

Water column monitoring results for 2009

Mike Mickelson
Environmental Quality Dept
MWRA

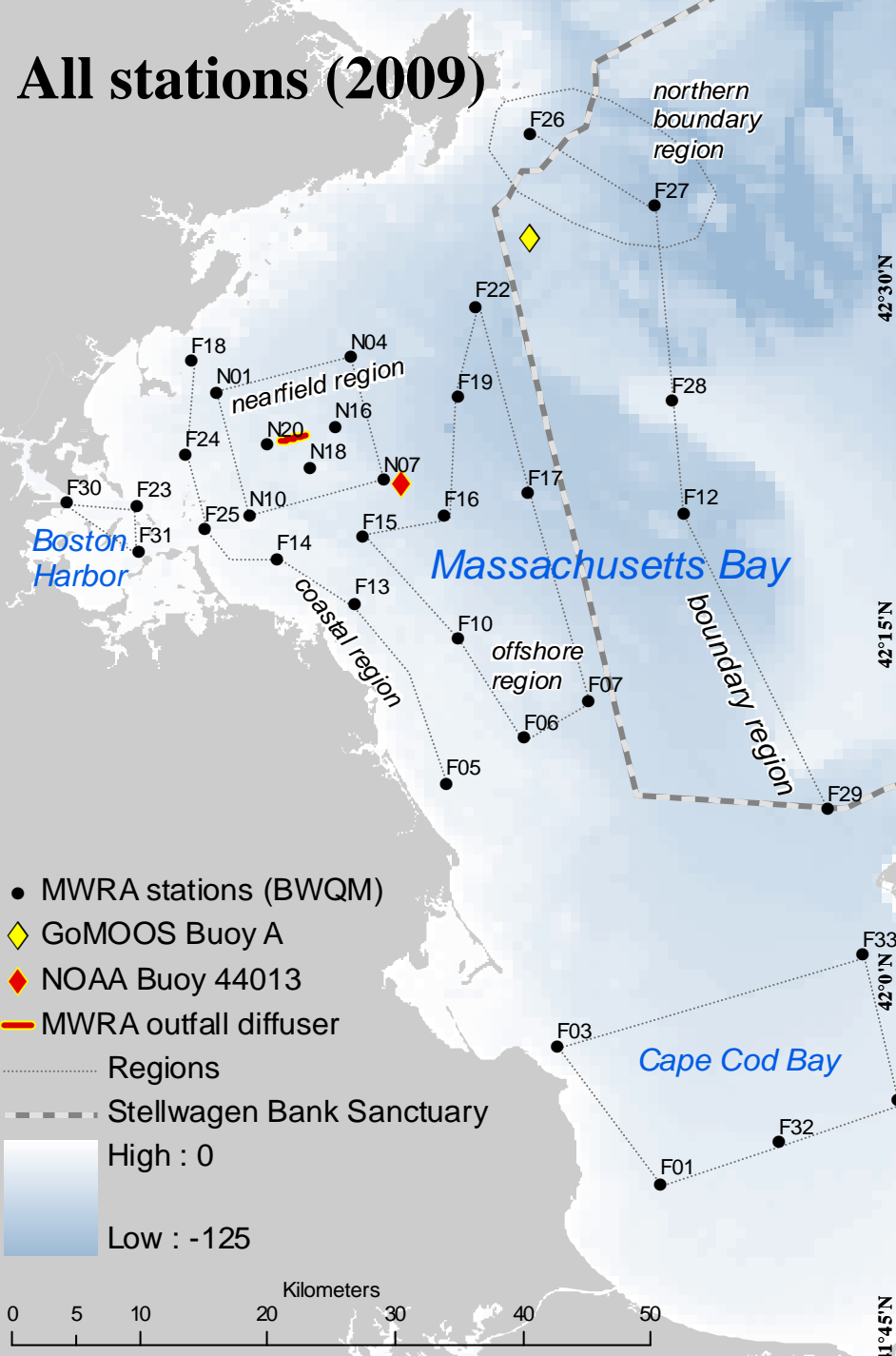
Wastewater Advisory Committee,
January 7, 2011



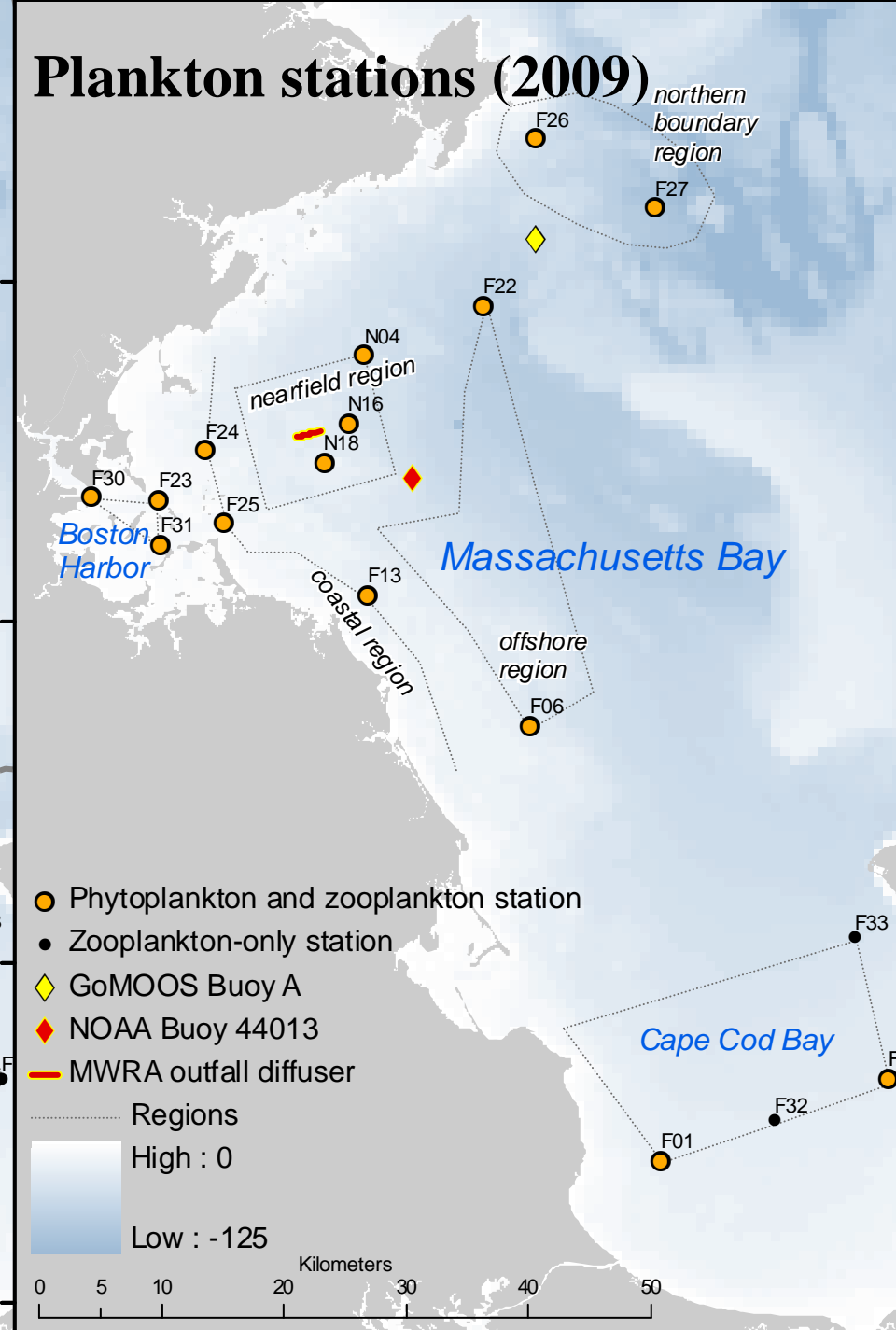
Water column monitoring focuses on potential nutrient effects

