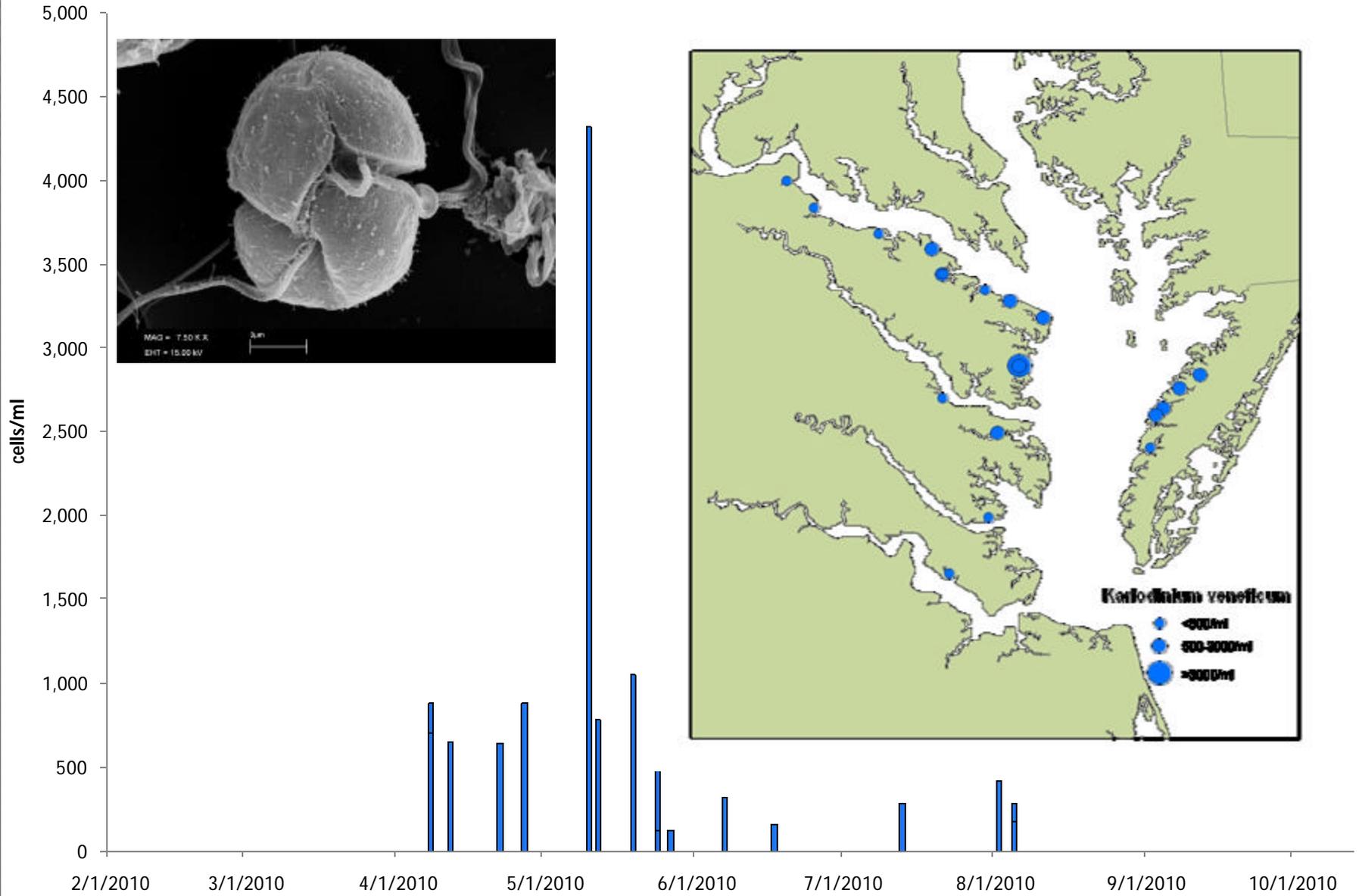
Virginia Tidal Rivers

2010

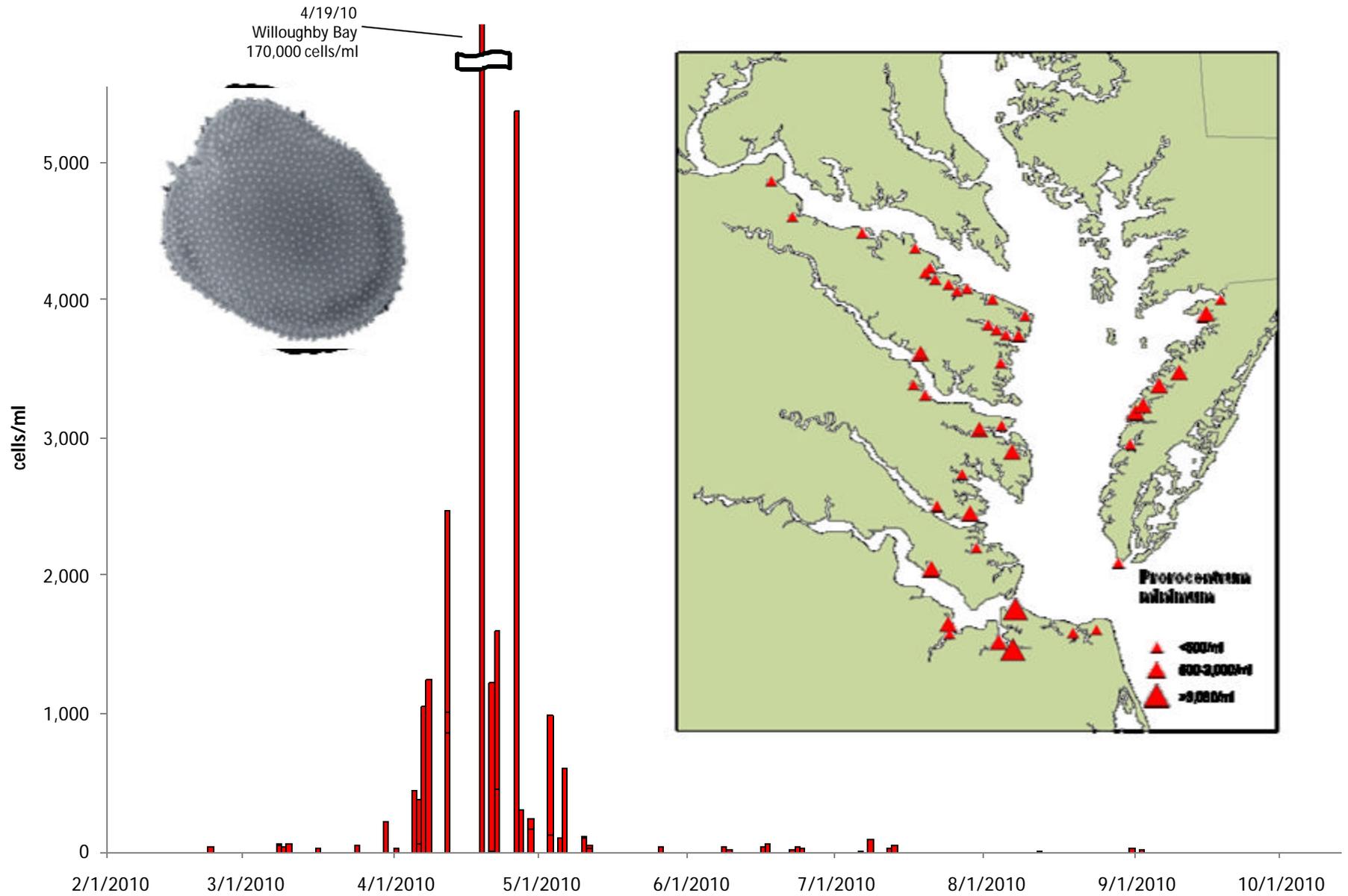
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Karolodinium veneficum

