Pseudo-nitzschia diversity in the North Pacific from Continuous Plankton Recorder surveys

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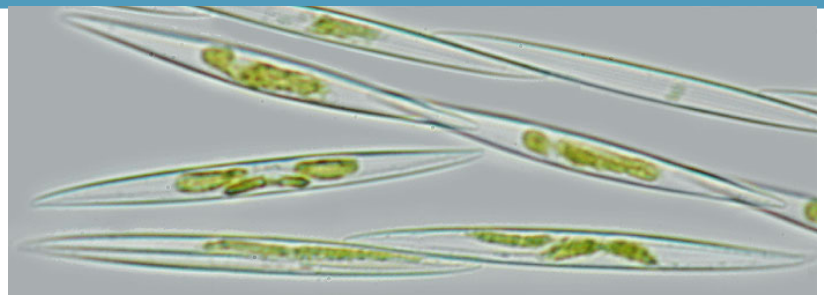
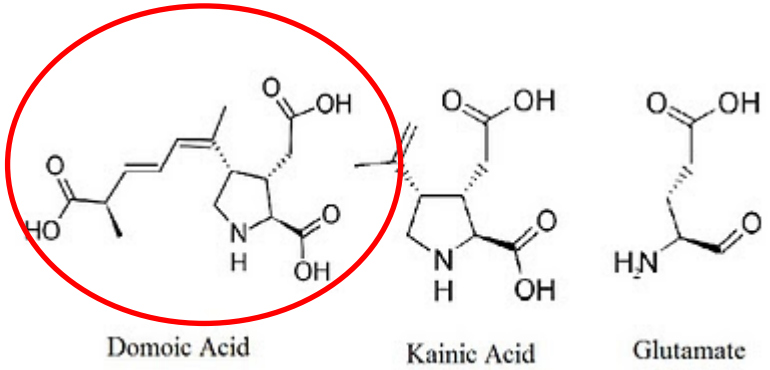
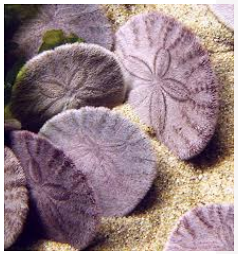
Stephanie Moore, Sonia Batten

