# Long-term changes in microalgae communities on the **Russian East coast** with emphasis on **toxic and bloom forming species**

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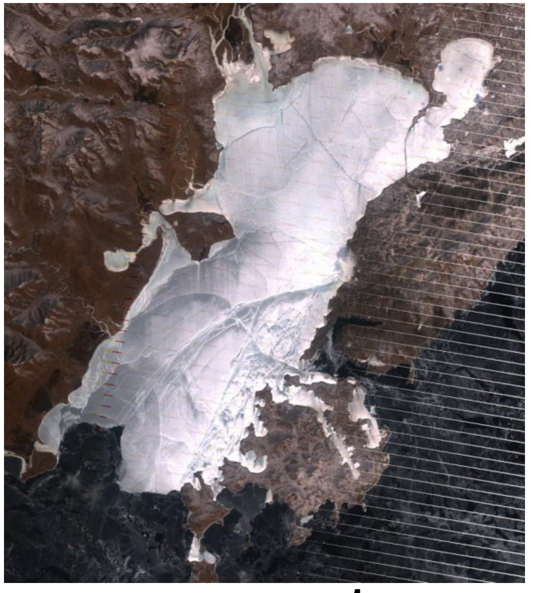
HABs MONITORING since 1999 :

- Monitor HAB populations (plankton/benthos)
- Reveal new sources of toxicity (new species/cycts)
- Early warning / mechanism

# Location of the study area

# Temperature and salinity characteristics of the study area



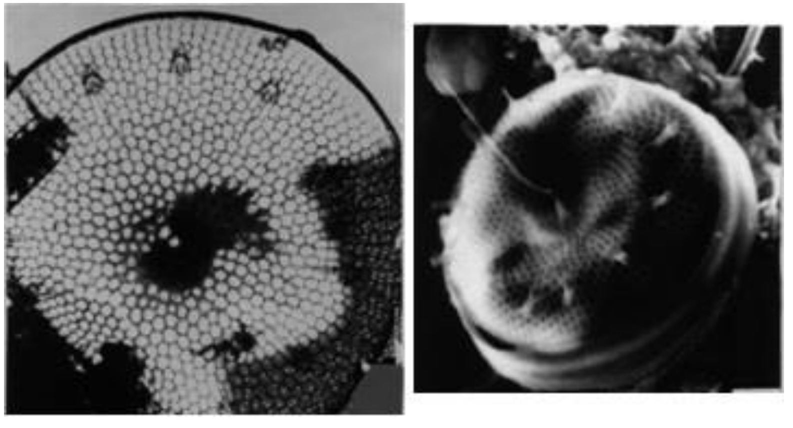
**Average surface temperature**
from -20°C to +25 °C

**Ice coverage** from December till March

(Peter the Great bay)