- Eutrophication - nutrients cause excess algal growth?
 - Effect of excess algal growth (and subsequent death) on dissolved oxygen?
- Harmful algal blooms?
 - Alexandrium (Paralytic Shellfish Poisoning)
 - Pseudonitzschia (Amnesic Shellfish Poisoning)
 - Phaeocystis (irritating sticky exudate)
- Ecosystem
 - plankton species composition
 - changes in timing, extent of blooms

All stations (2009)

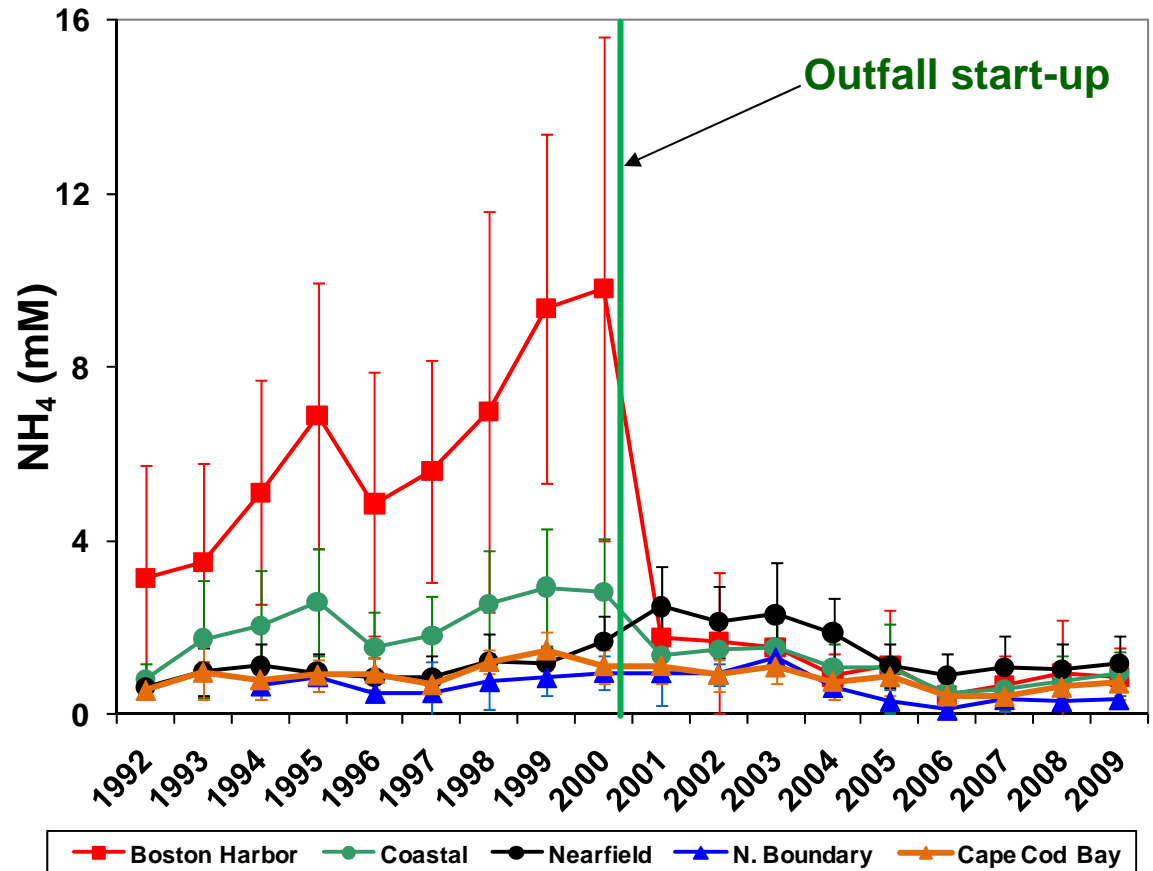


Plankton stations (2009)



Water column ammonia has decreased since 2001, including outfall nearfield, due to regional processes

- Ammonia indicates presence of discharge in nearfield area (black dots)
- Background ammonia (blue triangles) has dropped
- Ammonia from outfall is consistently about 1 micromole above background
- 2007-2009 nearfield ammonia concentration is similar to 1998-2000.