Harmful Algae on the Pacific NE coast



Amnesiac Shellfish Poisoning



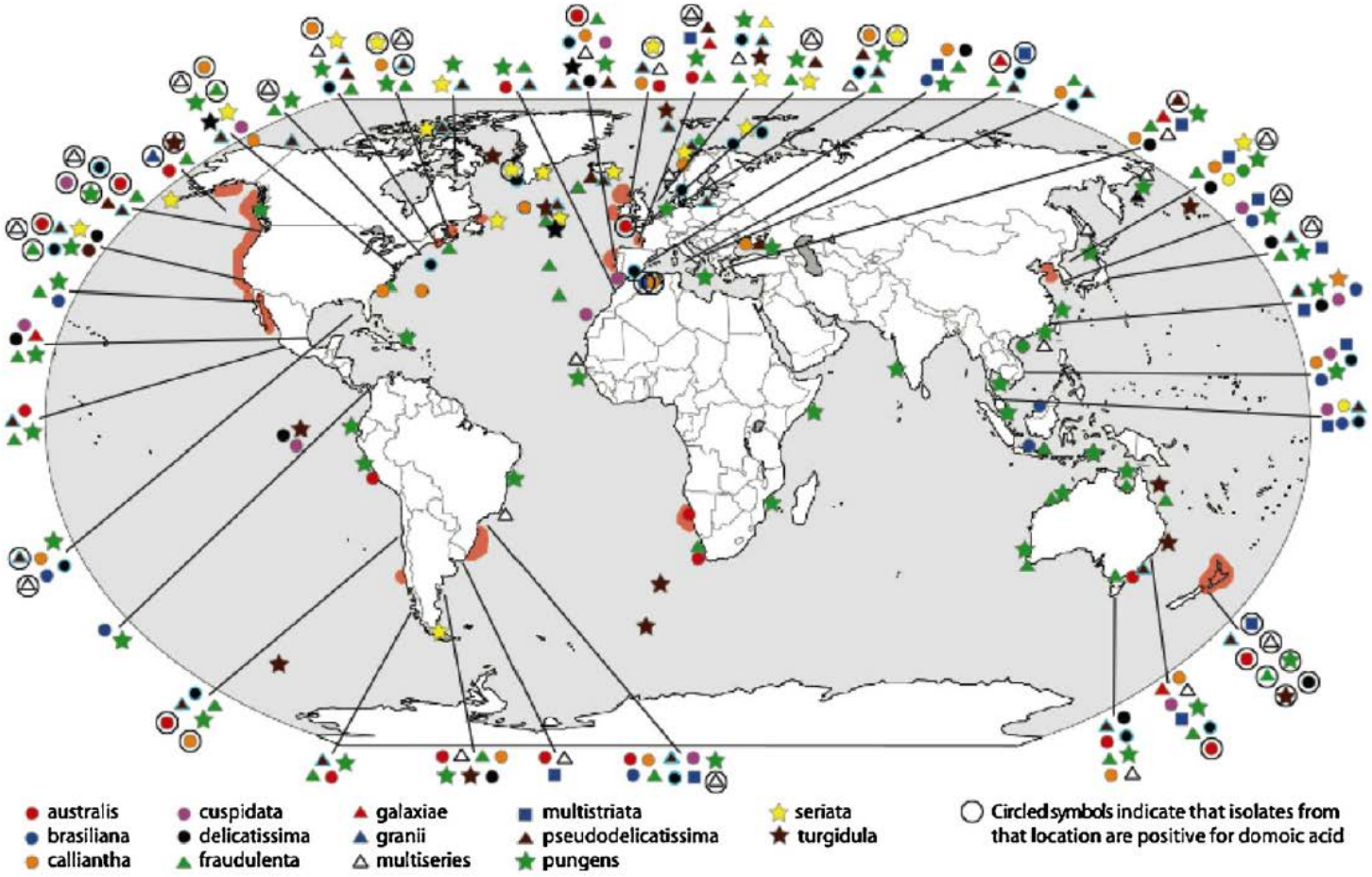


World-wide occurrence of Pseudo-nitzschia

Most toxigenic on Pacific NE coast: *P. australis, P. multiseries*

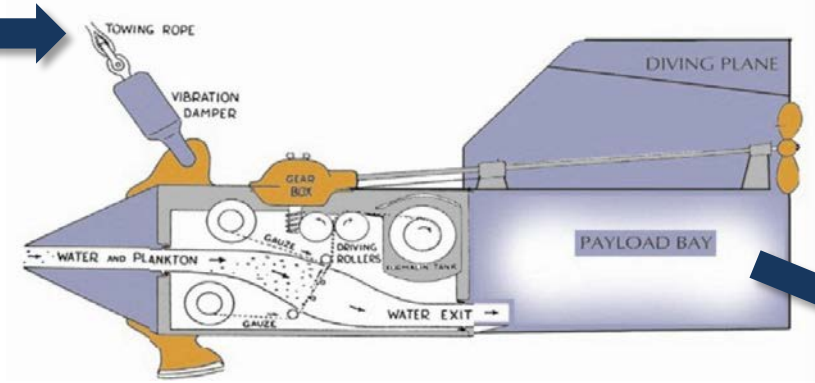
Affected by

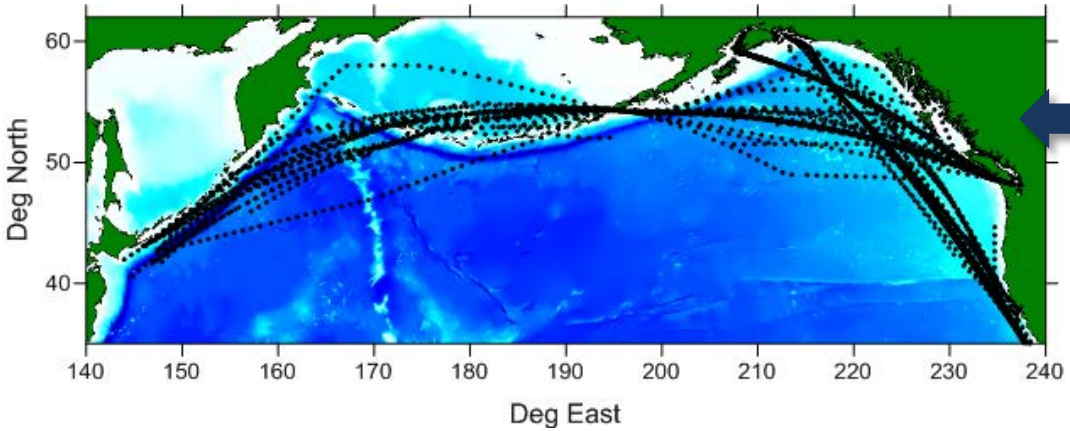
- Temp
- Nutrients
- Salinity



From Trainer et al. 2012

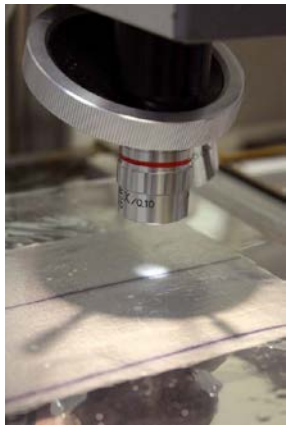
The North Pacific Continuous Plankton Recorder Survey

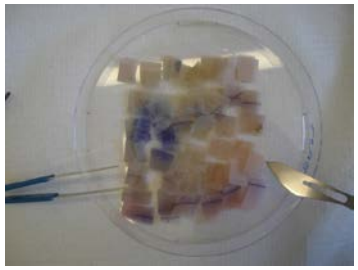


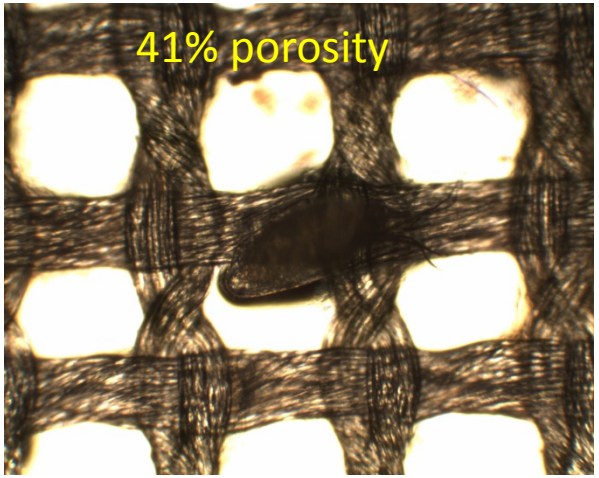


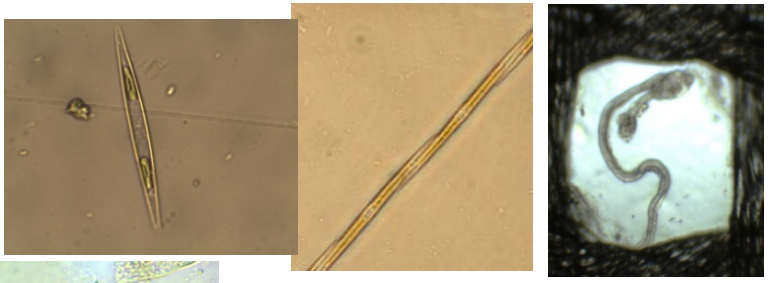
CPR sample archive can be used for hindcast studies

