

Aureococcus anophagefferens

Delaware Inland Bays 1998 - 2005

Partners

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DE STAC 3/31/06

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Outline

Analysis Method to ID and enumerate *Aureococcus*

***Aureococcus* cell densities across sampling period
and stations**

***Aureococcus* maximum cell density per station**

***Aureococcus* frequency of occurrence per station**

***Aureococcus* cell density per date per station
versus water temperature and salinity**

Recap

Aureococcus anophagefferens Analysis Methods

Delaware Inland Bays

Analytical Method	Year	Laboratory (Researcher)
Polyclonal Antibody & Epifluorescence microscopy May underestimate <i>Aureococcus</i> cell density by factor of 2 to 3 (D. Caron, communication)	1998	Suffolk County, NY, Dept. of Health Services
	2002	ACNS (Hartsig)
Quantitative PCR (Live Sample) Variable with physiological state of target cell	2001	UD CMS (Coyne/Popels)
Light Microscopy (Live Sample) using Transmitted Light	2002	MD DNR (Butler)
Qualitative PCR (Preserved Sample) Variable with physiological state of target cell	2004	U MD Baltimore (Bowers)

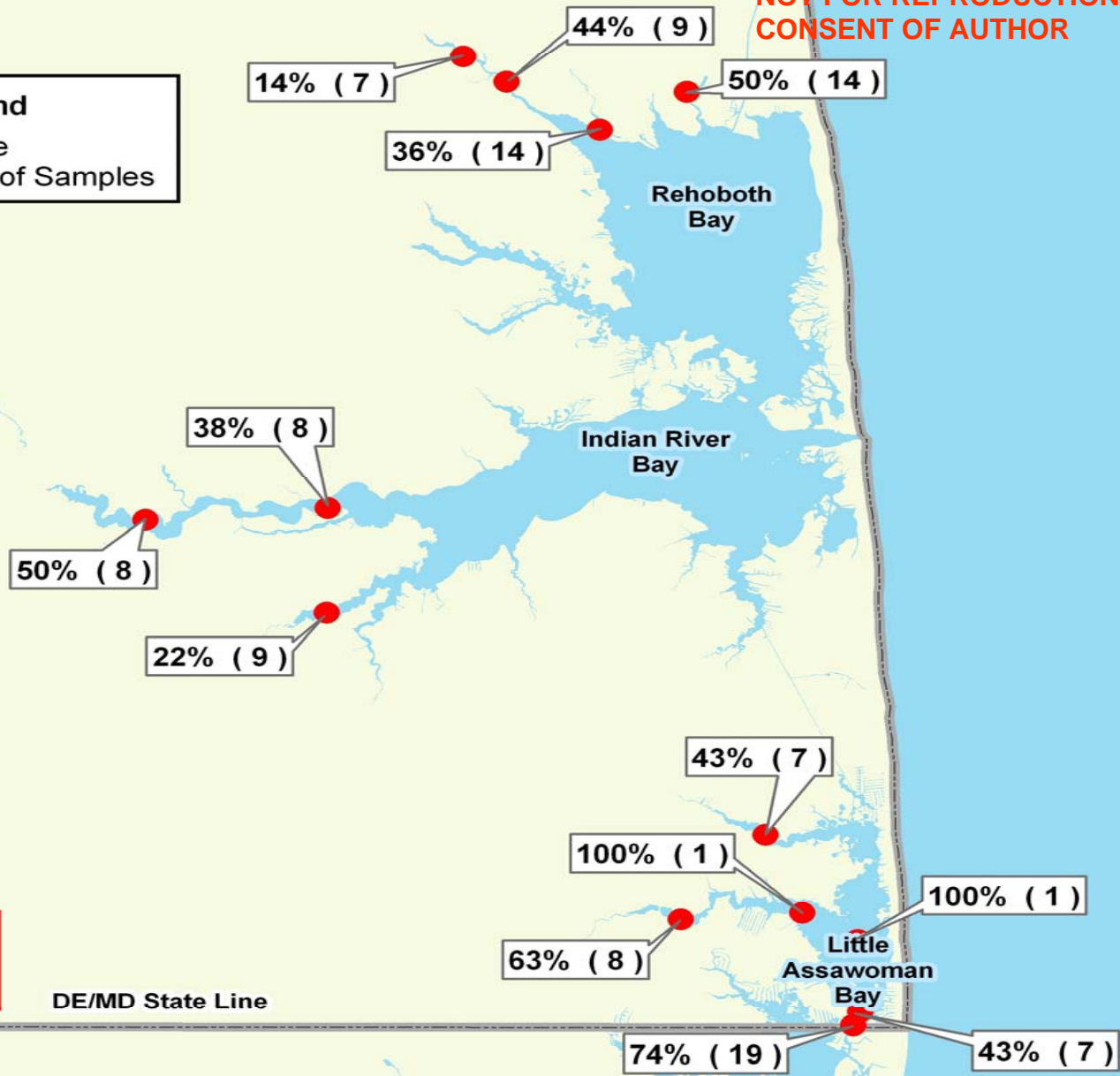
Aureococcus anophagefferens (Frequency of Occurrence) Delaware Inland Bays, 1998 through 2005

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Legend
% Presence
(#) Number of Samples



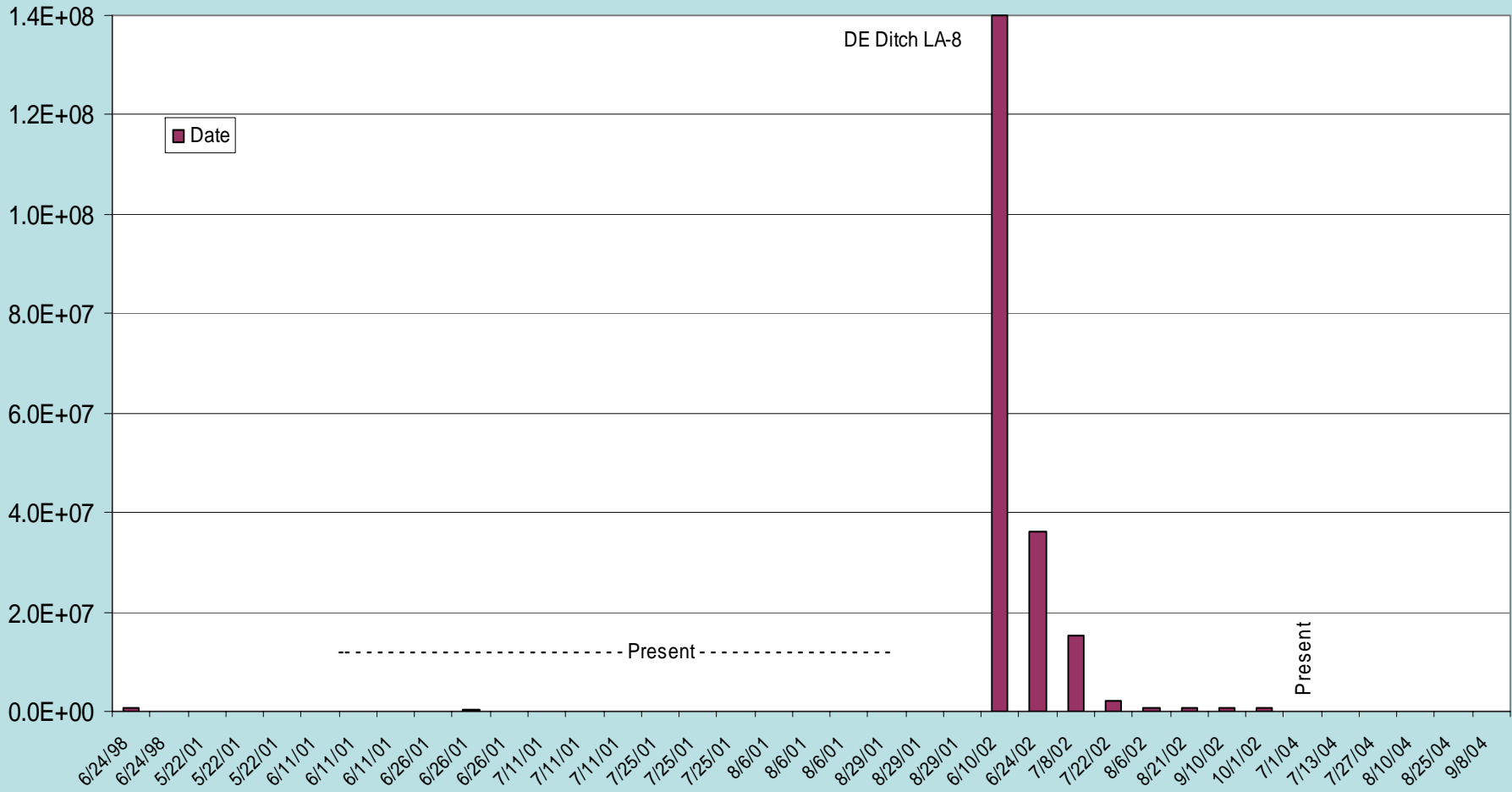
DE/MD State Line



Aureococcus (cells/L)