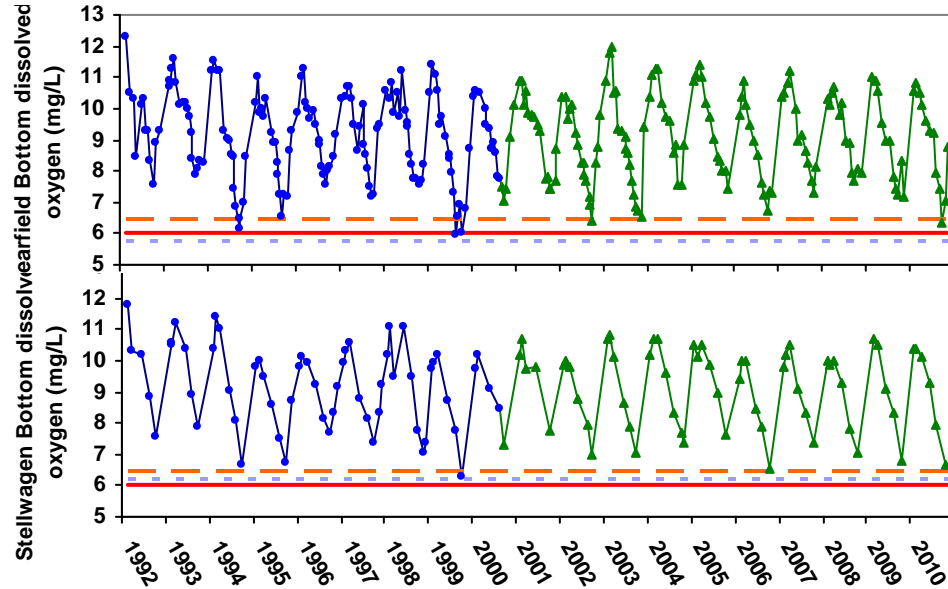
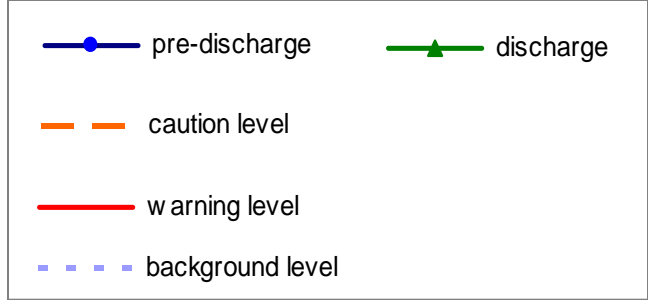
Location/ Parameter Type	Parameter	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Nearfield bottom water	Dissolved oxygen concentration	C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Dissolved oxygen saturation	C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Stellwagen Basin bottom water	Dissolved oxygen concentration	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Dissolved oxygen saturation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Nearfield bottom water	Dissolved oxygen depletion rate (June–October)	NA	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Nearfield chlorophyll	Annual	NA	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Winter/spring	NA	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Summer	NA	✓	✓	✓	✓	✓	C	✓	✓	✓	✓
	Autumn	C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Nearfield nuisance algae <i>Phaeocystis pouchetii</i>	Winter/spring	NA	✓	✓	✓	C	✓	✓	C	✓	✓	✓
	Summer	NA	✓	C	C	C	C	C	✓	✓	✓	✓
	Autumn	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Nearfield nuisance algae <i>Pseudonitzschia</i>	Winter/spring	NA	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Summer	NA	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Autumn	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Nearfield nuisance algae <i>Alexandrium</i>	Any sample	✓	✓	✓	✓	✓	C	C	✓	C	C	✓
Farfield shellfish	PSP toxin extent	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

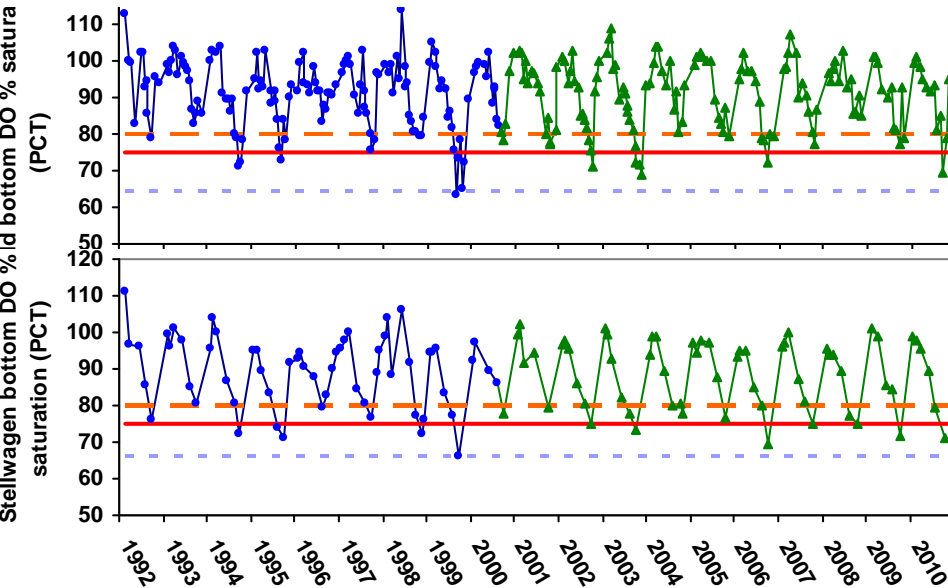
Plume	Initial dilution	NA	✓	Complete								
-------	------------------	----	---	----------	--	--	--	--	--	--	--	--

Dissolved oxygen thresholds



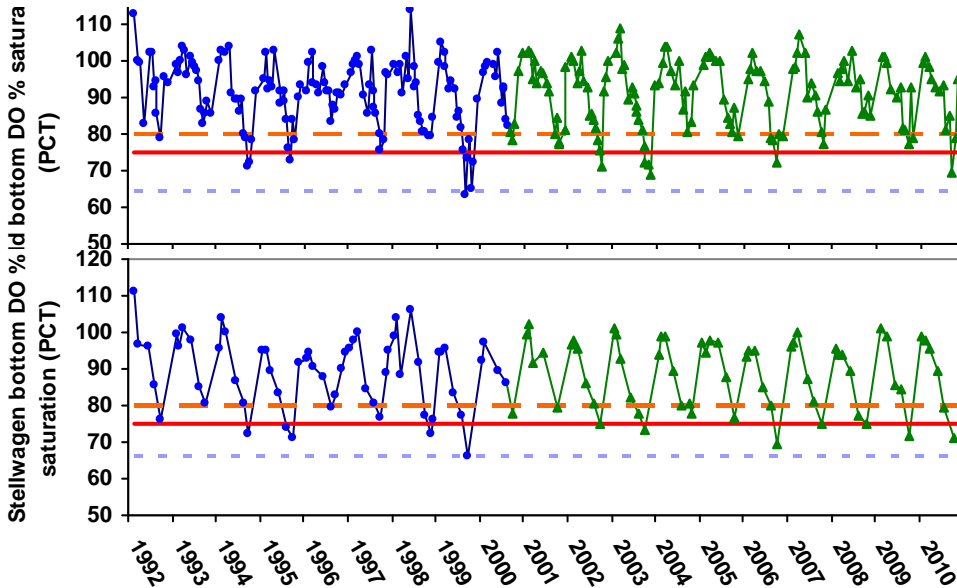
DO conc.