- >20,000 samples in N Pacific archive (2000-2013)
- >350 taxa recorded from N Pacific CPR samples





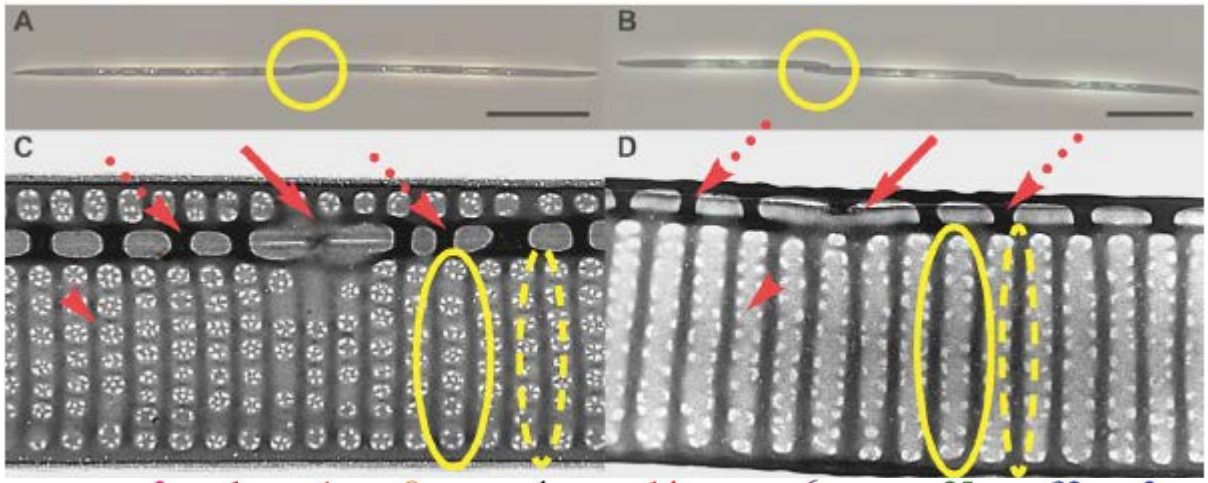


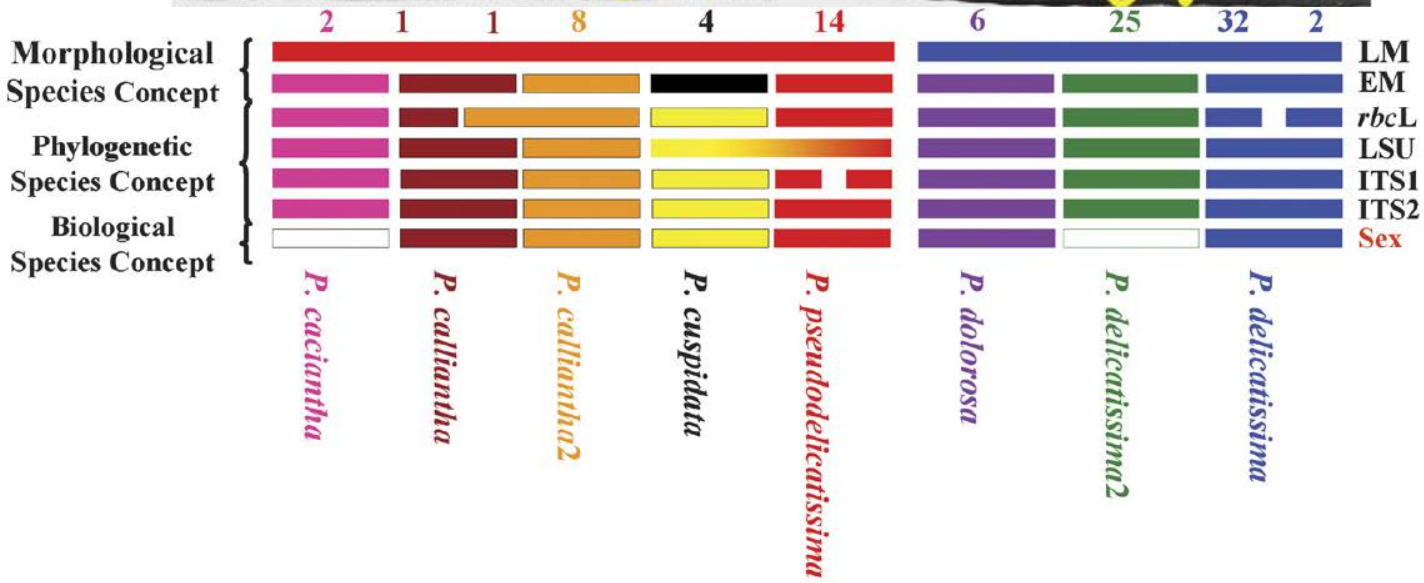


Pseudo-nitzschia displays a range of phenotypes through mating, only observable by EM or Molecular methods

Light Microscopy (LM)

