Potentially toxic epiphytic dinoflagellates in Peter the Great Bay, Russia

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Introduction

- Until recent time epiphytic algae were studied mostly in tropical and subtropical zones, because ciguatera is widespread in this region.

- Ciguatera, or ciguatera fish poisoning, is a human disease caused by the ingestion of contaminated marine finfish from tropical and subtropical regions, which results in gastrointestinal and neurological disorders and sometimes death.

- Polyether toxins (ciguatoxins and maitotoxins) that are produced by species from genera *Gambierdiscus*, *Coolia* and *Ostreopsis* may cause these symptoms.
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 area of the northern and southern hemispheres. Really expansion of *O. ovata* and *O. siamensis* was observed in the Mediterranean.
The small number of previous studies on epiphytic assemblages of macrophytes in the Russia Far Eastern seas reported only on diatoms among the microalgae (Kovalevskaya, 1982; Ryabushko, 1986; Kharlamenko, Lysenko, 1991).

The present work represent a preliminary results of research of species composition, seasonal and long-term dynamics of the density and spatial distribution of epiphytic dinoflagellates associated with macroalgae in Peter the Great Bay, East/ Japan Sea, with special emphasis on the influence of different substrata and the role of hydrodynamism on density and distribution of these organisms.
Study area

- Surface water temperature: $-1.5^\circ C - 24^\circ C$; salinity: 30 – 34 o/oo
Period of studies:
**Dynamic**: September 2008 - November 2009, June 2010 - November 2010; June 2011 - November 2011 once a month or 1-4 times in warmer seasons

**Distribution in Peter the Great Bay**: 15-25 September 2010

**Depth**: 0.5 - 3 m

A total of 493 samples from 31 species of macroalga were analyzed:

- **Rhodophyceae**: 18 species
- **Phaeophyceae**: 10 species
- **Chlorophyceae**: 3 species
Standard procedure to quantify epiphytic dinoflagellates (Ishikawa, Takeichi, 2011)

The abundance was expressed in cells/ g algae dry weight (DW)
Species composition of epiphytic dinoflagellates

- 13 species of epiphytic dinoflagellates were found on the macrophytes.
- Among these species *Ostreopsis cf. ovata, O. cf. siamensis, Prorocentrum lima, A. operculatum, and A. carterae* are known as potentially toxic species.

*Amphidinium carterae* Hulburt is the first records for the Far Eastern seas.
Supposedly, two species *Ostreopsis* differed from each other in cell form, size and the length of the Po plate.

(Selina, M.S. & Orlova, T.Y. First occurrence of the genus *Ostreopsis* in the Sea of Japan.

Botanica Marina 2010. 53(3): 243-249)

1-5 - *Ostreopsis* cf. *siamensis*
6-10 - *Ostreopsis* cf. *ovata*
Seasonal dynamics of the number of the species, density of epiphytic dinoflagellates and water temperature in September 2008- November 2009 on Neorhodomela larix at the monitoring station

The abundance of the epiphytic dinoflagellates varied from 59 to 70,000 cells per gram of DW of macrophytes.

Density of the Ostreopsis spp. reached 69,573 cells/g DW in September 2008 (99% of total dinoflagellates abundance)
Temporal dynamics of epiphytic dinoflagellates in September 2008 - November 2009 at the monitoring station

* The dinoflagellates density followed the same seasonal pattern on the 3 selected macroalgae
Seasonal changes in relative abundance of epiphytic dinoflagellates on *N. larix* in September 2008 - October 2009 at the monitoring station

* - the month in which the macroalgae were not collected
Seasonal dynamic of *Ostreopsis* spp. and water surface temperature during 2008-2011 on *N. larix* at the monitoring station

Maximal abundance, (cells/g DW):

2008  69 x10^3 *Neorhodomela larix*

2010  334 x10^3 *Bryopsis* sp.

2011  27 x10^3 *Sargassum palidum*
### Abundance of *Ostreopsis* in different regions

<table>
<thead>
<tr>
<th>Region</th>
<th>Max density, cell/g FW</th>
<th>Species</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>French Polynesia</td>
<td>4.0 x 10^3</td>
<td><em>O. lenticularis</em></td>
<td>Bagnis et al., 1985</td>
</tr>
<tr>
<td>Caribbean Sea</td>
<td>21 x 10^3</td>
<td><em>O. lenticularis</em></td>
<td>Carlson, Tindall, 1985</td>
</tr>
<tr>
<td>Singapore feofs</td>
<td>3.0 x 10^1</td>
<td><em>O. ovata</em></td>
<td>Holmes et al., 1998</td>
</tr>
<tr>
<td>Hawaii</td>
<td>18 x 10^3</td>
<td><em>Ostreopsis sp.</em></td>
<td>Parsons, Preskitt, 2007</td>
</tr>
<tr>
<td>Jeju Island</td>
<td>8.6 x 10^3</td>
<td><em>Ostreopsis spp.</em></td>
<td>Kim et al., 2011</td>
</tr>
<tr>
<td>NW Mediterranean</td>
<td>590 x 10^3</td>
<td><em>Ostreopsis sp.</em></td>
<td>Vila et al., 2001</td>
</tr>
<tr>
<td>Coastal waters of Genoa</td>
<td>2.5 x 10^6</td>
<td><em>O. ovata</em></td>
<td>Mangialajo et al., 2008</td>
</tr>
<tr>
<td>Northern Adriatic Sea</td>
<td>1.7 x 10^6</td>
<td><em>O. ovata</em></td>
<td>Totti et al., 2010</td>
</tr>
<tr>
<td>Northern Mediterranean</td>
<td>7.2 x 10^6</td>
<td><em>Ostreopsis spp.</em></td>
<td>Mangialajo et al., 2011</td>
</tr>
<tr>
<td>NW Sea of Japan</td>
<td>25 x 10^3</td>
<td><em>Ostreopsis spp.</em></td>
<td>This study</td>
</tr>
<tr>
<td>Rhodophyceae</td>
<td>Phaeophyceae</td>
<td>Chlorophyceae</td>
<td></td>
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<tr>
<td>12671±7513 ns</td>
<td>9261±3433 ns</td>
<td>8349±3237</td>
<td></td>
</tr>
</tbody>
</table>

Maximum 310 000 34 000 330 000

(mean abundance ±standard error; ns- not significant)

Densities of *Ostreopsis* spp. were not significantly different on macrophytes with branched thallus of all taxonomic divisions
On average, the abundance of *Ostreopsis* cells on branched thalli were statistically significant higher than those on non-branched ones.
Spatial distribution of the epiphytic dinoflagellates in the Peter the Great Bay in September 2010 and relation with hydrodynamic conditions
Spatial distribution of the epiphytic dinoflagellates in the Peter the Great Bay in September 2010

Average of density of *Ostreopsis* spp.: in slightly shaken sites –334 391± 13 475 cells/g DW; in shaken sites - 2 400 ± 90 cells/g DW. 

Maximal abundance, cells/g DW: *Ostreopsis* spp. – 310 000

p<0,01
Conclusions

- It is clear now that species of *Ostreopsis* are permanent and predominant component of epiphytic assemblages in slightly shaken sites in Peter the Great Bay.

- *Ostreopsis* is the only genus of potentially toxic dinoflagellates, which is regularly reported to bloom in waters of Peter the Great Bay. And its finding is the first record of this genus in regions with water temperatures below zero in winter.

- Due to the constant presence and high abundance of new potentially toxic dinoflagellates in summer–autumn period, monitoring of epiphytic assemblage is a necessity in Peter the Great Bay.
Thank you!