Nearfield



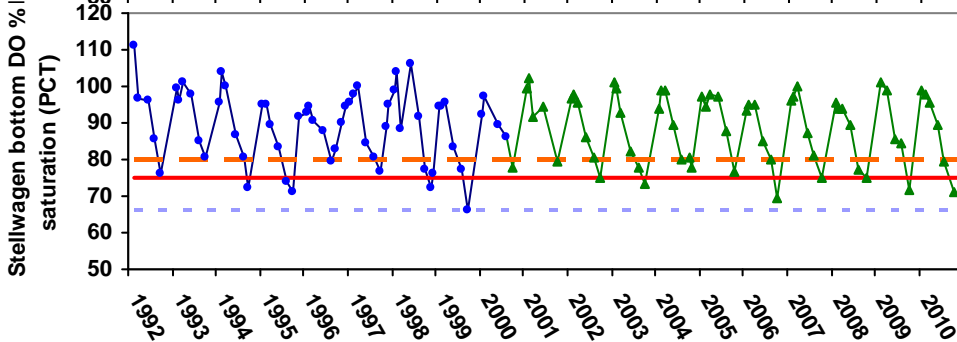
DO conc.

Stellwagen



DO saturation

Nearfield



DO saturation

Stellwagen



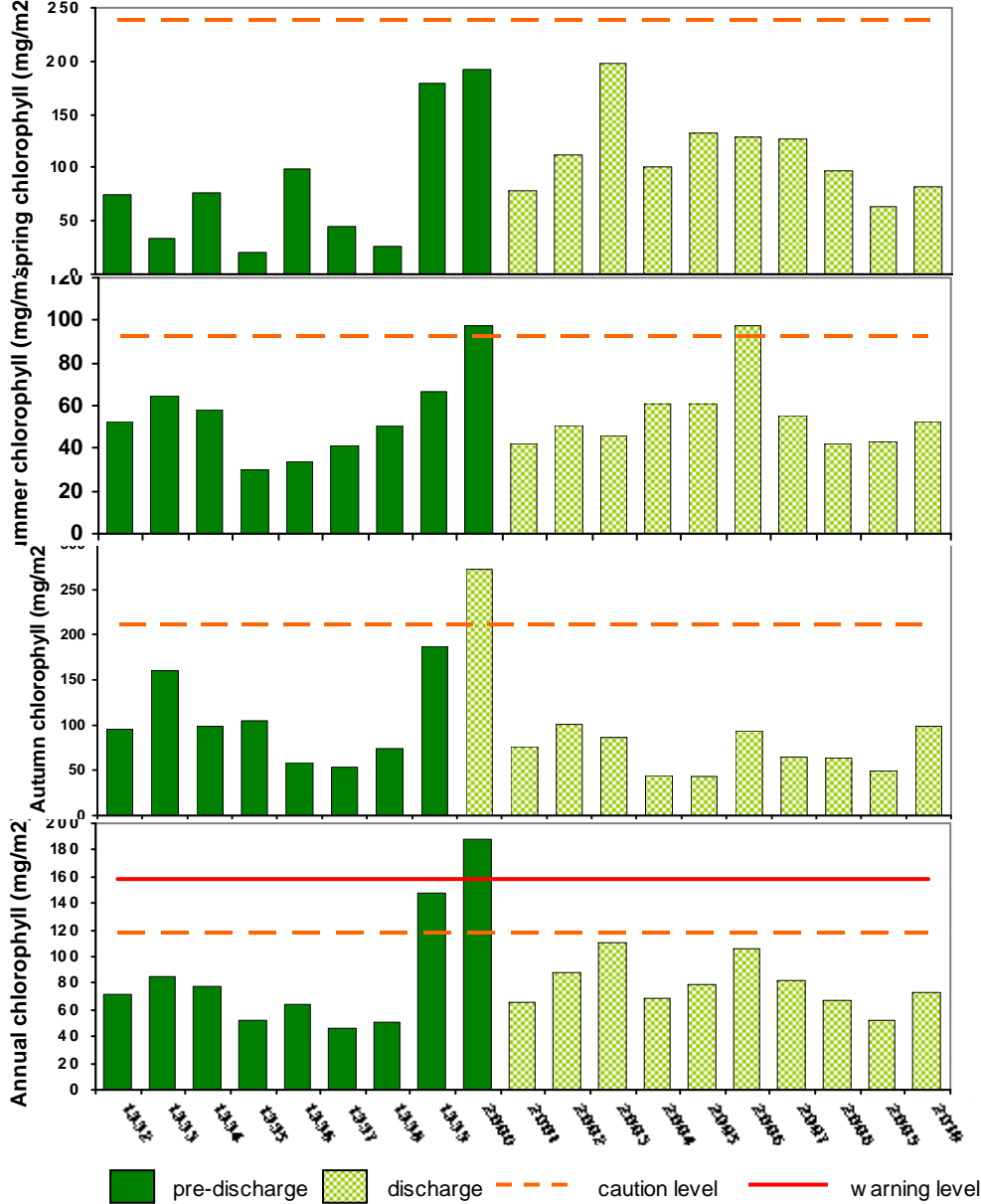
Chlorophyll thresholds

Months 1-4 winter-spring

Months 5-8 summer

Months 9-12 fall

Months 1-12 year



Alexandrium red tide"

- The 2005 Alexandrium bloom was a major regional event in New England, and broke several records.
- As prevailing currents swept the cells past Cape Ann, two strong northeasterly storms deflected the currents into Mass Bay

Toxic Microalgae

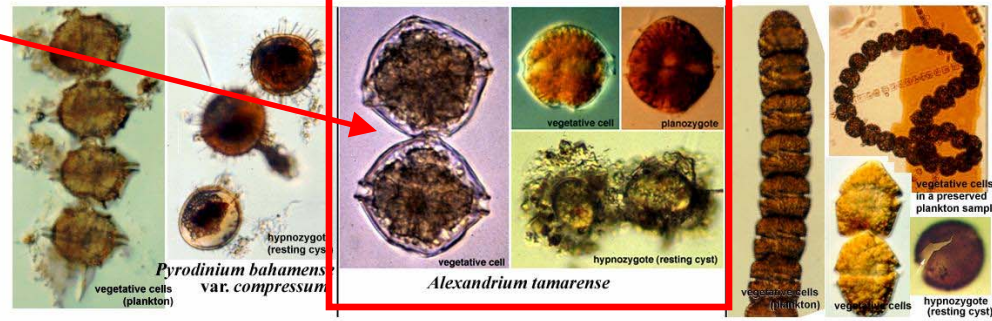
WESTPAC/IOC/UNESCO

Ver. 2.2 2000.1.1

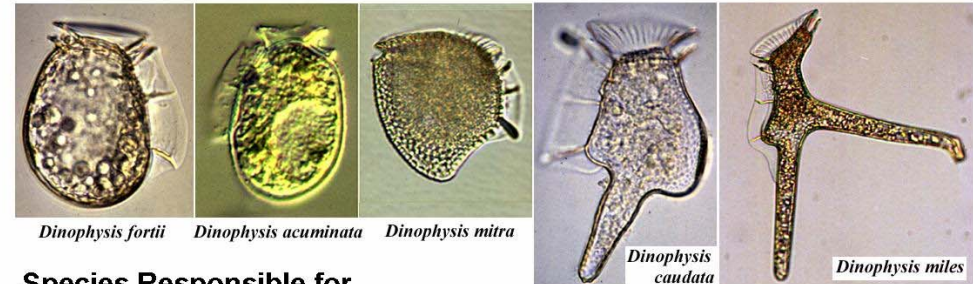
ed. by Yasuwo Fukuyo (ufukuyo@mail.ecc.u-tokyo.ac.jp)