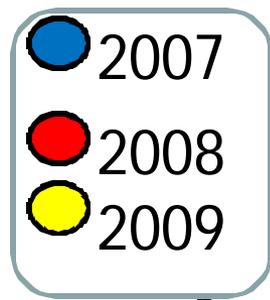
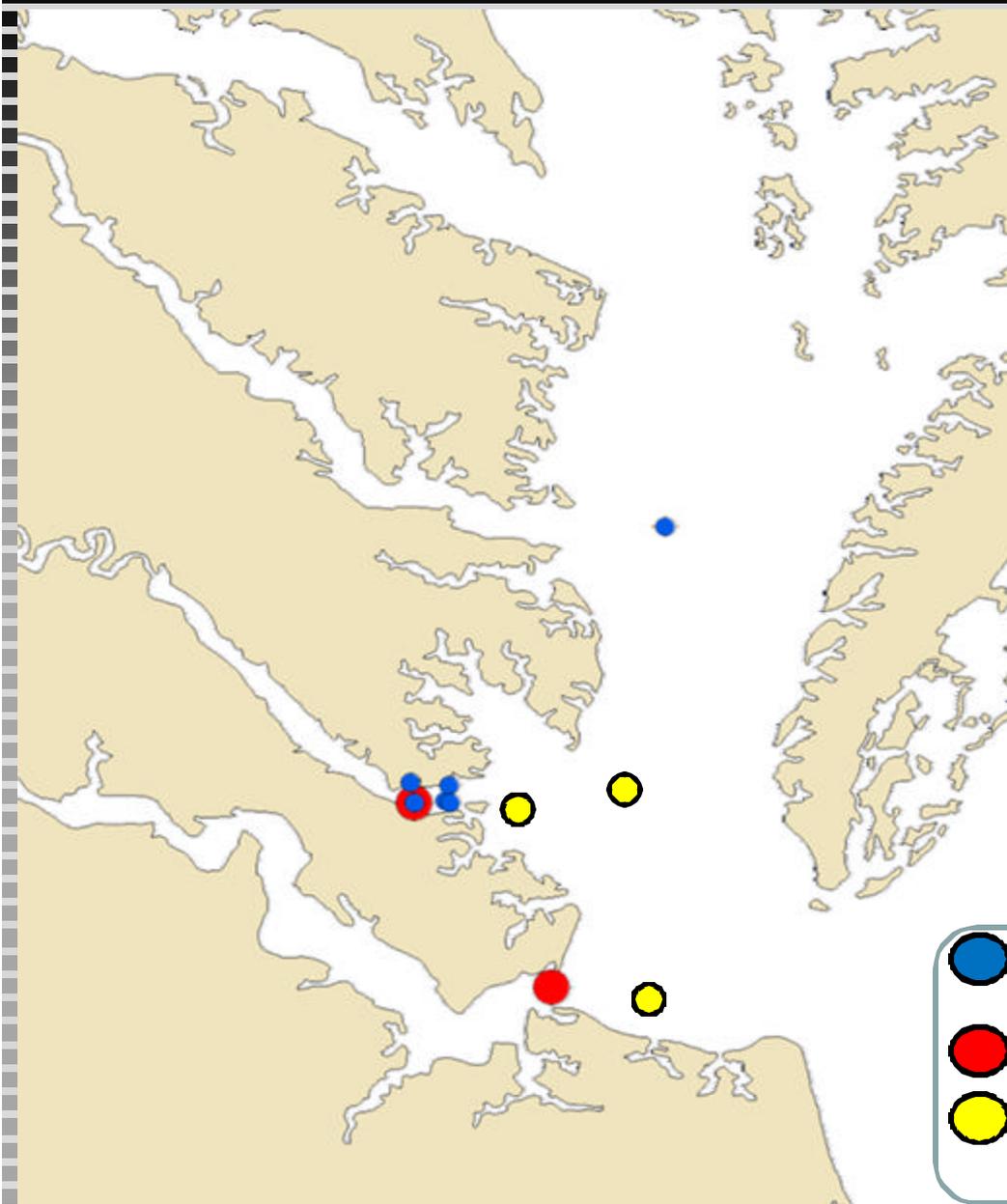


Prorocentrum minimum



Other Species of Potential Concern

- *Alexandrium monilatum*: an ichthyotoxic (hemolytic toxins) dinoflagellate. Identified at the James River entrance station in 2008, and lower Bay 2007 and 2009.
- *Chattonella subsalsa*: a raphidophyte, A *Chattonella* sp. noted in the Elizabeth River in 2011 and previously in other Virginia streams. A potential toxin producer. Levels >10,000 cells/ml linked to fish kills

