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Blue Biotechnology in Poland

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Institute of Oceanology,

Polish Academy of Sciences, Sopot, Poland



**University of Gdańsk
POLAND**

**Faculty of Biology
Department of Molecular Biology**

Partners:



**Faculty of Oceanography
and Geography**

**Institute of Oceanography
Laboratory of Biochemical Ecology
of Microorganisms**



Exploring Marine Resources for Bioactive Compounds: From Discovery to Sustainable production and Industrial Applications

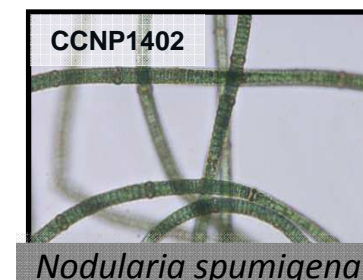
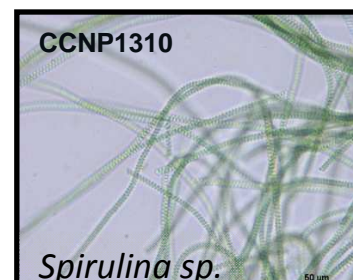
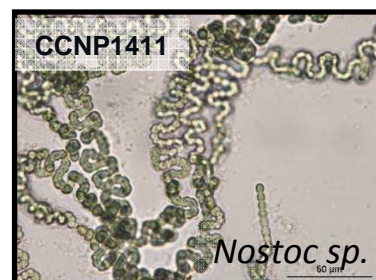
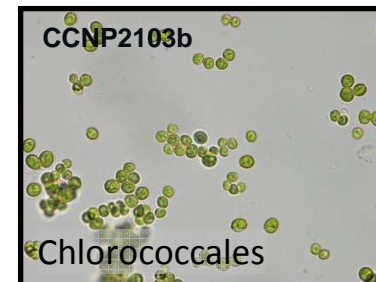
1. University of Helsinki (Coordinator), **Finland**
2. University of Ljubljana, **Slovenia**
3. University of La Laguna, Tenerife, Canary Islands, **Spain**
4. University of Gdansk, **Poland**
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6. Åbo Akademi University, **Finland**
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8. Universidad de Antofagasta, **Chile**
9. Université de Strasbourg, **France**
10. Ege University, **Turkey**
11. Università Degli Studi di Napoli 'Federico II', **Italy**
12. Universidad Catolica del Norte, **Chile**
13. Technical Research Centre of Finland, **Finland**
14. National Institute of Oceanography, **India**
15. IMEGO AB, **Sweden**
16. Xention, **UK**
17. Biovico, **Poland**
18. Ebiotec S.A., **Spain**
19. BiotechMarine, **France**

Collection of material from the Baltic Sea



Isolation, cultivation and production of biomass

- ❖ cyanobacteria
- ❖ green-algae
- ❖ diatoms
- ❖ dinoflagellata

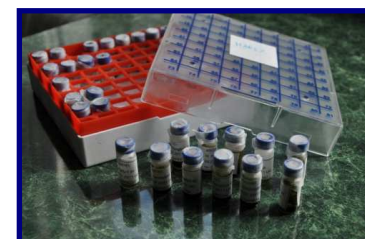




Screening for biological activity:

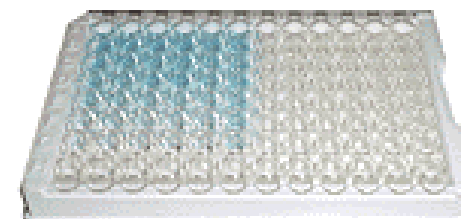
❖ proteases activity assay

- spumigins
- aeruginosins
- anabaenopeptins



❖ phosphatases activity assay

- microcystins
- nodularins



❖ antimicrobial activity

- *Anabaena* metabolites



❖ plant growth regulating activity

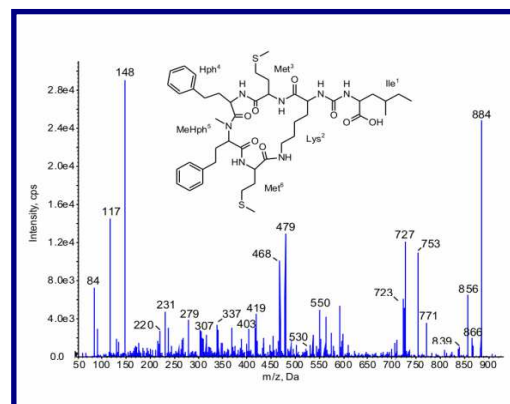
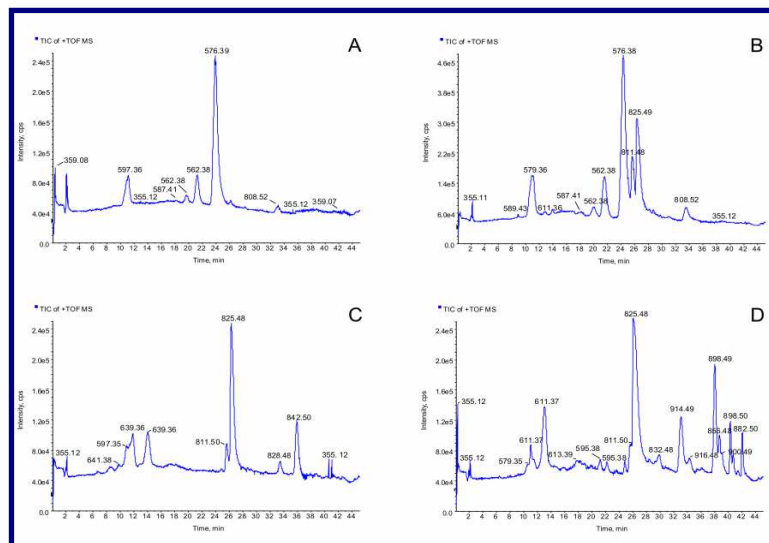
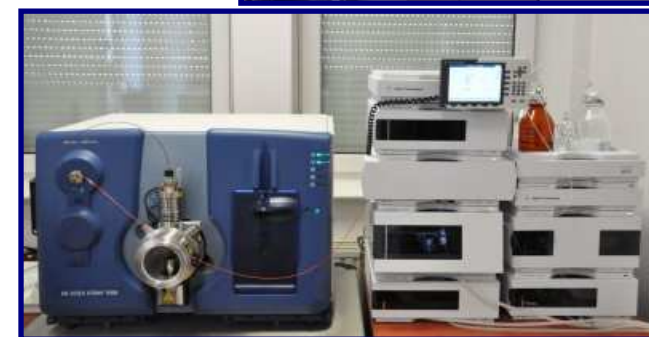
- extracts from *Coscinodiscus*,
Pseudanabaena and others



❖ toxicity tests on aquatic organisms

Biological active compounds produced by microorganisms:

- ❖ extraction
- ❖ activity guided fractionation
- ❖ isolation
- ❖ identification
- ❖ chemotaxonomy of microorganisms