Species Responsible for Paralytic Shellfish Poisoning



Species Responsible for Diarrhetic Shellfish Poisoning

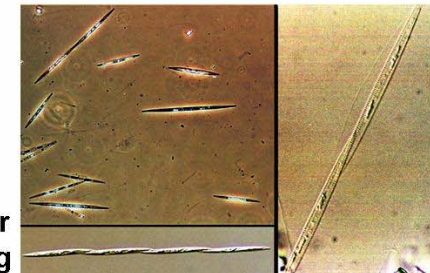


Species Responsible for Neurotoxic Shellfish Poisoning



Gymnodinium breve

Species Responsible for Amnesic Shellfish Poisoning

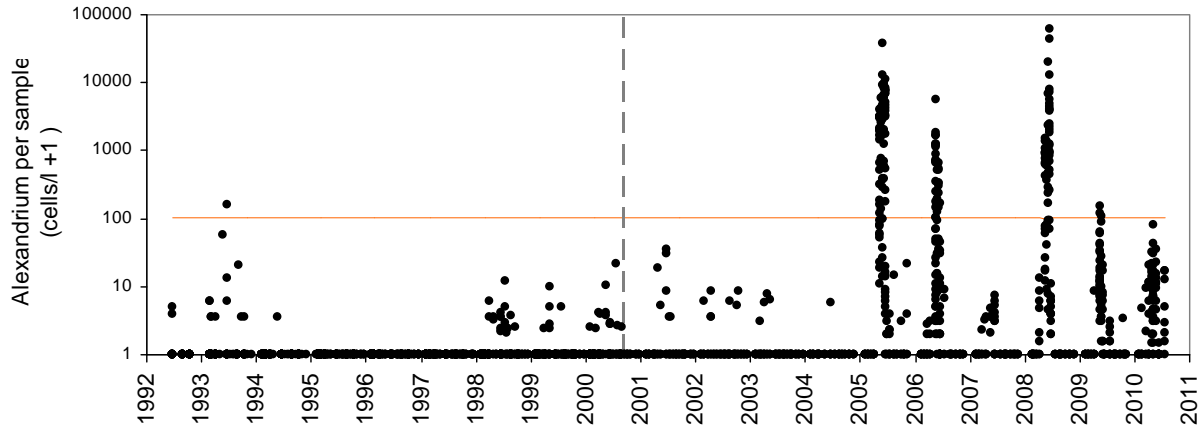


Pseudonitzschia spp.

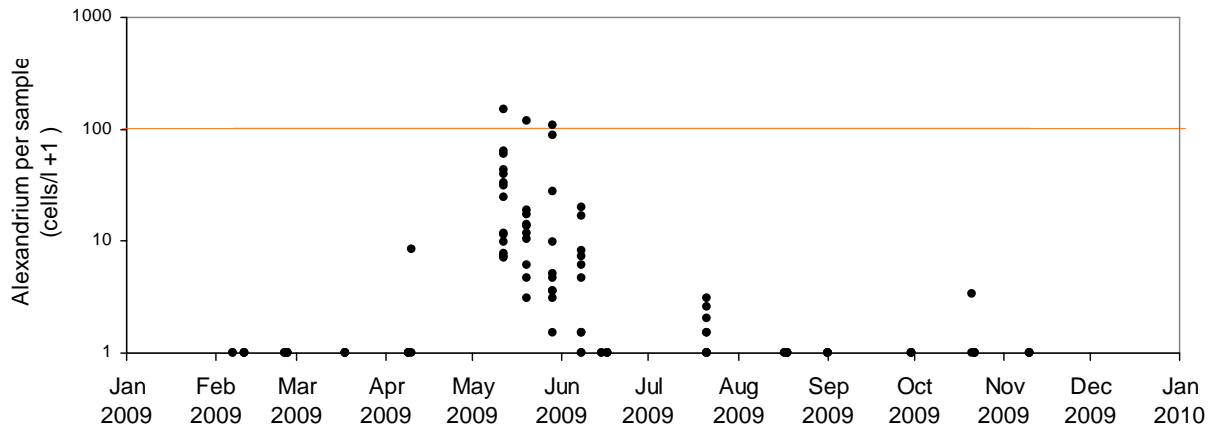
Species Responsible for and implicated in Ciguatera Fish Poisoning



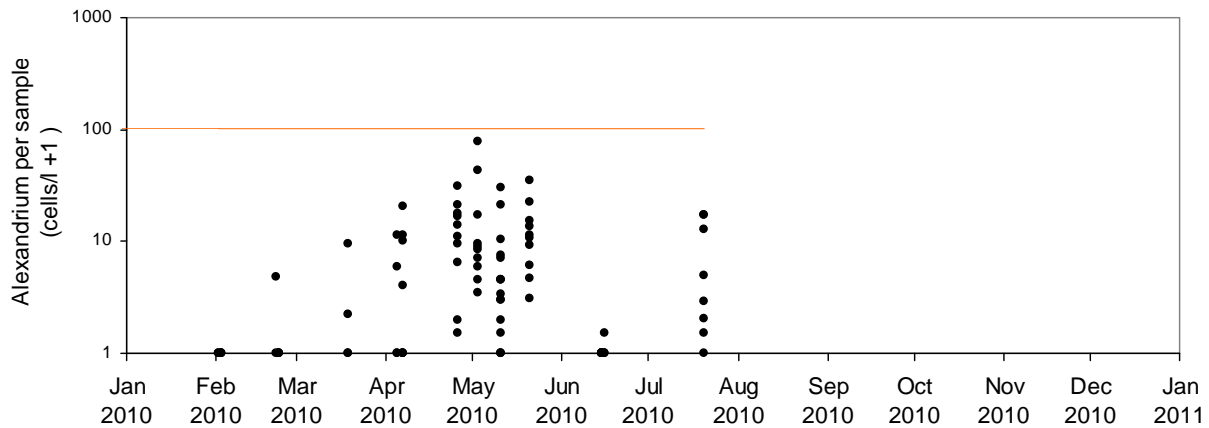
Gambierdiscus toxicus *Ostreopsis lenticularis* *Ostreopsis ovata* *Coolia monotis* *Amphidinium klebsii* *Amphidinium carterae* *Prorocentrum lima*



