What we have learned from our studies of dinoflagellates, their cysts, and biogenic silica content in sediment traps

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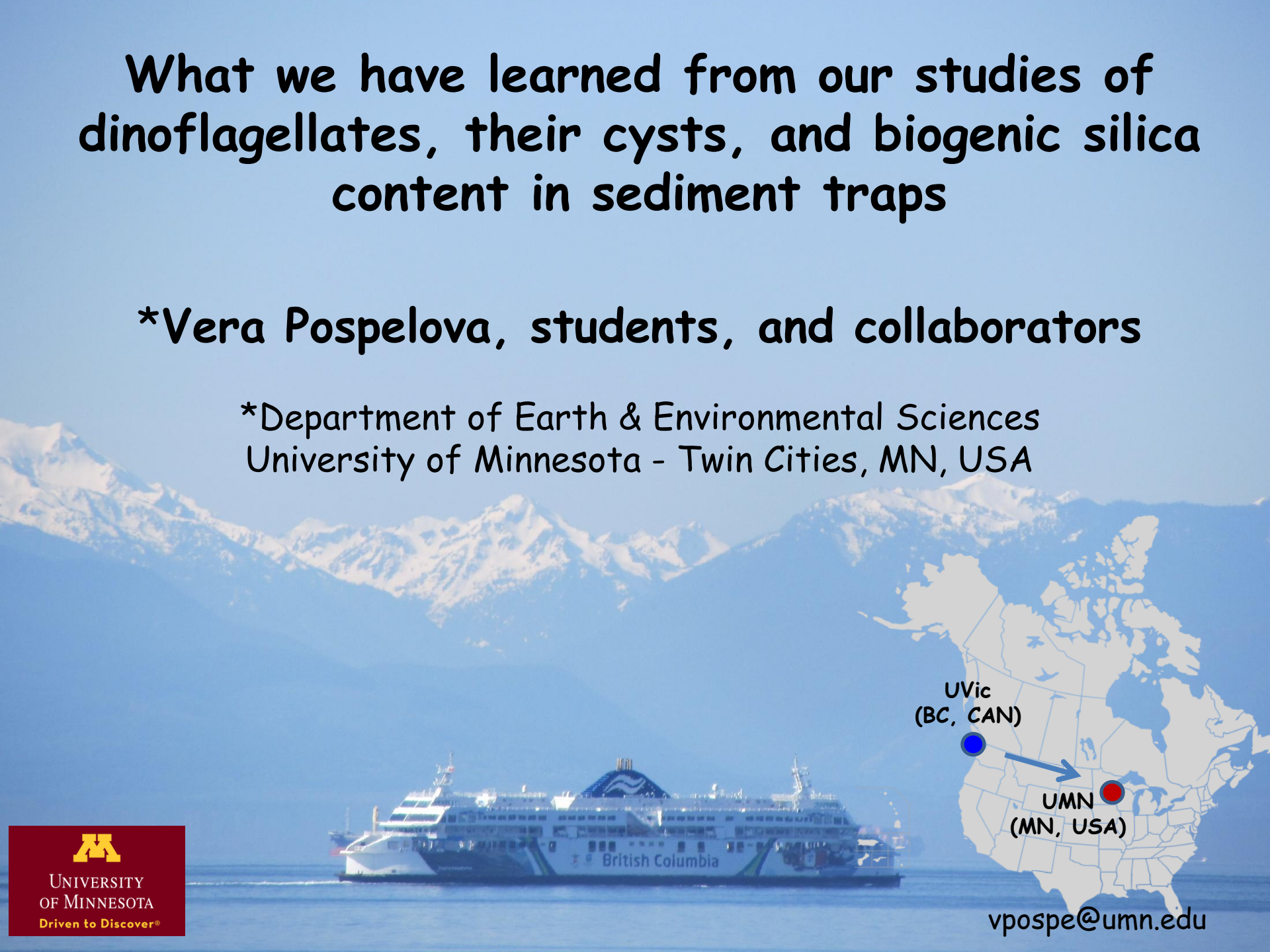

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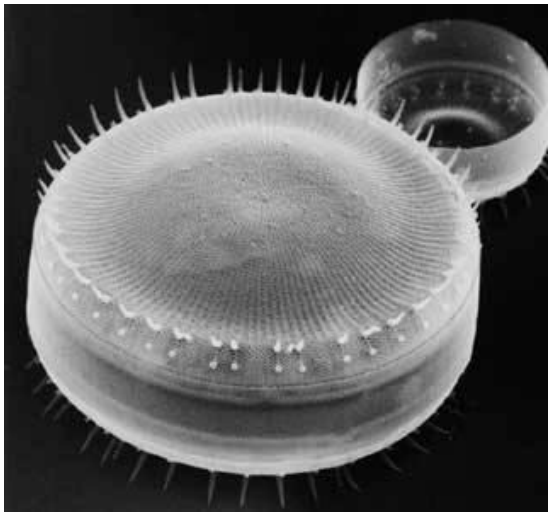
Major groups of marine eukaryotic phytoplankton (microfossils)

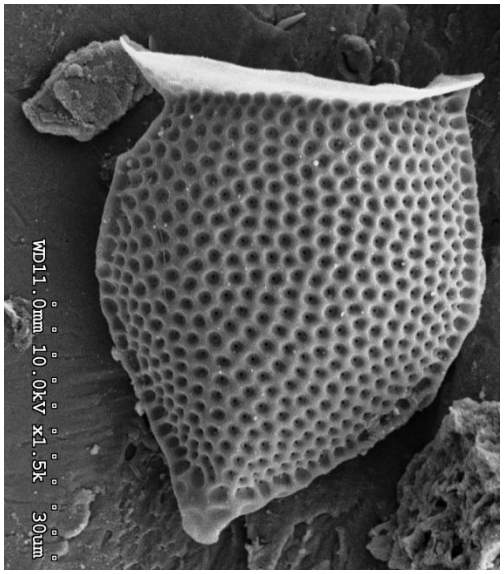
Preservation potential or dissolution issues