Delaware Little Assawoman Bay: 1998, 2001, 2002, 2004

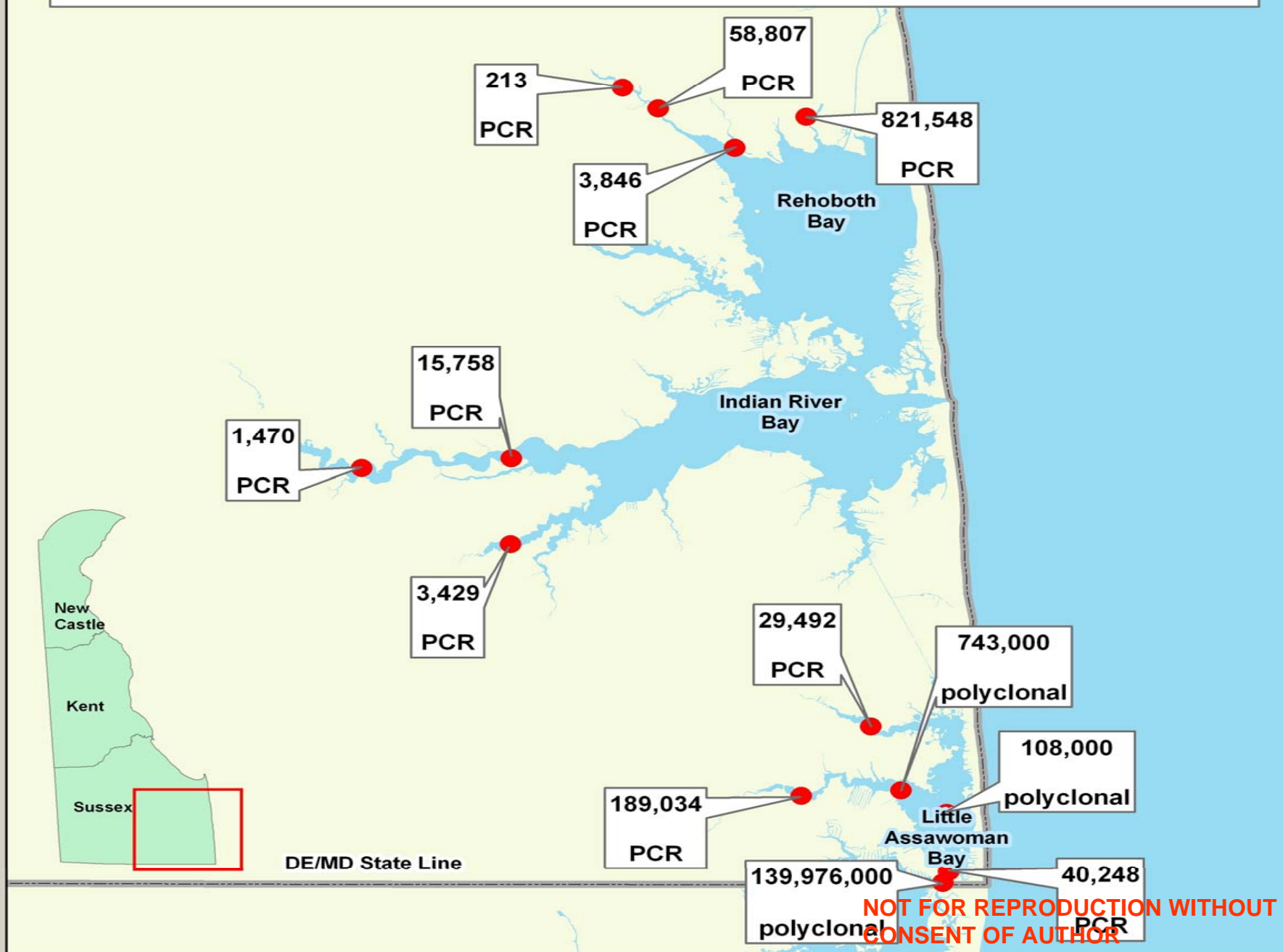
(Site location variable by year)



Collection Dates

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Aureococcus anophagefferens (Maximum Cell Density in #cells/L) Delaware Inland Bays, 1998 through 2005



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Aureococcus anophagefferens (Maximum Cell Density)

Year	Month	Waterbody	Station	#cells/L	Analytical Method
1998	June	Little Assawoman Bay (LAB)	LA-2	108,000	polyclonal
		Dirickson Creek, LAB	LA-4	743,000	polyclonal
2001	May	Arnell Creek, Rehoboth Bay (RB)	AC-2	3,846	PCR quant.
		Love Creek, RB	RLC-2	58,807	PCR quant.
		Torquay Canal, RB	TC-1	821,548	PCR quant.
	June	Miller Creek, LAB	LA-5	29,492	PCR quant.
		Dirickson Creek, LAB	LA-6	189,034	PCR quant.
	August	Indian River	IR-1	15,758	PCR quant.
		Indian River	IR-4	1,470	PCR quant.
		Pepper Creek, Indian River/Bay (IRB)	IP-2	3,429	PCR quant.
		Little Assawoman Bay - open bay	LA-1	40,248	PCR quant.
	Sept.	Love Creek, RB	RLC-3	213	PCR quant.
2002	June	The Ditch, LAB	LA-8	82,000,000	live screening
		The Ditch, LAB	LA-8	139,976,000	polyclonal
2004	July	The Ditch, LAB	LA-8	positive	PCR qual.

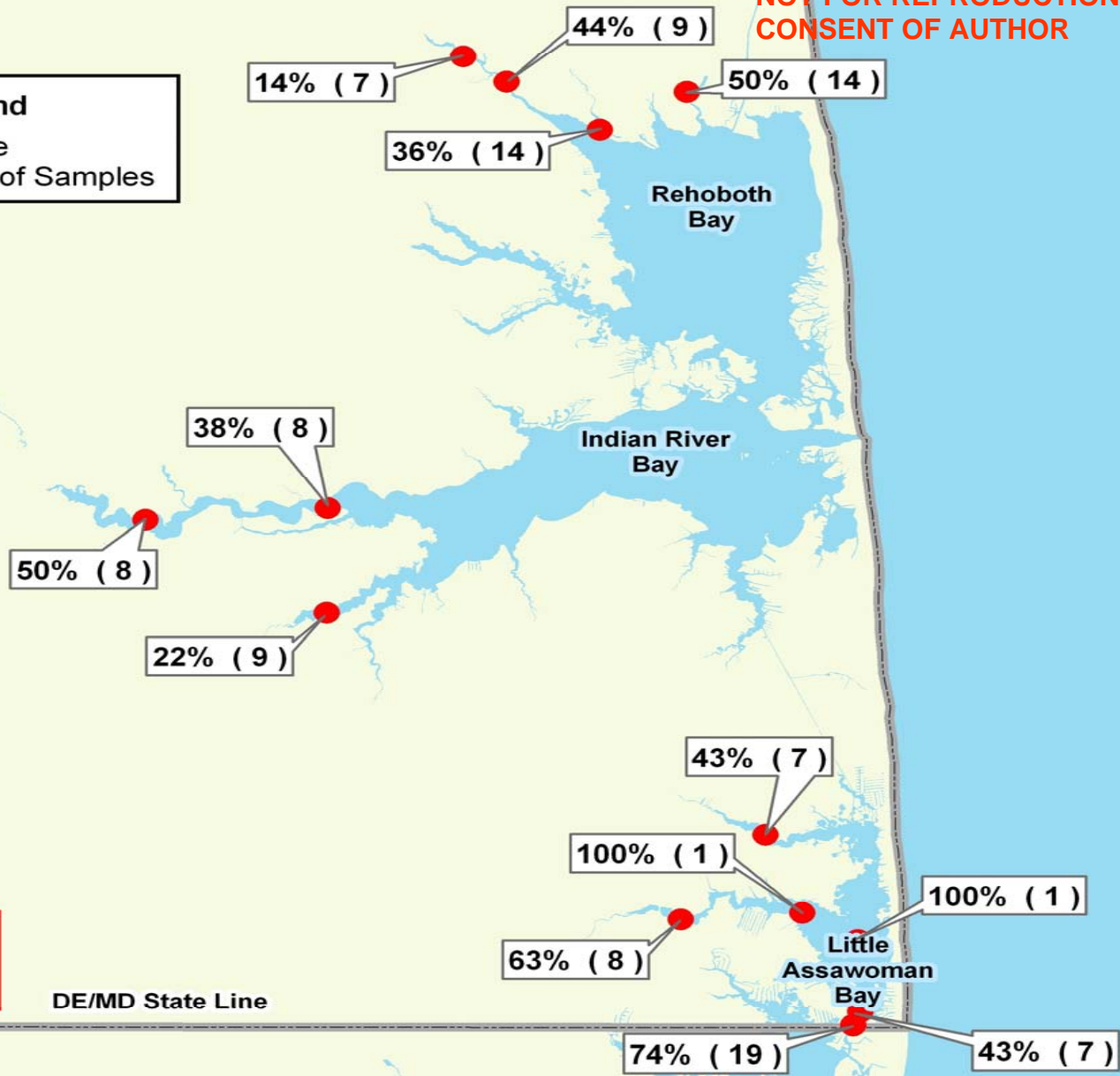
Aureococcus anophagefferens (Frequency of Occurrence) Delaware Inland Bays, 1998 through 2005