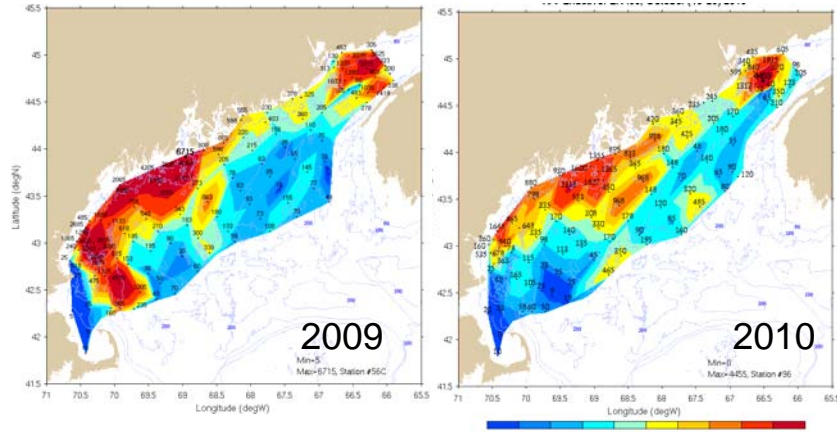
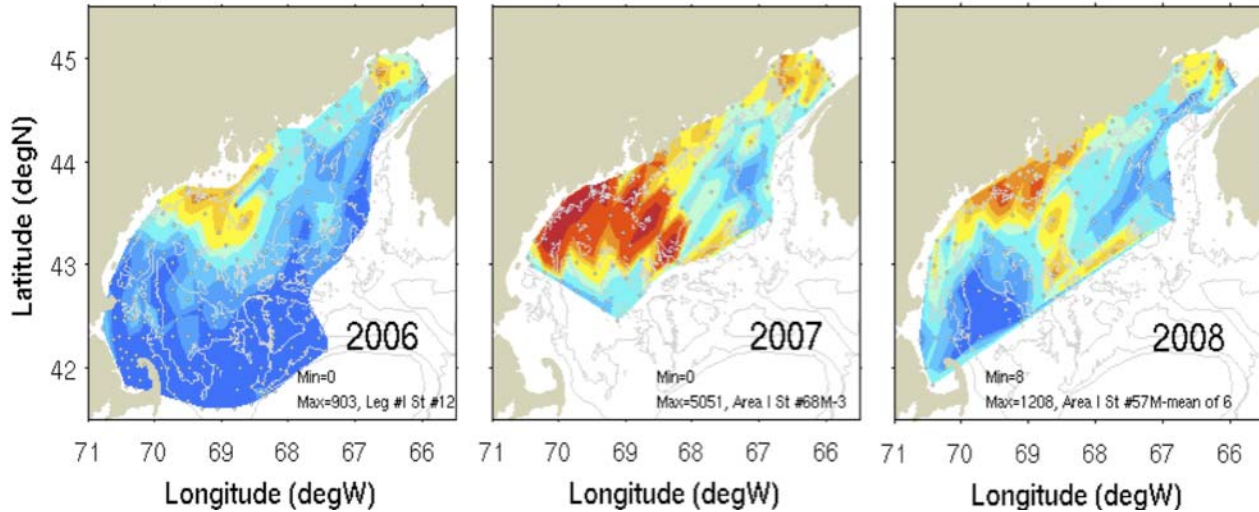
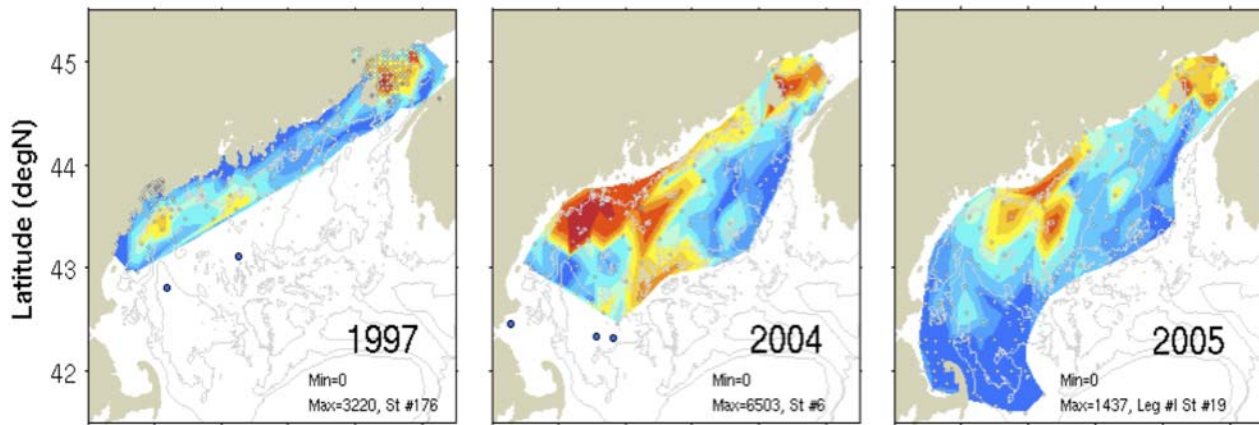
Alexandrium 1992-2010



