



# RIDEM

## Harmful Algal Bloom Monitoring Plan and Response Plan Revisions

December 16, 2016  
Coastal Institute Building, URI

# HAB Phytoplankton monitoring

Species ?

Locations?

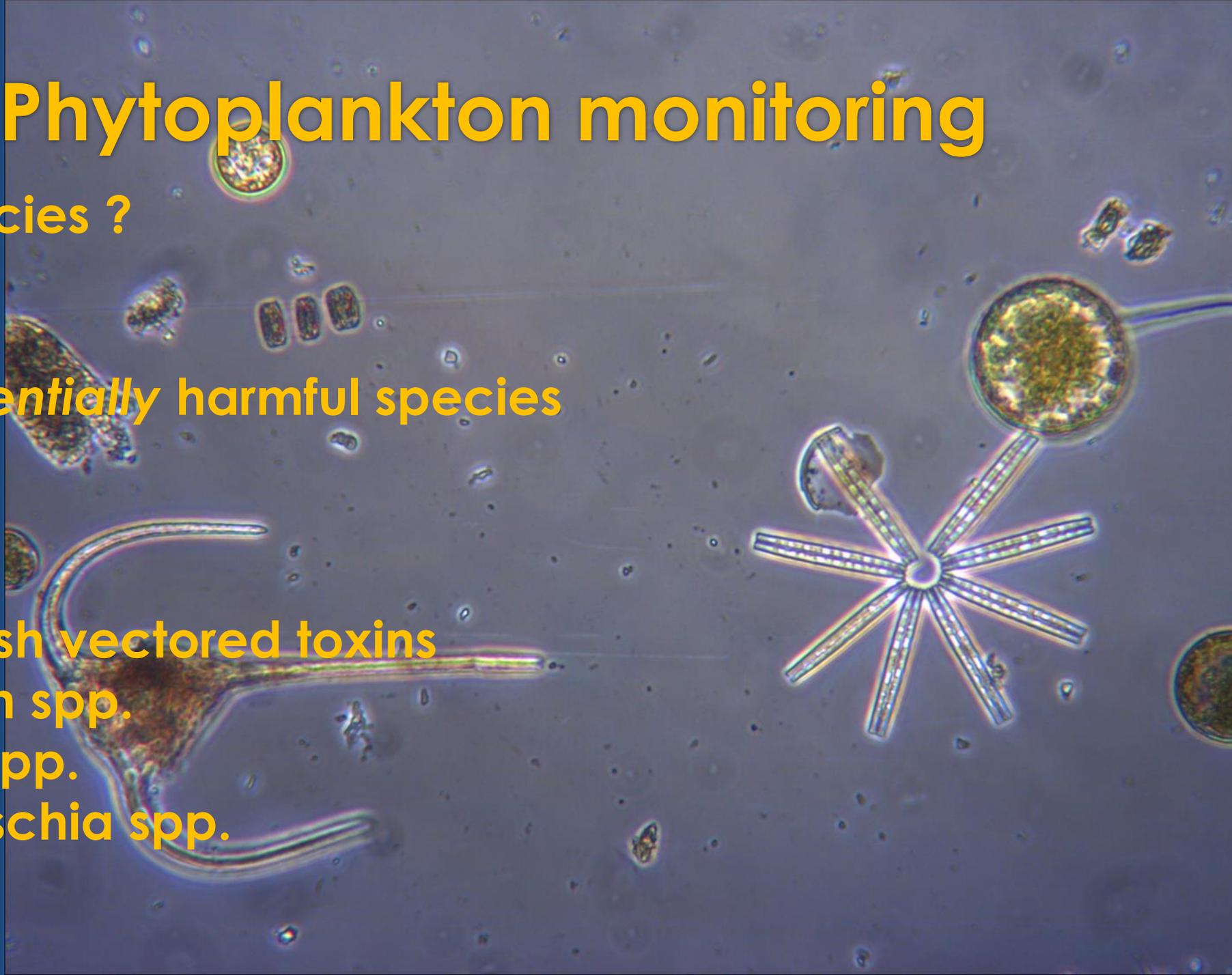
Frequency?



# RI DEM HAB Phytoplankton monitoring

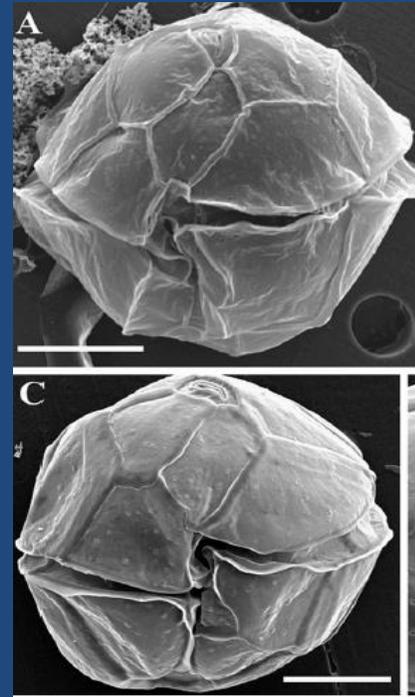
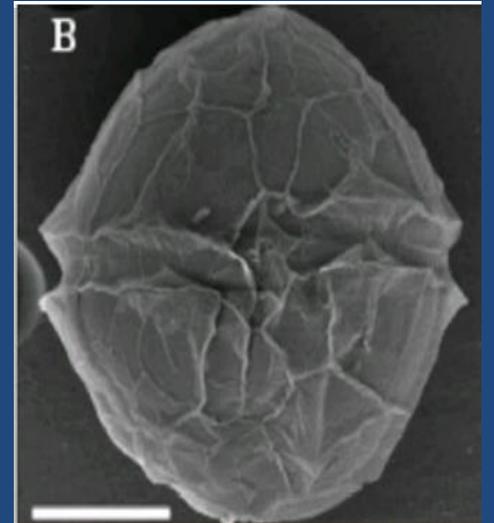
## Phytoplankton species ?

- 99%+ benign
- NE US: ~45 *potentially* harmful species
- Public health
- Produce shellfish vectored toxins
  - Alexandrium spp.
  - Dinophysis spp.
  - Pseudo-nitzschia spp.



