SPATIAL AND TEMPORAL DISTRIBUTION OF DIATOMS IN SHELLFISH FARMS IN BOKA KOTORSKA BAY (SOUTH-EASTERN ADRIATIC SEA)

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Abstract

The spatial and temporal distribution of planktonic diatoms was analyzed in Boka Kotorska Bay. Results of water samplings conducted from November 2014 to April 2015 at three positions are presented. Maximum abundance of diatoms was 2.78 x 10^5 cells L^{-1}. Potentially toxic diatom genus, *Pseudo-nitzschia* spp. was one of the most frequent. Species indicators of nutrients enriched waters were dominant.

Keywords: Aquaculture, Diatoms, South Adriatic Sea

Introduction

Boka Kotorska Bay is an area located in the southeastern Adriatic Sea. There are 18 marine aquaculture farms located in the Boka Kotorska Bay area [1]. Shells, especially mussels are efficient filter feeders which feed on phytoplankton, among other groups, and because of such method of feeding, can accumulate toxins from toxic phytoplankton. Some species from genus Pseudo-nitzschia can produce the neurotoxin domoic acid that belongs to Amnesic Shellfish Poisoning (ASP). Growing of these species can cause problems in the ecosystem functioning and public health. The aim of this paper was to assess spatial and temporal distribution of diatoms on shellfish farms in the Boka Kotorska Bay.

Materials and methods

Sampling was performed from November 2014 to April 2015, on montly basis, at 2 positions in the inner part (Kotor Bay) of Boka Kotorska Bay and at one reference position in the open sea – Žanjic (Fig.1). Samples were taken using 5l Niskin bottles at four depths (0m, 2m, 4m and bottom). Phytoplankton cells were enumerated using Leica inverted microscope following Utermöhl [2].

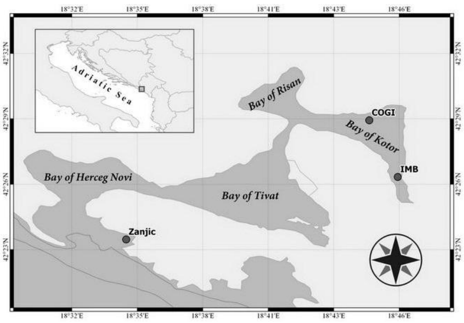

Fig. 1. Investigated area.

Results

Abundance of diatoms reached values on the order of 10^5 cells L^{-1} and highest abundance was in November on 2 m depth (2.78 x 10^5 cells L^{-1}) at the IMB position. Most of these dominant and frequent diatom species (*Chaetoceros affinis*, *Leptocylindrus mediterraneus*, *Proboscia alata*, *Pseudo-nitzschia* spp., *Thalassionema nitzschioides)* preferred nutrients enriched conditions [3]. In the current study, the frequently (with frequency of 89.85%) registered diatom genus, *Pseudo-nitzschia* spp., is considered potentially toxic (highest abundance was 1.85 x 10^5 cells L^{-1}).This potentially toxic diatom presented most of the microplankton. Diatoms belonging to the genus *Pseudo-nitzschia* are generally considered to be dominant in the phytoplankton of the Adriatic Sea [4]. The total list of planktonic diatoms found during investigated period in the Boka Kotorska Bay comprises 40 entries (Tab. 1).

Tab. 1. List of diatoms species found in the Boka Kotorska Bay during investigated period (max-maximum abundance; Fr(%)- frequency of appearance)