Alexandrium 2009

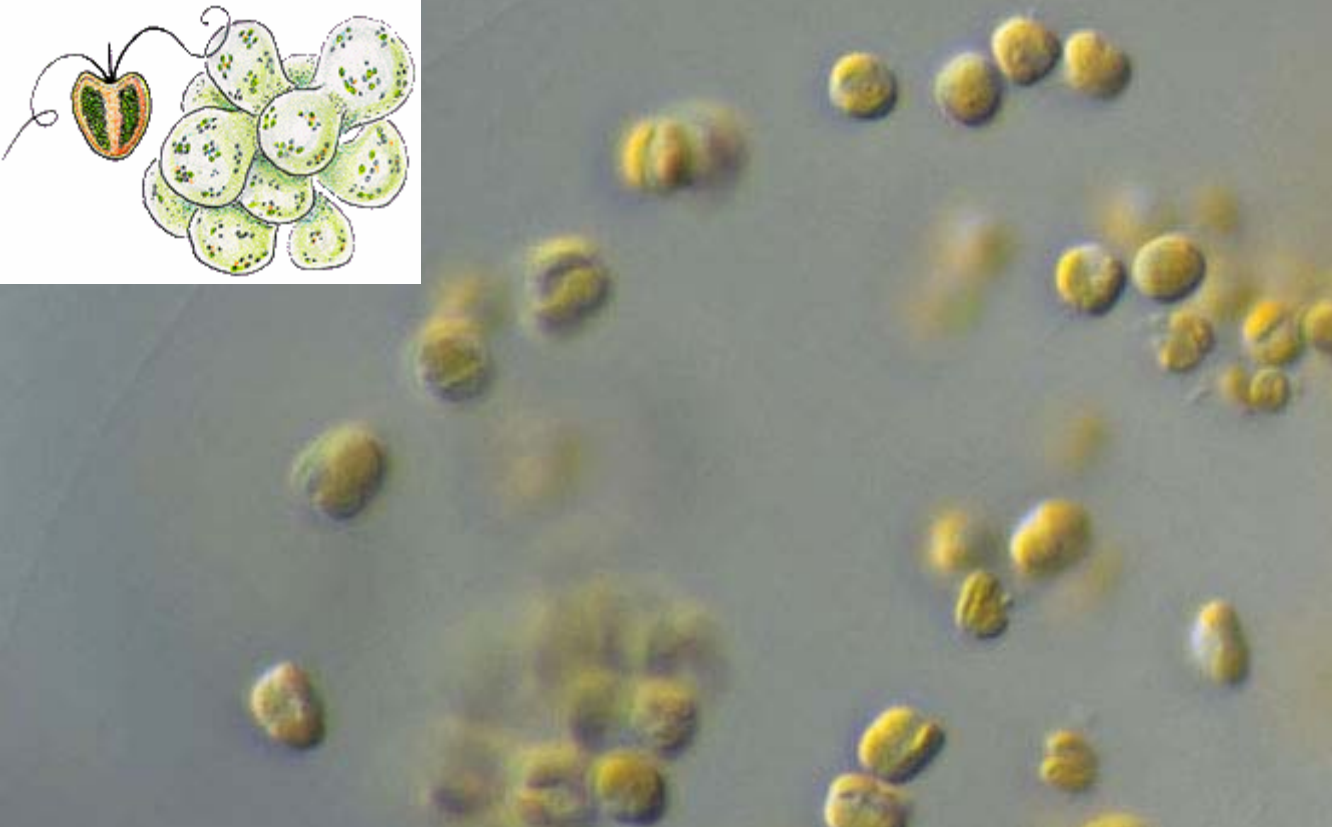
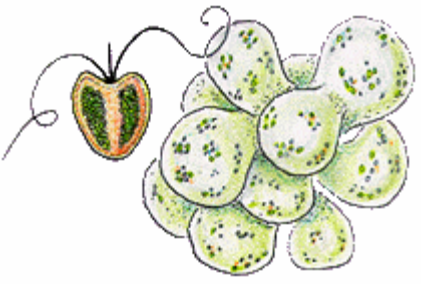


Alexandrium 2010

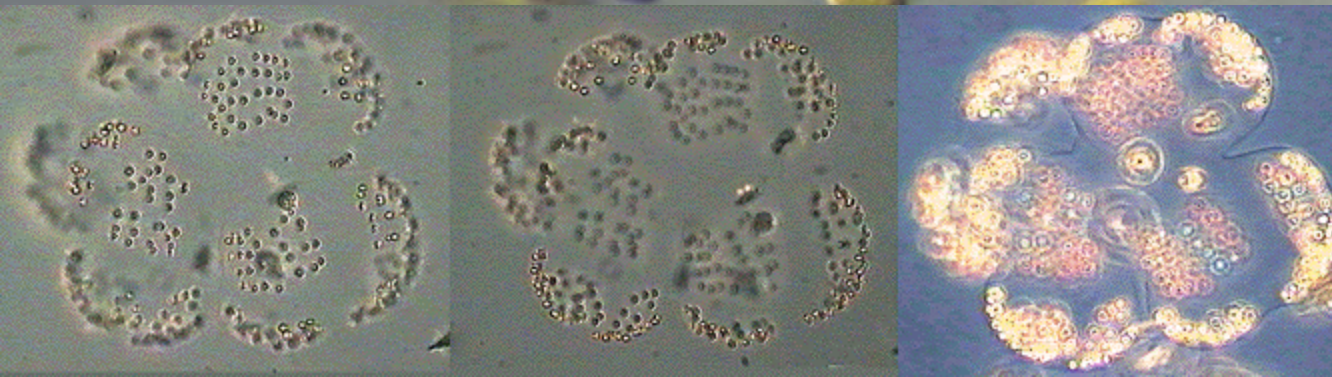


WHOI measures the number of *Alexandrium* cysts found in mud to predict the next year's bloom