Slightly lower **salinity** - 33,7—34,3‰

# Representatives of cold and warm waters



*Thalassiosira nordenskioeldii*

*Ostreopsis cf ovata*

# Surface water temperature rise 1982-2006

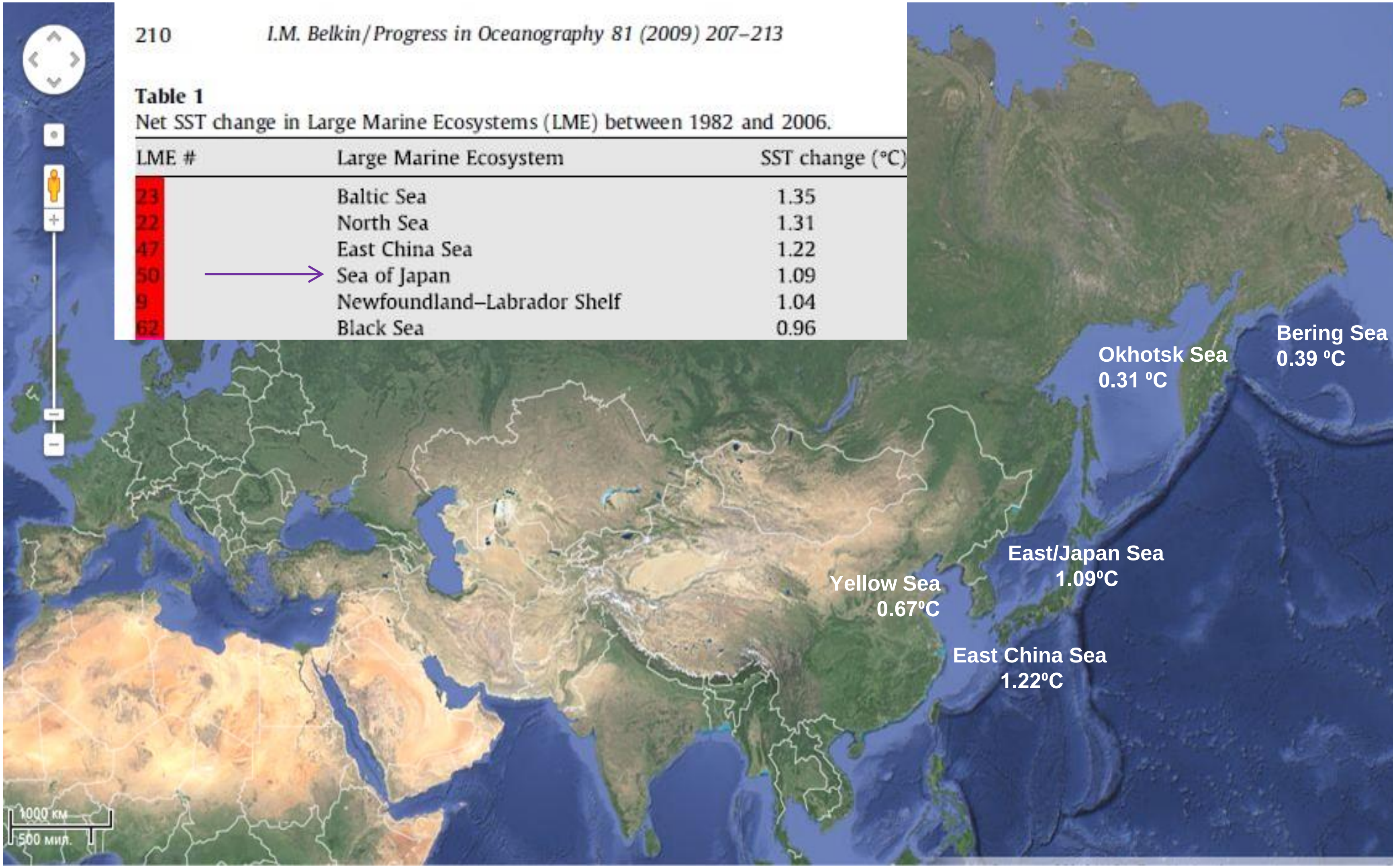


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**Table 1**
Net SST change in Large Marine Ecosystems (LME) between 1982 and 2006.

| LME # | Large Marine Ecosystem | SST change (°C) |
|---|---|---|
| 23 | Baltic Sea | 1.35 |
| 22 | North Sea | 1.31 |
| 47 | East China Sea | 1.22 |
| 50 | Sea of Japan | 1.09 |
| 9 | Newfoundland–Labrador Shelf | 1.04 |
| 62 | Black Sea | 0.96 |



(Belkin et al., 2004)

# Reasons for faster warming

- Nearby land warming, linked to climate changes and anthropogenic pollution ( Trenberth et al,. 2007)
- The effect of Yangtze river runoff (Zhang et al,. 2007)
- Activation of warm currents (Kuroshio Current, Tsushima Current)

(Adrianov, 2014)

# General changes and patterns of microalgae communities

- Changes in abundance of microalgae (*Karenia, Pseudo-nitzschia*)

- New bloom-forming species (*Heterosigma akazhiwo, Pseudogaptolina birgeri*)

- Changes in species composition (*Sceletonema*)

- Warm-loving species in temperate zone (*Ostreopsis*)

- Non-diatom component increases

- New toxic species

# Changes in abundance of microalgae

*Karenia brevis* and
*Karenia mikimotoi*

First record – 1987

Maximum concentrations:

*Karenia brevis – 3.5x$10^3$ cell/L in 1993*

*Karenia mikimotoi – 1x$10^6$cell/L in 1990*

*Decrease in abundance since the early 2000*

*Pseudo-nitzschia*

*11 species recorded*

*Maximum concentration 11 x$10^6$ cells/L in 1992*

*Since 2012 no more then 2 x$10^6$cells/L*

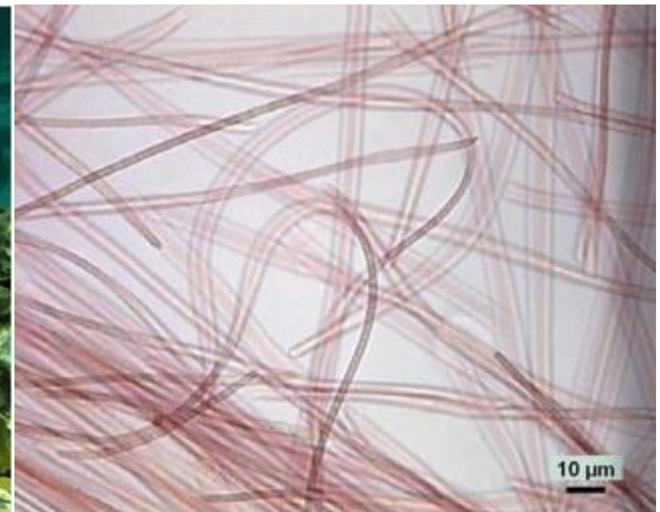
# New bloom-forming species

*Heterosigma akashiwo* bloom in coastal waters of Vladivostok since 2010 (ITX)

# New bloom-forming species


*Pseudohaptolina birgeri*
275 million cells/L  (Chl a - 20,77 mg/L)
Sea water t -1,8ºC (ITX)