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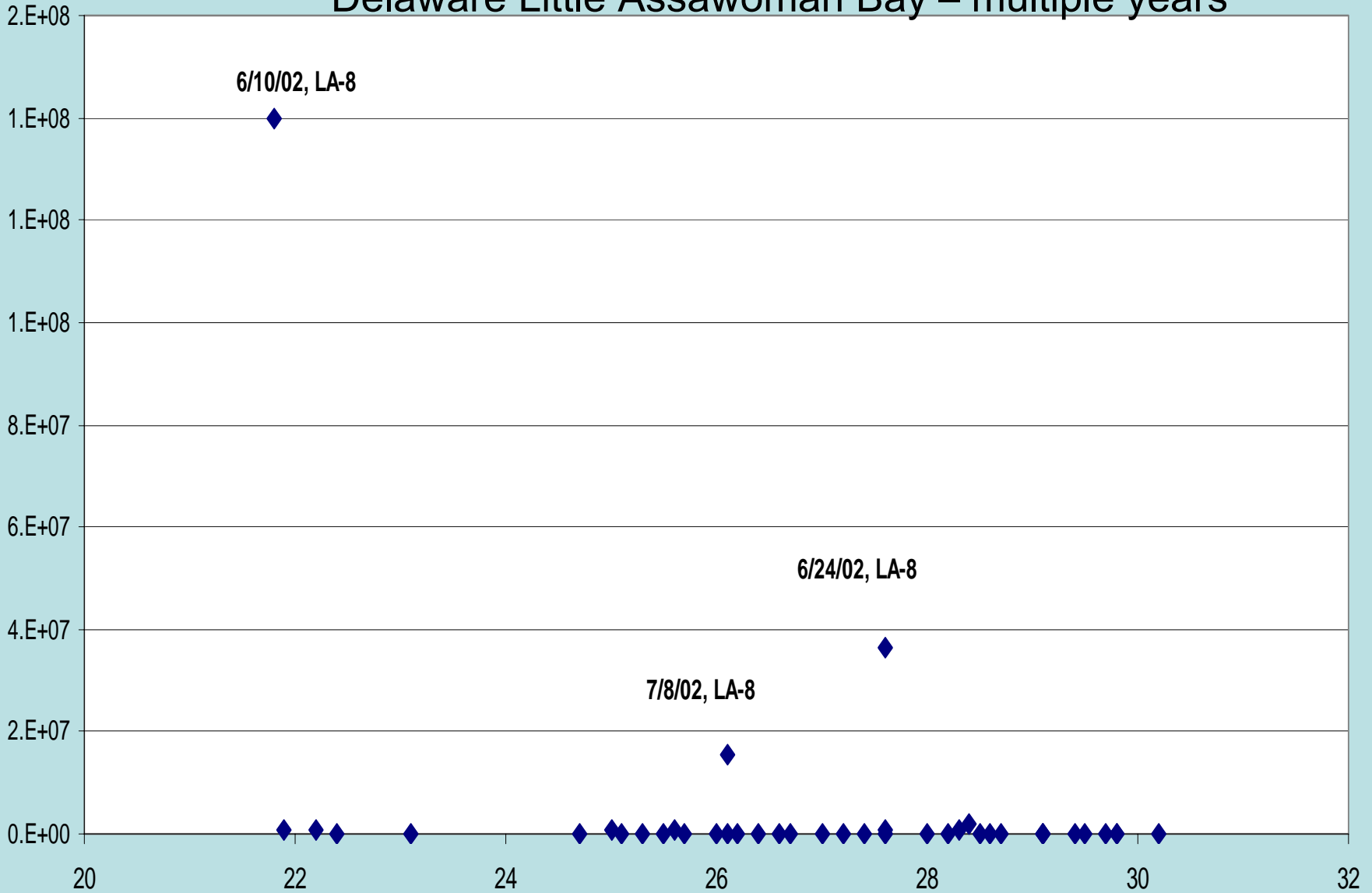


DE/MD State Line



Aureococcus (cells/L) vs. Water Temperature °C

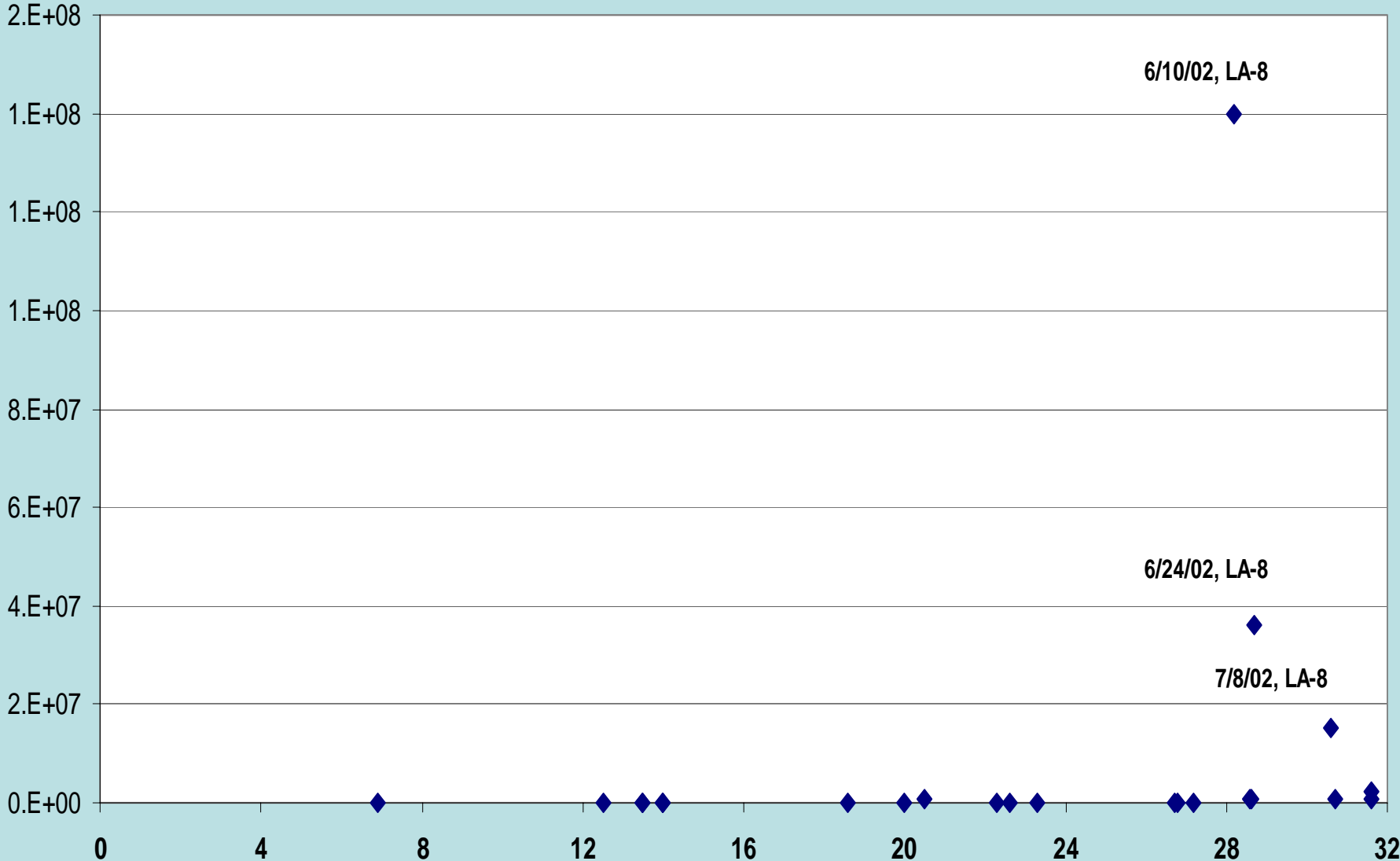
Delaware Little Assawoman Bay – multiple years



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Aureococcus (cells/L) vs Salinity (ppt)

Delaware Little Assawoman Bay – multiple years



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RECAP: Delaware Inland Bays

Only 1 in 113 samples tested for *Aureococcus* showed densities of bloom magnitude (approximately 100,000,000 cells/L)

NO sample exhibited a cell density equivalent to a Maryland Category 3 Bloom (> 200,000,000 cells/L, polyclonal technique)

Cell density varies by analysis method

Cell density was compared to concentrations of selected environmental parameters (Urea, TN, DNH₃, DOC, DON/DIN, TDN, TP) ---
No significant relationship - sample size small and varied: 58 – 68

Highest concentration was reported from “The Ditch”, which joins Delaware Little Assawoman Bay to Maryland Assawoman Bay

Aureococcus anophagefferens

A glimpse !