Taxon	Max (cells L^{-1})	Month	Position	Fr (%)
Diatoms				
Achnanthes brevipes	1200	Nov, Dec, Jan, Feb, Mar, Apr	IMB,COGI, Zanjic	20.29
Amphora ostrearia	120	Nov, Apr	IMB, COGI, Žanjic	8.69
Amphiprora sulcata	40	Feb, Mar	IMB, Zanjic	4.35
Asterionellopsis glacialis	200	Feb	COGI	1.45
Bacteriastrum hyalinum	69080	Nov, Feb	IMB,COGI	10.14
Bacteriastrum delicatulum	29045	Nov	IMB, COGI	2.90
Cerataulina pelagica	80	Dec	Žanjic	1.45
Chaetoceros affinis	39250	Nov, Dec, Feb, Mar	IMB, COGI	11.59
Chaetoceros spp.	4710	Feb, Apr	IMB, COGI, Zanjic	2.90
Cocconeis scutellum	160	Nov, Dec, Jan, Feb, Mar, Apr	IMB, COGI, Žanjic	26.09
Coscinodiscus perforatus	3140	Dec, Jan, Mar	IMB,COGI, Zanjic	15.94
Cylindrotheca closterium	40	Feb	Žanjic	1.45
Diploneis bombus	240	Nov, Dec, Jan, Feb, Mar, Apr	IMB, COGI, Zanjic	24.64
Grammatophora oceanica	680	Feb, Apr	IMB, Žanjic,	5.80
Hemiaulus hauckii	80	Dec, Feb, Mar	Zanjic	5.80
Hemiaulus sinensis	120	Feb, Mar	COGI, Žanjic	2.90
Leptocylindrus mediterraneus	1280	Nov, Dec, Feb, Mar	COGI, Zanjic	13.04
Licmophora paradoxa	240	Nov, Feb, Mar, Apr	IMB, COGI, Žanjic	14.49
Licmophora flabellata	240	Jan, Feb, Mar, Apr	COGI, Zanjic	15.94
Lioloma pacificum	320	Nov, Dec, Jan	IMB, COGI, Žanjic	13.04
Lithodesmium undulatum	1280	Jan, Feb, Mar, Apr	IMB, COGI, Zanjic	13.04
Melosira nummuloides	1920	Nov, Dec, Jan, Feb, Mar	IMB, COGI, Žanjic	24.64
Navicula spp.	1400	Nov, Dec, Jan, Feb, Mar, Apr	IMB, COGI, Zanjic	91.30
Nitzschia incerta	520	Dec, Feb, Mar, Apr	IMB, COGI, Žanjic	11.59
Nitzschia longissima	200	Nov, Dec, Mar	IMB, COGI, Zanjic	10.14
Neocalyptrella robusta	80	Mar	COGI	1.45
Odontella mobiliensis	40	Jan	COGI	1.45
Paralia sulcata	160	Nov	COGI	1.45
Pleurosigma angulatum	120	Nov, Dec, Jan, Feb, Mar	IMB, COGI, Zanjic	24.64
Pleurosigma elongatum	960	Nov, Dec, Jan., Feb, Mar	IMB, COGI, Žanjic	8.69
Pleurosigma formosum	920	Nov, Dec, Jan, Feb, Mar, Apr	IMB, COGI, Zanjic	15.94
Proboscia alata	800	Nov, Dec, Mar	IMB,COGI Žanjic	11.59
Pseudosolenia calcar avis	80	Nov, Dec, Feb, Mar, Apr	IMB, COGI Zanjic	14.49
Pseudo-nitzschia spp.	185260	Nov, Dec, Jan, Feb, Mar, Apr	IMB, COGI, Žanjic	89.85
Rhizosolenia imbricata	120	Nov	Zanjic	2.90
Rhizosolenia setigera	80	Nov, Feb	IMB, COGI	2.90
Synedra crystallina	80	Feb, Mar, Apr	COGI, Zanjic	5.80
Thalassiosira eccentrica	19625	Jan, Feb, Mar, Apr	IMB, COGI, Žanjic	15.94
Thalassionema fraunfeldii	240	Mar, Apr	IMB, COGI, Zanjic	7.25
Thalassionema nitzschioides	76930	Nov, Dec, Jan, Feb, Mar, Apr	IMB, COGI, Žanjic	100

Conclusion *Pseudo-nitzschia* spp. is only diatom genus known to produce a potent toxin which bioaccumulates in shellfish, impacting mussel aquaculture and contaminating farmed species with amnesic shellfish poisoning (ASP) toxin and which in the case of species that are highly toxic my result in significant consequences to the human health. However, several species of this genus are nontoxic or produce extremely low concentrations of toxin per cell [5]. Records of higher values of potentially toxic diatom genus *Pseudo-nitzschia* spp. indicates the necessity of continuous monitoring of this area, especially due to the fact that all Montenegrin mussel production is concentrated in the investigated area.

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References

1 - MONSTAT 2014. Statistical Office of Montenegro. *Year Book*. Podgorica.
2 - Utermöhl C.,1958. Zur Vervollkommnung der quantitativen Phytoplankton Methodik. *Mitt. Int. Ver. theor. angew. Limnol.*9*:1-38.*
3 - Revelante N. and Gilmartin M., 1985: Possible phytoplankton species as indicators of eutrophication in the northern Adriatic Sea. *Rapp.Comm. int. Mer Médit*.(CIESM), 11-19 October, Lucern, Switzerland, 29:89–91
4 - Vilicic D., Đakovac T., Buric Z. and Bosak S., 2009. Composition and annual cycle of phytoplankton assemblages in the northeastern Adriatic Sea. Botanica Marina 52, 291–305.
5 - Rhodes L., Scholin C. and Garthwaite I., 1998. Pseudonitzschia in New Zealand and the role of DNA probes and 402 L. L. Rhodes et al. immunoassays in refining marine biotoxin monitoring programmes. Natural Toxins, 6: 105–111.