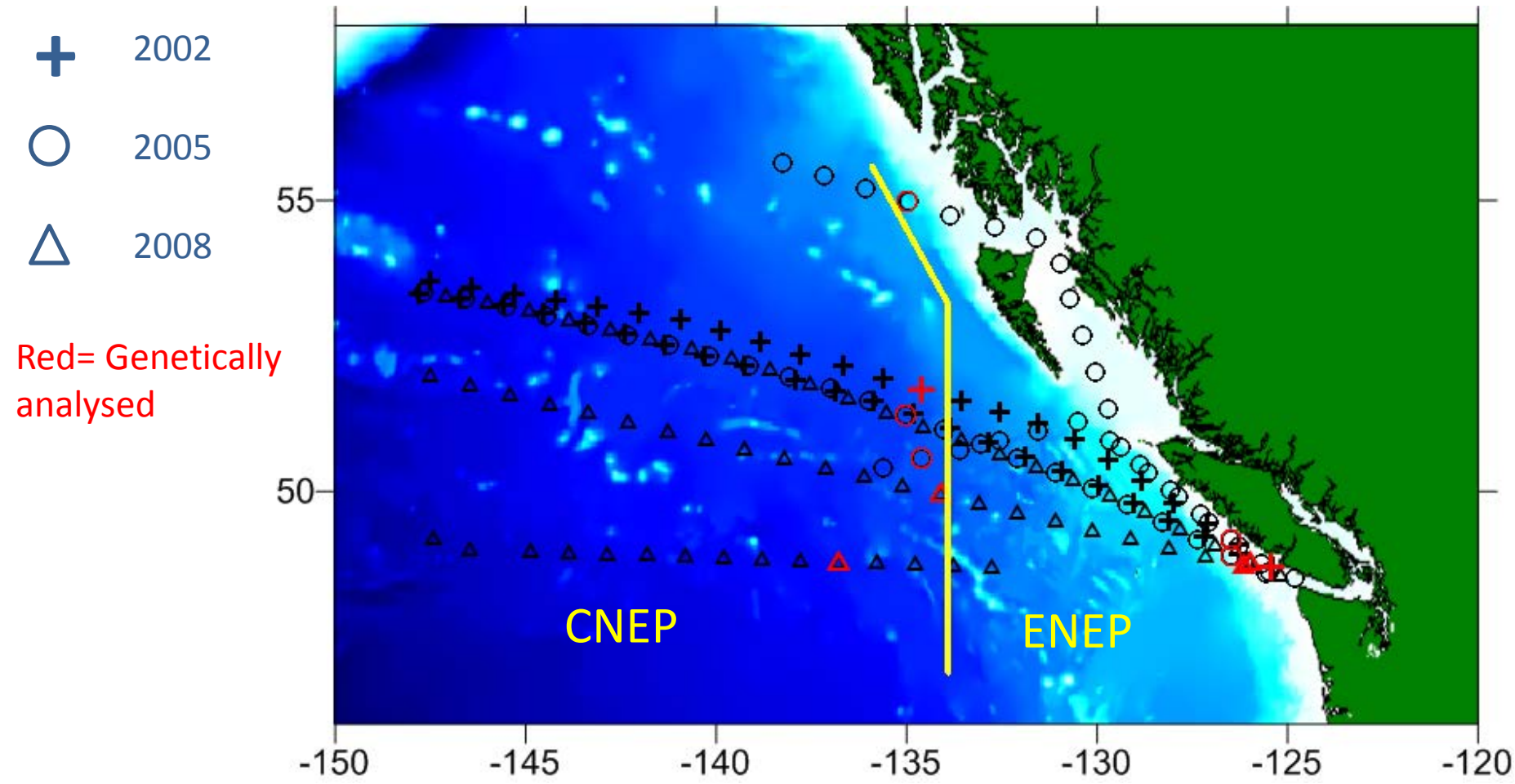
Electron Microscopy (EM)