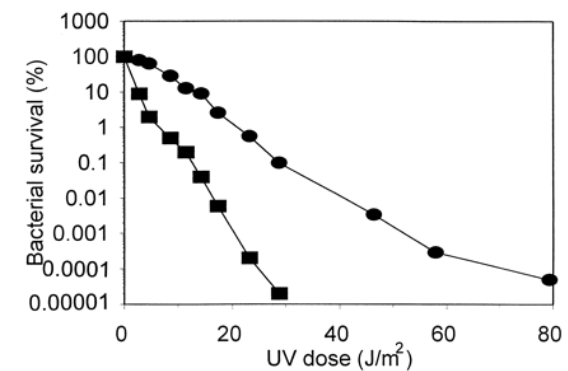
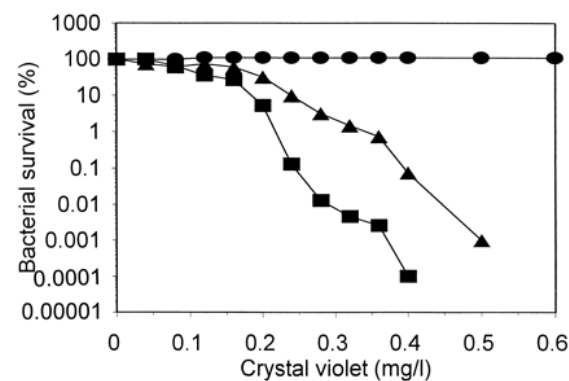
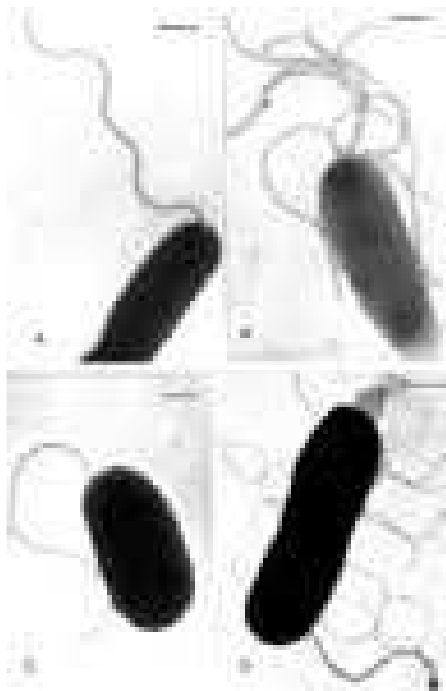


Department of Molecular Biology

The use of marine bacterium *Vibrio harveyi* in novel mutagenicity tests

Vibrio harveyi:

- Marine bioluminescent bacterium
- Tolerant to various environmental conditions (e.g. temperature, salinity)
- Non-pathogenic to humans
- Cellular envelope naturally permeable to
 - various organic compounds

