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Current state of benthic diatoms exploration in the Black Sea: diversity, taxonomic structure and response to pollution

Nevrova[1] Elena, Petrov[1] Alexey, Witkowski[2] Andrzej, Kulikovskiy[3] Maxim, Lange-Bertalot[2] Horst

[1]Institute of Biology of Southern Seas NASU, 2 Nakhimov av, Sevastopol 99011, Ukraine; el_nevrova@mail.ru, alexpet-14@mail.ru,
[2]Palaeoceanology Unit, University of Szczecin, Mickiewicza 18, PL-70-383 Szczecin, Poland; a.witkowsk@gmail.com,
[3]Institute of Biology of Inland Waters RAS, 152742 Yaroslavl, Nekouz, Borok, Russia, max-kulikovsky@yandex.ru

Benthic diatoms is one of the most important taxonomic group in microphytobenthos of the Black Sea (BS) sublittoral communities regarding abundance, species richness and their role in trophic relationships of coastal ecosystem. BS benthic diatoms have been studied for over a century; however, the published information on that issue is still scarce. Earlier studies were mostly performed for the Western and Northwestern part of the BS basin, whereas the shores of Crimea and Caucasus were less investigated and information on the diatoms from the Southern part is almost lacking. Most of the publications are devoted to floristic analysis, species composition and seasonal dynamics [5, for review], and rather few studies dedicated to diatom assemblages structure and to assessment of diversity features in relation to influence of environmental factors including pollution [2, for review].

Principal changes into recent diatom taxonomy and accretion of disembodied data has stipulated for the necessity of the BS diatoms inventory. Even recent studies [1] also did not encompass all available information. The taxonomic database of Black Sea Bacillariophyta, based on the review of available literature (e.g. 30 ref.) consideration of 5 regions (Caucasian, Crimean, Bulgarian, Romanian coasts and North-Western shelf) and results of own sampling surveys (1984-2010), was created using Microsoft Office Access. Updated inventory of Black Sea benthic Bacillariophyta holds 728 species (877 sp. and ssp.), pooled in 130 genera, 59 families, 32 orders and 3 classes, according to the recent taxonomical systems [4, 7].

The latest check-list of Crimean coast includes 586 species (668 species and intraspecific taxa), belonging to 114 genera, 52 families, 27 orders. Thus, the highest species richness of diatoms, ever registered in the Black Sea, was recorded near Crimea (76% of the total number). For the NW shelf 55 % (485 sp. but without species-dwellers only in brackish-water lagoons) were marked. Regarding other regions, the species richness and this relative index were lower: for Bulgarian coast were marked 270 species and varieties (31 %); for Romanian shore – 360 (41 %); for Caucasian area – 279 (32 %).

The most representative families of Black Sea benthic diatoms are Bacillariaceae (5 genera / 108 sp. and ssp.), Naviculaceae (10 / 106), Catenulaceae (3 / 82), Cocconeidaceae (2 / 47). The highest richness at genera level has scored by the family Fragilariaceae (16 / 48).

Recent studies of the Crimean coast and collections of A.I. Proshkina-Lavrenko by light and electron microscopic observations revealed the occurrence of new genera for Black Sea flora: *Astartiella*, *Amicula*, *Cocconeiopsis*, *Chamaepinnularia*, *Hippodonta*, *Rhoicosigma*, *Trachysphenia*. Their representatives are: *Astartiella bahusiensis*, *A. producta*, *Amicula speculum*, *Cocconeiopsis breviata*, *C. fraudulenta*, *C. pullus*, *Chamaepinnularia alexandrowiczii*, *Ch. clamans*, *Ch. margaritiana*, *Ch. truncata*, *Rhoicosigma compactum*, *Trachysphenia australis* and 4 species of *Hippodonta*.

Besides, more than 50 newly-found for the Black Sea diatom flora species were found.

Comparative analysis of benthic diatom taxocenes from several bays of Crimea, differing by level of anthropogenic pollution load, has been fulfilled [2, for review].

The influence of sediment-associated inorganic (heavy metals) and organic pollutants (PAHs, PCBs and pesticides) on diatom assemblages' structure had been comparatively studied by methods of multivariate statistical analysis. The environmental gradients through the investigated bottom areas with different pollution extent were assessed by PCA analysis. Cluster analysis and MDS ordination of environmental factors were employed to distinguish the stations grouping in relation to key pollutants levels. The most significant species (i.e. discriminating species) that are mainly responsible for differences between the assemblages, corresponding to each of the locations, were carried out. There are *Nitzschia compressa*, *N. sigma*, *Bacillaria paxillifer*, *Grammatophora marina*, *Synedra tabulata*, *S. gaillonii*, *Thalassionema nitzschioides*, *Diploneis smithii*, *Caloneis liber*, *Melosira moniliformis*, *Lyrella abrupta*, *Cocconeis scutellum*, *Amphora proteus* [2, 3].

Evaluation of Spearman rank correlation have shown that the highest value of ρmax corresponded to the combination of key abiotic variables: depth, % of sand fraction, PCBs, TOC, Eh, pesticides and heavy metals (Hg, Cd, Mn, Zn). This set of factors is best correlated with the alteration in biotic parameters and presumably is the cause of changes in the structure of diatom assemblages at a different extent of pollutants.

Taxonomic Distinctness Indices (TaxDI) were also applied [6] for comparative estimation of diversity features in diatom assemblages from different regions of the Black Sea. By means of TaxDI calculations and comparative taxonomical analysis, phylogenetically separated mono- and oligo-taxonomic branches on hierarchical tree of diatoms and the species attributed to such branches in each region were identified. Every of these species has been considered and graded in context of their taxonomic exclusiveness, since if such taxa disappear, the entire phylogenetic branch, including genus, family and order, would also be eliminated from the diatom flora. Therefore, presence or disappearance of such species in the certain location can lead to pronounced changes in the total phylogenetic structure of whole diatom assemblages. Results of comparative quantitative and taxonomical evaluation of diatoms diversity should be employed for protection of nearshore environment and conservation of marine flora diversity at the modern transformation of the Black Sea shores.

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