# Alexandrium in R.I. waters

- Dinoflagellate; produces Saxitoxins (PSP)
- Locally, 3 spp. with toxin producing potential
- May be present year-round in low numbers
  - Spring - early summer peak in abundance
- RI Bloom abundance (1,000s cells/L)
  - Seldom seen in RI waters at high abundance
  - Lower toxin variants than Gulf of Maine

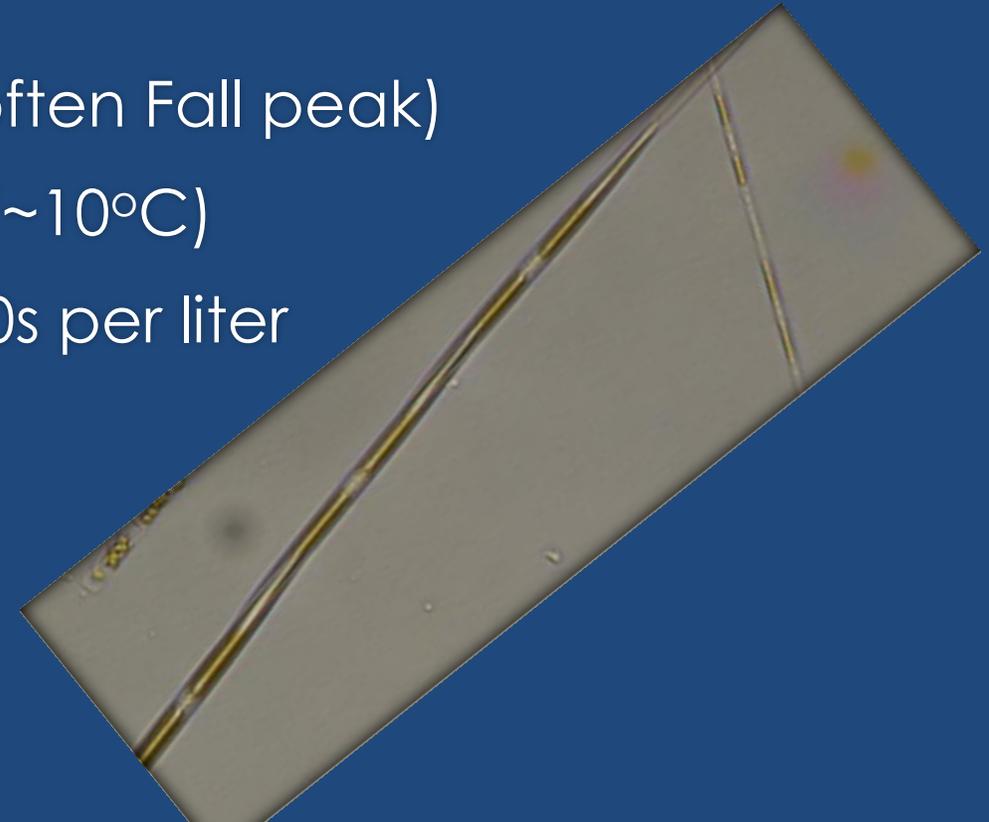


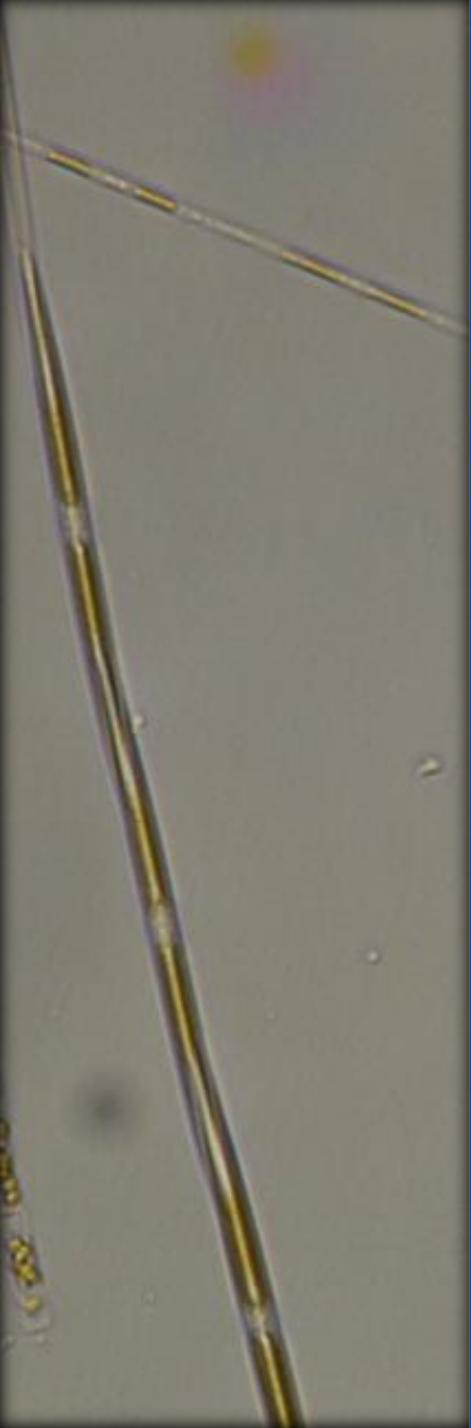
# Dinophysis in R.I. waters

- Dinoflagellate; produces Okadaic Acid (DSP)
- Several (6) species locally may produce toxin (OA)
- Greater abundance warmer months, > ~50°F (~10°C)
- RI bloom abundance (10,000s cells/L)
  - Low toxin variants locally (?)

# Pseudo-nitzschia in R.I. waters

- Diatom; produces Domoic Acid (ASP)
- 6 spp. locally that **may** produce toxin
- May be present year-round
  - Not 'new' to RI waters
  - Highest abundance during May-Nov (often Fall peak)
  - Water temperature greater than ~50°F (~10°C)
- RI bloom abundance variable; to 1,000,000s per liter
- Difficult species ID
- Problem: Toxin production on/off





# DEM Shellfish HAB plan:

- Presence of HAB species In plankton (cell counts)
- Analysis of toxin in plankton
- Analysis of toxin in shellfish meats