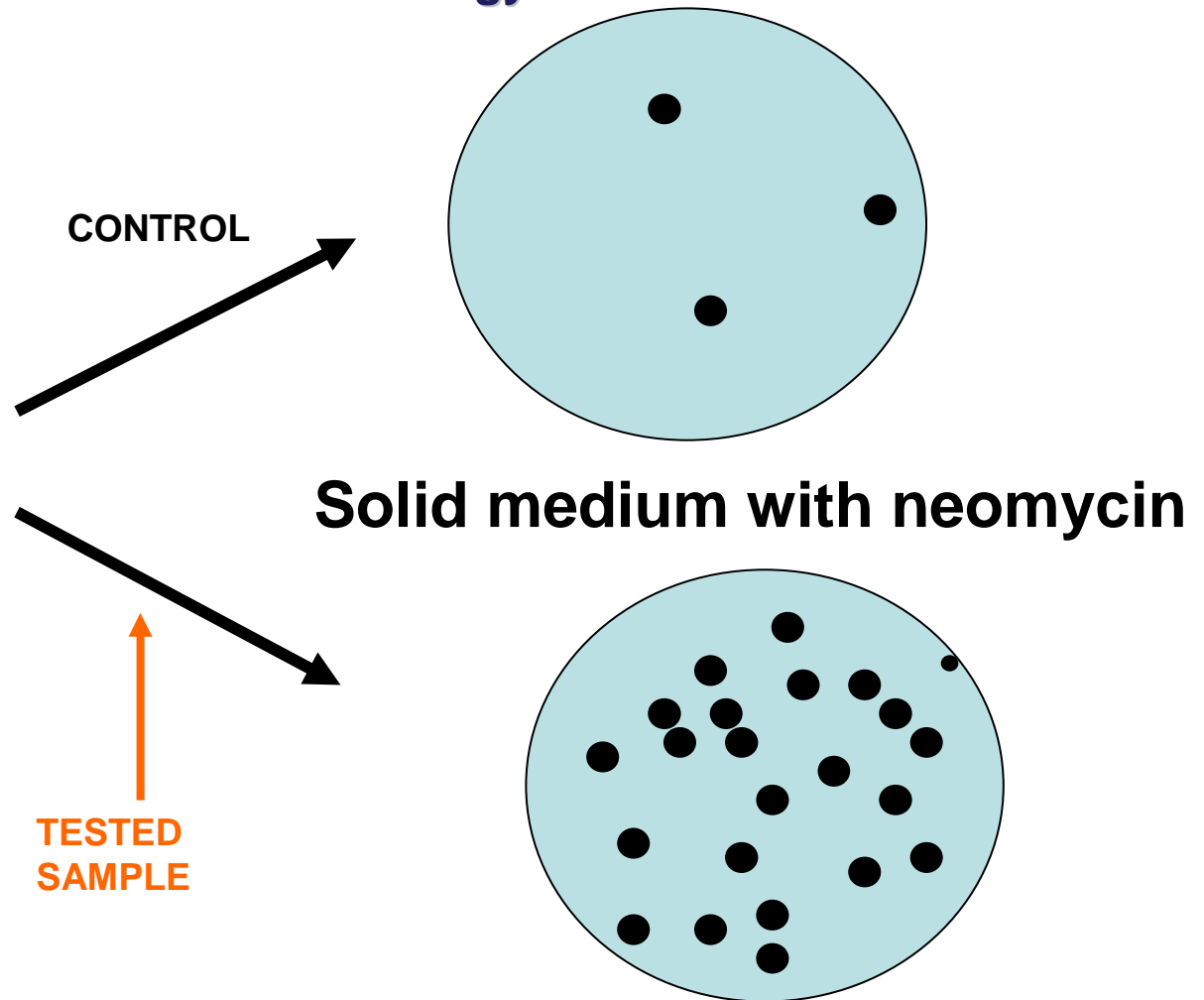




Department of Molecular Biology

Scheme of test 1

Culture of
genetically
modified
(of increased
sensitivity to
mutagens)
Virbrio harveyi





Department of Molecular Biology

Scheme of test 2

Culture of a dim mutant (*luxE*) of *V. harveyi*



Tested
compound
or sample

Luminescence
enhanced due to
mutagen-induced
reverse mutation



Detection of light in luminometer





Department of Molecular Biology

Advantages of the novel bioluminescence *Vibrio harveyi* mutagenicity test

- Rapid (3-4 h)
- Sensitive (more sensitive than the Ames test)
- Easy to perform
- Safe (*V. harveyi* is not pathogenic to humans)

Department of Molecular Biology

University of Gdansk

<http://www.biology.ug.gda.pl/kbm>



Potentially Toxic Cyanobacteria In Polish Water

Department of Biotechnology, Faculty of Biotechnology University of Gdańsk and
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Regular paper

Detection and identification of potentially toxic cyanobacteria in Polish water bodies

Joanna Głowacka, Magdalena Szefel-Markowska, Małgorzata Waleron, Ewa Łojkowska
and Krzysztof Waleron[✉]

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The main goal of this study was to determine the distribution of potentially toxic cyanobacteria in 39 selected Polish water bodies. From the water bodies with blooms and also from those in which blooms were not visible 87 samples were investigated. For the first time samples from ponds localized in villages with high agricultural activities were included. Lakes for which microcystin concentrations had been determined before were included as a reference for the research. The detection of cyanobacteria was conducted by microscopic observation as well as by PCR amplification of the *rpoC1* gene fragment. Cyanobacteria were present in 75 out of 87 samples. The presence of potentially toxic cyanobacteria was detected by amplification of the *mcyB* and *mcyE* genes, which are involved in the biosynthesis of microcystins. Both genes were detected in 7 out of 9 blooms investigated. In the case of samples collected from water

lecular methods. Molecular techniques have facilitated culture-independent studies and identification of microorganisms collected from environment and difficult to culture. In addition, molecular methods do not require axenic cultures. The importance of the polyphasic approach, combining morphological observations with molecular data in improving the taxonomy of cyanobacteria is unquestionable.