Phaeocystis pouchetii is a colony-forming flagellate that blooms here in April

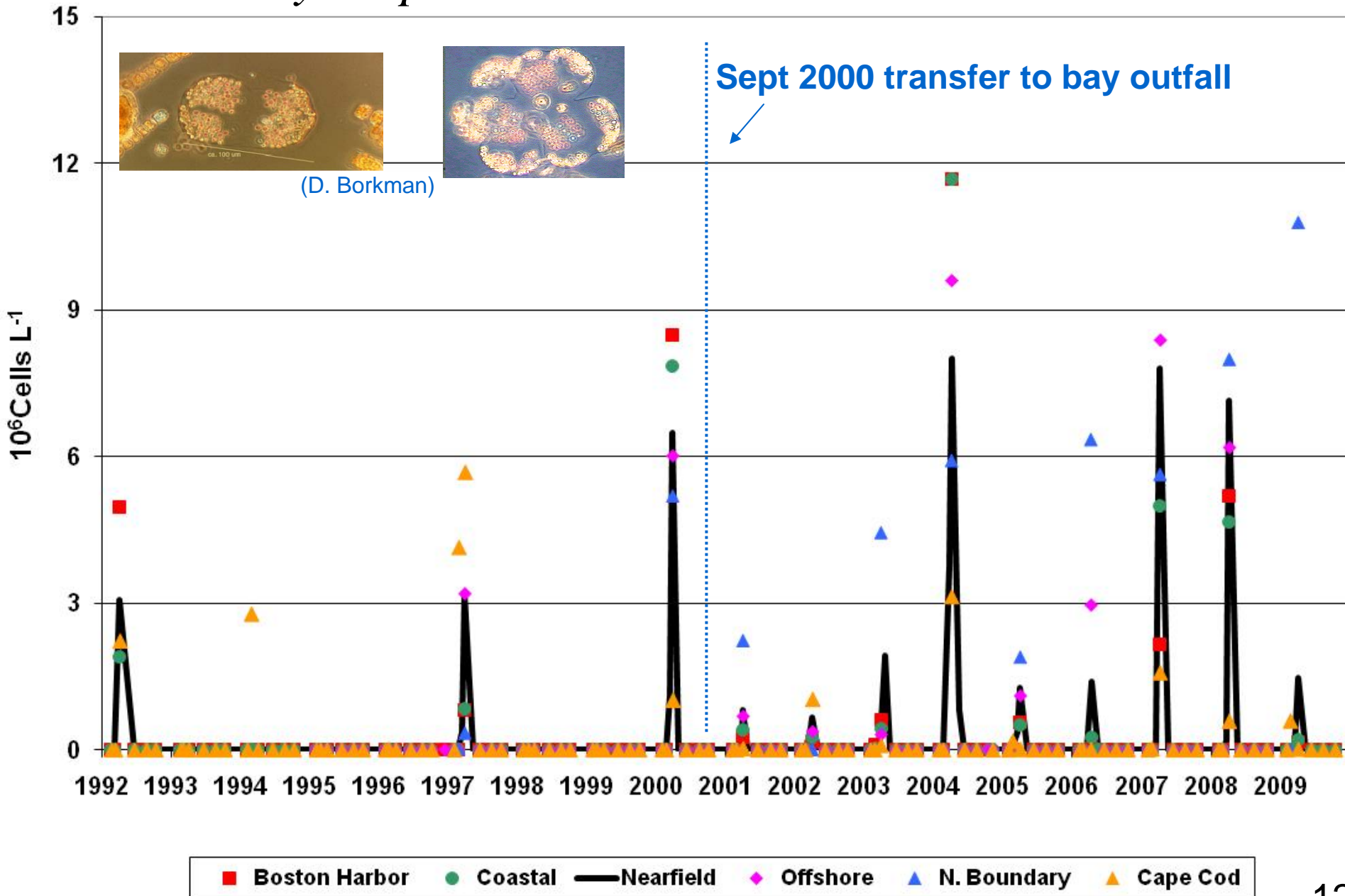


foam on beach in UK

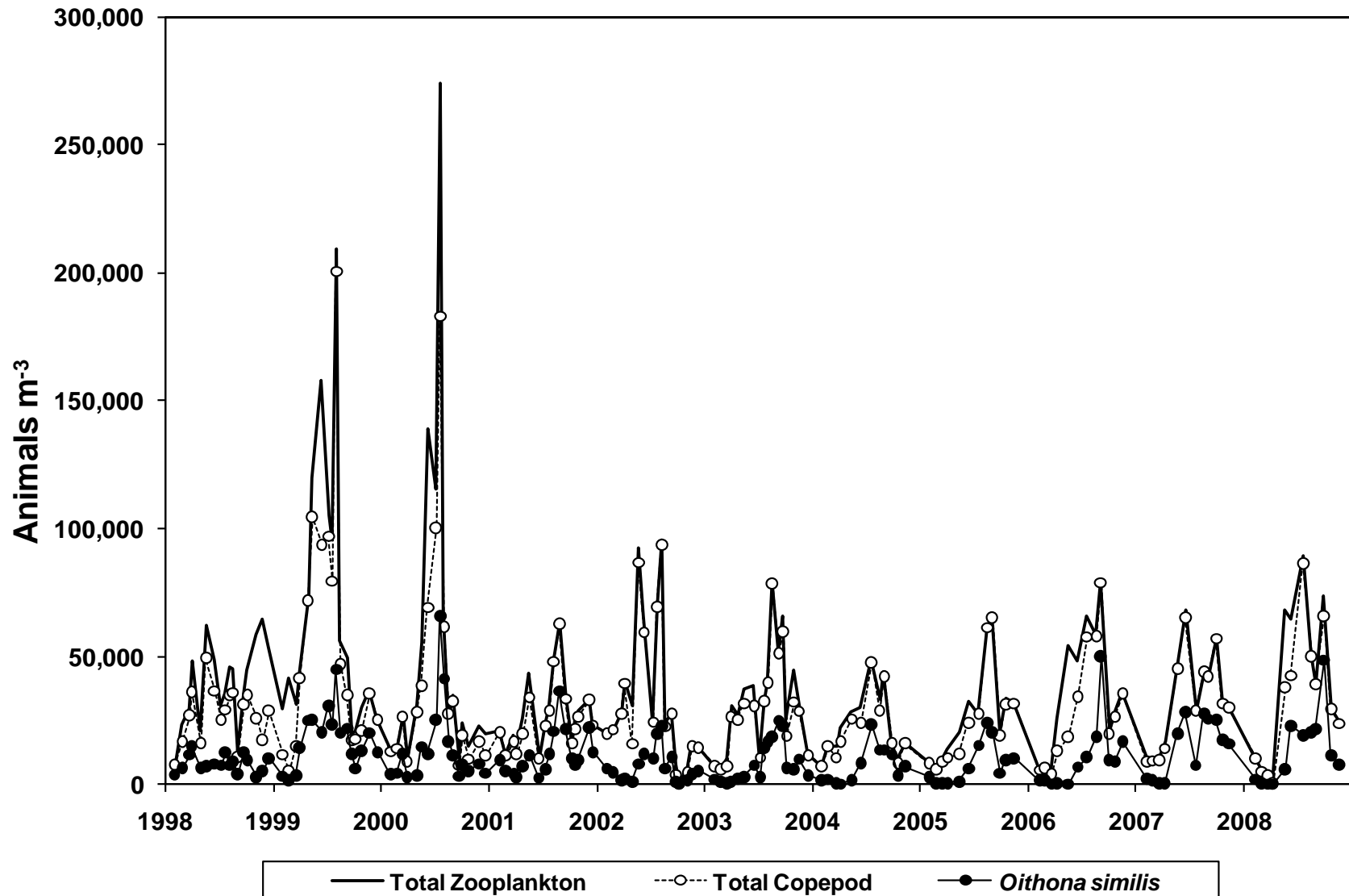


www.coastalstudies.org
www.smhi.se
www.marinet.org.uk
www.nies.go.jp

Phaeocystis pouchetii blooms 1992-2009



Zooplankton abundance varies between years



Conclusions

- The outfall plume elevates ammonium concentrations to a distance of 10-20 km.
- There have been trends in chlorophyll and plankton, but these appear to be regional in nature, occurring throughout Massachusetts Bay and further offshore in the western Gulf of Maine
- The long time series has interesting ecological stories, but most of those are not related to outfall.