# New bloom-forming species

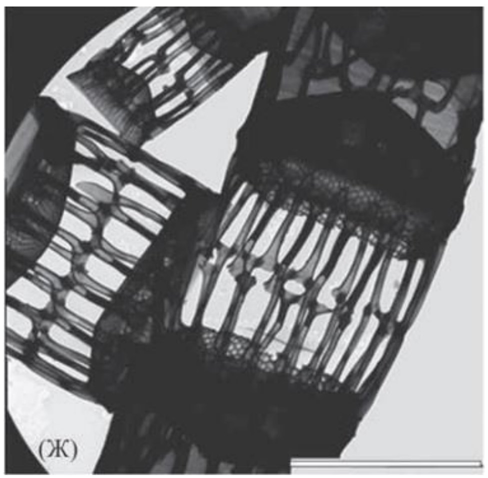


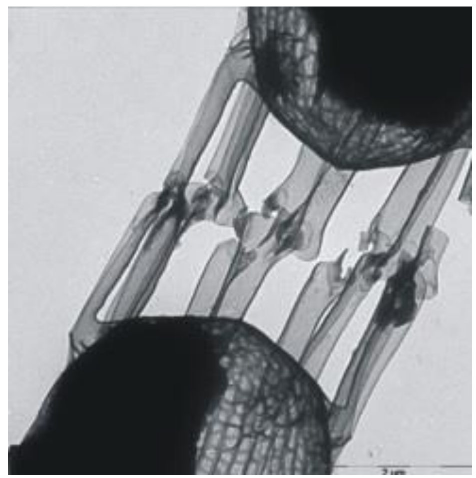

*Oscilatoriales* – lithophylic cyanobacteria

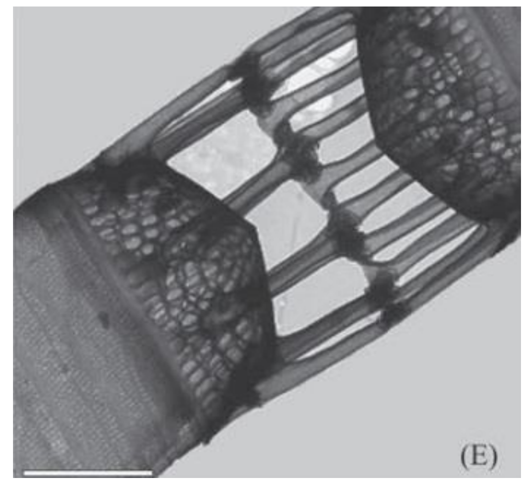

# Changes in species composition

*Skeletonema costatum*

*Skeletonema grethae* *Skeletonema marinoi* *Skeletonema japonicum*



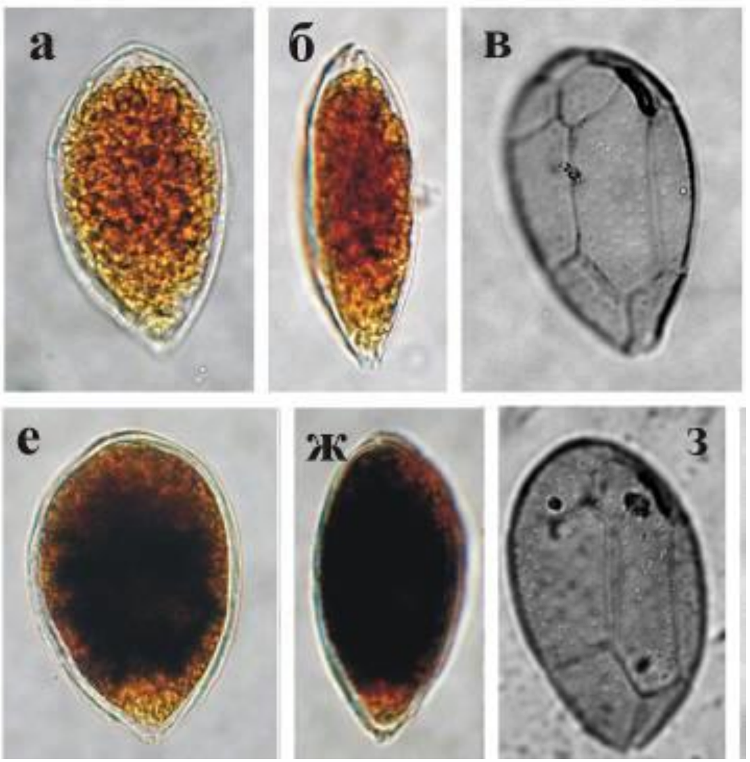


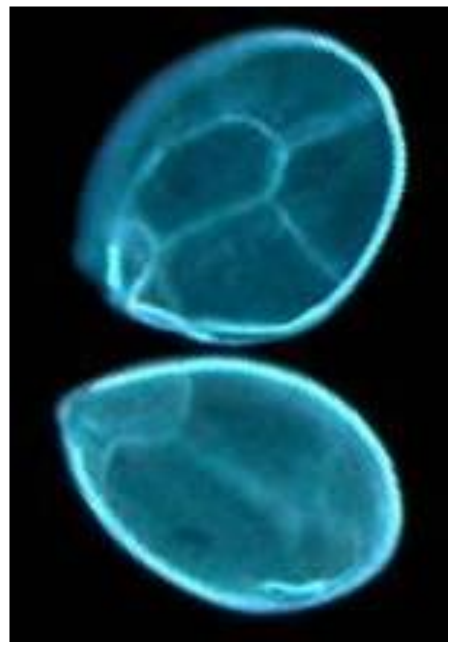

Form blooms average - *$2x10^6$ cells/L*

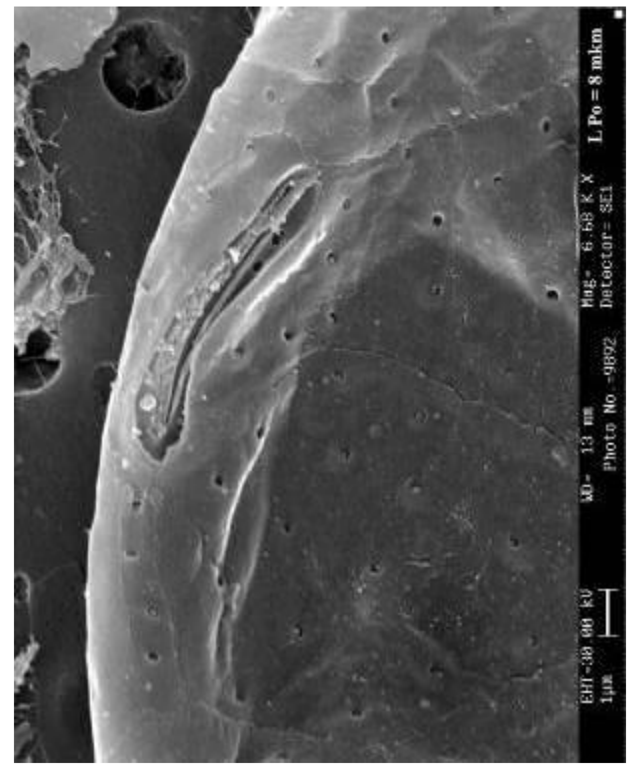
(Shevchenko & Aizdaicher, 2014)