The *rpoC1* gene, coding for the γ subunit of RNA polymerases, is recommended as a molecular marker for the detection and identification of cyanobacteria (Jameson *et al.*, 2008; Yoshida *et al.*, 2008; Valerio *et al.*, 2009). The DNA-dependent RNA polymerase of cyanobacteria contains a unique core subunit γ , which is not present in the RNA polymerases of other eubacteria (Bergsland & Haselkorn, 1991). This subunit is a common and unique



The *Arthrospira* genus - edible cyanobacteria with biotechnological potential

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Genome Sequence of the Edible Cyanobacterium *Arthrospira* sp. PCC 8005[∇]

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M. Waleron,⁴ A. Wilmotte,⁵ P. Quillardet,⁶ N. Tandeau de Marsac,⁶ E. Talla,⁷
C.-C. Zhang,⁷ and N. Leys¹

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Received 2 February 2010/Accepted 24 February 2010

We determined the genome sequence of *Arthrospira* sp. PCC 8005, a cyanobacterial strain of great interest to the European Space Agency for its nutritive value and oxygenic properties in the Micro-Ecological Life Support System Alternative (MELiSSA) biological life support system for long-term manned missions into space.

Arthrospira is a genus of nonheterocystous filamentous cyanobacteria that typically reside in alkaline lakes (9). Although they clearly form a separate taxonomic unit (4), various *Ar-*

and *Lyngbya* PCC8106, with 3,083 BDBHs. The MaGe annotation system assigned 63% of the CDSs to one or more functional COGs (clusters of orthologous groups) and reported



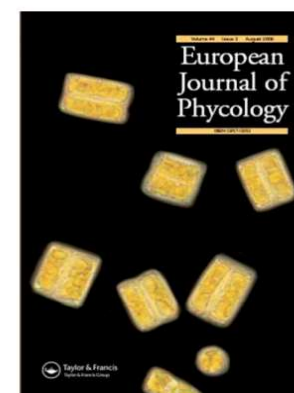
Elucidation of the gas-vesicle gene clusters in cyanobacteria of the genus *Arthrospira* (Oscillatoriales, Cyanophyta) and correlation with ITS phylogeny

Magdalena Miklaszewska¹, Małgorzata Waleron¹, Nicolas Morin³,
Magdalena Całusinska³, Annick Wilmotte³, Nicole Tandeau De Marsac⁴,
Rosmarie Rippka⁴ And Krzysztof Waleron^{1,3}

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Institute of Oceanology Polish Academy of Sciences

Strategic Directions of IO PAN Research:

- Role of the oceans in climate change and its effects for the European Seas
- Natural and antropogenic variability of the Baltic Sea environment
- Contemporary changes of the coastal ecosystems in the shelf seas
- Genetic and physiological mechanisms of functioning marine organisms; principles of marine biotechnology



IOPAS, Sopot, Poland

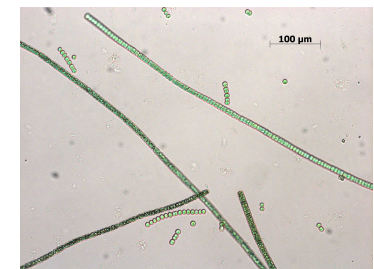
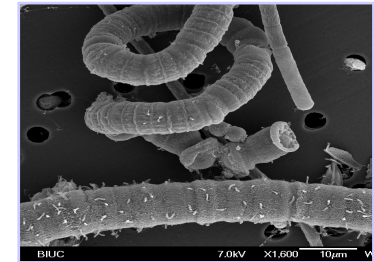


Research Vessel s/y OCEANIA



Marine Biochemistry Laboratory

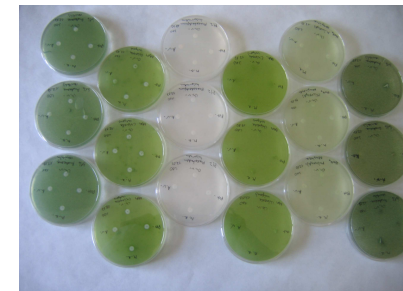
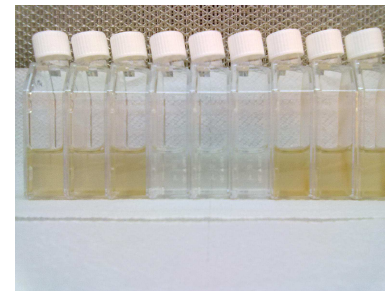
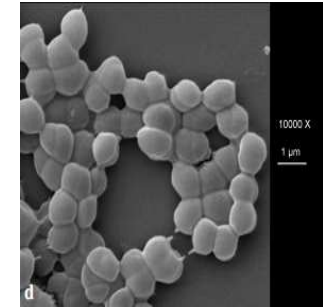
- factors influencing transport of metal ions through cell membranes, and distribution within cells (at present iron)
- development and maintenance of an algal culture collection including axenic cultures isolated from the Baltic Sea
- short and long-term trends in phytoplankton of the Baltic Sea