# Alexandrium spp., PSP (Saxitoxin)

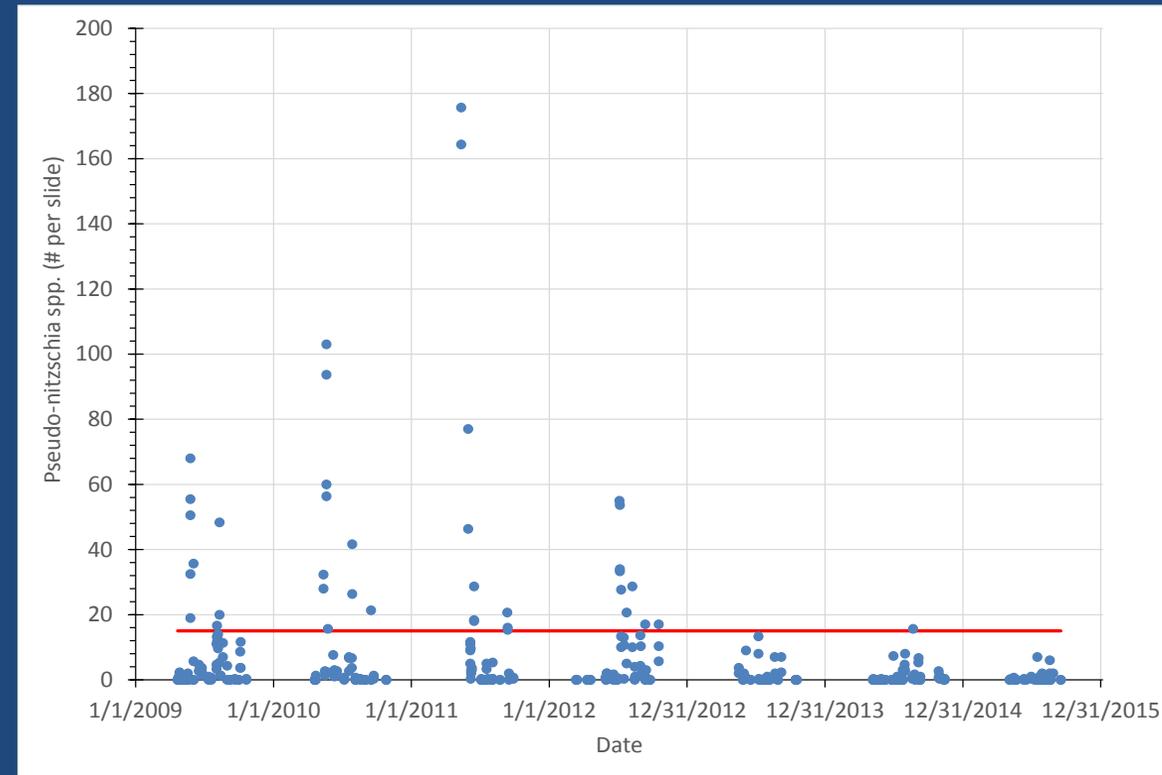
- PSP Toxin in RI Shellfish?
  - 1970s to 1990s: 1,000s of mouse assays
  - 1990s to now: Cell counts & screening kits
    - Cell count warning never reached
    - 2005 Gulf of Maine bloom = no toxin detect in RI shellfish
- **Extremely rare in RI shellfish (2 occurrences during 1970s; none since 1979)**

# Dinophysis spp., DSP (Okadaic Acid)

- DSP Toxin in RI Shellfish?
  - Cell count threshold never exceeded
  - No testing for toxin
- Research, *Dinophysis acuminata*:
  - Narragansett Bay 1980s = low toxin
  - Long Island, 2010s = low toxin

# Pseudo-nitzschia spp., ASP (Domoic Acid)

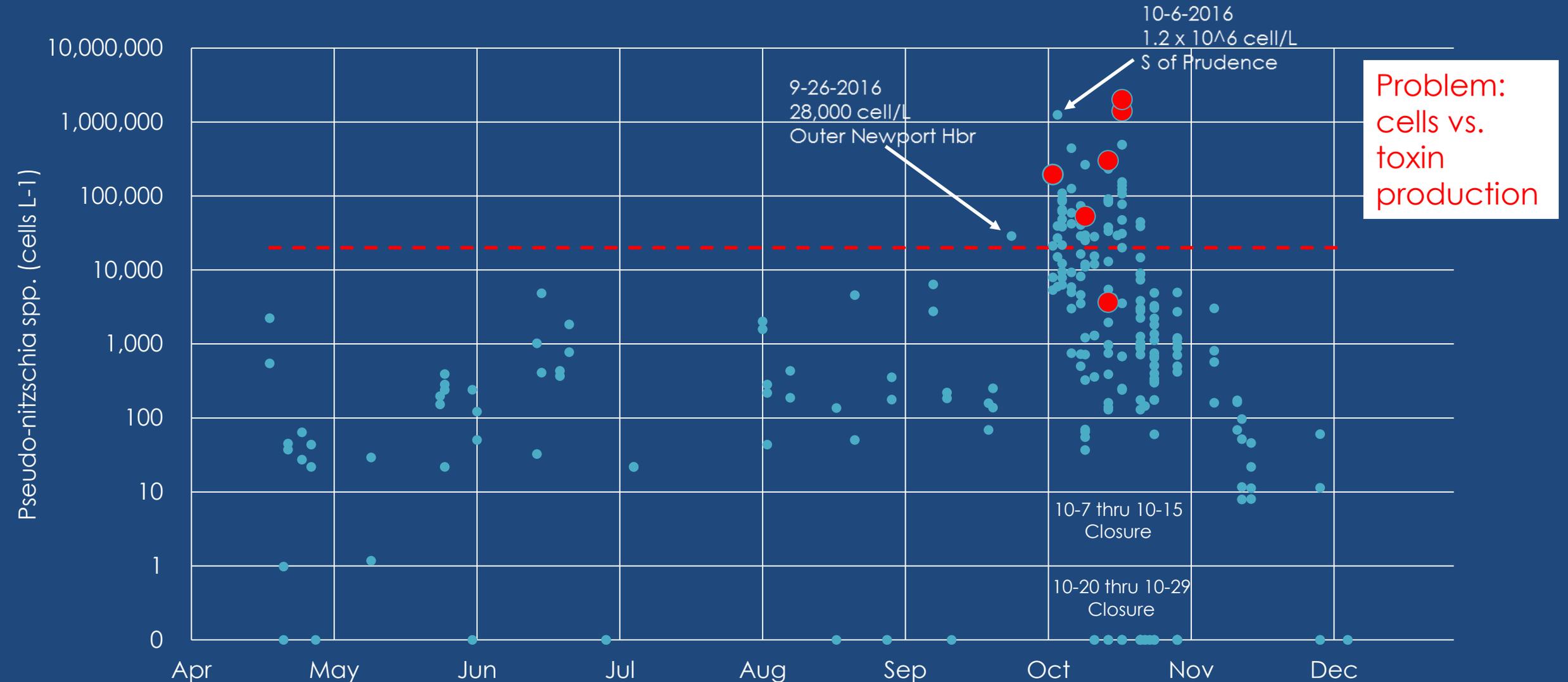
- ASP Toxin in RI Shellfish?
  - Cell count warning exceeded 29 separate events (2000-2015)
- Follow-up screening for Domoic Acid presence in shellfish NEGATIVE (2000-2015)
- Problem of spp. ID
- Problem of abundance vs. toxin production