Diatoms



BioSi

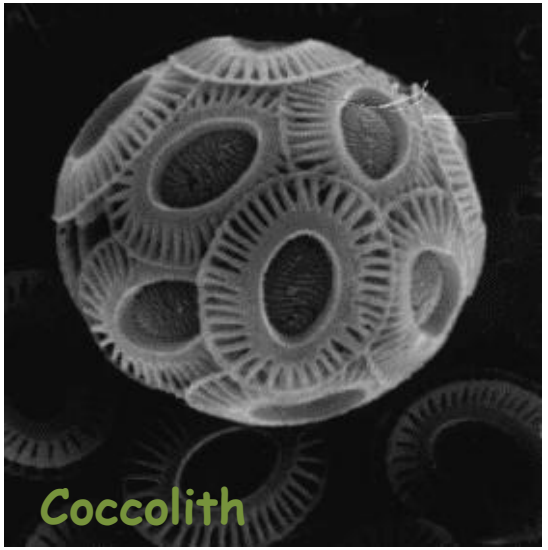
Dinoflagellates



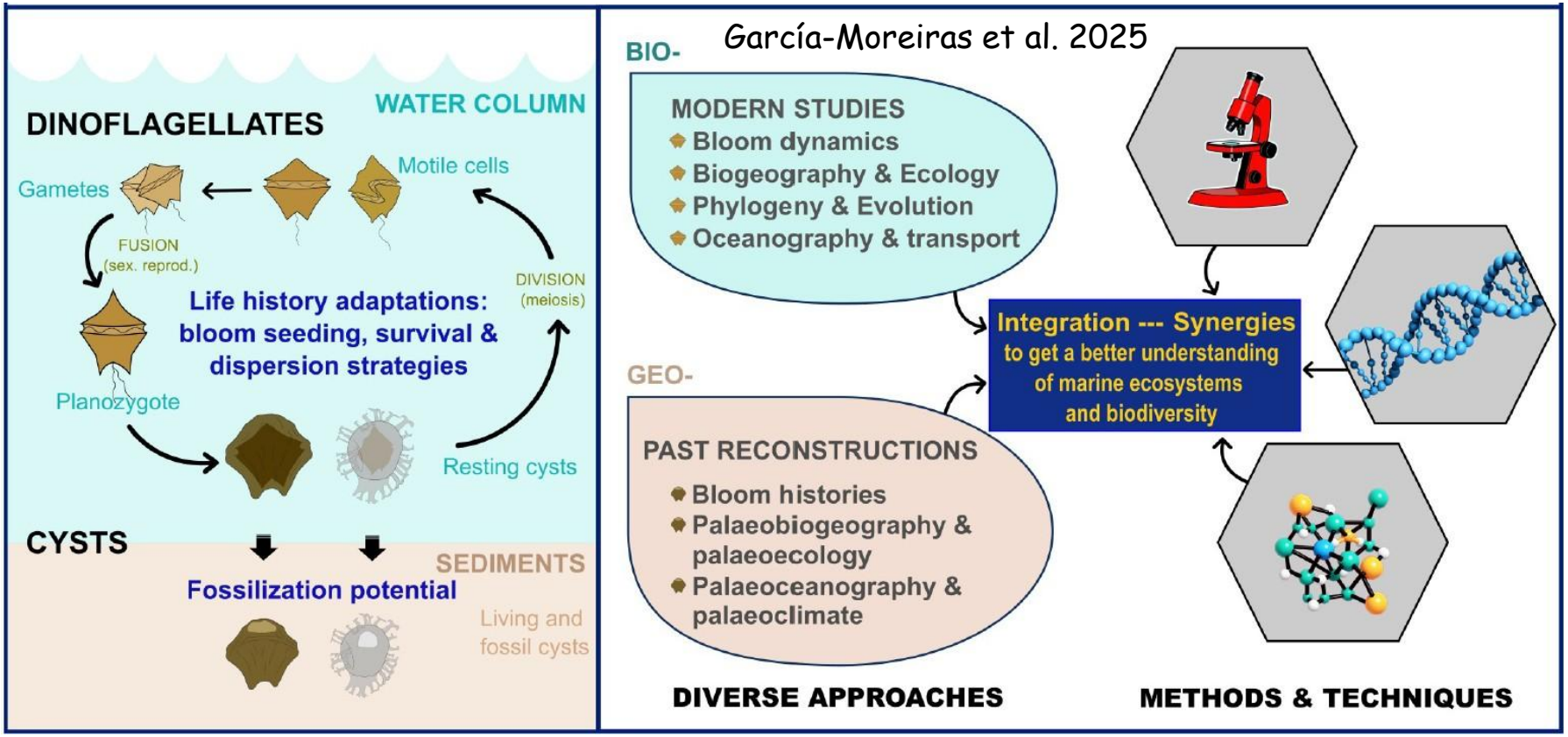
Organic

$CaCO_3$

Coccolithophores



Dinoflagellates have a complex life cycle (including cysts that are preserved in sediments).



Applications

Biodiversity: Ecology of cyst-producing dinoflagellates, including potentially toxic taxa. Provide insights on the magnitude and frequency of blooms of **HAB-causing dinoflagellates** that can be traced by their cyst records in sediments.
Paleoceanography: To reconstruct **past environmental conditions**, e.g. marine primary productivity, sea-surface temperature, salinity, eutrophication & pollution.

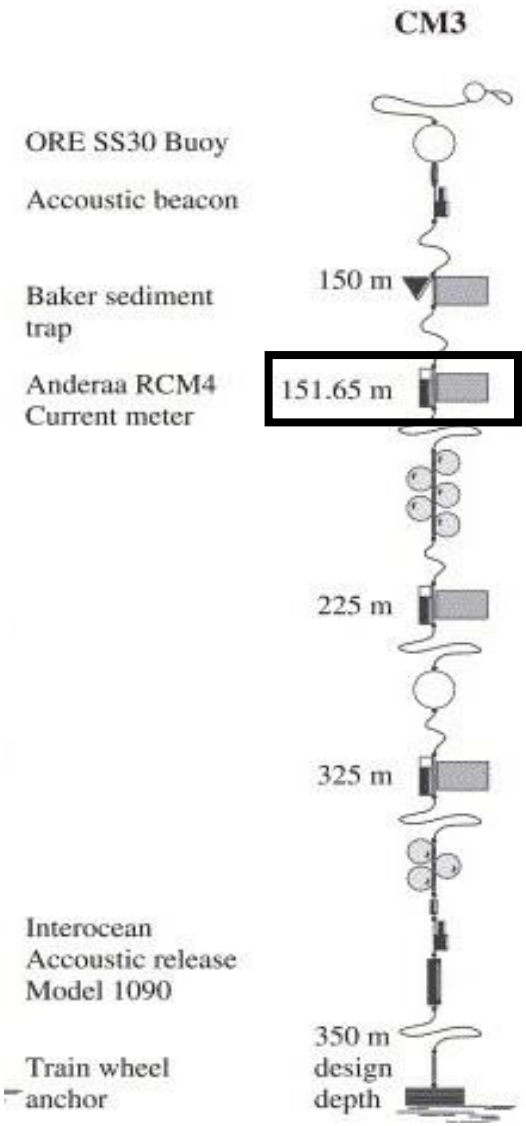
Why sediment traps?

If there is no long-term or high-frequency water quality and phytoplankton monitoring, the use of a sedimentary record is the only solution.

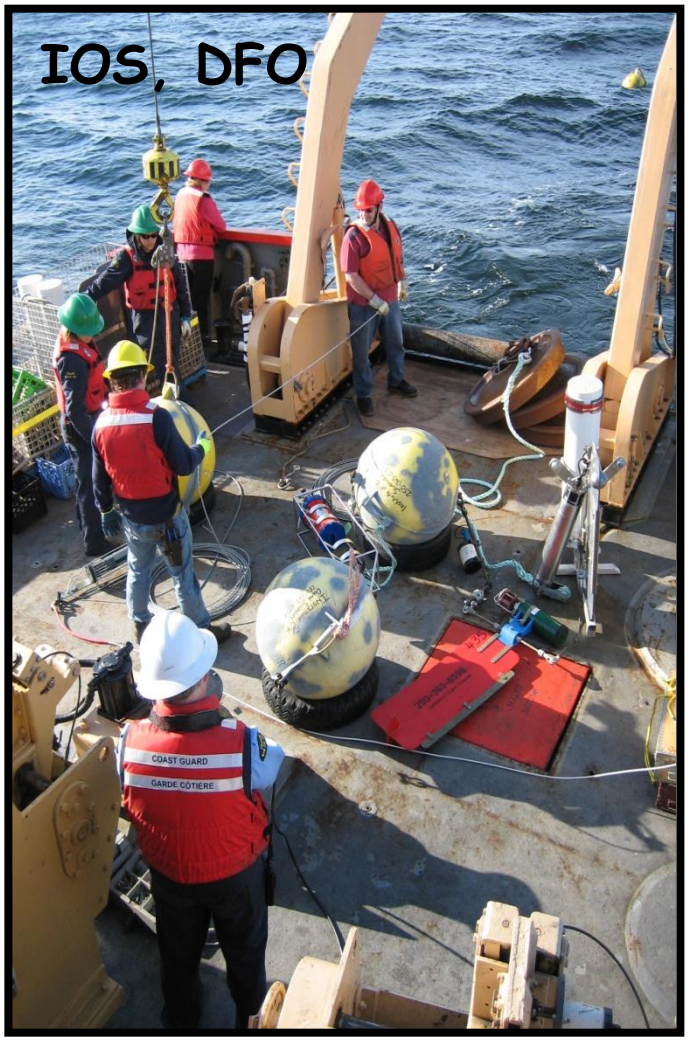
- to monitor the composition of phytoplankton groups
- to document sediment, POM, total and individual species fluxes in the entire water column
- to examine seasonal, annual and inter-annual variations in phytoplankton (DC) production
- to correlate individual taxa or groups with environmental parameters & to understand phytoplankton dynamics.
- to provide "signals" that are preservable in sediments and can be use for paleoreconstructions

Informs us about the frequency and intensity of HABs, as well as about a "seed bank" of toxic species!