# Warm-loving species in temperate zone

Studies of epiphytic dinoflagellates on macrophytes from Peter the Great Bay revealed the presence of *Ostreopsis cf. ovata* (species are known as producers of putative palytoxin and its analogue, ovatoxins).





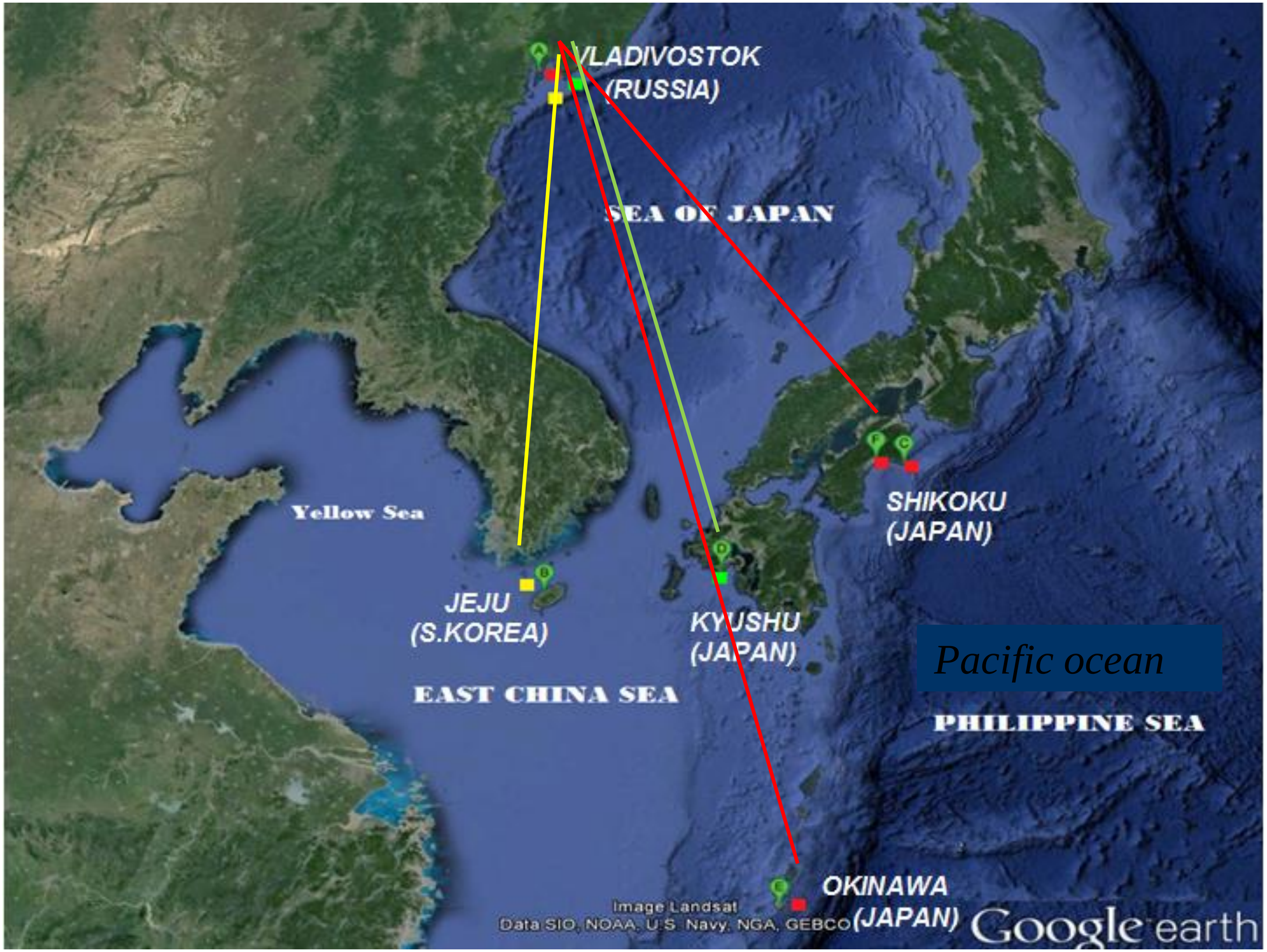
(Selina et al., 2014)

Until recently, it was thought that the genera *Gambierdiscus*, *Coolia* and *Ostreopsis* are endemics of tropical and subtropical areas.

During the last decade these genera were found in the temperate areas of the northern and southern hemispheres.

Real expansion of *O. ovata* and *O. siamensis* was observed in the Mediterranean.