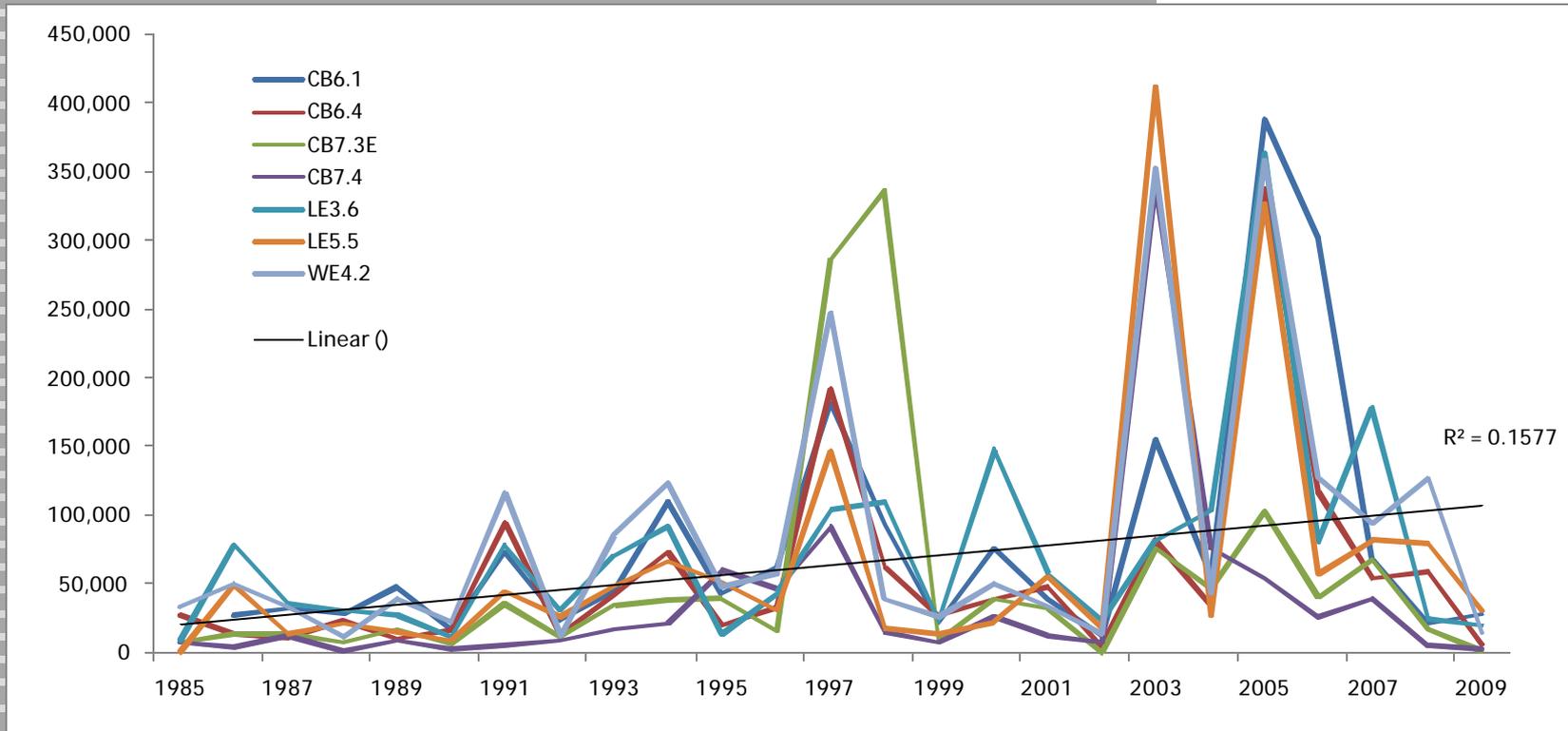
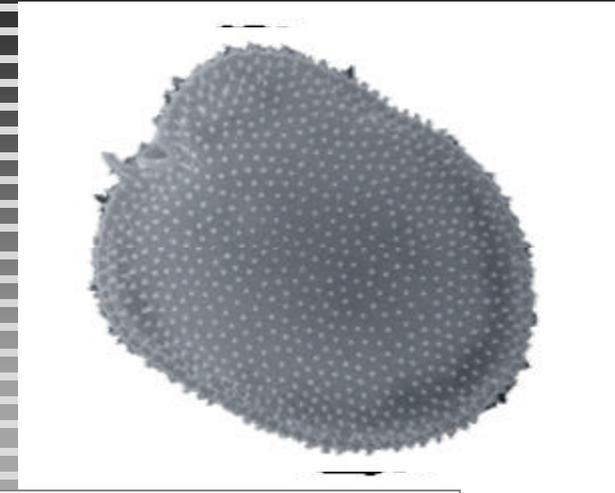


Prorocentrum minimum

(Pavillard) Schiller

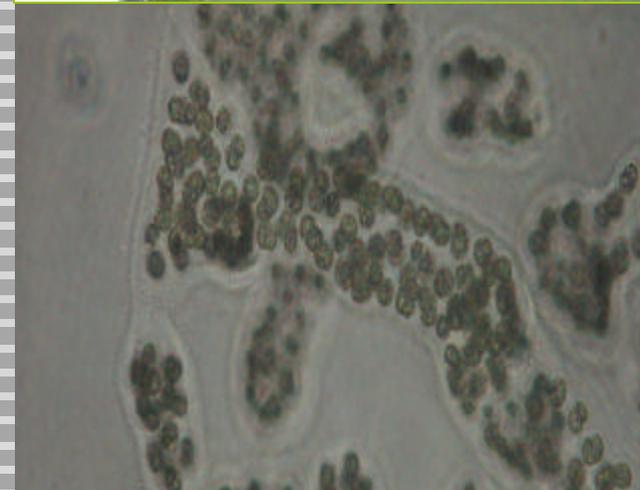
An example of increasing abundance in recent years:

Southern Chesapeake Bay Stations



Microcystis aeruginosa Kützing

- Its bloom levels have been given an official health precautionary regionally
- Bloom levels generally begin at $>1,000$ cells/ml, and may be associated with the production of toxins (e.g. microcystins).
- For Chesapeake Bay and Virginia, grounds for issuing cautionary recreational usage are those waters having >27 ug/L chlorophyll a, $> 50,000$ cells/ml of *Microcystis*, and > 10 ug/L of microcystin.
- Shoreline accumulation of the bloom often contain higher and more dangerous levels of microcystin in the surface scum.