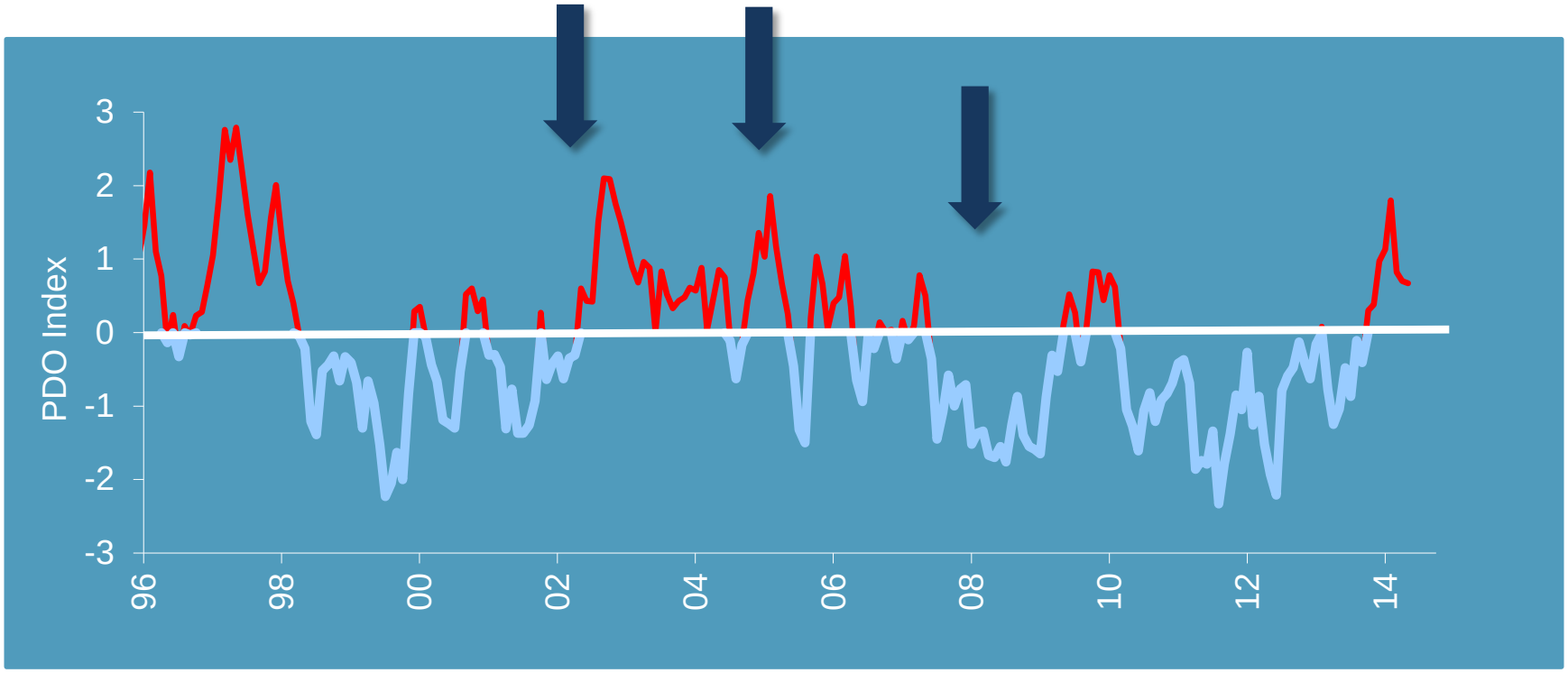


Adapted from Amato et al. 2007

Are there spatio-temporal differences in diversity between Central (CNEP) versus Eastern (ENEP) NE Pacific Regions?

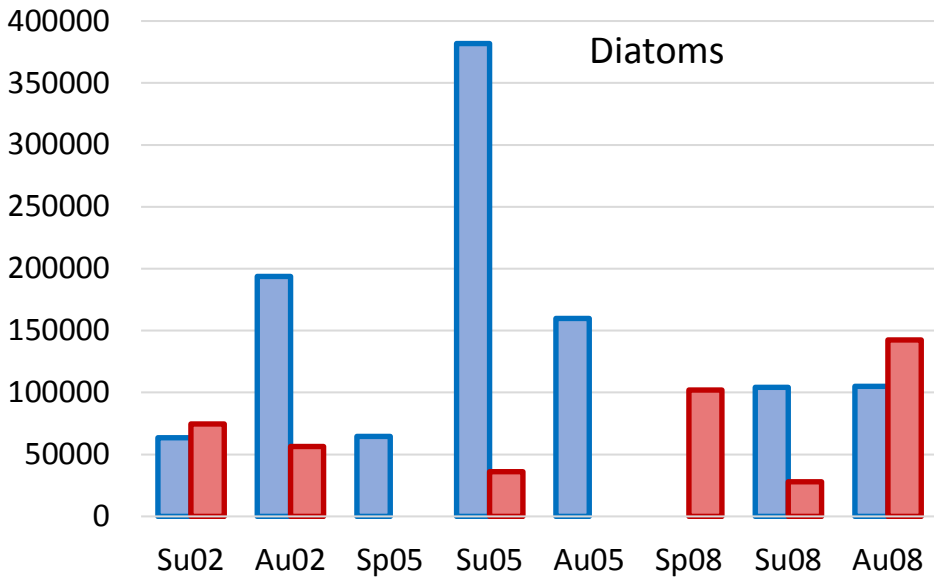


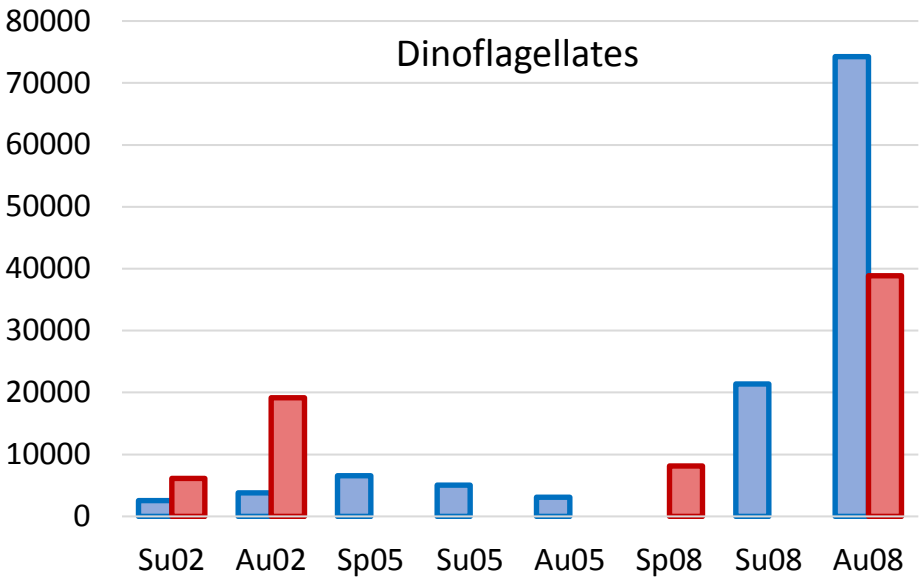
Does the Pacific Decadal Index (PDO) influence species distribution?