Delaware Little Assawoman Bay

and

Maryland Assawoman Bay

Results: 2001, 2002, and 2004

Edythe Humphries, Delaware DNREC

DELAWARE STAC 3/31/06

Outline

Little Assawoman Bay & Assawoman Bay Vital Facts

Sampling Sites in DE and MD

Analysis Methods: DE and MD

Cell Densities and Surface Water Temperature: DE and MD

Cell Densities and Surface Salinity: DE and MD

Cell Densities: DE and MD

2001

2002

2004

2001 – 2004 at “The Ditch”

General Observations

Monitoring Activities in 2006: DE and MD

Little Assawoman Bay (LAB) Vital Facts

Water Surface Area: ~ 4 sq. miles **14%** of watershed

Groundwater Contribution: yes, to bay shore and as stream baseflow

Watershed Size (2002 record) : **37** sq. miles (**35%** agriculture, 20% wetlands, **19%** urban, **10%** forest, 2% barren/range, 14% water)

Residence Time: currently unknown

Tidal Influence: From North (Assawoman Canal) – max. 5 cm/sec at Canal
From South (Ocean City Inlet) – ~ 50cm/sec at The Ditch
(wind driven: max. 10 cm/sec)

Eelgrass: none reported

Widgeon grass: isolated stands

Shellfish:

ribbed mussel - present

hard clams – historically, currently limited natural set, currently an active gardening program

oysters – currently an active gardening program (good oyster growth)

scallops – none reported

Assawoman Bay (AB) Vital Facts

Water Surface Area: 9.2 sq. miles **85%** of watershed

Groundwater Contribution: yes, 35% of Nitrogen source

Watershed Size (2002 record) : **10.7** sq. miles (**23.7%** agriculture, 21.4% wetlands, **28.3%** urban, **25%** forest, 1.6% barren/beaches, 85% water)

Residence Time: 20.9 days

Tidal Influence: From South (Ocean City Inlet)

SAV (Eelgrass, Widgeon grass, etc.) : 8% of bay bottom
most prevalent in south end of Bay

Shellfish:

hard clams – average of 0.18 live clams/m² (2003) – low compared to other Maryland Coastal Bays
scallops – reported in 2002

Comparison

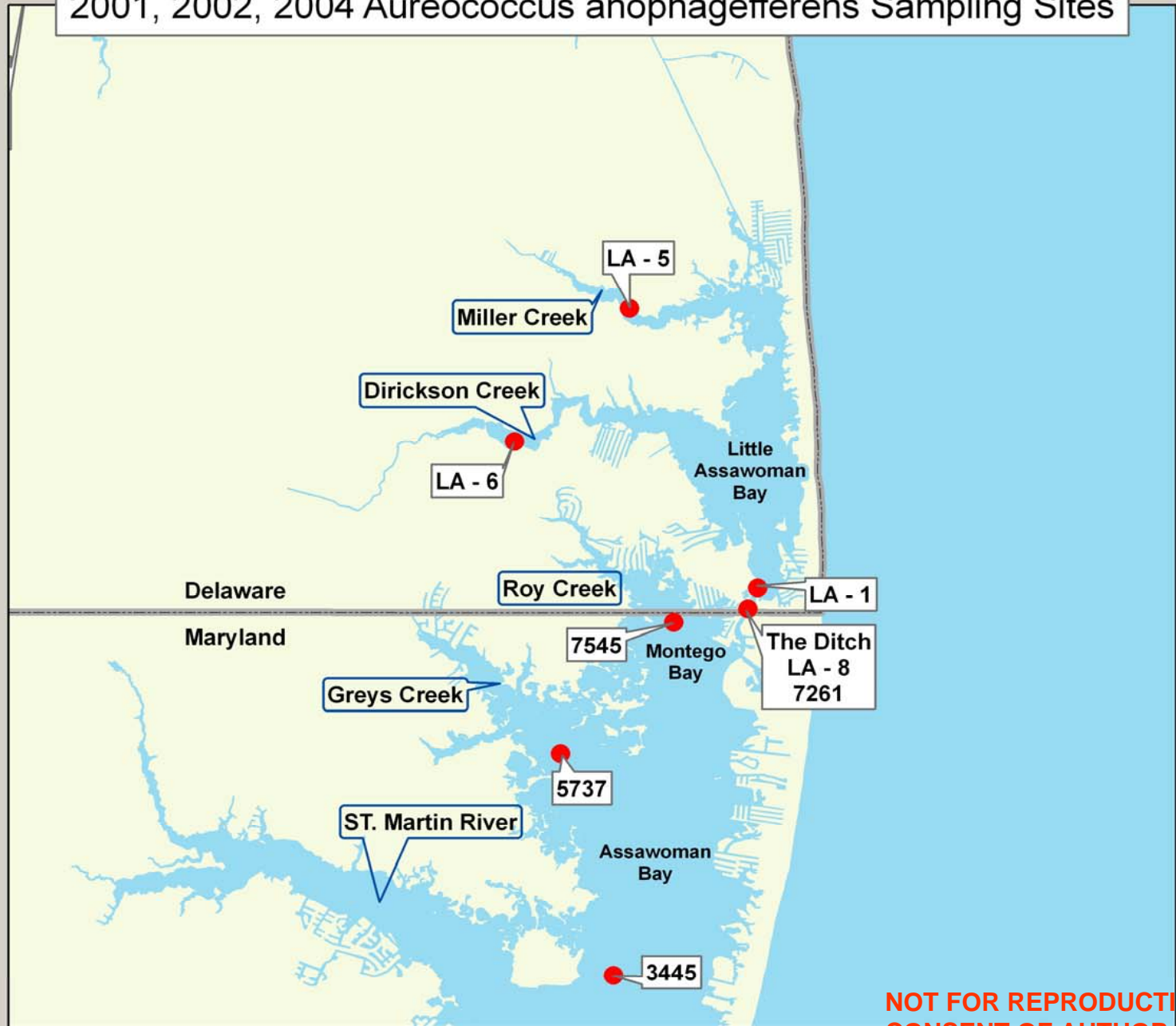
Delaware Little Assawoman Bay (LAB)

versus Maryland Assawoman Bay (AB)

RPD = Relative Percent Difference

- 110 RPD – Watershed Size – LAB larger %
- 38 RPD – Agriculture/Watershed – LAB larger %
- 143 RPD – Surface Water/Watershed – AB larger %
- 85 RPD – Forest/Watershed – AB larger %
- 39 RPD – Urban/Watershed – AB larger %

Little Assawoman Bay, Delaware and Assawoman Bay, Maryland
2001, 2002, 2004 *Aureococcus anophagefferens* Sampling Sites