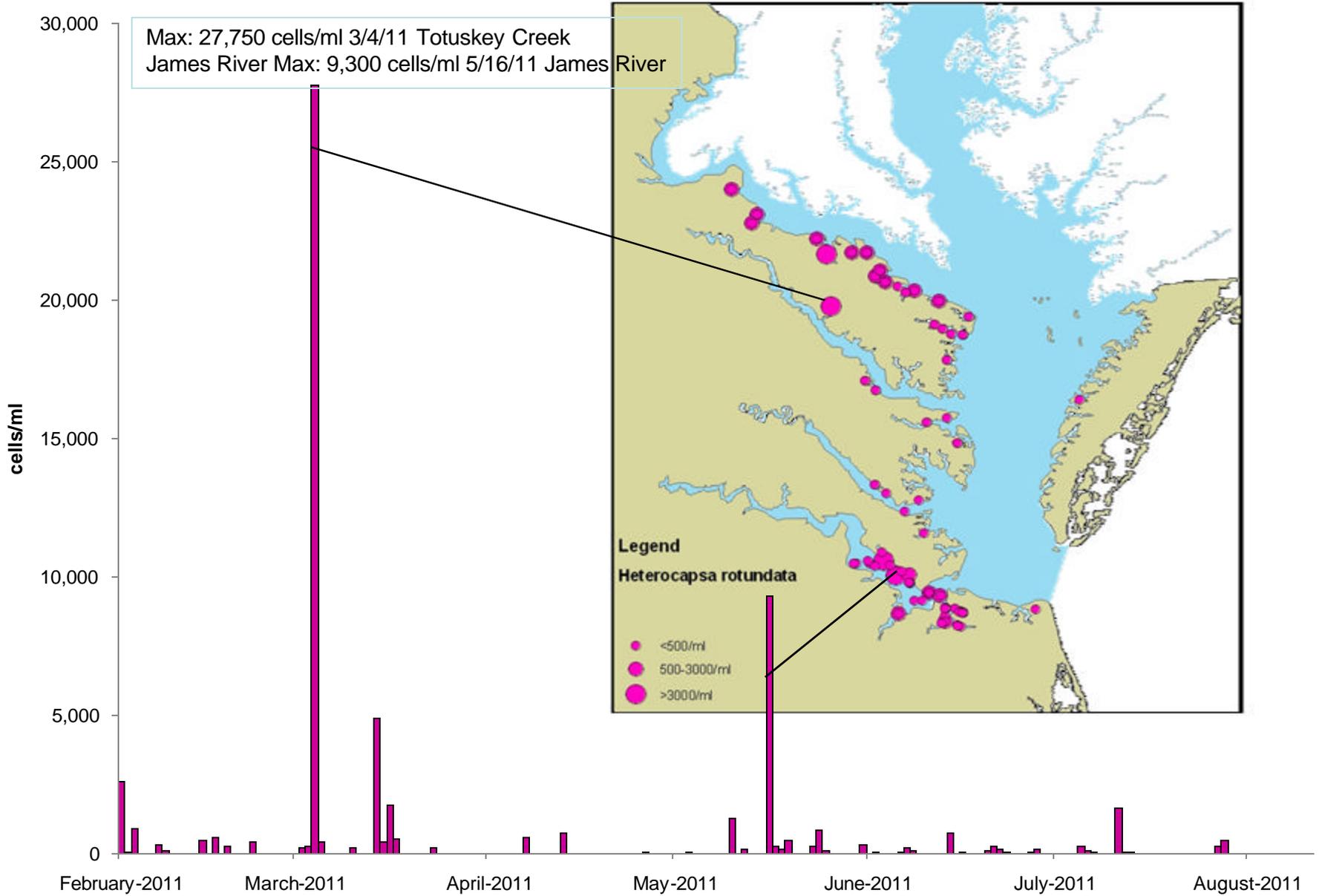


Algal Blooms

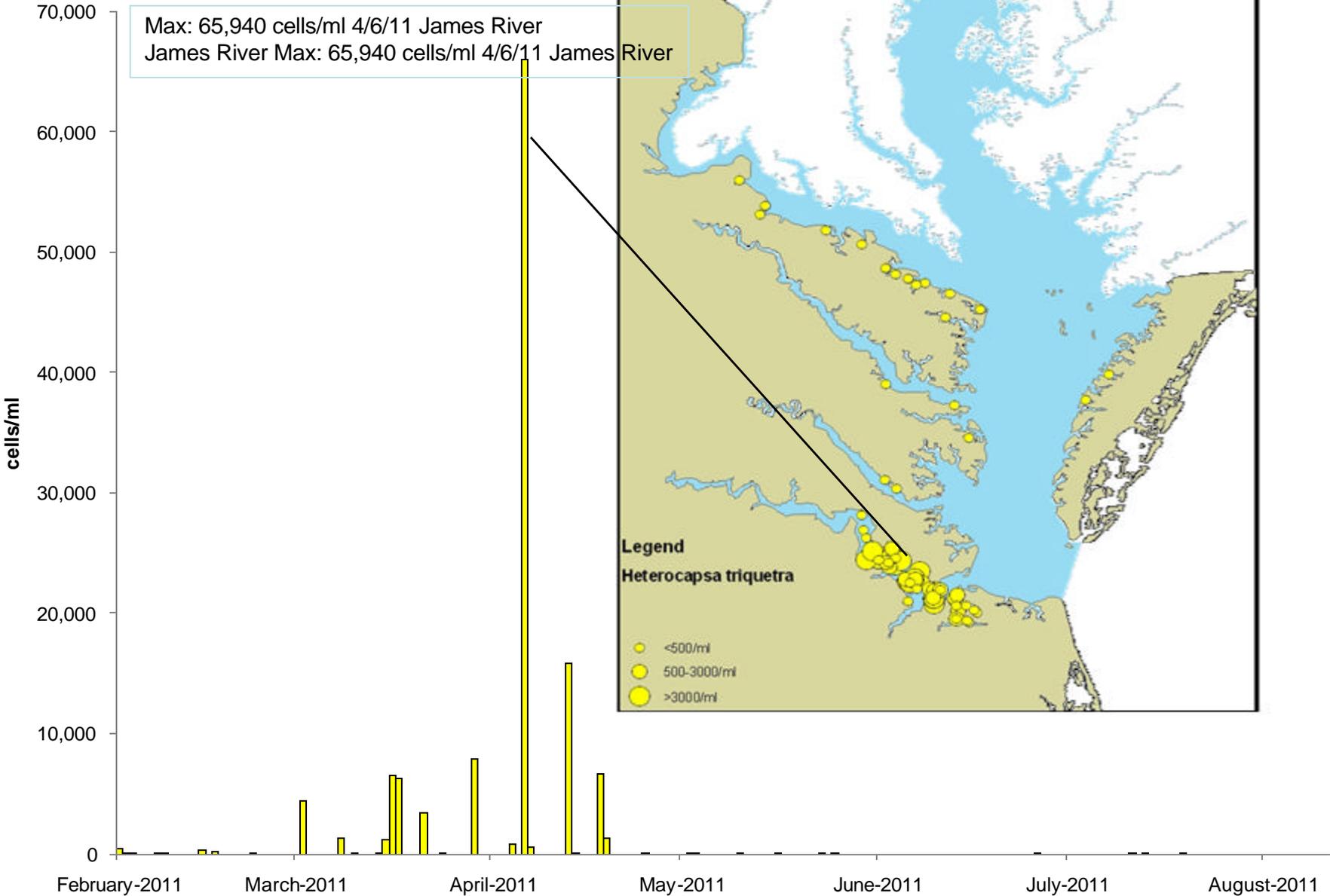
Virginia Tidal Rivers