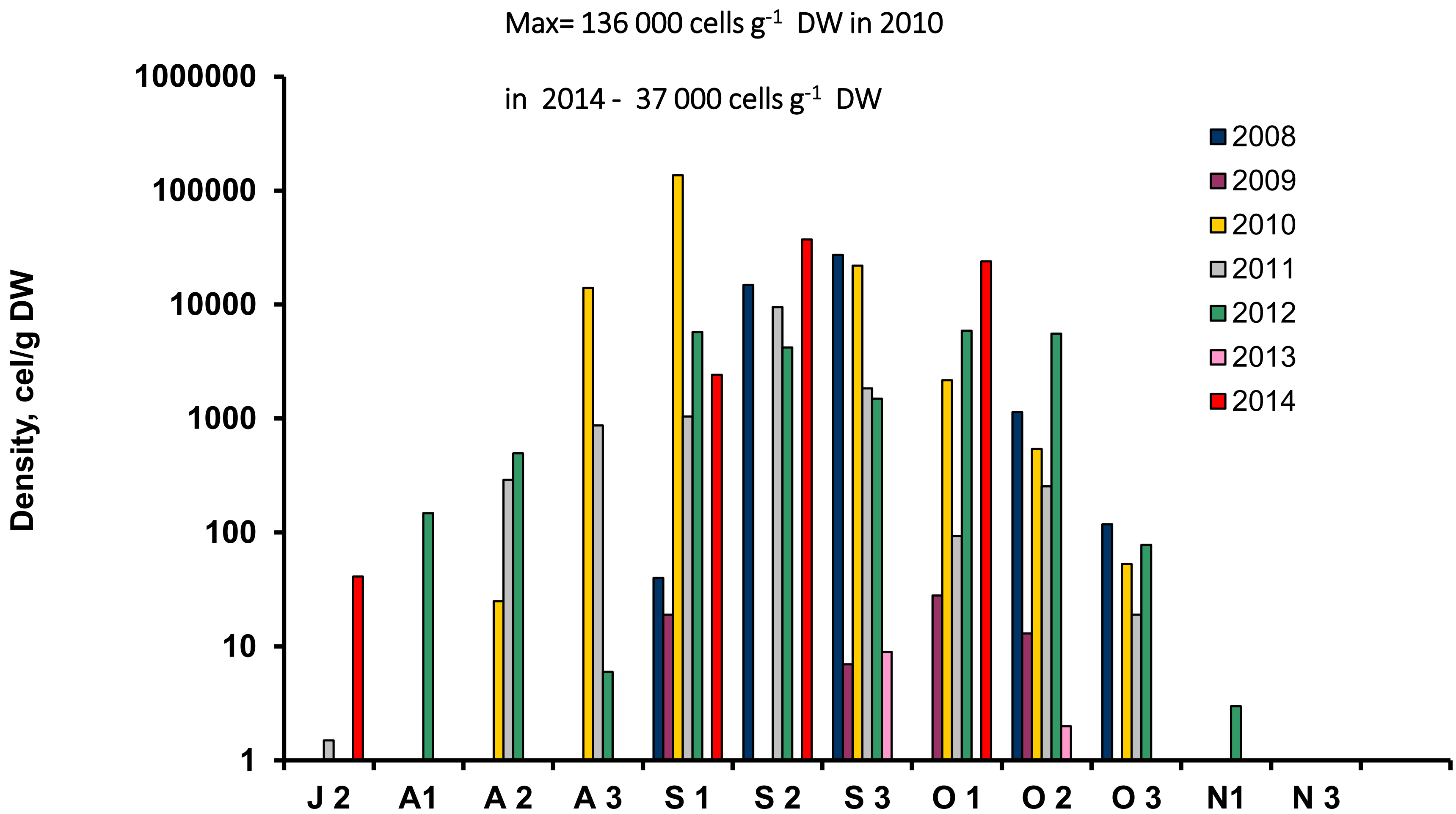
(Selina et al., 2014)




Geographical distribution of the *Ostreopsis* ribotypes registered in Russian waters. Identical ribotypes are depicted in one color.