Sediment Traps



The central Strait of Georgia



Pospelova, Esenkulova, Johannessen, O'Brien, Macdonald. 2010.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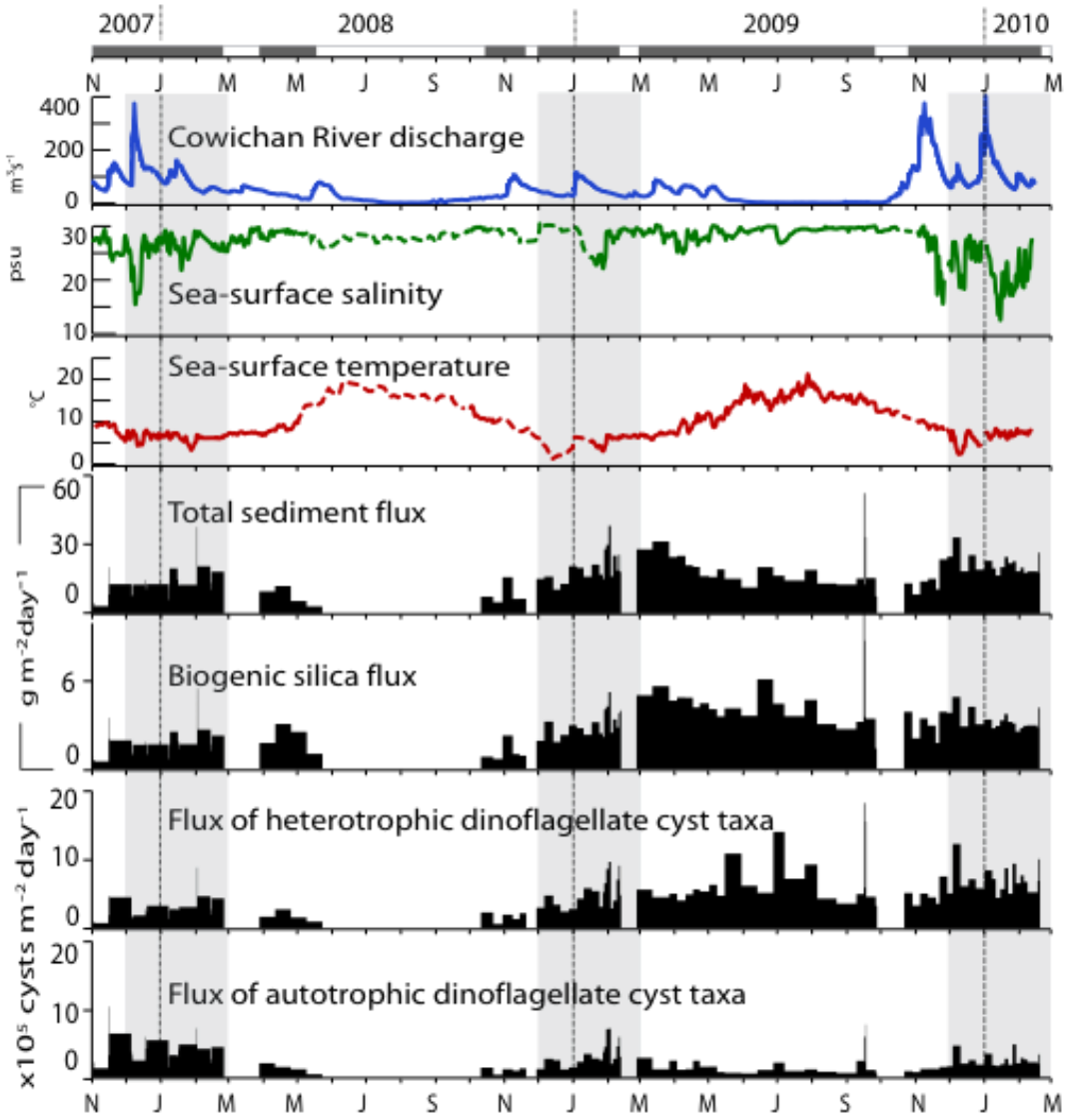
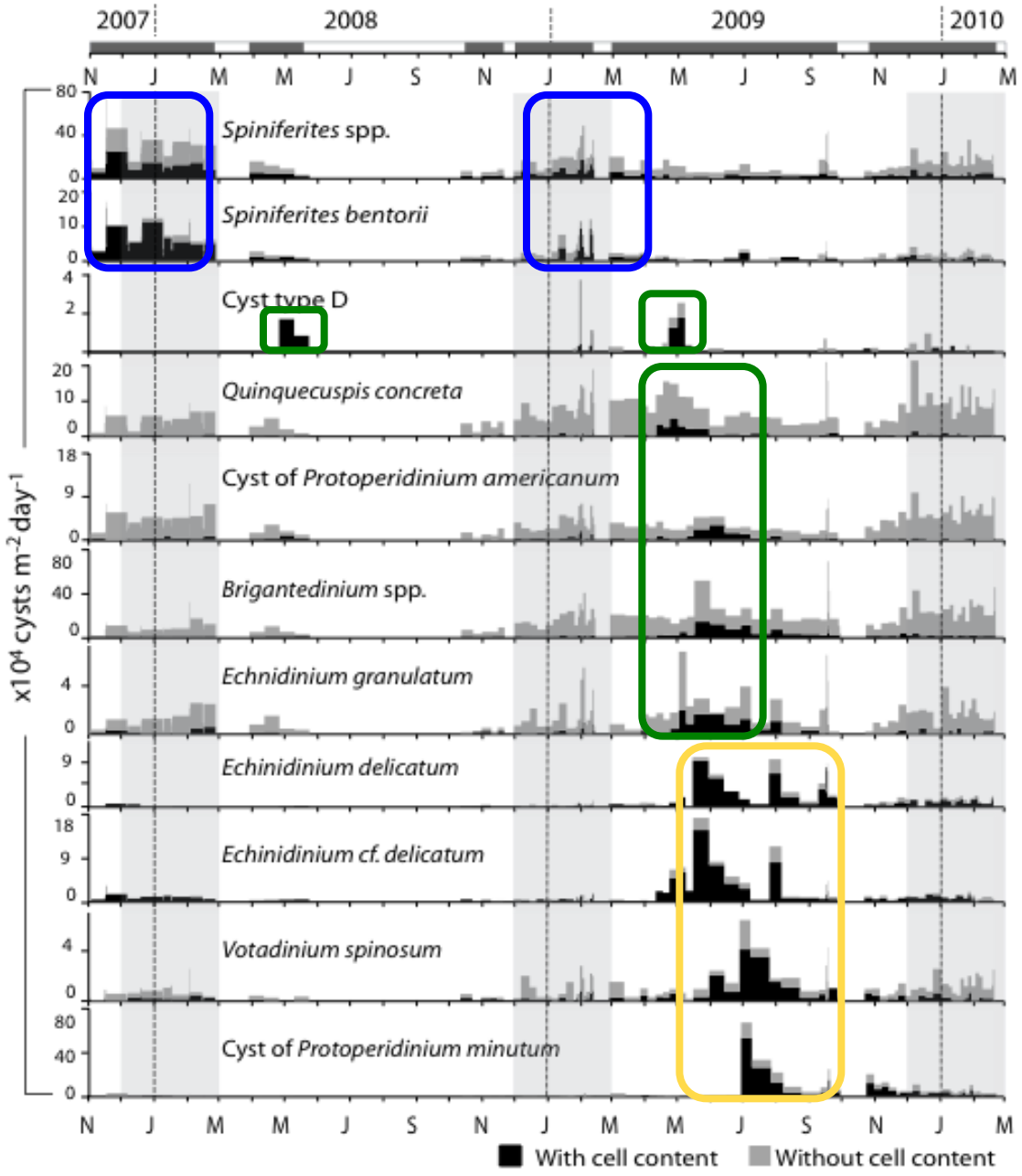
Environmental data and fluxes