2011 through Mid-August

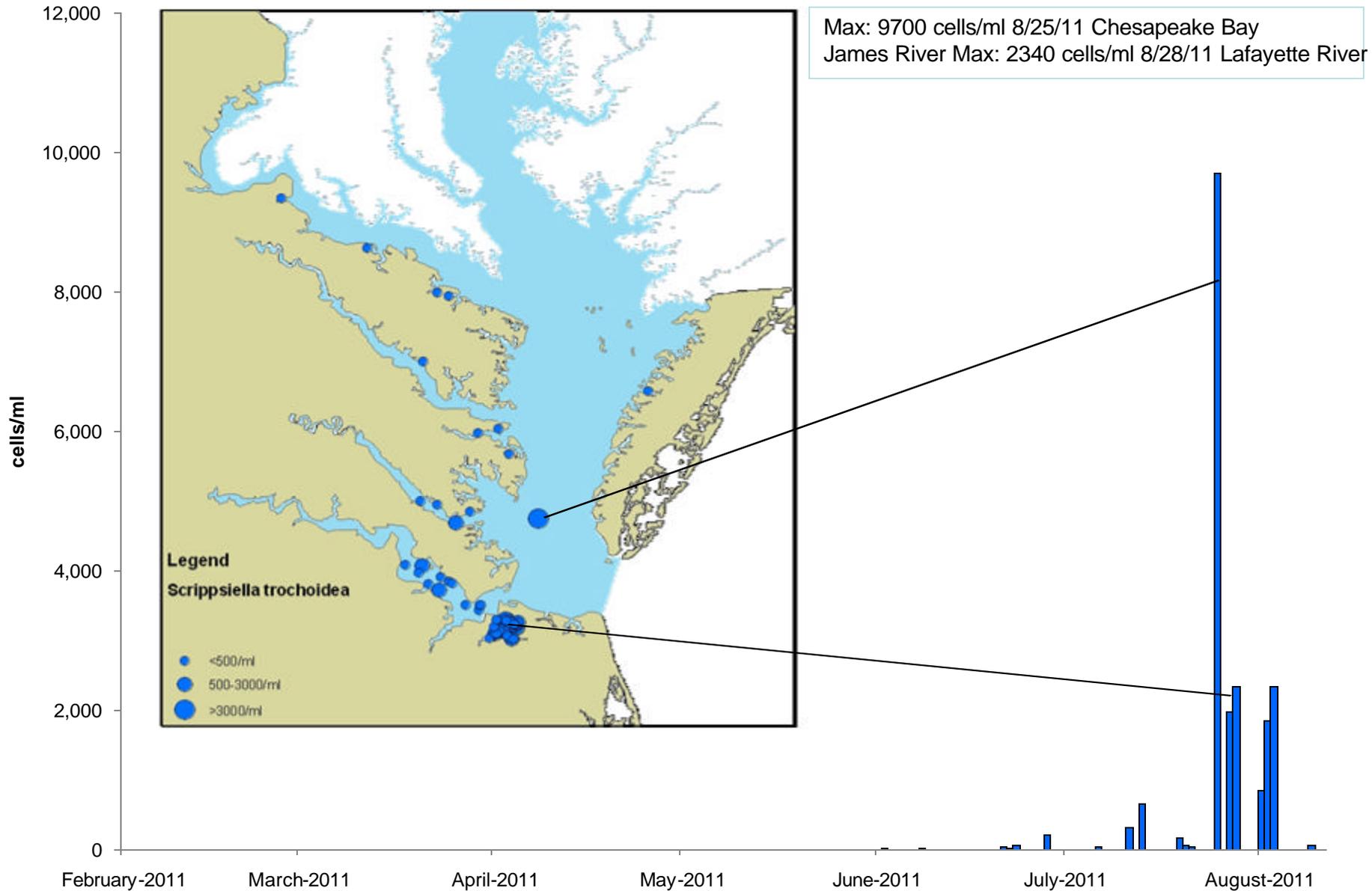
Heterocapsa rotundata



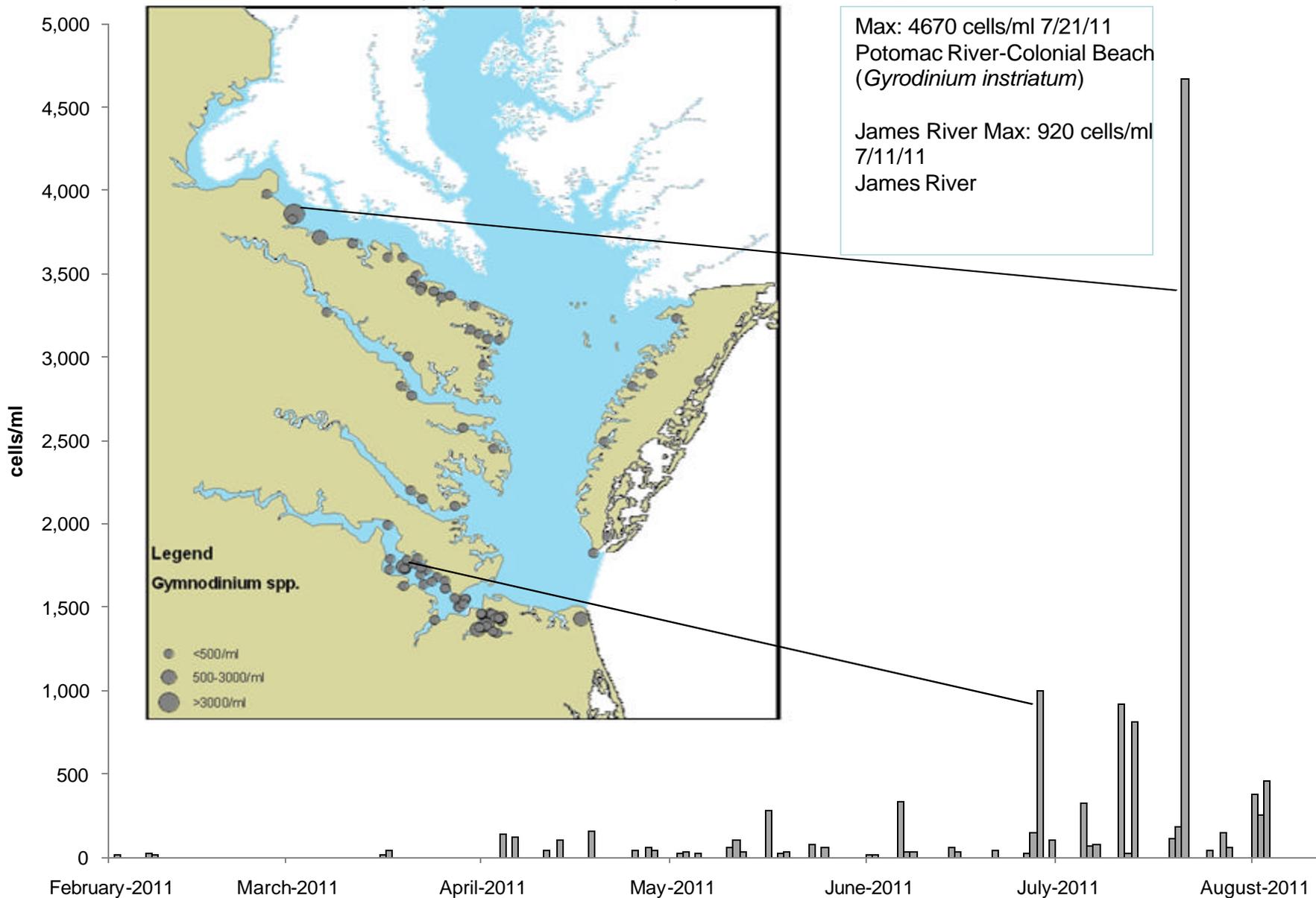