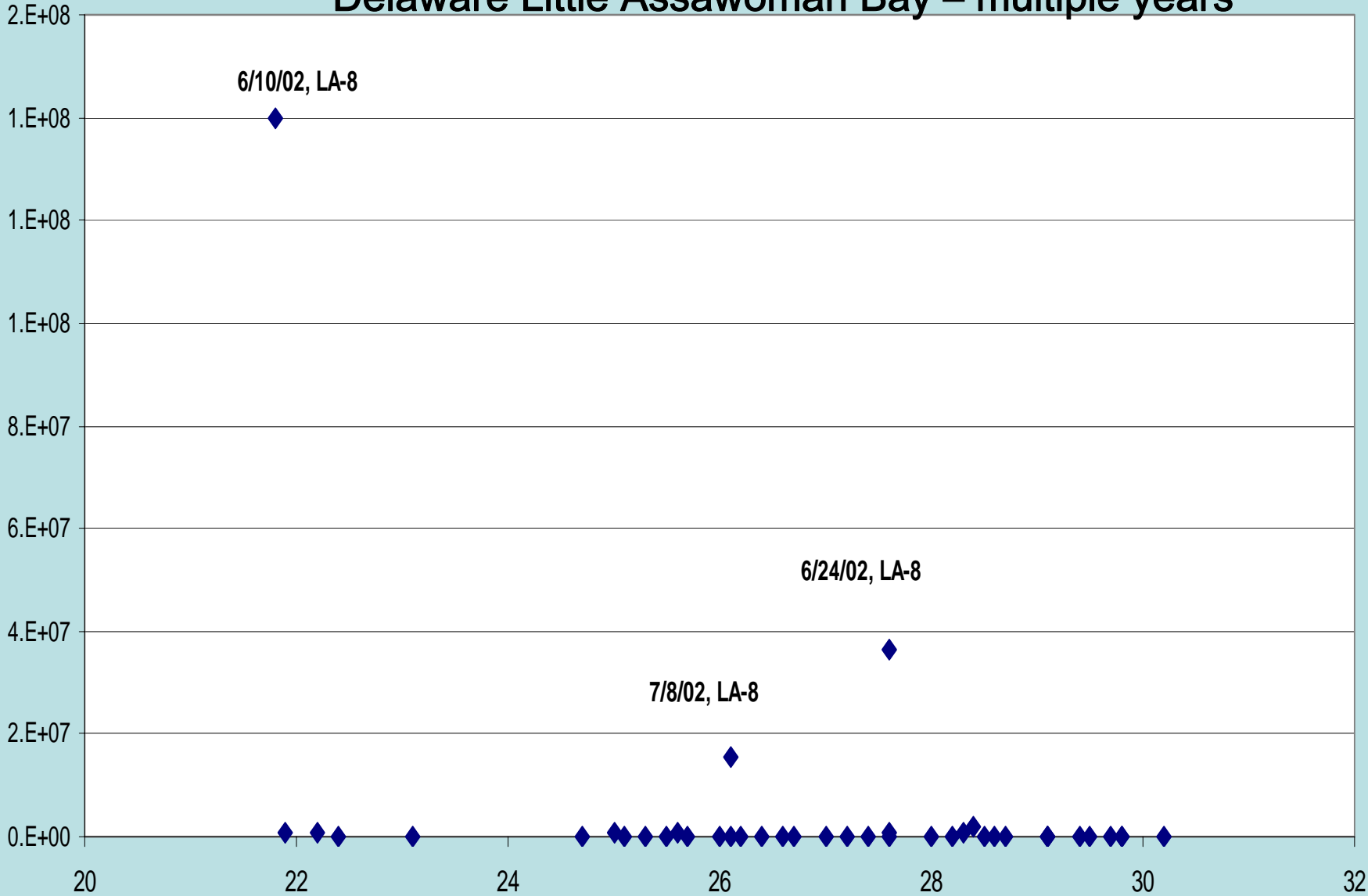
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Analysis Method: *Aureococcus* Determination

Year	Analysis Method for Natural Water Samples	Delaware	Maryland
2001	Polyclonal Antibody & Epifluorescence Microscopy High cross reactivity with other protists & bacteria		ACNS (Hartsig)
	Quantitative PCR (Live Sample -DNA) Variable with physiological state of target cell	UD CMS (Coyne/Popels)	
2002	Polyclonal Antibody & Fluorescence microscopy	ACNS (Hartsig)	ACNS (Hartsig)
	Light Microscopy (Live Sample)	MD DNR (Butler)	MD DNR (Butler)
2004	Qualitative PCR (Preserved Sample - DNA) Variable with physiological state of target cell	U MD Baltimore (Bowers)	
	Monoclonal Antibody & ELISA Low cross-reactivity with other protists & bacteria		Dave Caron

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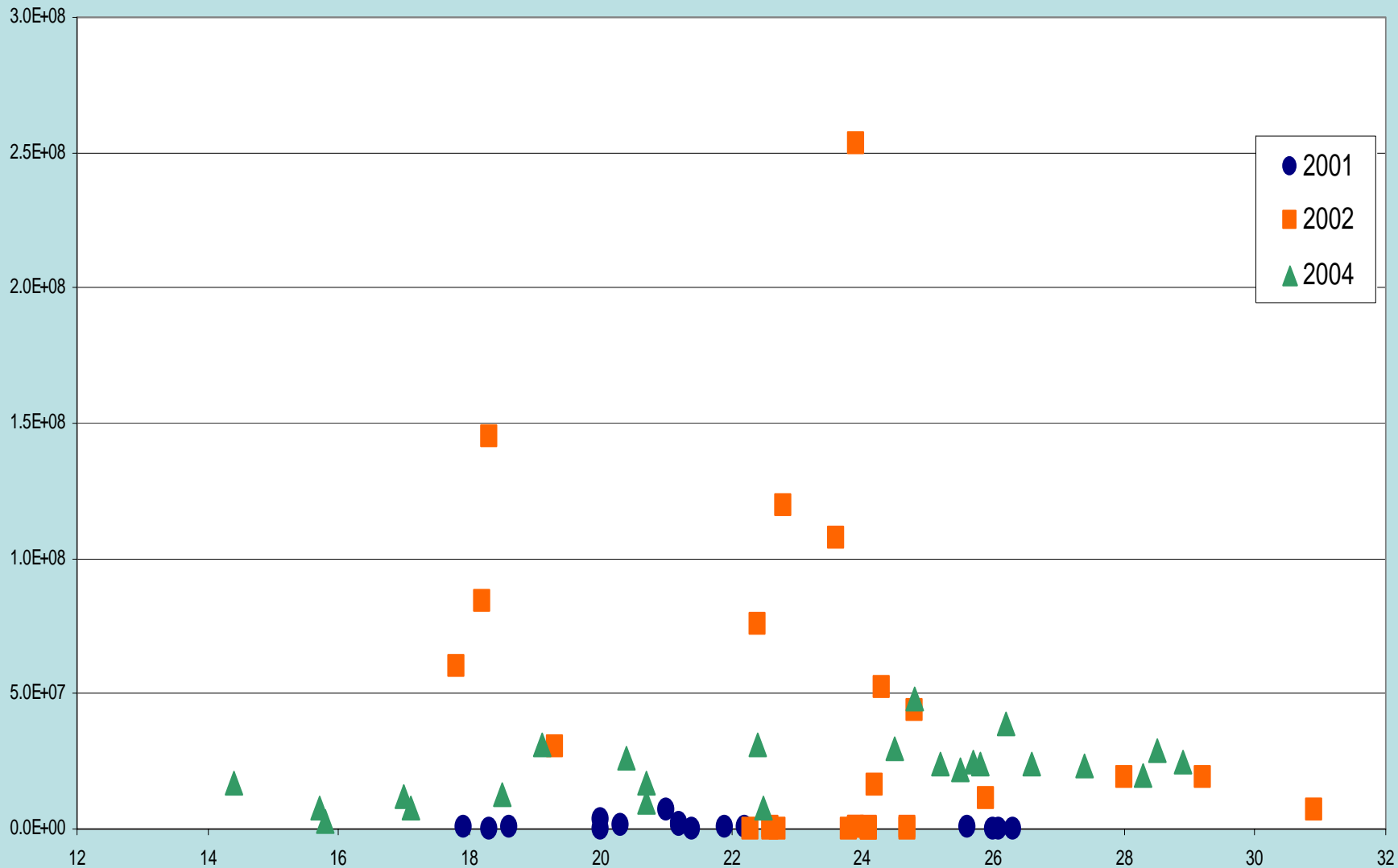
Aureococcus (cells/L) vs. Water Temperature °C Delaware Little Assawoman Bay – multiple years



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Aureococcus (cells/L) vs. Water Temperature °C