# 2016 Pseudo-nitzschia timeline

2016 Pseudo-nitzschia spp DEM cell counts all areas

● Positive cell toxin



# HAB Phytoplankton monitoring

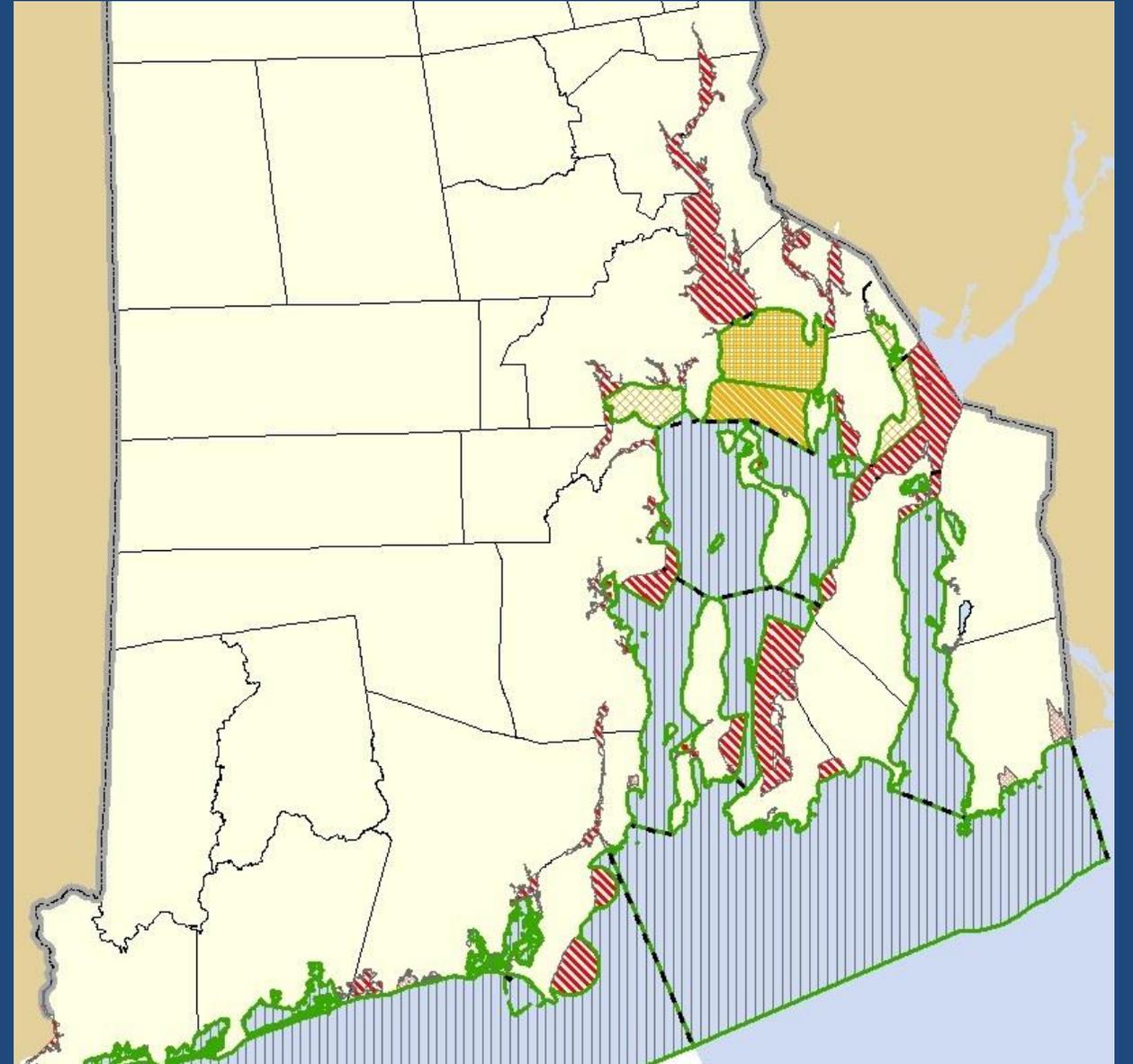
Species ?

Locations?

Frequency?

RI Shellfish Waters:

- Conditional shellfish grow areas (12X per year)
- Open shellfish grow areas (6X per year)
- Want to characterize HAB abundance in each area



# HAB Phytoplankton monitoring

Species ?

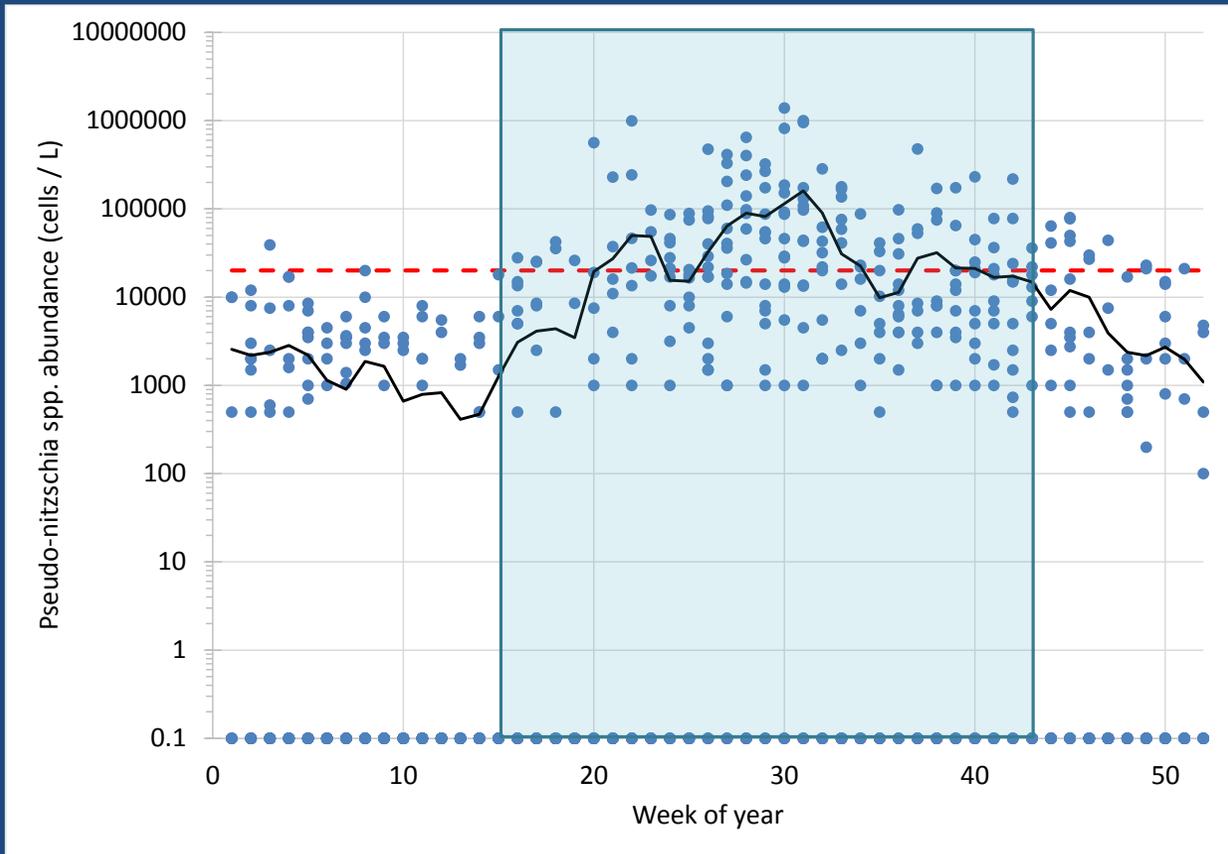
Locations?