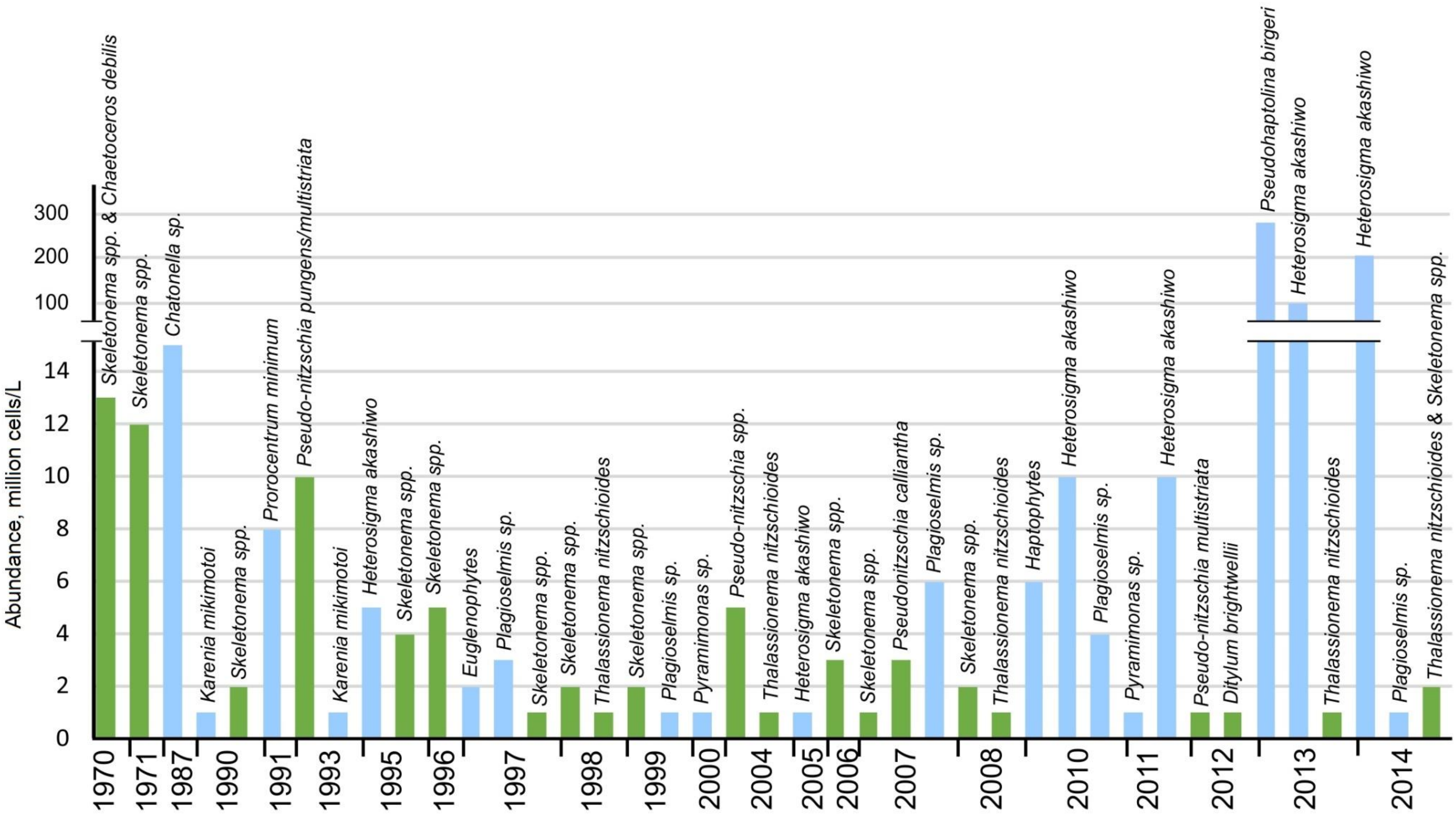
(Efimova et al., 2013)

# Abundance of *Ostreopsis* spp.




(Selina et al., 2014)

# Diatom and non-diatom dynamic



# New toxic species

Domoic acid (ASP) concentrations were studied in 20 *Pseudo-nitzschia* strains isolated from
Peter the Great Bay during 2008-2013. The highest DA content was found in stationary-phase *P. multistriata* and *P. calliantha* strains at
DA cell quota varying between 0.1 and 0.53 pg/cell which is comparable to the values reported for other strains of these species (Trainer et al., 2012).

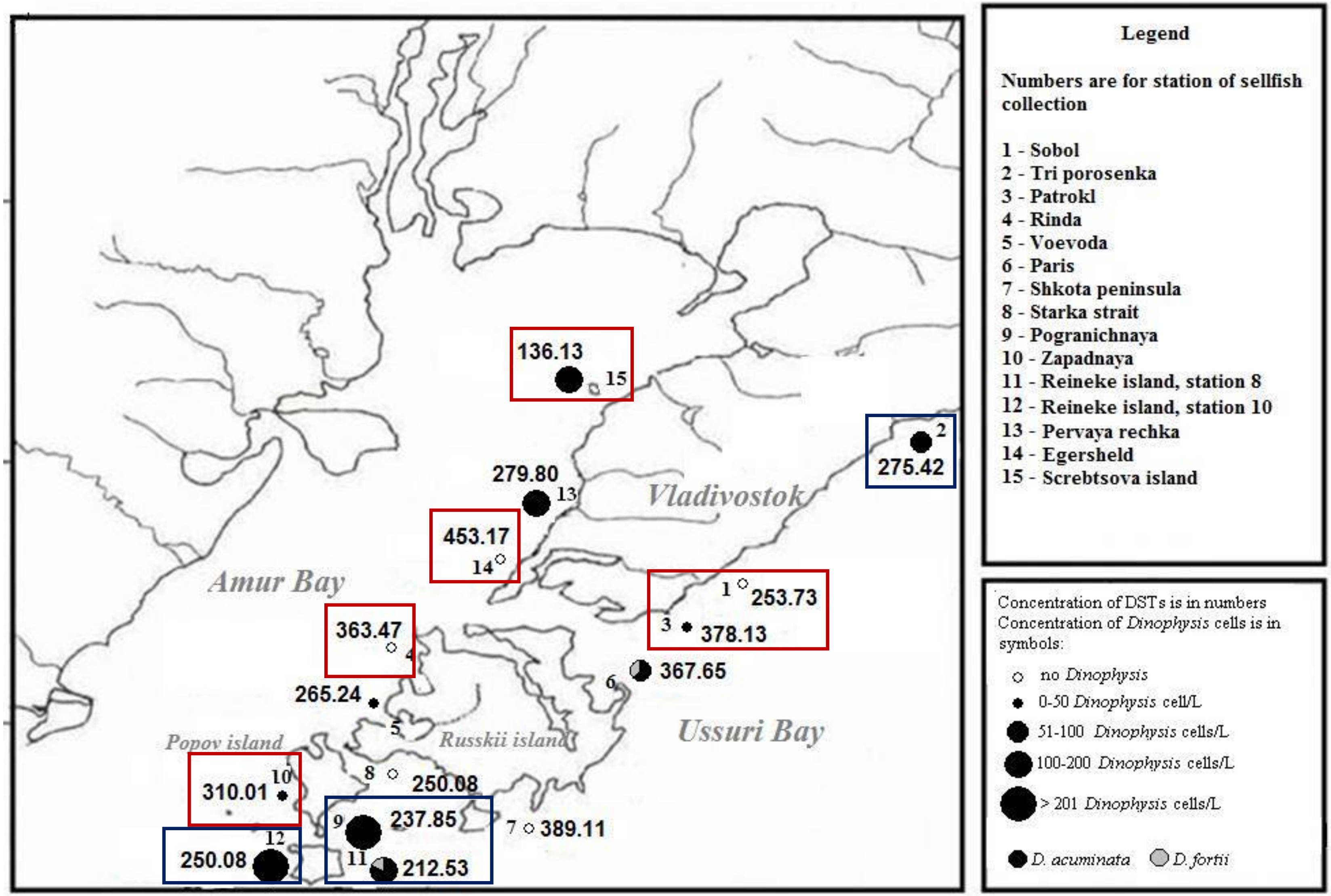
| Strain | Species | Origin of strain | Date of Isolation mm/dd/yyyy | Domoic acid concentration* | | Day in culture |
|---|---|---|---|---|---|---|
| | | | | Concentration per cell volume, **ng/ml** | Cell quota, **pg/cell** | |
| PMS-12 | *P. multistriata* | Peter the Great bay | 10/02/2012 | 22.56±2.35 | 0.171 | 34 |
| PMS-12 | *P. multistriata* | Peter the Great bay | 10/02/2012 | 10.037±1.96 | 0.529 | 41 |
| PMS-12 | *P. multistriata* | Peter the Great bay | 10/02/2012 | 4.49±0.6 | 0.08 | 60 |
| PC-12 | *P. calliantha* | Peter the Great bay | 10/02/2012 | 8.32±1.69 | 0.441 | 36 |
| PC-12 | *P. calliantha* | Peter the Great bay | 10/02/2012 | 3.7±1.39 | 0.246 | 43 |