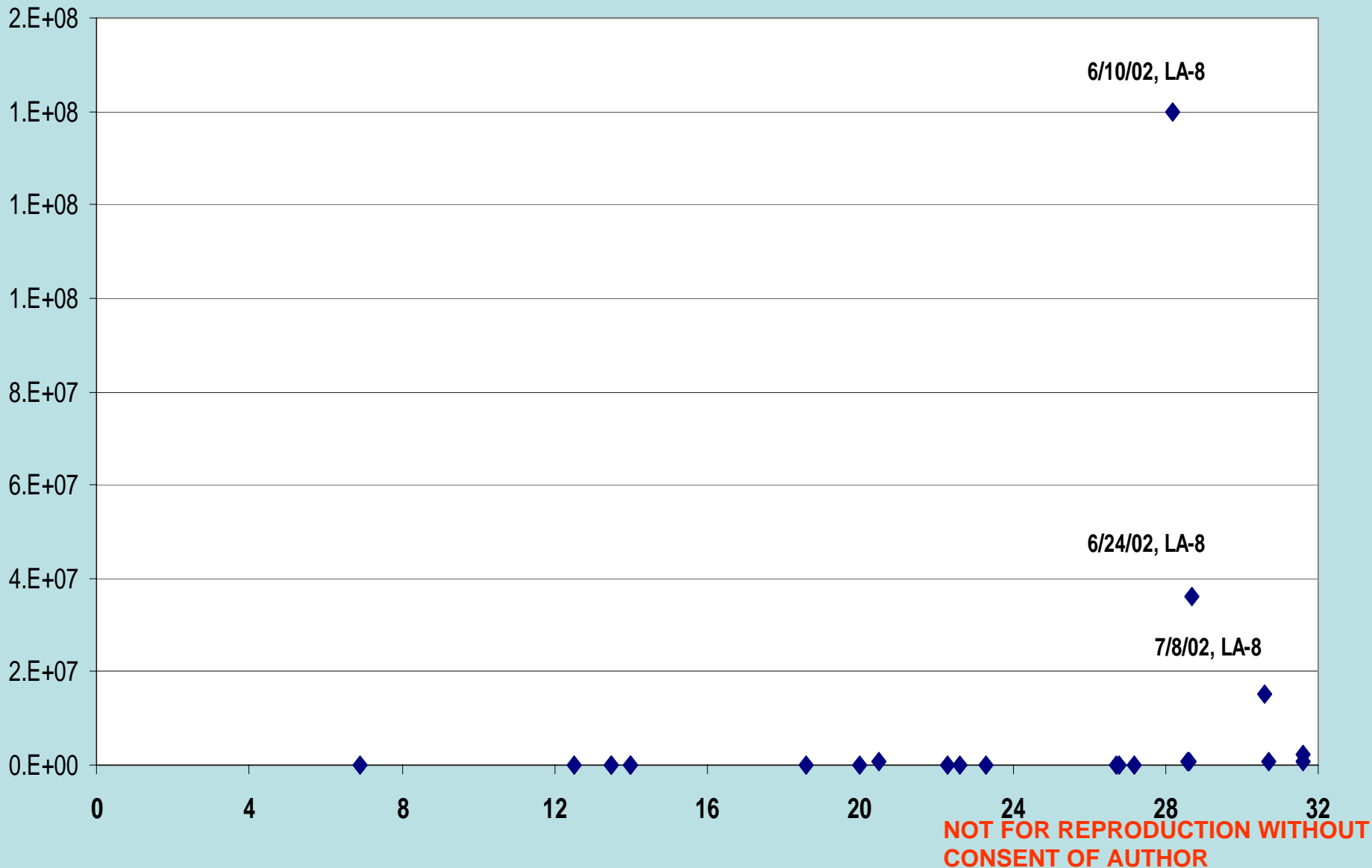
Maryland Assawoman Bay



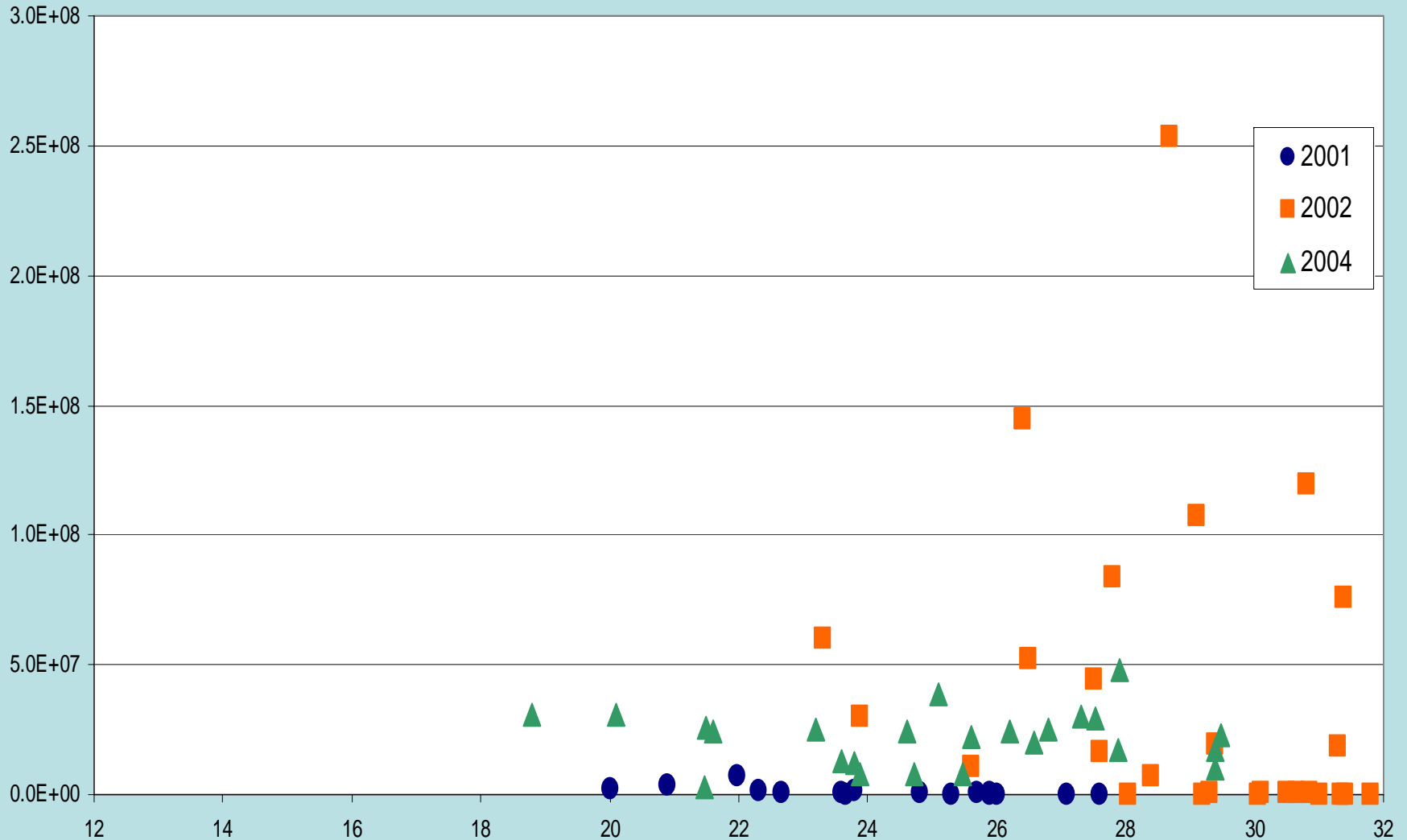
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Aureococcus (cells/L) vs Salinity (ppt)