Heterocapsa triquetra



Scrippsiella trochoidea

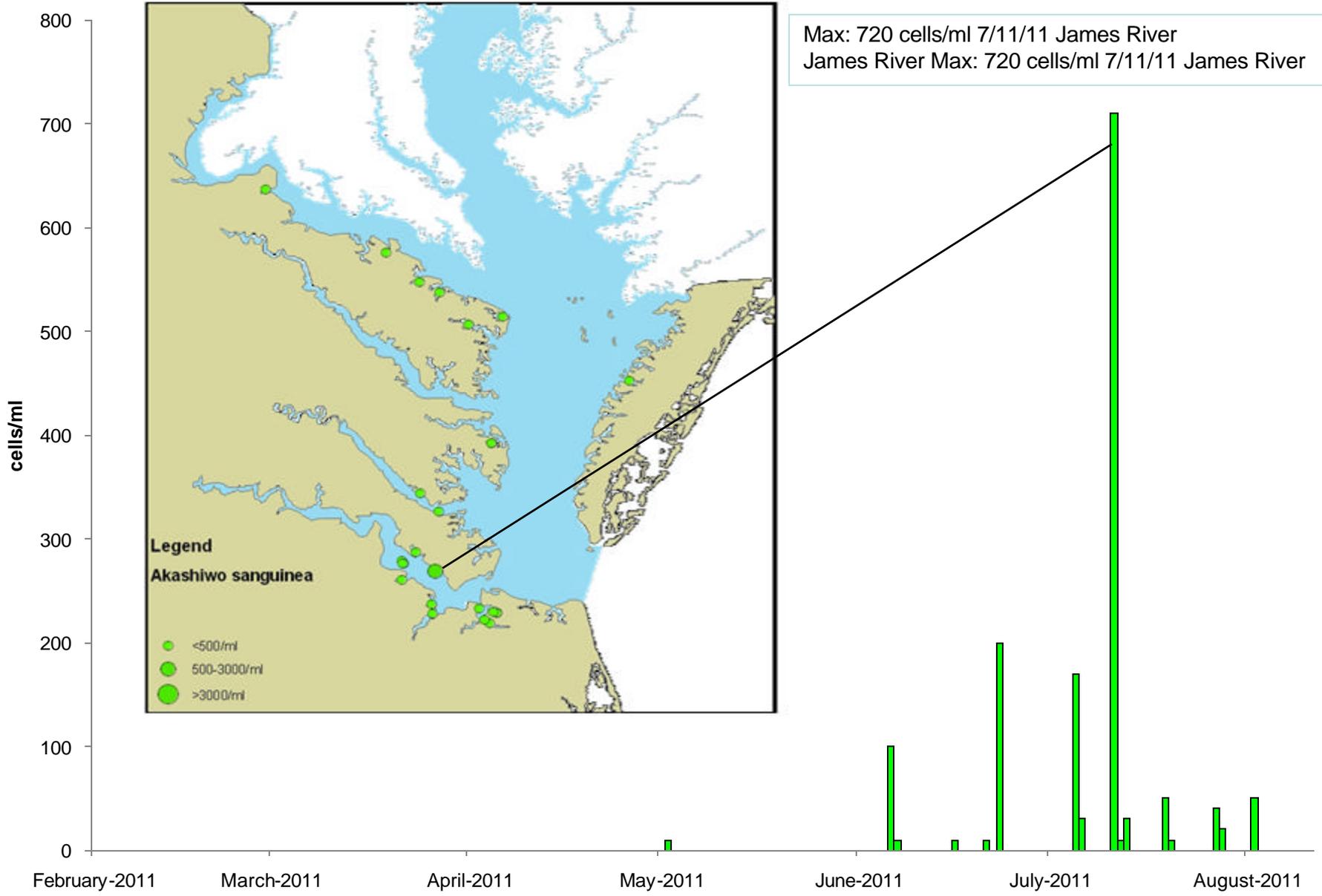


Gymnodinium/Gyrodinium spp.