PDO: cyclic Pacific phenomenon that increases sea surface temperatures during positive phases
Courtesy of Mantua, http://jisao.washington.edu/pdo/PDO.latest

Regional differences in diversity (conventional sample analysis)

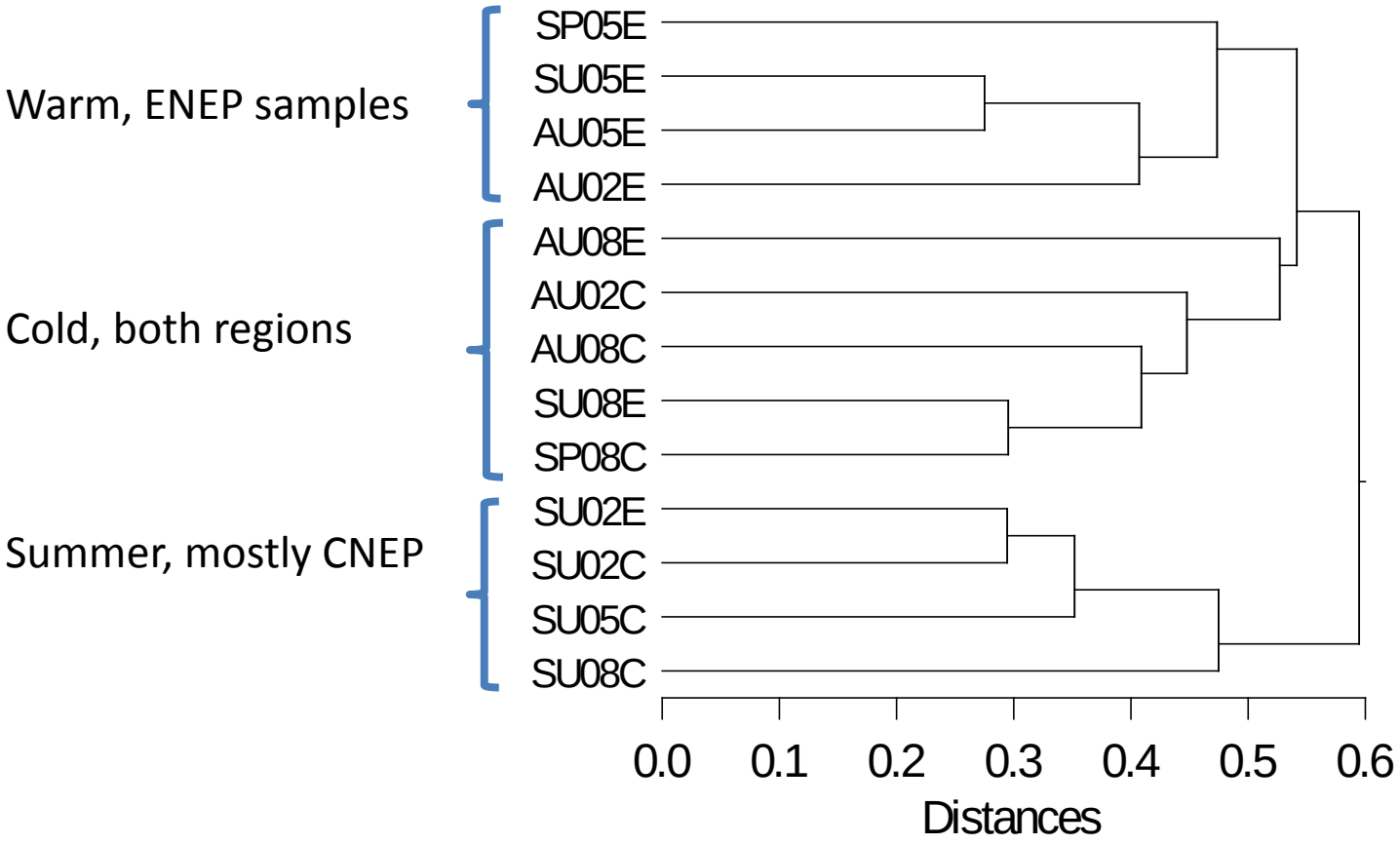




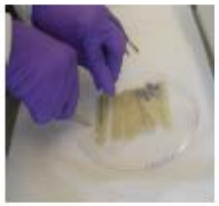
- Typically higher diatom abundances in ENEP than in CNEP

Regional and temporal differences in diversity (conventional sample analysis)

Over 80 separate taxa, abundances transformed, Bray-Curtis dissimilarities:



Methods: Next Generation Sequencing (NGS) using *Pseudo-nitzschia* specific marker (Large Ribosomal Subunit marker)



PCR amplification:
10/14 success for Pseudo-nitzschia specific LSU, D1-D2 (3)

454 sequencing
total: 14906 reads
range: 2632-6505 per sample

Analysis:
Quantitative Insights into Microbial Ecology (Qiime) pipeline → biolinux platform

Unique operational taxonomic unit (OTU) clusters at 97% =240

Check OTU of diatom origin by Blastn
(all good)