Delaware Little Assawoman Bay – multiple years

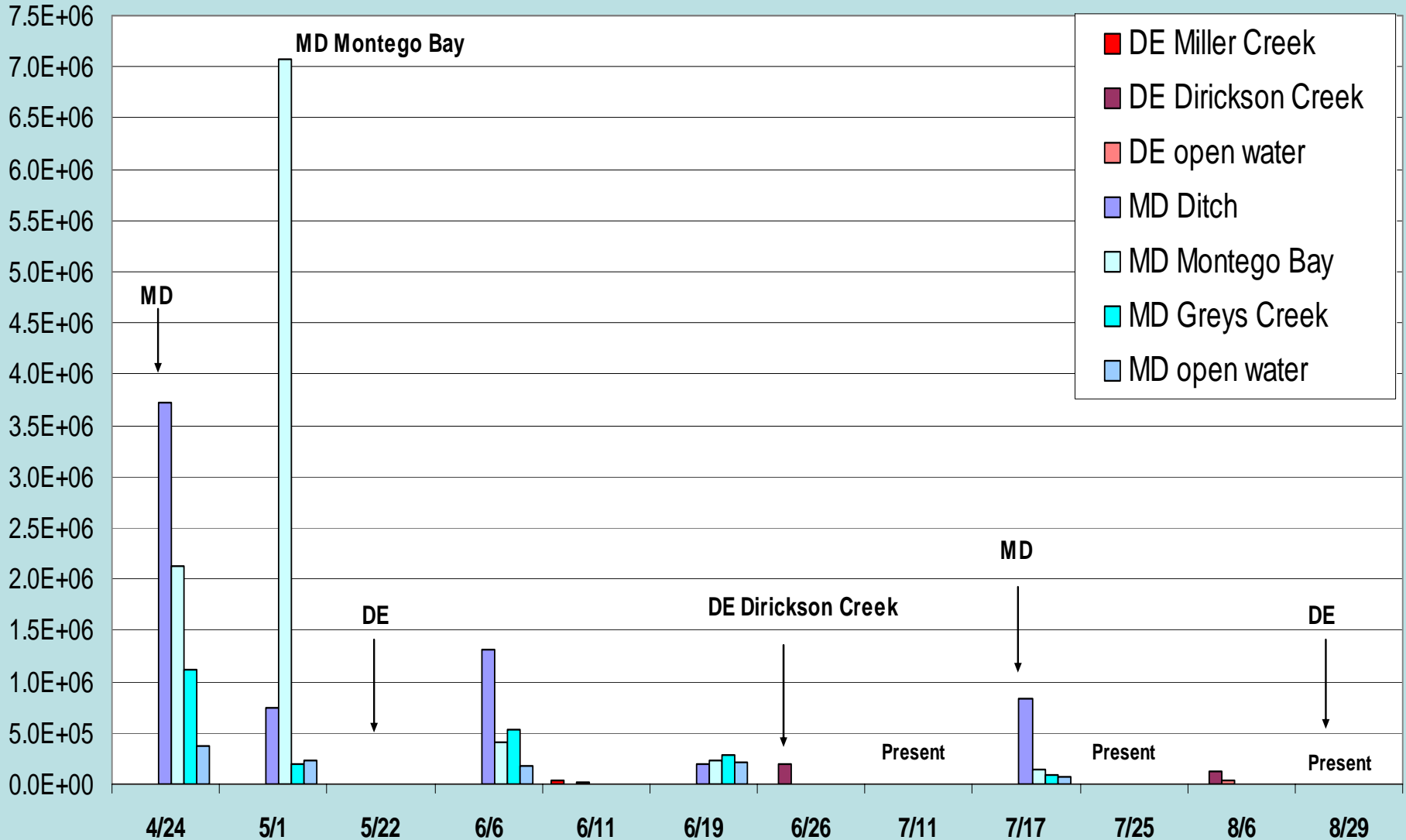


Aureococcus (cells/L) vs. Salinity (ppt) Maryland Assawoman Bay



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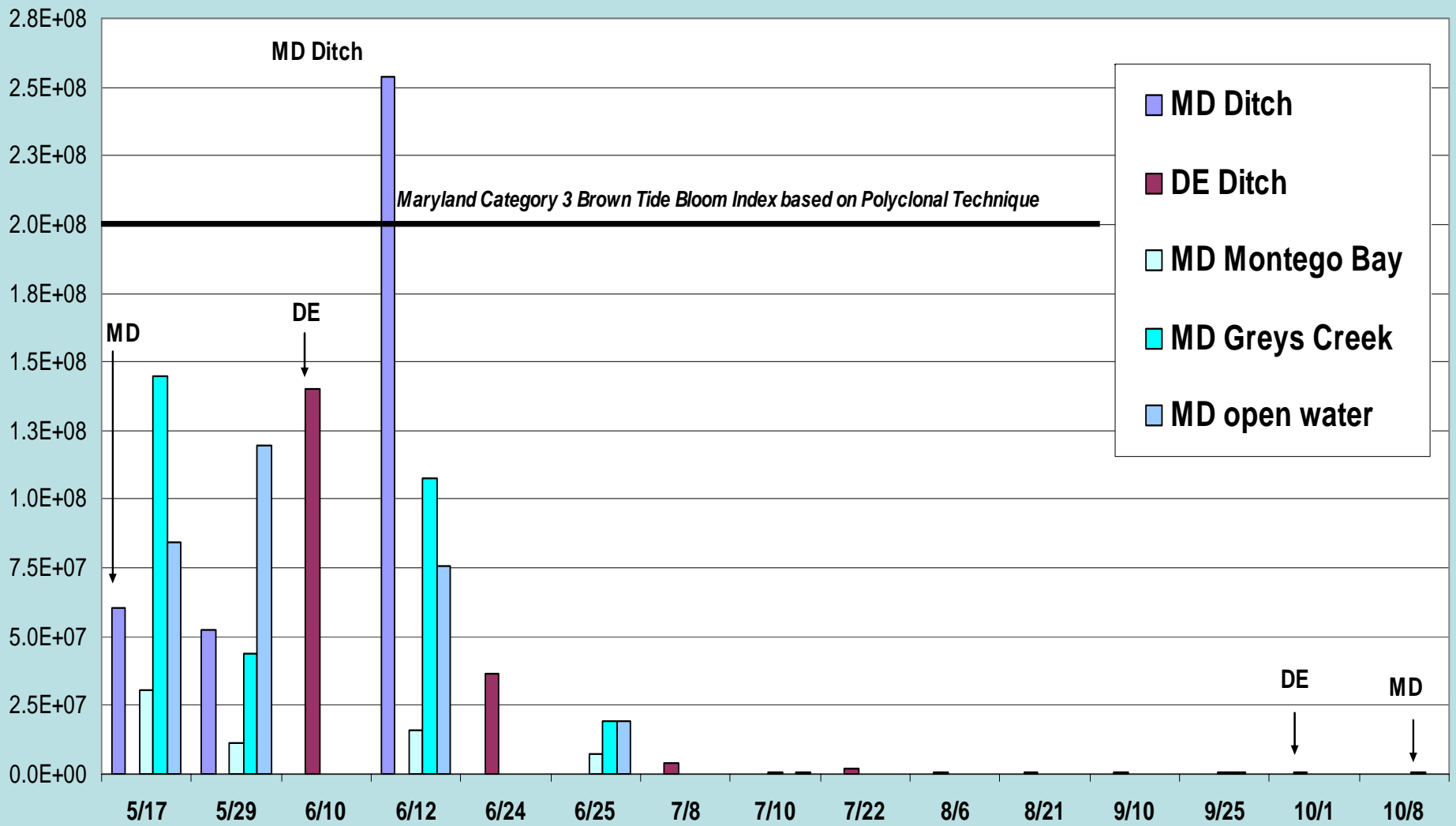
2001 - *Aureococcus* (cells/L): North to South



Collection Dates

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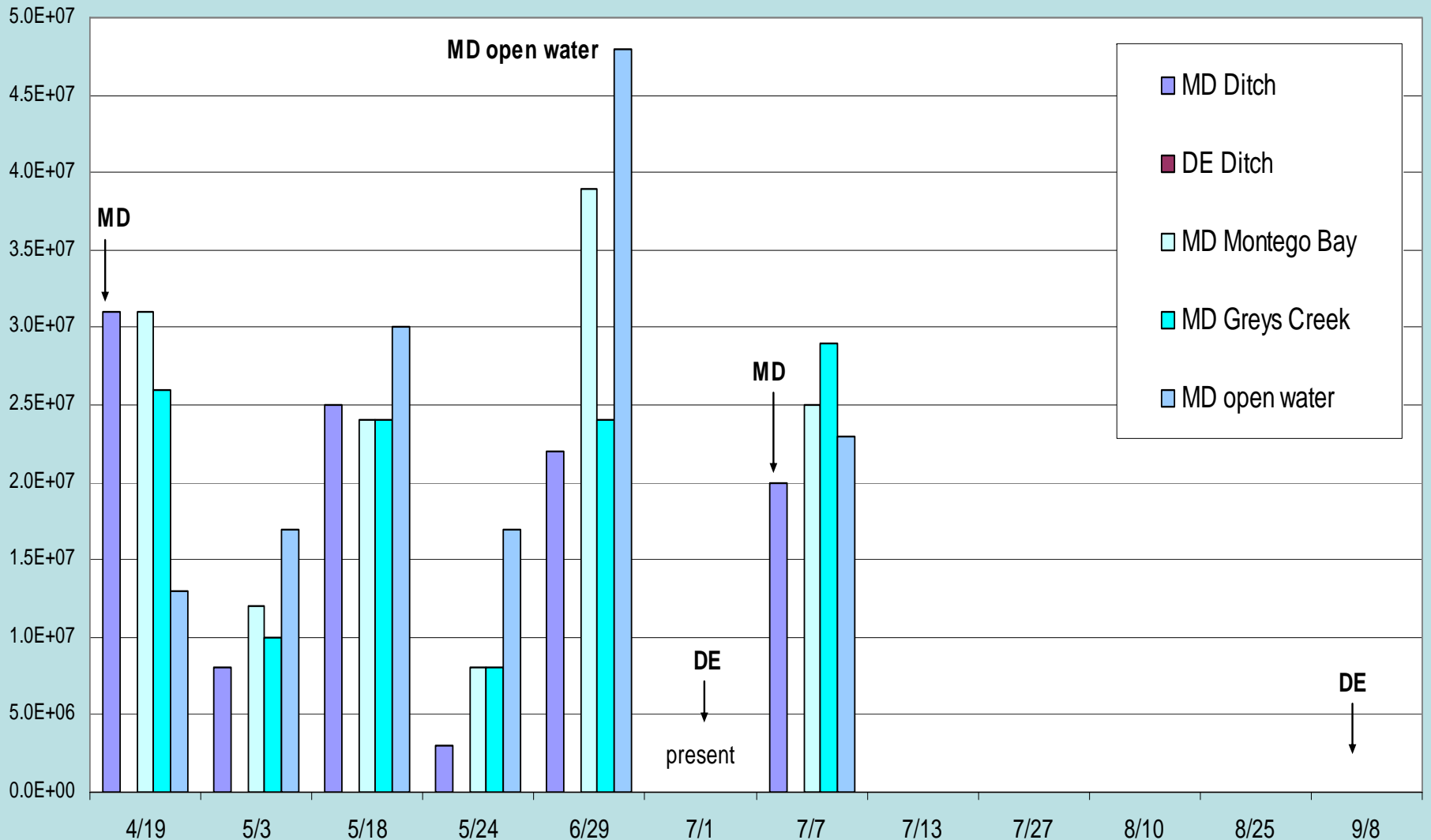
2002 – *Aureococcus* (cells/L): North to South