Marine Biochemistry Laboratory

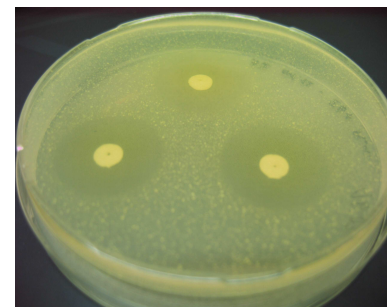
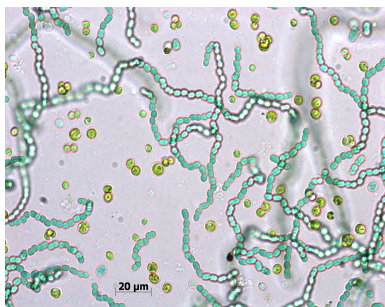
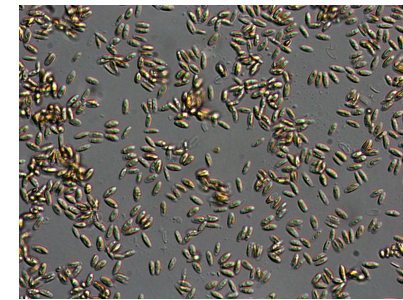
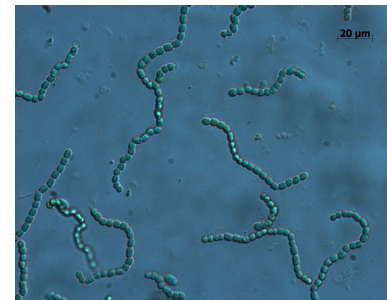
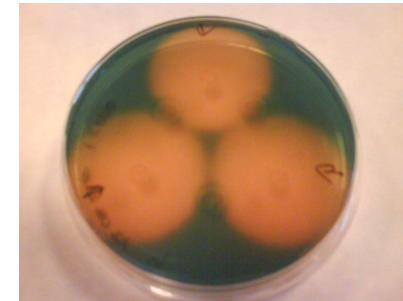
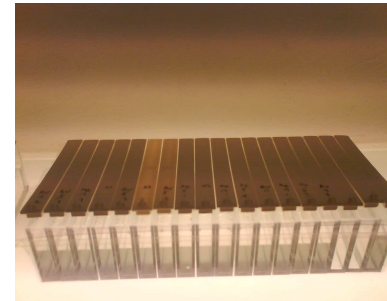
- pigments of phytoplankton as ecophysiology and chemotaxonomy indicators
- isolation and characterization of proteins
- isolation and characterization of siderophore-like substances, natural iron chelators

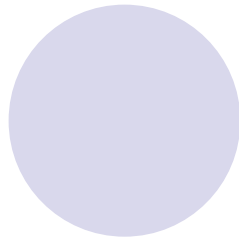




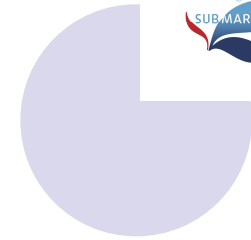
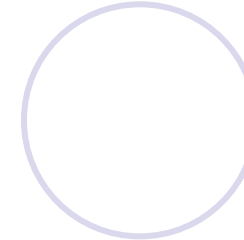
Marine Biochemistry Laboratory

- allelopathic interactions between phytoplankton species
- cyanobacterial and microalgal secondary metabolites with biological activity





Blue Biotechnology in Poland



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prof. Alicja Kosakowska, head of the department and laboratory

Thank you for your attention