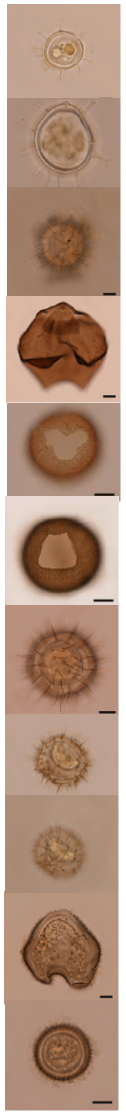
Sampling interval was ~7 days (2007-10)



Price and Pospelova (2011). Saanich Inlet – Venus sediment trap

Seasonal trends - dinoflagellate cyst fluxes



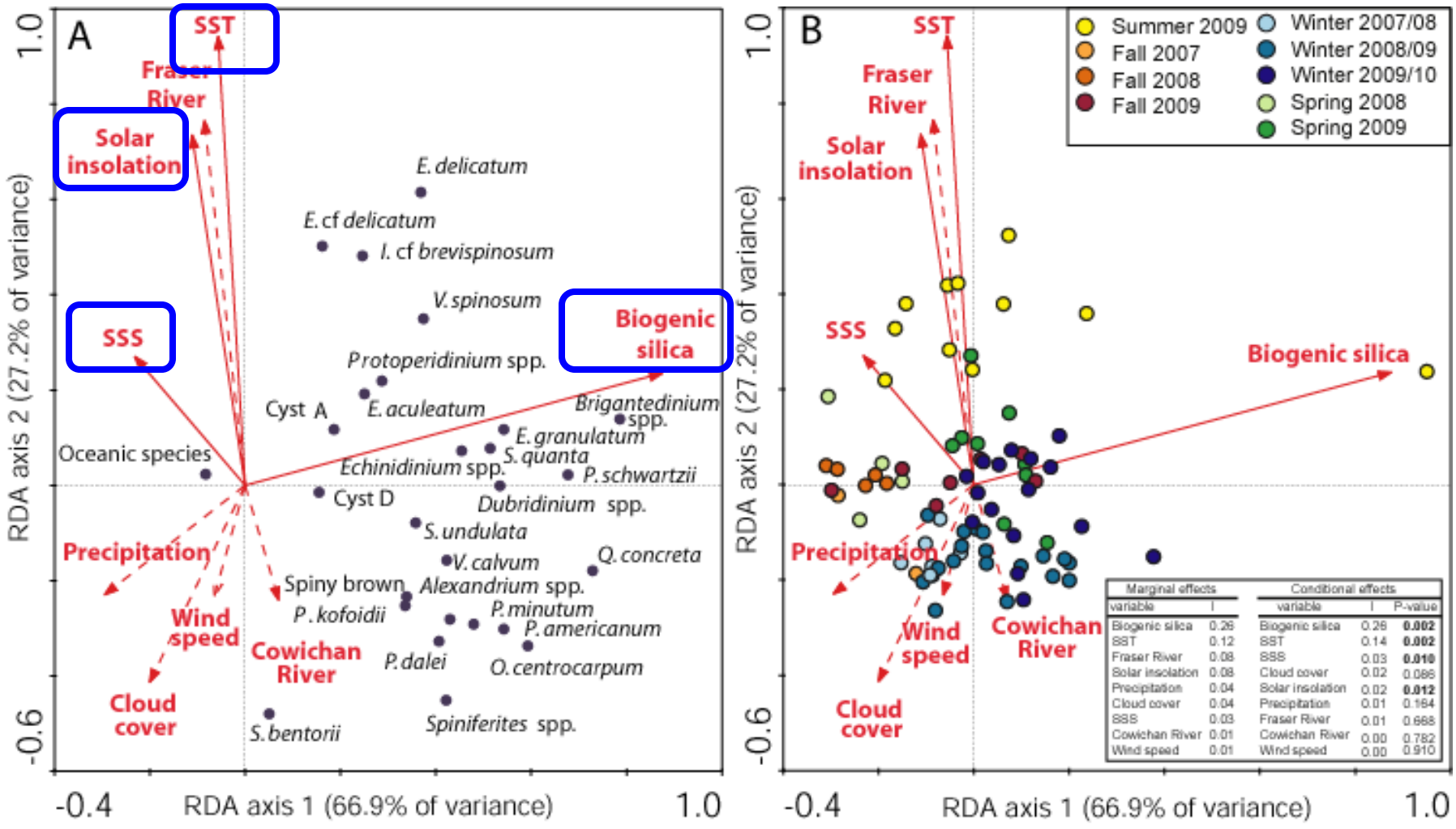


Autotrophic taxa

Heterotrophic taxa

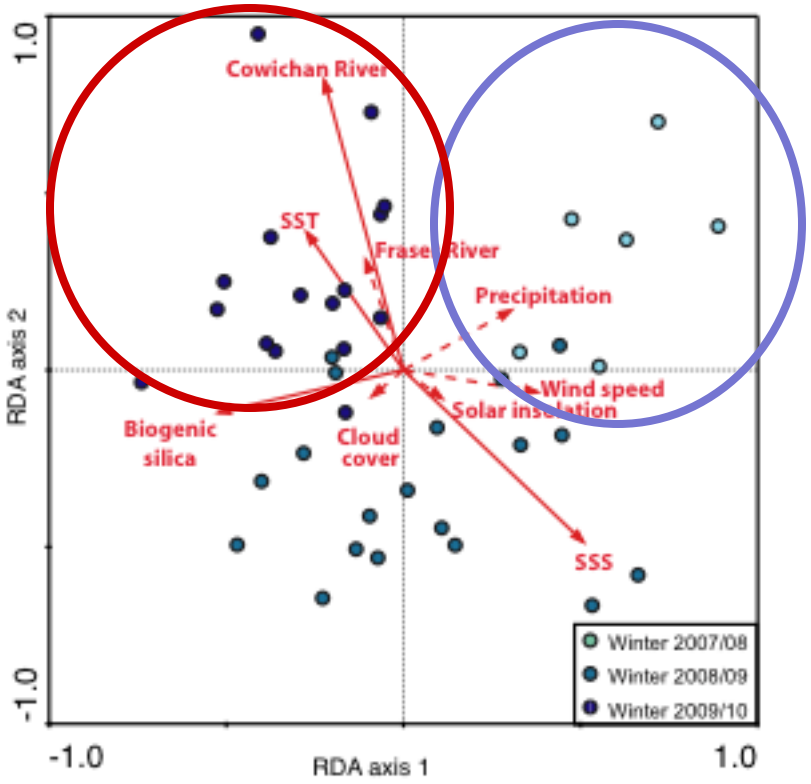
Price and Pospelova. 2011.