**Frequency?**

How often to sample HAB phytoplankton?

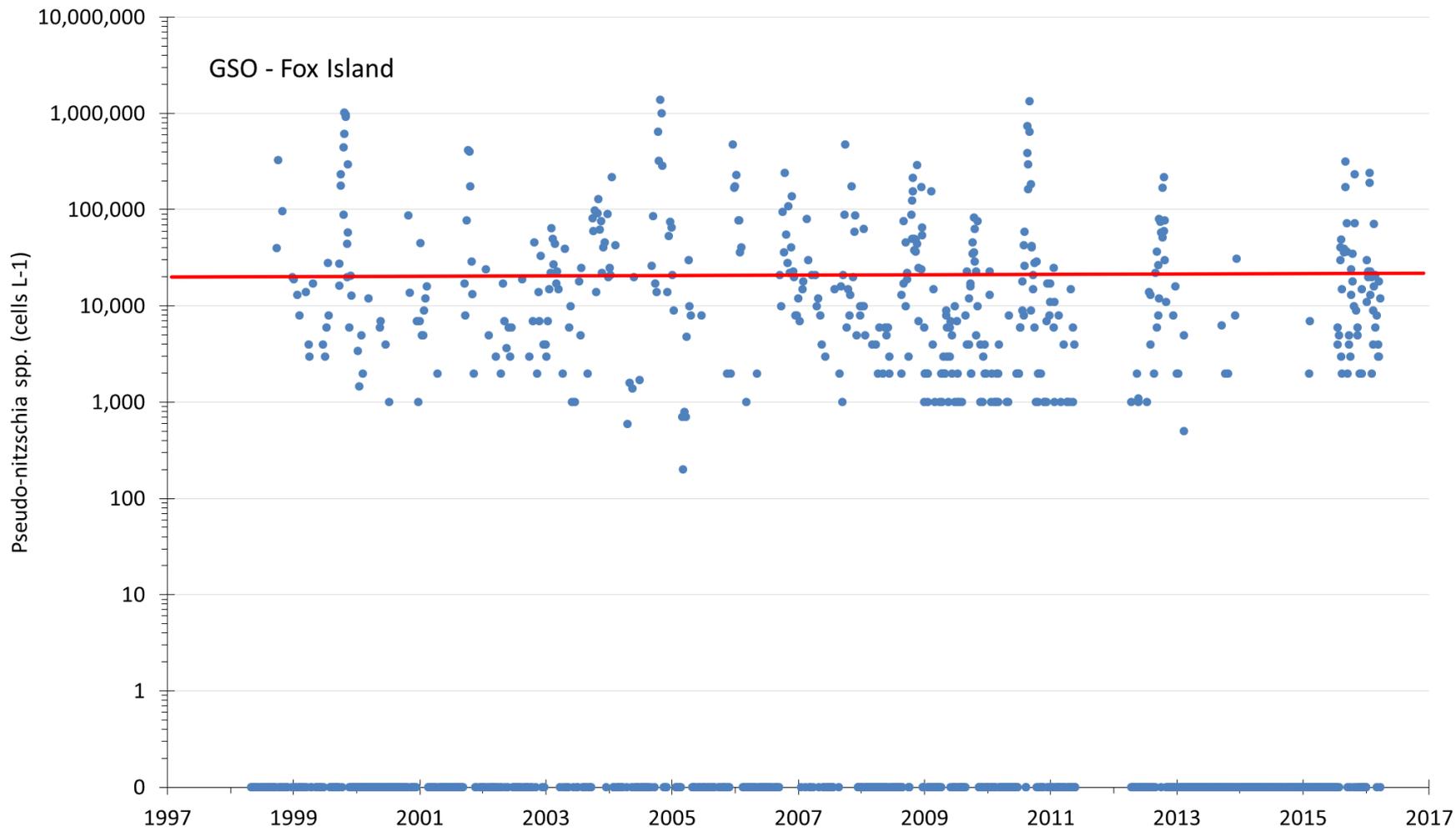
- Compromise: cost vs. protection of public health
- Sample frequency match bloom period and bloom duration

*Pseudo-nitzschia* spp. annual abundance pattern at GSO Fox Island station during 1999-2016 in lower Narragansett Bay, RI.



URI-GSO Phytoplankton Time Series  
- Weekly observations since 1959  
- 1999-2016 records analyzed

*Pseudo-nitzschia* spp.  
- Present year-round  
- Abundance can exceed warning level most months



URI- GSO Time Series  
@ 20,000 cell L-1  
threshold

~20 events 1999-2016

Duration from 0 to 9  
weeks (2.3 week avg.)

Threshold	Range of # of weeks per year exceeding during 1999-2016	Average duration of exceedance duration (duration range)
10,000 cells / L	0-20	7.6 weeks (0 to 11 weeks)
20,000 cells / L	0-17	2.3 weeks (0 to 9 weeks)
50,000 cells / L	0-9	3.5 weeks (0 to 6 weeks)
75,000 cells / L	0-7	1.67 weeks (0 to 6 weeks)
100,000 cells / L	0-5	1.5 weeks (0 to 5 weeks)

Summary of frequency and duration of *Pseudo-nitzschia* abundance exceeding various thresholds at Fox Island (URI- GSO, lower West Passage) during 1999-2016.