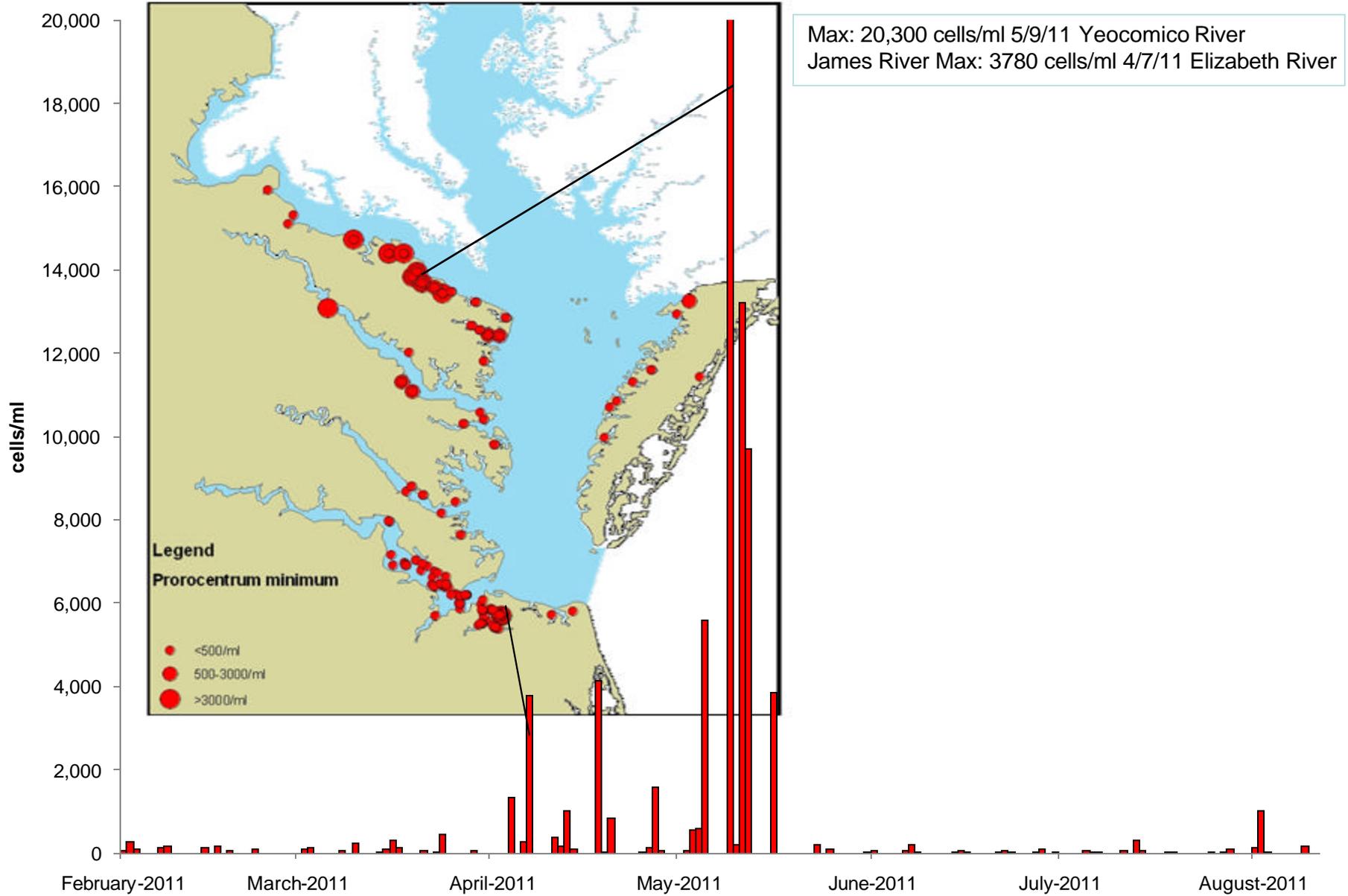


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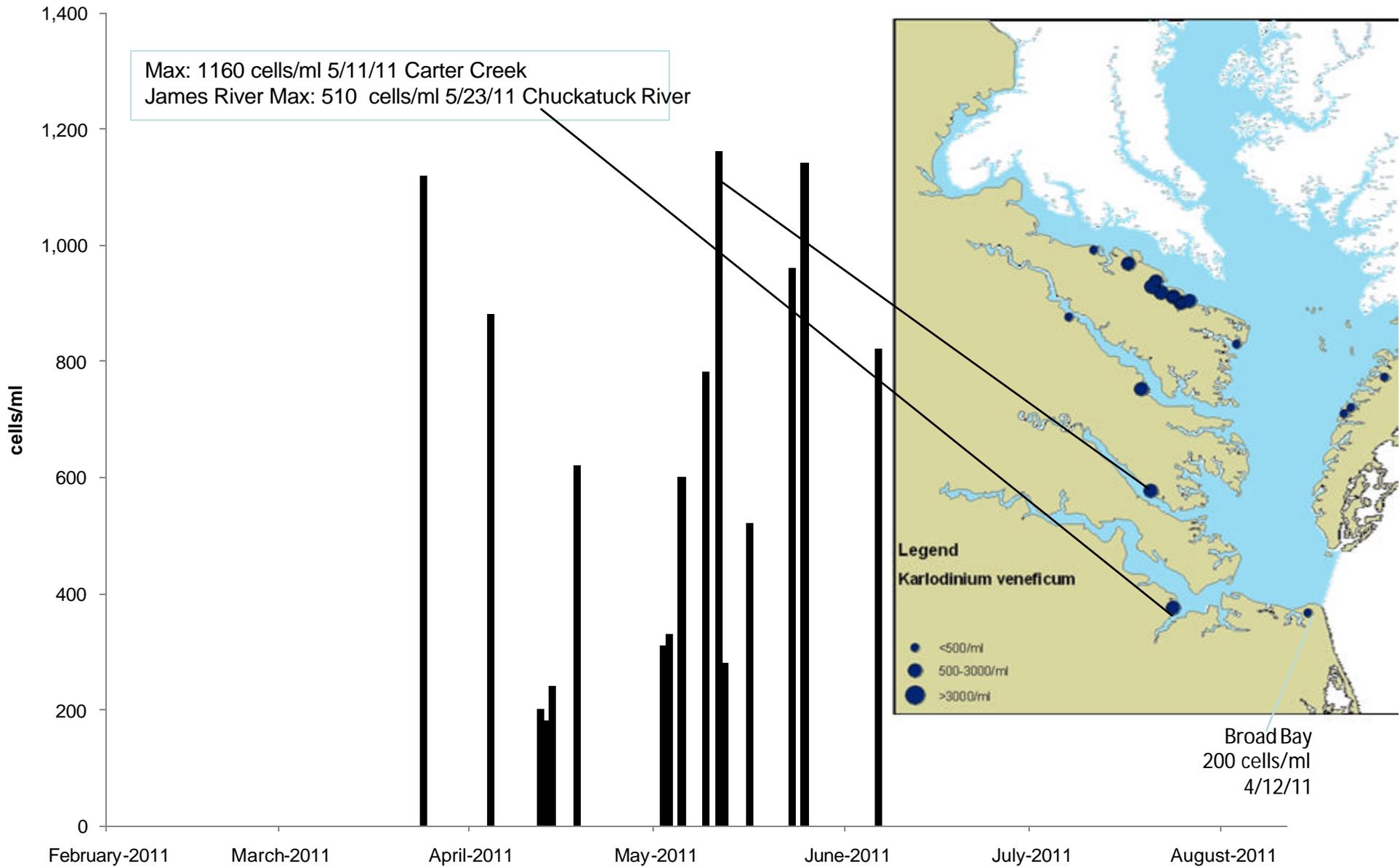
Max: 720 cells/ml 7/11/11 James River
James River Max: 720 cells/ml 7/11/11 James River