Multivariate analysis to understand ecology of individual species and environmental triggers of change



Price and Pospelova. 2011.

Interannual variability - Comparing winters (Dec-Feb)

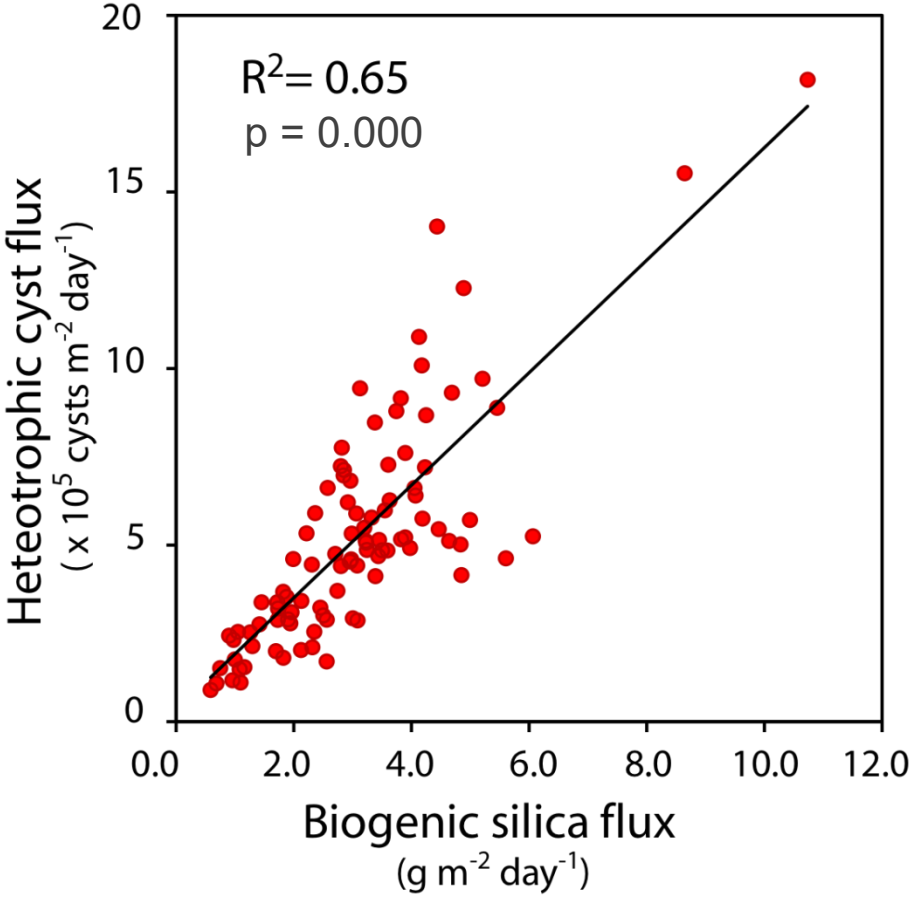


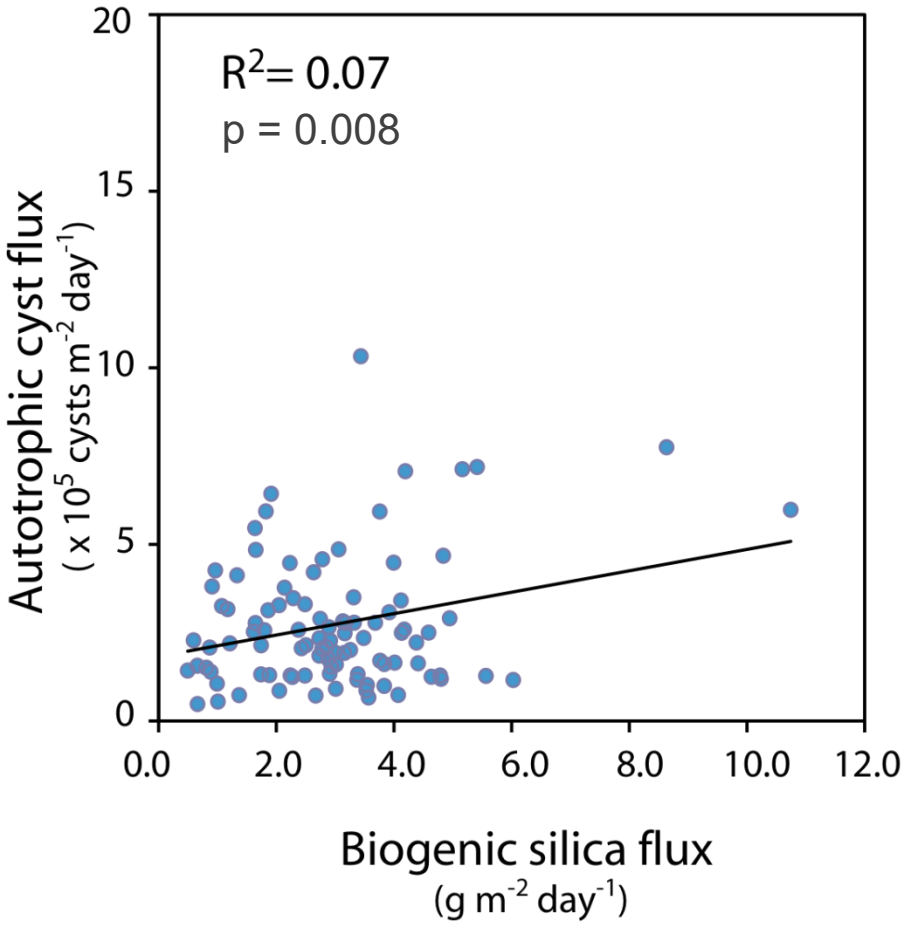
- 2007/08- La Niña, moderate river discharge, moderate SSS
  - **Lowest BioSi flux, lowest abundance of heterotrophic taxa (~43%)**
- 2008/09- cooler, lower river discharge, higher SSS
  - Moderate BioSi flux, moderate abundance of heterotrophic taxa (~61%)
- **2009/10 El Niño** - warmer, high river discharge, low SSS
  - **Highest BioSi flux, highest abundance of heterotrophic taxa (73 %)**

Price and Pospelova. 2011.