*Pseudo-nitzschia* spp.: 2-3 week bloom duration @ 20-50,000 cells/L

# DEM HAB Phytoplankton monitoring

## Sample Frequency:

GA 10 only (PJ Pond)		
DATE	GA 10	Sample Interval (days)
4/21/2016	2	
5/25/2016	2	34
6/30/2016	2	36
8/4/2016	2	35
10/11/2016	2	68
10/17/2016	2	6
10/20/2016	2	3
10/24/2016	2	4
10/27/2016	2	3
11/1/2016	2	5
12/2/2016	2	31
	AVG	22.5

East Middle Bay	
Date	Sample Interval (days)
6/2/2016	
8/4/2016	63
9/21/2016	48
10/5/2016	14
10/7/2016	2
10/9/2016	2
10/20/2016	3
10/24/2016	6
11/1/2016	8
12/2/2016	31
AVG	19.7

### 2016 Frequency of HAB samples:

- Average of 12 to 28 days
- 2016 increased sampling
- Gaps of up to 100 days some areas

# DEM HAB Phytoplankton monitoring

## Concerns:

- Sample Frequency
  - extend to year-round vs. April – October
  - increase frequency of sampling (esp. peak season)
- Cell counts vs. Toxins?
  - PSP: low cells, no to low toxin
  - DSP: low cells, no to low toxin
  - ASP: HIGH cells, no toxin (until 2016)
    - 2016: toxin in plankton at high or low cell count



# DEM Shellfish HAB plan:

- Presence of HAB species In plankton (cell counts)
- Analysis of toxin in plankton
- Analysis of toxin in shellfish meats

# DEM HAB Monitoring plan revisions

- Goal:

- Increase HAB plankton sample frequency in all grow areas

- Proposed change:

- Increase plankton collection during bacteria monitoring
  - Add synoptic plankton sampling cruises during peak bloom season (May – October)

# DEM HAB Monitoring plan revisions

- Extend HAB sampling to year-round
- Increase sample frequency

Area type	# of areas	# times sampled per year	# HAB Phytoplankton samples
Conditional areas	4	12	96
Open areas (incl. Block Island)	9	6	108
Offshore	3	2	12
		TOTAL	216

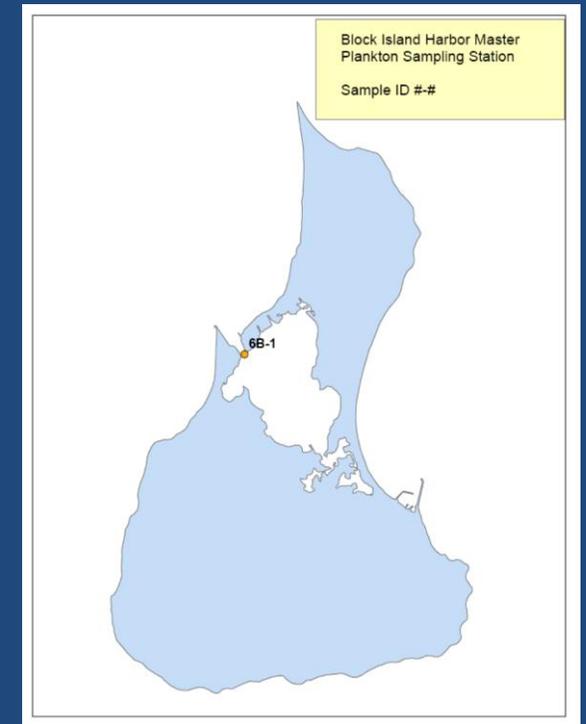
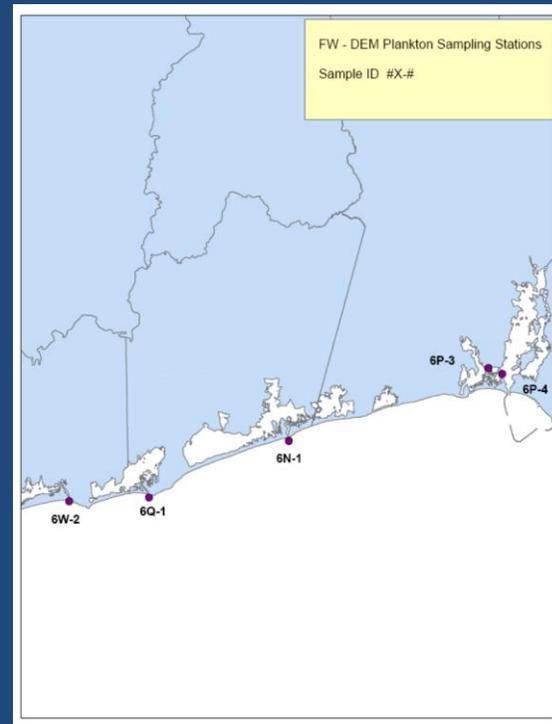
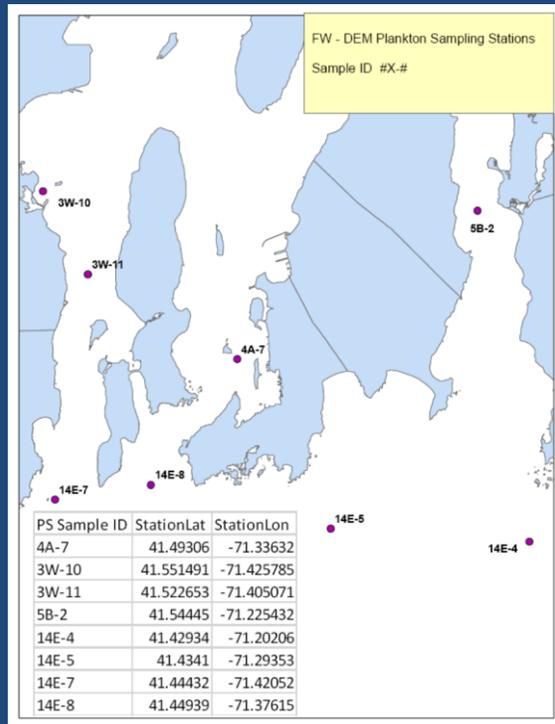
Proposed schedule of HAB phytoplankton monitoring sample collection conducted by DEM-OWR as part of the routine monitoring of RI shellfish growing areas.

**APPROXIMATE DOUBLING OF PAST EFFORTS**

# DEM HAB Monitoring plan revisions

- Increase sample frequency and spatial coverage

## Synoptic plankton monitoring stations



# DEM HAB Monitoring plan revisions

## - Synoptic plankton monitoring stations

Area	# of HAB Stations Monitored	# trips per year	Total
Upper Bay	7 (1A-1, 1B-2, 2-2, 3W-12, 4A-6, 4A-8, 5A-1)	6	42
Sakonnet	2 (5B-1, 5B-2)	6	12
East & West Passages	6 (3W-10, 3W-11, 14E-4, 14E-5, 14E-7, 14E-8)	6	12
Coastal Salt Ponds	5 (Pt. Judith, Potter, Ninigret, Quonnie, Winnipaug)	6	30
Block Island	1 (6B-1)	6	6
		TOTAL	102

- ADDED SYNOPTIC CRUISES DURING PEAK SEASON
- 6X per year (May to October)
- Reduce sampling gaps during peak season
- Combined, added year-round sampling (216) and synoptic sampling (102)
- = ~3X prior HAB phytoplankton monitoring effort