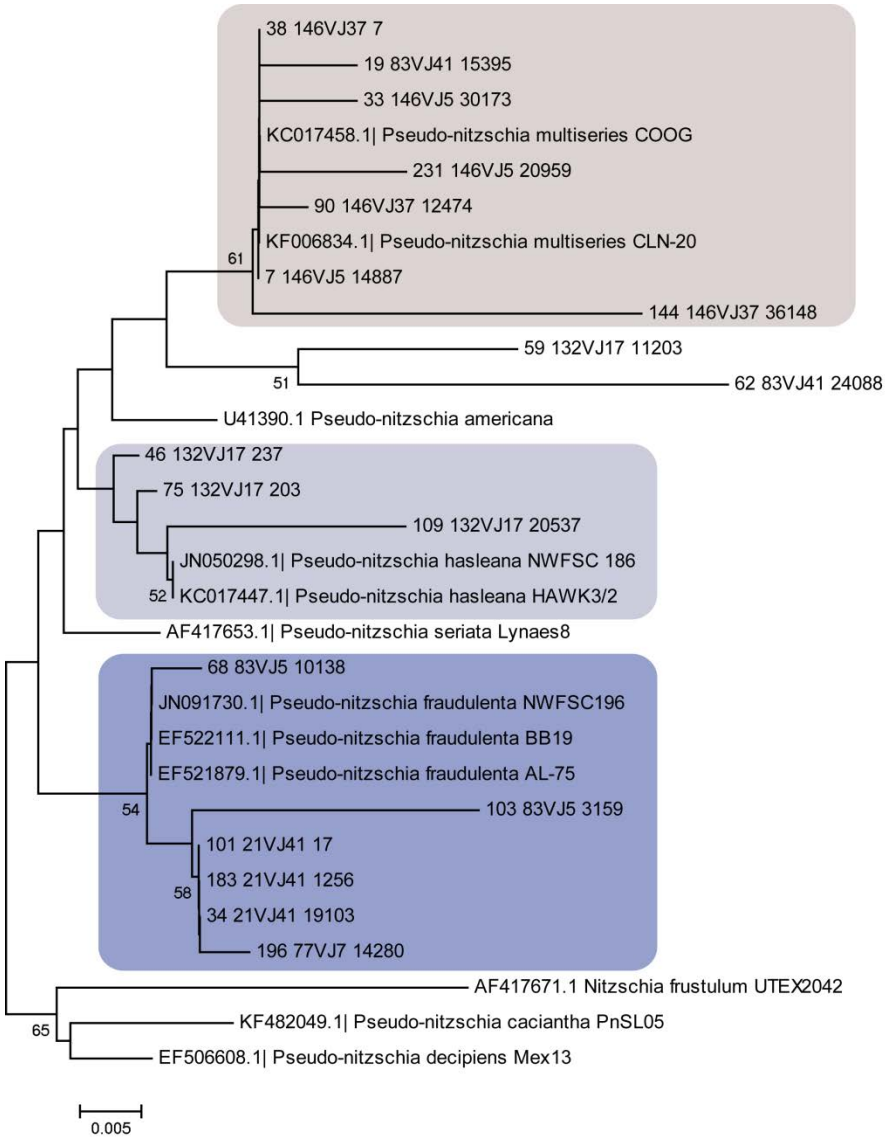
create custom LSU diatom training set
(align, fasta, taxonomy files)