Saanich Inlet, BC

Relationship b/w **dinoflagellate cyst production** & **biogenic silica flux** (diatoms and silicoflagellates)





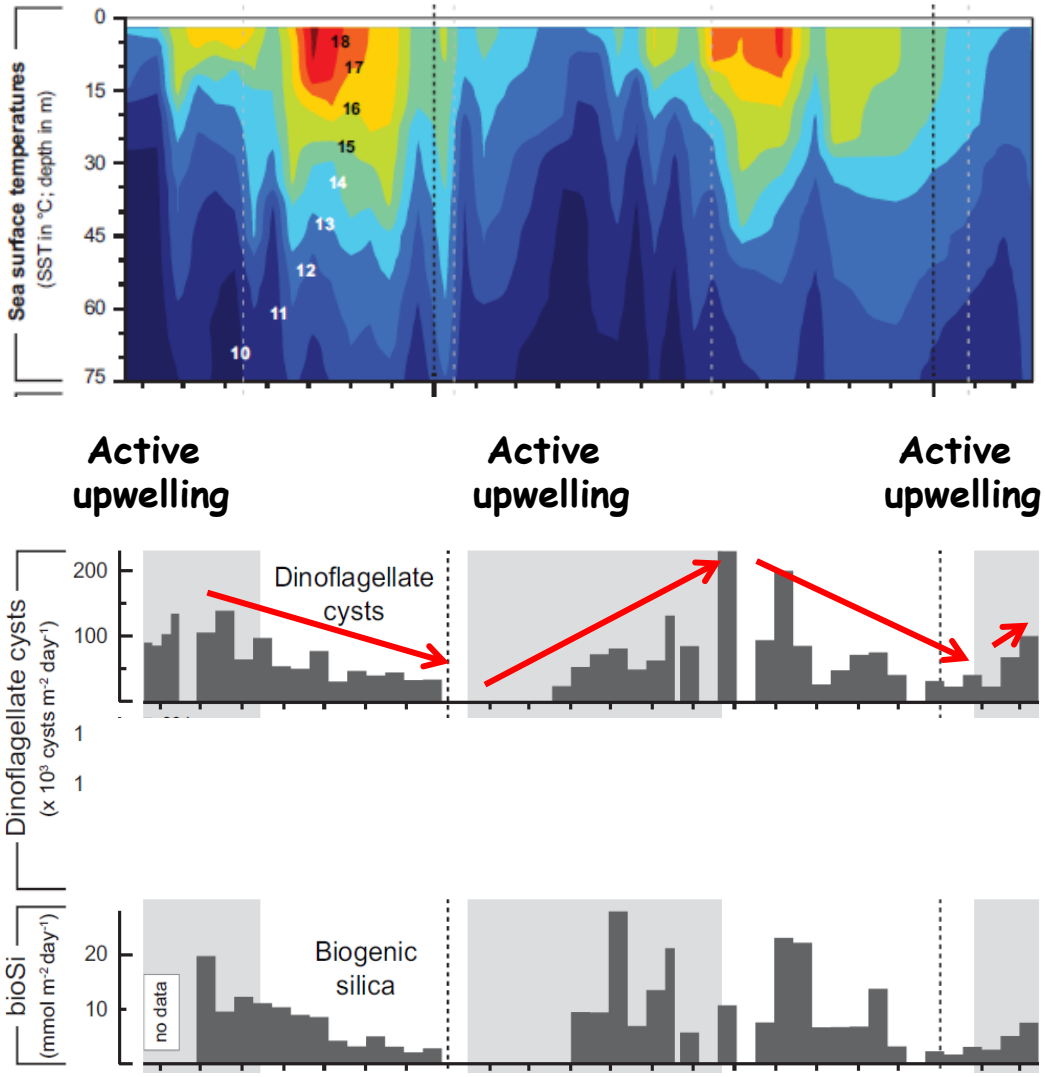
Price and Pospelova. 2011.

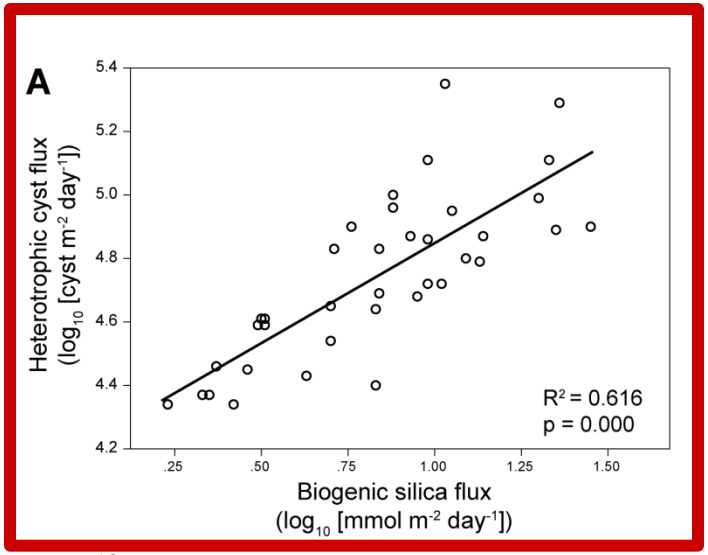
Price and Pospelova. 2011.

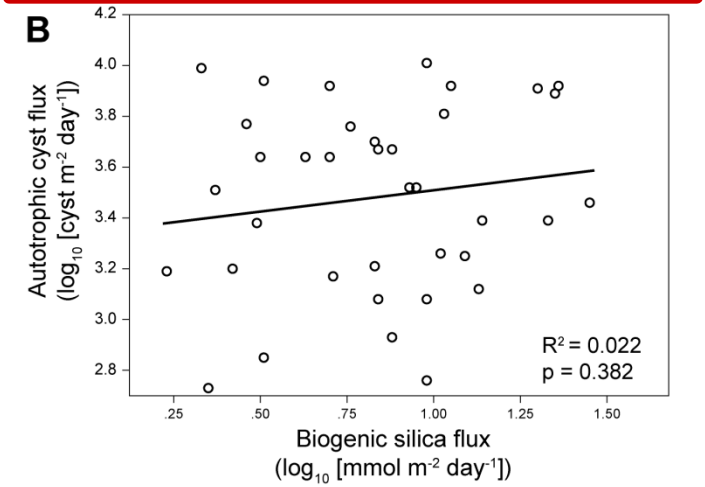
Bringué, Pospelova, Pak. 2013.

Santa Barbara Basin sediment trap study

Upwelling duration vs Primary Productivity







Bringué, Pospelova, Pak. 2013.

- All our sediment trap studies (at multiple geographical locations) have shown that fluxes of heterotrophic taxa significantly correlated with biogenic silica flux! (SofG and SI are the first such studies)
- Thus, we can use the sedimentary abundances of heterotrophic (round brown Protoperidinium) cysts to reconstruct past diatom production (and detect preservation or dilution issues with sedimentary BioSi)

Marine Micropaleontology 96–97 (2012) 48–62

Contents lists available at SciVerse ScienceDirect

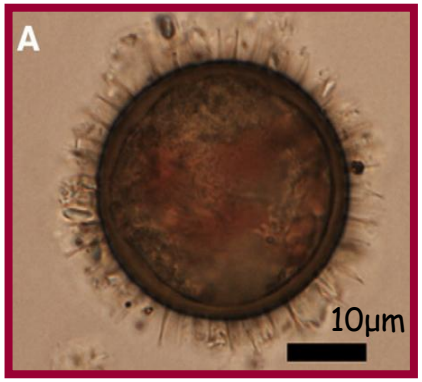
Marine Micropaleontology

journal homepage: www.elsevier.com/locate/marmicro

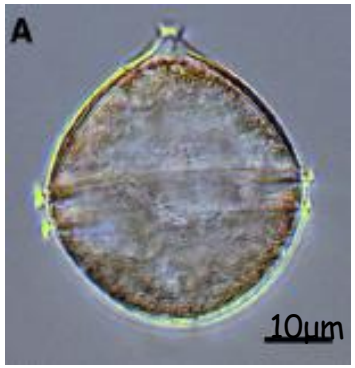
Archaeperidinium saanichi sp. nov.: A new species based on morphological variation of cyst and theca within the *Archaeperidinium minutum* Jörgensen 1912 species complex