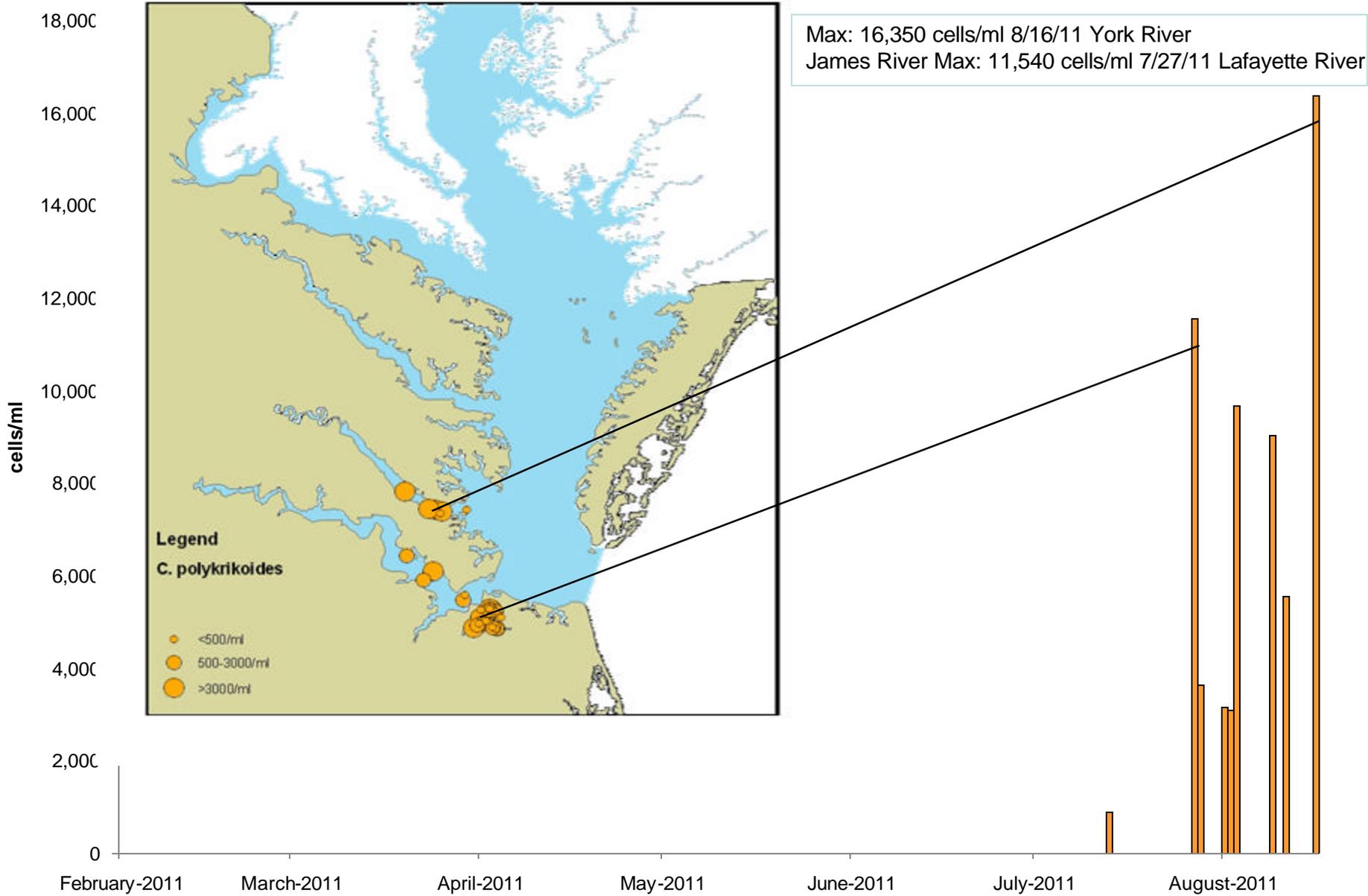
Prorocentrum minimum



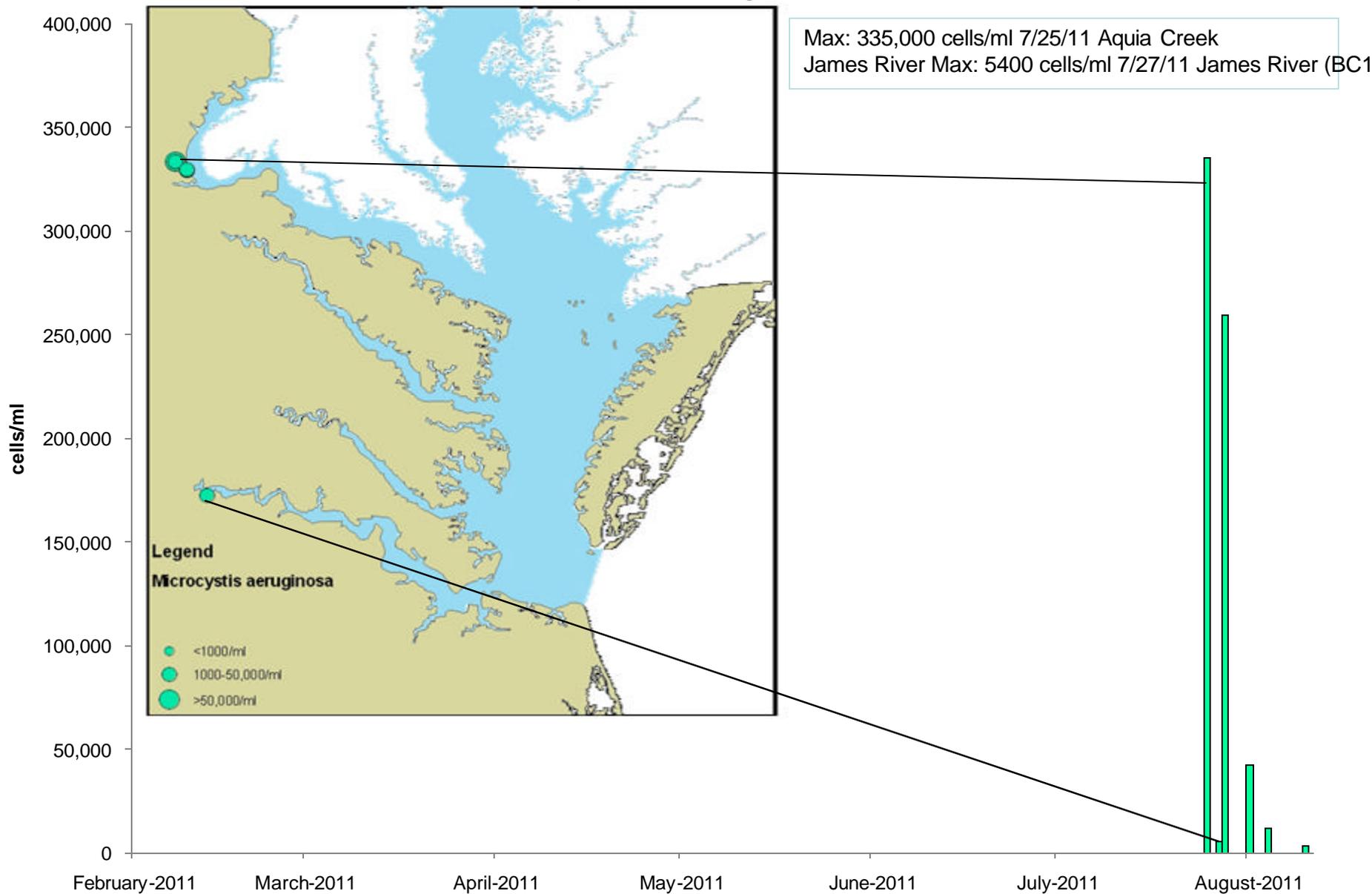
Karlodinium veneficum



ides



Microcystis aeruginosa



Lower James River

HABs of Major Concern

Cochlodinium polykrikoides

Prorocentrum minimum

Other HABs of Potential Concern

Alexandrium monilatum

Chattonella subsalsa

Karlodinium veneficum

Non-HABs of concern include a variety of bloom producing dinoflagellates.

Upper James River

Species of Major concern;

Microcystis aeruginosa

Species of potential Concern:

Aphanizomenon flos-aquae

Cylindrospermopsis raciborskii

Limnothrix redekei

Summary: Algal Blooms

Virginia Tidal Rivers

- Algal blooms are common events throughout the year.
- The common bloom producers include several HABs.

James River

- Dinoflagellates are the dominant HABs and non-HABs of concern in the lower James.
- Cyanobacteria are the dominant HABs of concern in the upper James.



HRSD monitoring

- 172 collections made between 3/8/11 and 8/3/11
- Routine collections as well as bloom samples (increased chlorophyll levels)
- YSI chlorophyll measurements