* **Domoic acid concentrations were determined by Enzyme Linked Immunosorbent Assay (kit "ASP direct cELISA", Biosense Laboratories, Norway)**

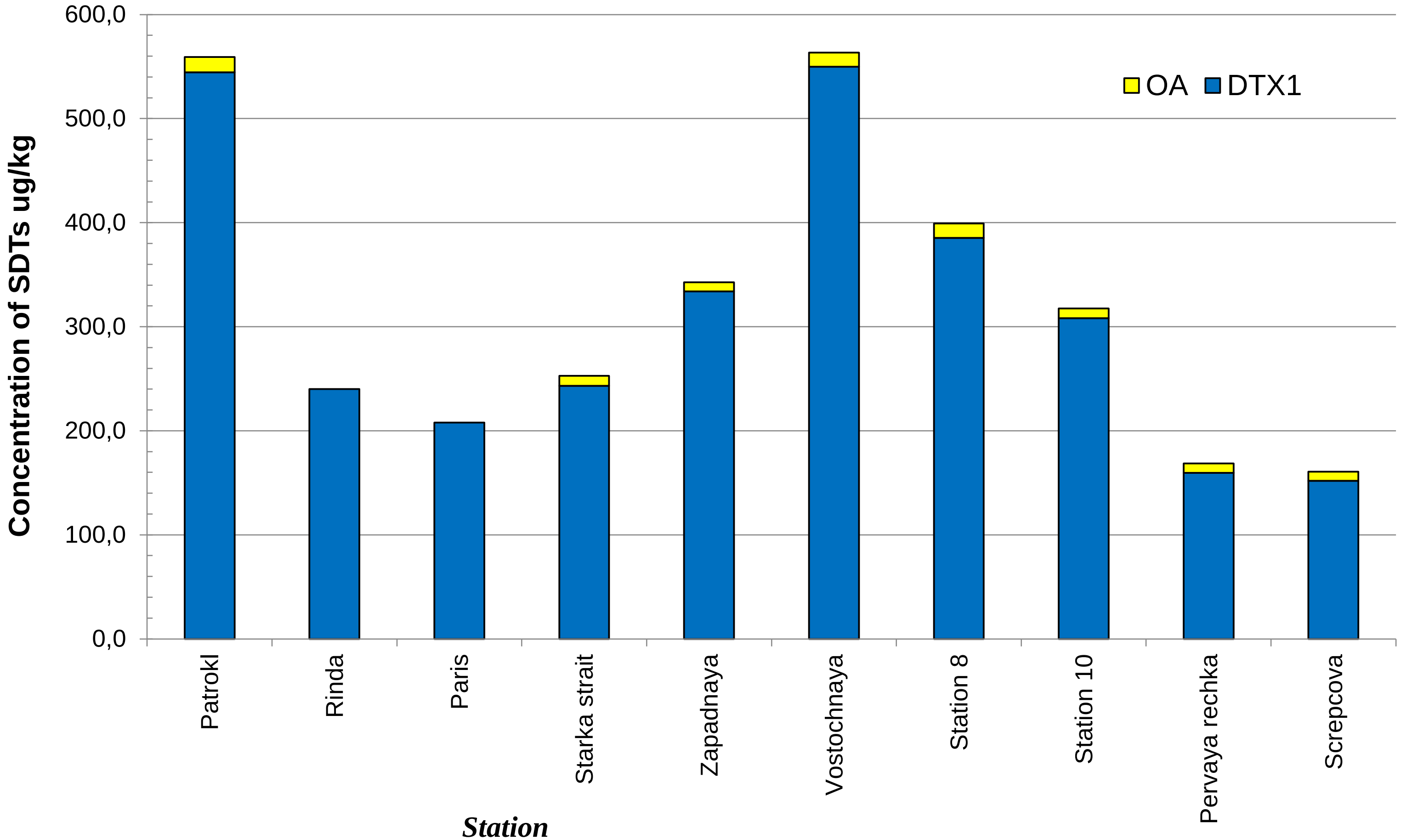
Stonic et al., 2015

# New toxic species

## Problem of DSP (okadaic acid and its analogues)



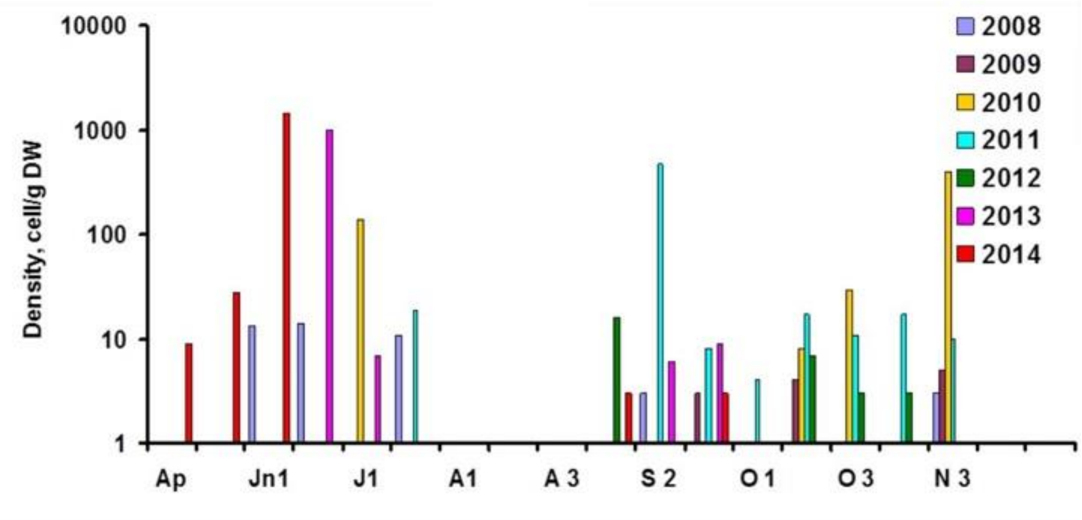
# Qualitative composition of DSTs in mussels

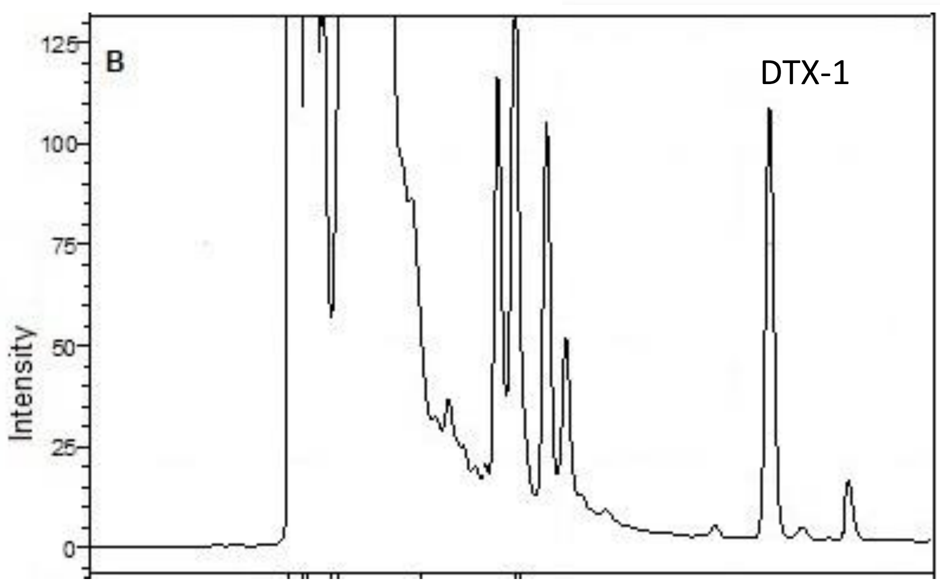



Tatiana Yu. Orlova, Polina A. Kameneva, Inna V. Stonik, Tatiana V. Morozova, Kseniya V. Efimova, Leslie Moore, Bich-Thuy L. Eberhart, Mark L. Wells, and Vera L. Trainer // JSR in press

# New vector of DSP

## *Prorocentrum foraminosum*




In culture of *P.foraminosum* containing 3500-5000 cell/mL

**DTX-1** was determined 8.4 ± 2.4 pg/cell

22.46 ± 17.6 ng/mL of media

# Conclusion

1. Long-term changes in microalgae communities on the Russian East coast are observed
2. There is a decreasing dynamic of diatom component of microalgae communities, which substituted by the non-diatom component
3. New boom forming species were detected for the study area and new toxin producing species were revealed