Kenneth Neil Mertens [a,*,1], Aika Yamaguchi [b,c,1], Hisae Kawami [d], Sofia Ribeiro [e], Brian S. Leander [b,c], Andrea Michelle Price [f], Vera Pospelova [f], Marianne Ellegaard [e], Kazumi Matsuoka [d]

Cyst of *Protoperidinium minutum* & "cyst type L"



Cyst isolation and germination experiments



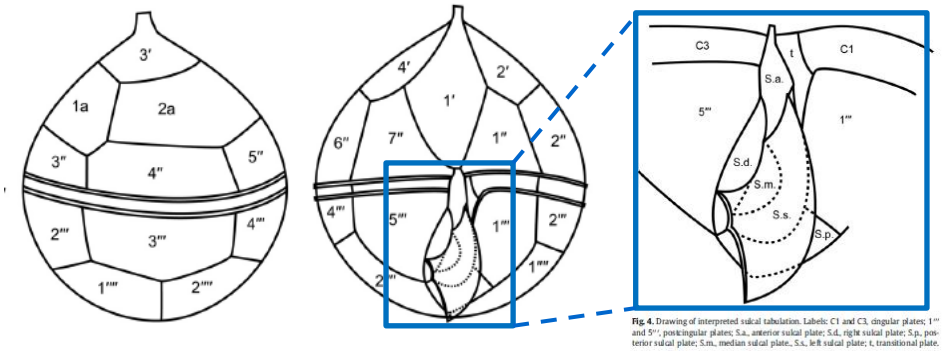
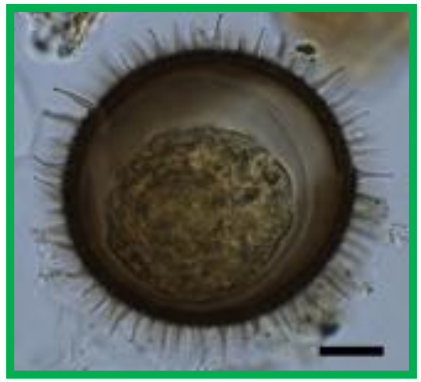


Fig. 4. Drawing of interpreted sulcal tabulation. Labels: C1 and C3, cingular plates; 1"" and 5"', postcingular plates; S.a., anterior sulcal plate; S.d., right sulcal plate; S.p., posterior sulcal plate; S.m., median sulcal plate., S.s., left sulcal plate; t, transitional plate.



"Molecular phylogenetic analyses of large and small subunit (LSU and SSU) rDNA sequences demonstrated a close affinity of this species to *A. minutum*; however, the relatively high level of sequence conservation in dinoflagellate rDNA sequences made these particular markers inadequate for distinguishing one species from the other. **Sediment-trap data suggest that *A. saanichi* has a preference for cooler temperatures and lowered salinities.**"

The Journal of Eukaryotic Microbiology
Published by the International Society of Protistologists
Journal of Eukaryotic Microbiology ISSN 1066-5234

ORIGINAL ARTICLE

A New Heterotrophic Dinoflagellate from the North-eastern Pacific, *Protoperidinium fukuyoi*: Cyst–Theca Relationship, Phylogeny, Distribution and Ecology

Kenneth N. Mertens[a], Aika Yamaguchi[b,c], Yoshihito Takano[d], Vera Pospelova[e], Martin J. Head[f], Taoufik Radi[g], Anna J. Pieńkowski[h], Anne de Vernal[g], Hisae Kawami[d] & Kazumi Matsuoka[d]

ONC (Venus) in acknowledgments

PALYNOLOGY
2020, VOL. 44, NO. 2, 310–335
https://doi.org/10.1080/01916122.2019.1580627
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Check for updates

Taxonomic revision, phylogeny, and cyst wall composition of the dinoflagellate cyst genus *Votadinium* Reid (Dinophyceae, Peridiniales, Protoperidiniaceae)

Pieter R. Gurdebeke[a], Kenneth N. Mertens[b], Vera Pospelova[c], Kazumi Matsuoka[d], Zhen Li[c], Kristin E. Gribble[e], Haifeng Gu[f], Kara Bogus[g,h], Henk Vrielinck[i] and Stephen Louwye[a]

Eukaryotic Microbiology
ISOP Published by the International Society of Protistologists
Journal of Eukaryotic Microbiology ISSN 1066-5234

ORIGINAL ARTICLE

Cyst-Theca Relationship and Phylogenetic Position of *Impagidinium caspienense* Incubated from Caspian Sea Surface Sediments: Relation to *Gonyaulax baltica* and Evidence for Heterospory within Gonyaulacoid Dinoflagellates

Kenneth N. Mertens[a], Yoshihito Takano[b], Haifeng Gu[c], Siamak Bagheri[d], Vera Pospelova[e], Anna J. Pieńkowski[f,g], Suzanne A. G. Leroy[h] & Kazumi Matsuoka[b]

Many new species – biodiversity & ecology

PALYNOLOGY
2020, VOL. 44, NO. 1, 80–93
https://doi.org/10.1080/01916122.2018.1549118
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Islandinium pacificum sp. nov., a new dinoflagellate cyst from the upper Quaternary of the northeast Pacific

Pieter R. Gurdebeke[a], Kenneth Neil Mertens[b], Vera Pospelova[c], Nicolas Van Nieuwenhove[d] and Stephen Louwye[a]

Marine Pollution Bulletin 215 (2025) 117899

Contents lists available at ScienceDirect

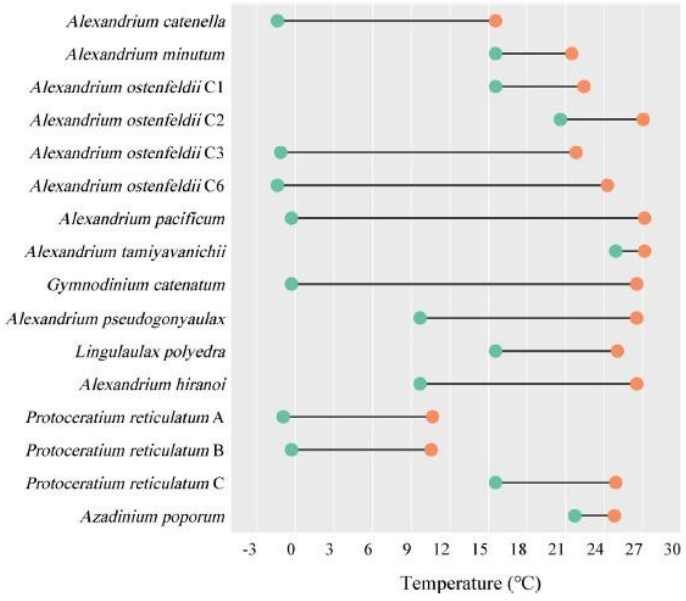
Marine Pollution Bulletin

journal homepage: www.elsevier.com/locate/marpolbul

ONC (Venus) in acknowledgments

High-resolution DNA metabarcoding of modern surface sediments uncovers a diverse assemblage of dinoflagellate cysts in the Pacific and Arctic Oceans

Junyue Wang [a,b], Qian Liu [a], Shuning Huang [a,b], Kenneth Neil Mertens [c], Vera Pospelova [d], Xin Shen [e], Haifeng Gu [b,*]



Refined thermal windows of toxic dinoflagellate species.