# DEM HAB Monitoring plan revisions

- Proposed sampling schedule

<u>Sample date</u>	<u>Conditional Areas</u> <u>Sample interval (days)</u>	<u>Open Areas</u> <u>Sample interval (days)</u>
15-Jan	1 <sup>st</sup> sample	
15-Feb	31	
15-Mar	29	
15-Apr	31	
1-May	16	1 <sup>st</sup> sample
15-May	14	14
1-Jun	17	17
15-Jun	14	14
1-Jul	16	16
15-Jul	14	14
1-Aug	17	17
15-Aug	14	14
1-Sep	17	17
15-Sep	14	14
1-Oct	16	16
15-Oct	14	14
15-Nov	31	
15-Dec	30	
AVG (annual)	19.7	
AVG (May - Oct)	15.3	15.2

## Additional HAB Sampling:

- Reduce sample interval to ~2 weeks  
May to October

# DEM HAB Monitoring plan revisions

- HAB cell count contingency levels
- FDA NSSP guidance; use as early warning
- Trigger
  - expanded sampling
  - toxin screening in plankton

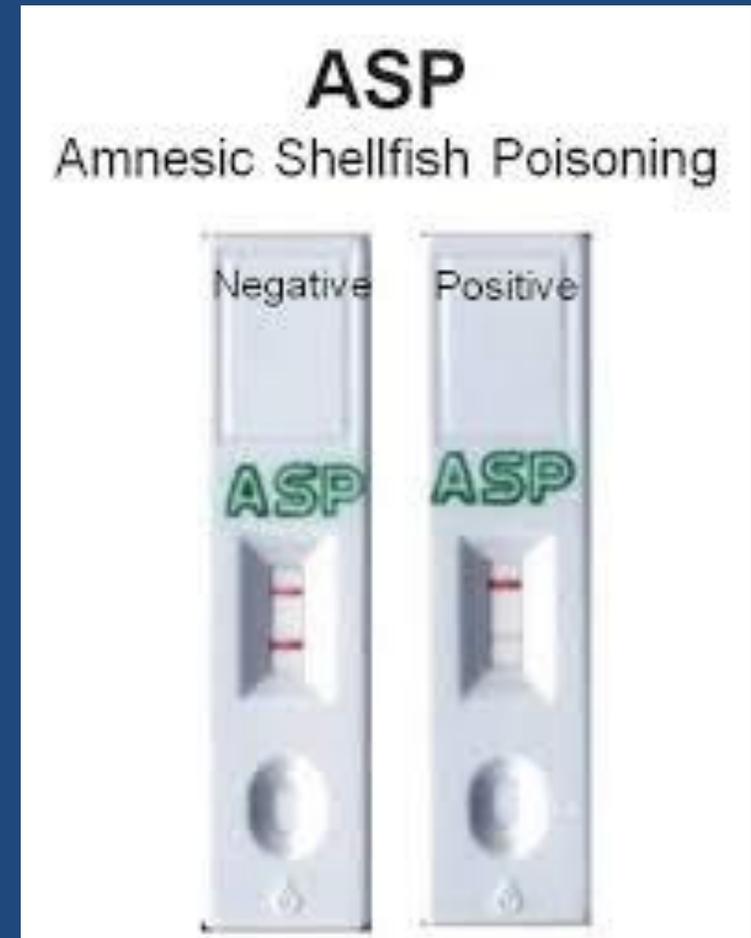
HAB Taxa	Toxin	Shellfish Syndrome	Abundance threshold
Alexandrium spp.	Saxitoxins	Paralytic Shellfish Poisoning (PSP)	1,000 cells L <sup>-1</sup>
Dinophysis spp.	Okadaic Acid	Diarrhetic Shellfish Poisoning (DSP)	30,000 cells L <sup>-1</sup>
Pseudo-nitzschia spp.	Domoic Acid	Amnesic Shellfish Poisoning (ASP)	20,000 cells L <sup>-1</sup>

# DEM Shellfish HAB approach:

- Presence of HAB species In plankton (cell counts)
- Analysis of toxin in plankton ←
- Analysis of toxin in shellfish meats



- Screening kits for toxin in plankton
- If **NEGATIVE**
  - Continue HAB phytoplankton monitoring
- If **POSITIVE**
  - Initiate shellfish toxin monitoring



# DEM Shellfish HAB approach:

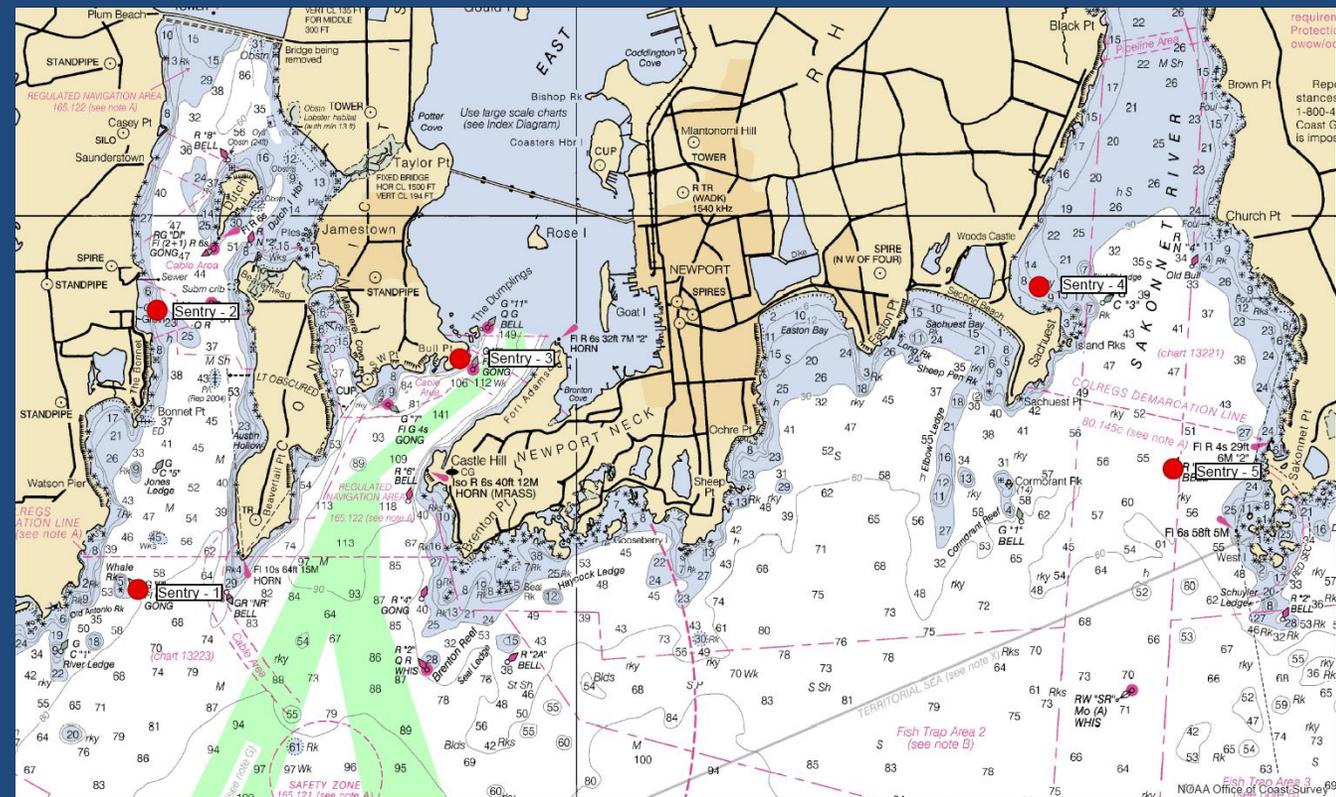
- Presence of HAB species In plankton (cell counts)
- Analysis of toxin in plankton
- Analysis of toxin in shellfish meats ←