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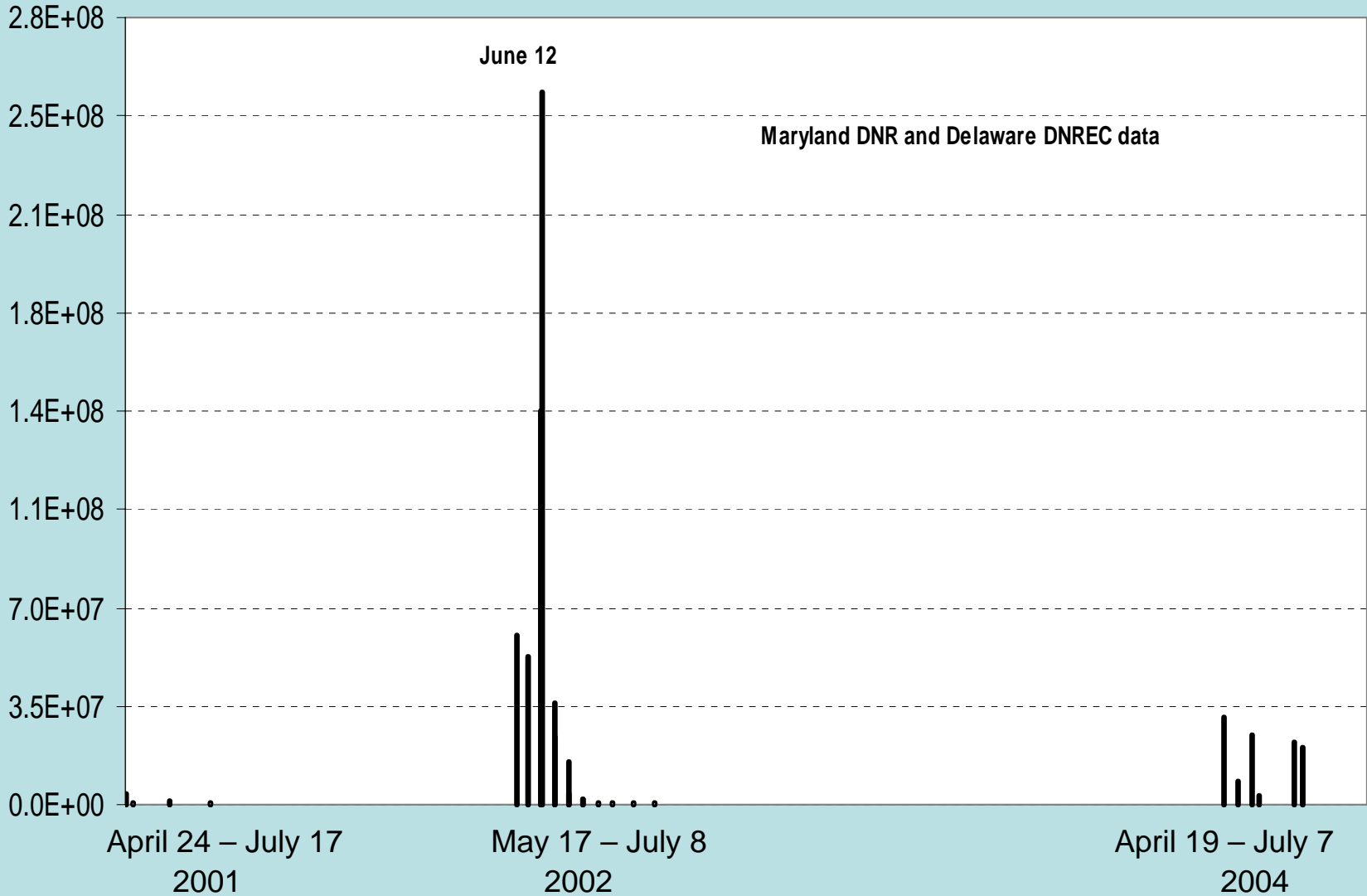
2004 - *Aureococcus* (cells/L): North to South



Collection Dates

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Aureococcus (cells/L) – The Ditch



General Observations: *Aureococcus* Occurrence

Little Assawoman Bay and Assawoman Bay

- **Cell concentrations: annual variability**
- Category 3 Bloom concentrations reported in “The Ditch” on 1 occasion in 3 yr. analysis
- **Salinity: 7 - 31 ppt**
- Water Temperature: 14 -31 C (18-25 C)
- **Cell concentrations: spatial variability**

***Aureococcus* Monitoring in 2006**

Maryland Assawoman Bay

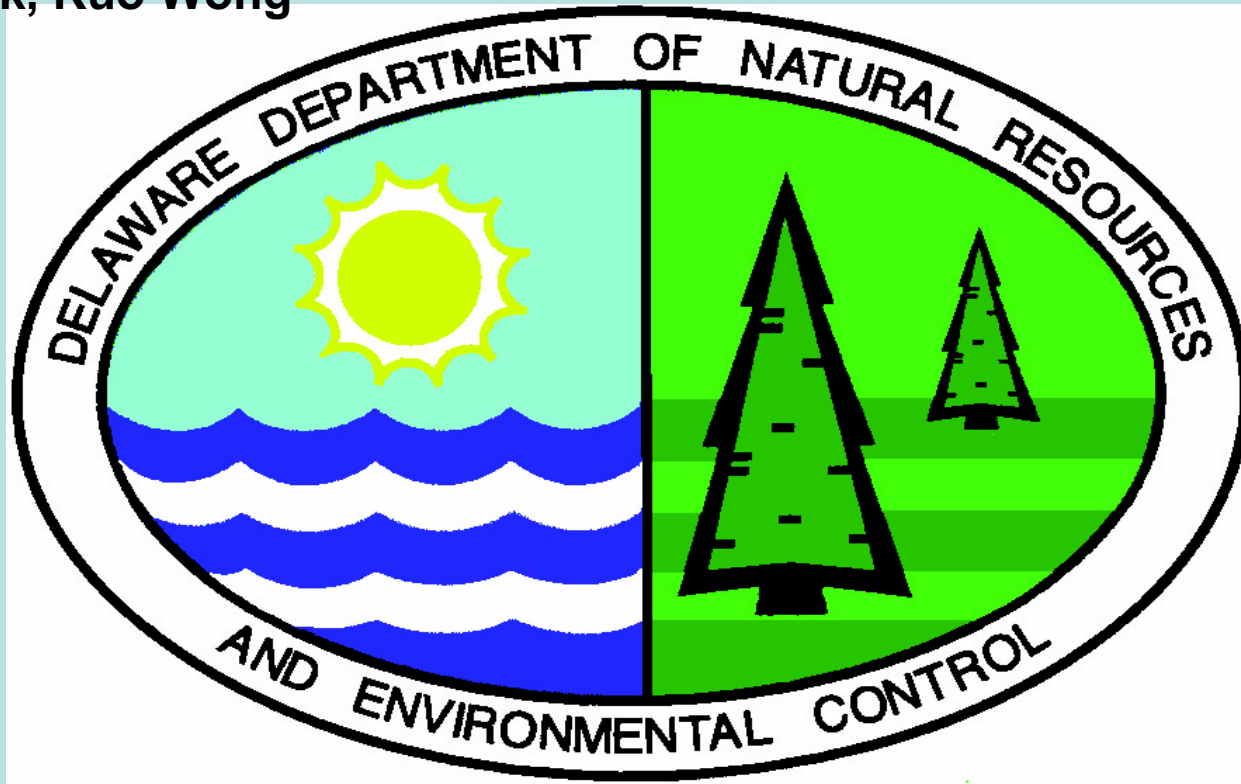
Routine Monitoring: same sites as previous years
late April to mid July, and late September

Delaware Inland Bays

- * No Routine Monitoring scheduled as of this date
- * Continual monitoring of *Aureococcus* results from MD Coastal Bays
- * Rapid Response Capabilities in place for episodic sampling of Phytoplankton Blooms
- * Data sonde with fluorescent probe placed in vicinity of “The Ditch” (funding dependent)

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