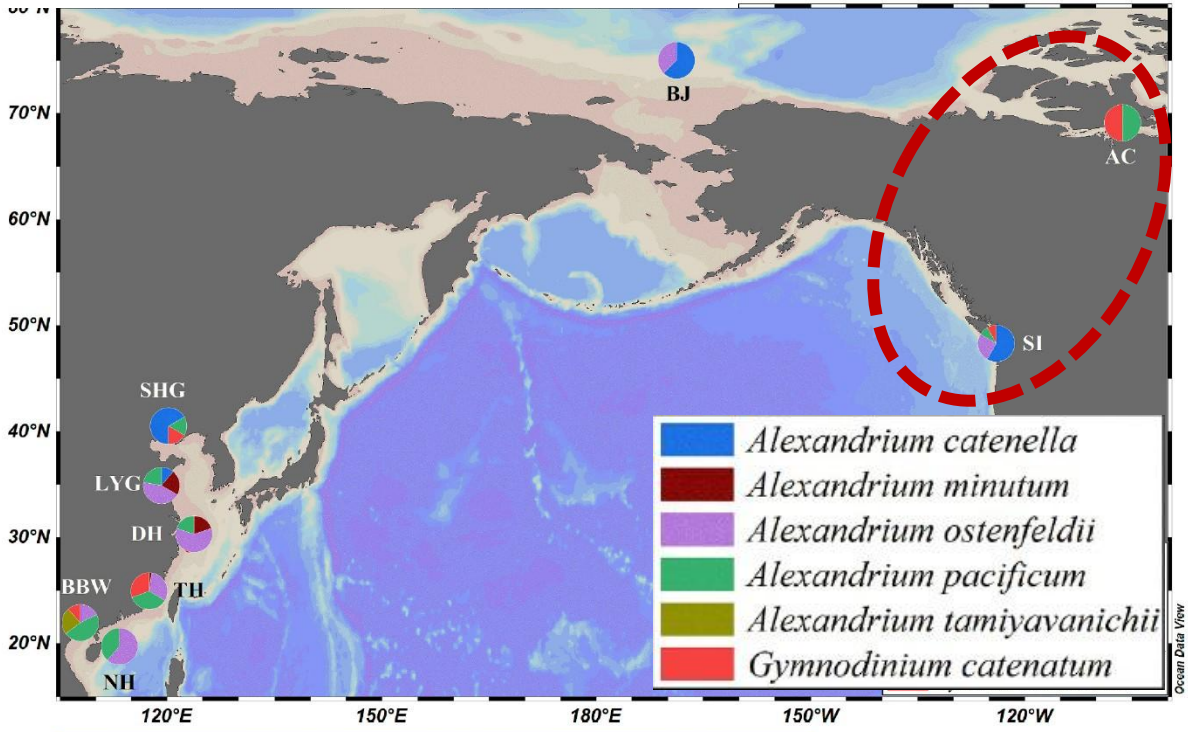


Fig. 3. Distribution of paralytic shellfish toxin-producing dinoflagellates, based on the LSU and ITS1 datasets. Only ASVs with abundances >5 were counted. The abbreviations for site names are as follows: BJ: the Chukchi Sea; AC: Cambridge Bay, Nunavut, Canada; SI: the Salish Sea, British Columbia, Canada; SHG: Shanhaiguan, the Bohai Sea; LYG: Lianyungang, the Yellow Sea; DH: the East China Sea; TH: the Taiwan Strait; BBW: Beibu Gulf, China; NH: the South China Sea. (For

Prof. Pospelova's group & collaborators

- **Research:**

Continue working with SI sediment trap material to monitor primary productivity respond to climate and environmental changes, and to understand seasonal phytoplankton dynamics, harmful algal blooms (HABs), ecology of dinoflagellates and ciliates, and environmental triggers, as well as biodiversity in the Salish Sea.

Instruments/data used: Sediment traps, measurements of water quality (environmental) parameters, push cores, etc.

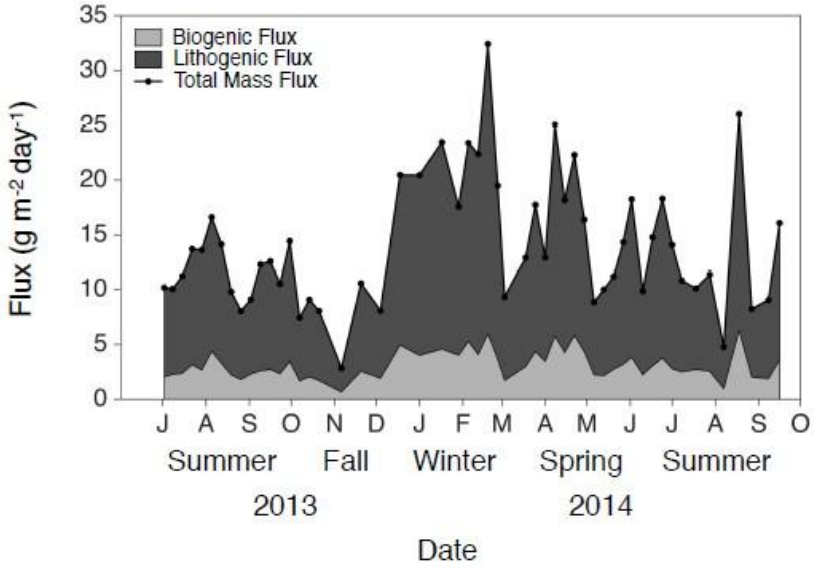
- **Education: Teaching at UMN**

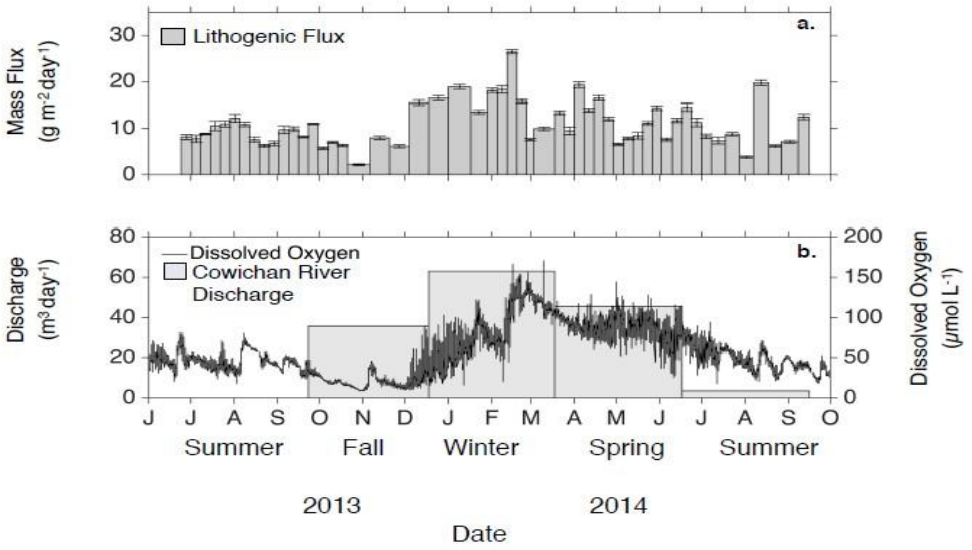
ESCI1006 Oceanography course, ~250-450 students per year: two ONC labs, the Venus data lab on Saanich Inlet. **Thank you to Mauricio Carrasquilla.**

Prof. Diana Varela's group

UVic, Department of Biology/SEOS

Ex.: Curtis Martin, Honours Thesis on "Benthic-pelagic coupling of particulate flux and nutrient stoichiometry in Saanich Inlet."





"The total mass flux of particulate matter to depth was variable throughout the year in Saanich Inlet, and appeared to be influenced by a combination of environmental (SST, oxygen, precipitation, solar radiation, and windspeed) and surface biological (Chl *a* and bSi) factors."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Thank you to
the ONC team!