# DEM HAB Monitoring: Shellfish collection

- Not always straight forward!
- North of Jamestown:
  - Reliable resource; DEM F&W dredge sampling
- South of Jamestown:
  - More difficult shellfish collection
  - F&W plan to deploy blue mussel cages at sentry sites
- Salt Ponds (and throughout Bay)
  - Aquaculturists

Proposed mussel sentry sites



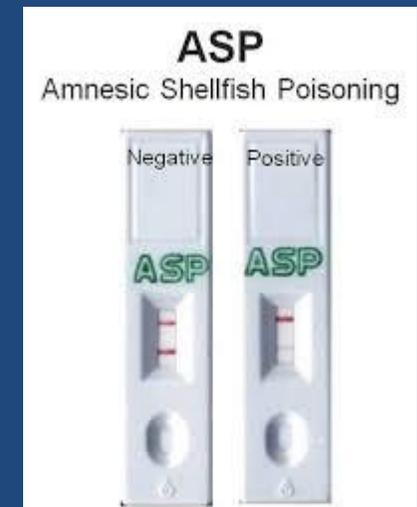
# Thresholds of Concern Shellfish Meat Toxin Concentrations

Toxin	Concentration	Action
Saxitoxin (PSP)	0.40 – 0.79 ppm	Precautionary Closure
Saxitoxin (PSP)	>0.80 ppm	FDA Mandatory Closure
Okadaic Acid (DSP)	>0.08 – 0.15 ppm	Precautionary Closure
Okadaic Acid (DSP)	>0.16 ppm	FDA Mandatory Closure
Domoic Acid (ASP)	0.10 – 0.19 ppm	Precautionary Closure
Domoic Acid (ASP)	>20 ppm	FDA Mandatory Closure

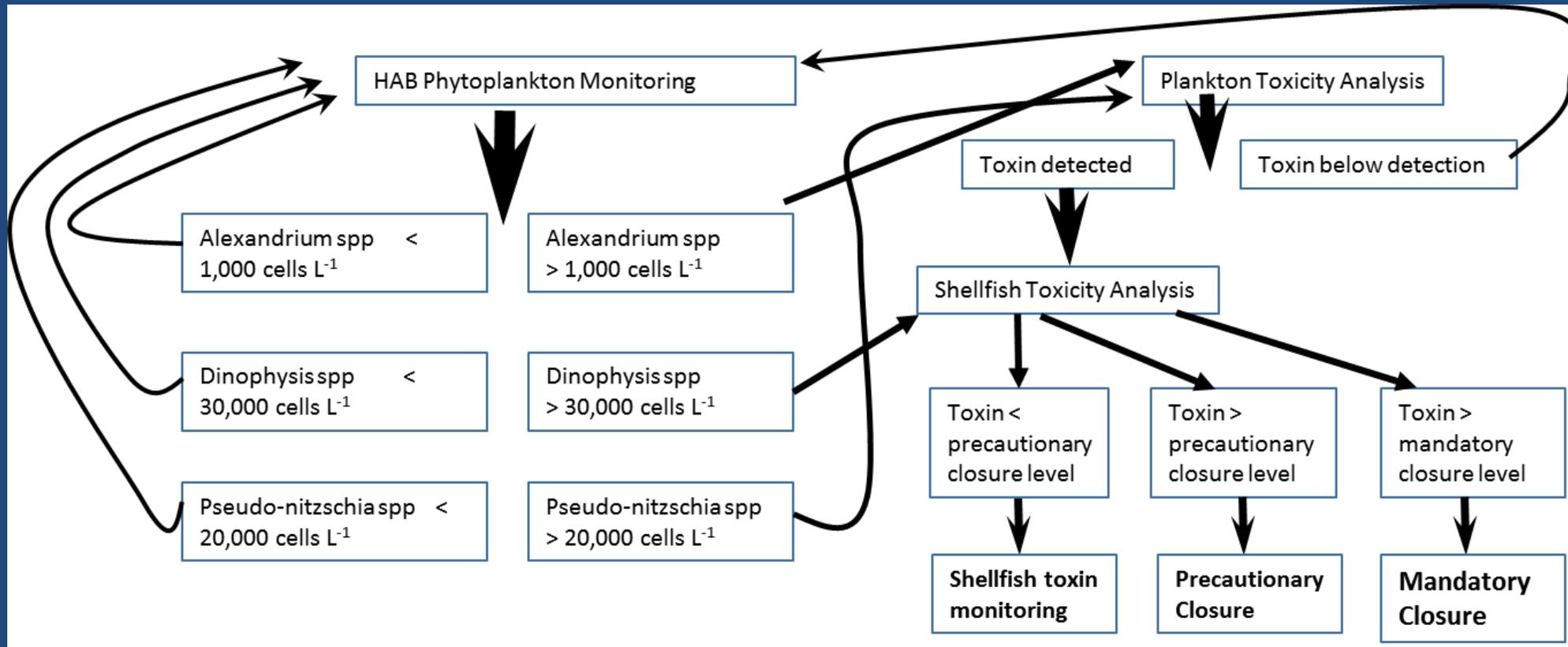
# DOH HAB Analyses:

Phytoplankton	Toxin	Spp. ID & Counts	Toxin Screening (plankton)	Toxin Screening (shellfish)	Toxin Analysis (FDA - Quantitative)
<b>Alexandrium spp.</b>	Saxitoxin (PSP)	✓	✓	✓	✓
<b>Dinophysis spp.</b>	Okadaic Acid (DSP)	✓		✓	✓
<b>Pseudo-nitzschia spp.</b>	Domoic Acid (ASP)	✓	✓	✓	✓

Phytoplankton counts – early warning  
 Screening protective of public health  
 FDA – Quantitative analysis for re-opening



# Flow chart summarizing proposed HAB and biotoxin monitoring plan



# thank you



## Shellfish Program

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