Align sequences (pyNAST
trim to 295bp,
remove outlyers

141 Unique taxonomic Operational Units

1. Realign with publically-available diatom sequences by MAFFT
2. ML phylogeny (Kimura- 2, +G) with MEGA5.1
3. Heat map

Three major species groups were found but with much diversity

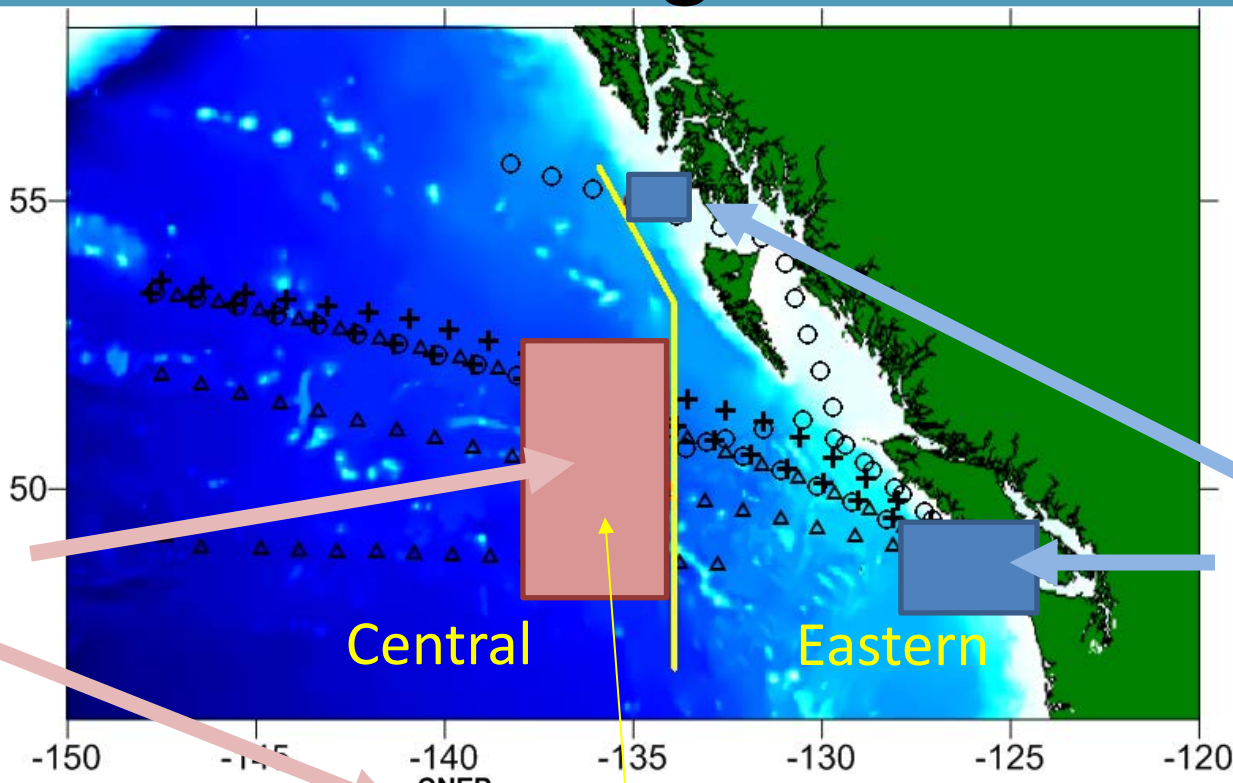


P. multiseries

P. hasleana

P. fraudulenta

Geographical Split between CNEP and ENEP regions



P. multiseries (38)

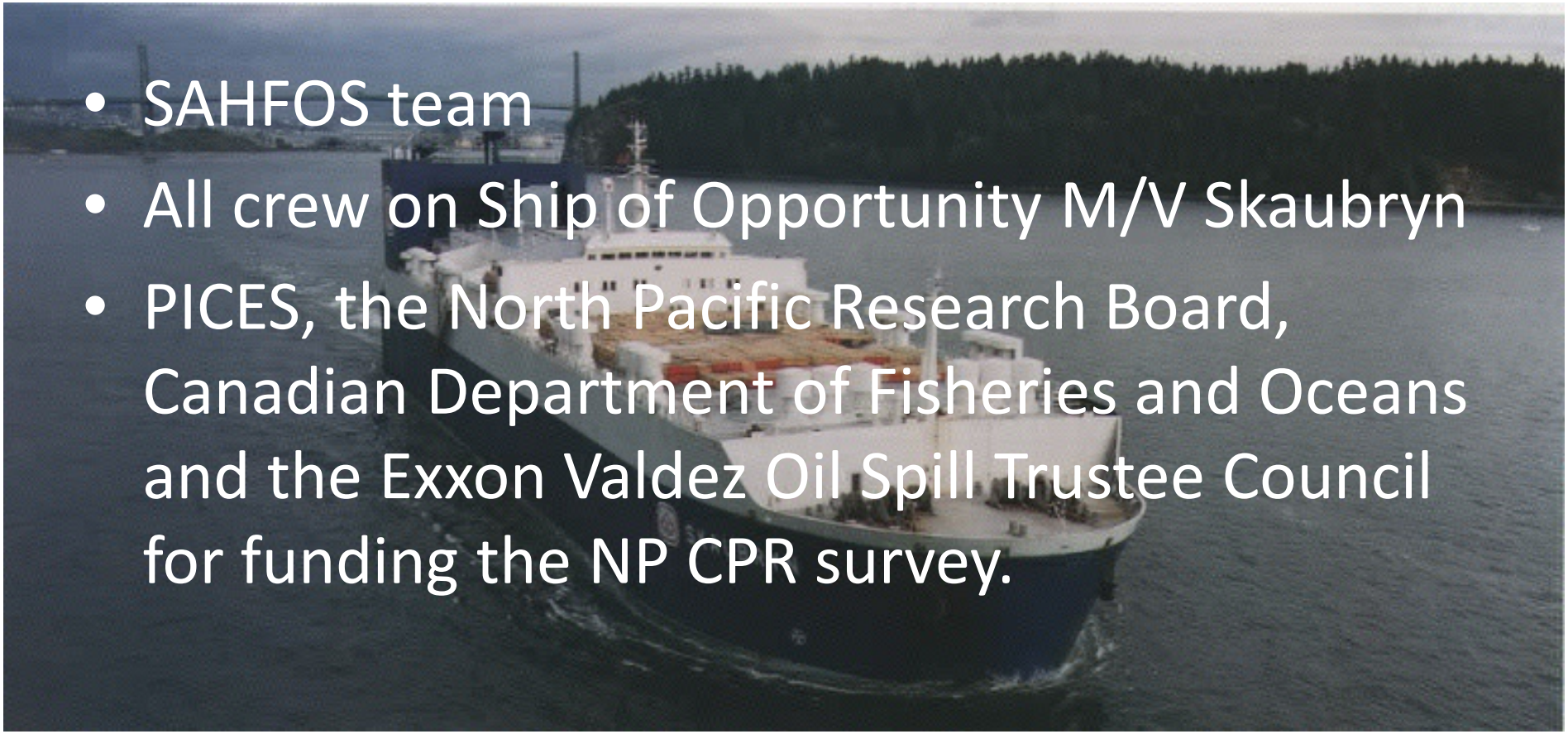
P. fraudulenta (101)

		CNEP										ENEP									
#OTU ID	Code	5	7	12	23	34	38	40	43	46	48	51	54	58	59	61	68	90	96	101	107
77VJ7	Sp05E	8		9	10	3	8	8				3	15	4	1	2	4			4987	
139VJ1	Su08E	8		6	13	8	1	15				3	2	1	2	3	3			4855	
21VJ1	Au02E	1		5	6	1		9				3	5	2	1	2	2			3088	
83VJ5	Su05E	6		2	12	9		12				4		1	2	5	7			4361	
146VJ5	Au08E		11	1			5662		8		11				2			9	6	97	5
21VJ41	Au02C	5		2	10	8	21	10				2	3	4	1		1			3587	
146VJ37	Au08C	1	2	1			2549		3		9							3		9	1
83VJ41	Su05C		5				6308		19		14							7	6	1	6
132VJ17	Sp08C		2	2		1	1533	2	2	787	4				20			3		445	

Conclusions

- 454 Next Generation Sequencing technology can work well on archival, formalin-preserved samples.
- Spatio-temporal differences in phytoplankton communities are evident from conventional CPR analysis.
- Two major species of Pseudo-nitzschia were found over three years that were geographically split.
- No real effect of PDO on Pn -except perhaps for P. hasleana that appeared during a strongly negative PDO phase. Pseudo-nitzschia may be influenced by other environmental factors

Thank you!



- SAHFOS team
- All crew on Ship of Opportunity M/V Skaubryn
- PICES, the North Pacific Research Board, Canadian Department of Fisheries and Oceans and the Exxon Valdez Oil Spill Trustee Council for funding the NP CPR survey.

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