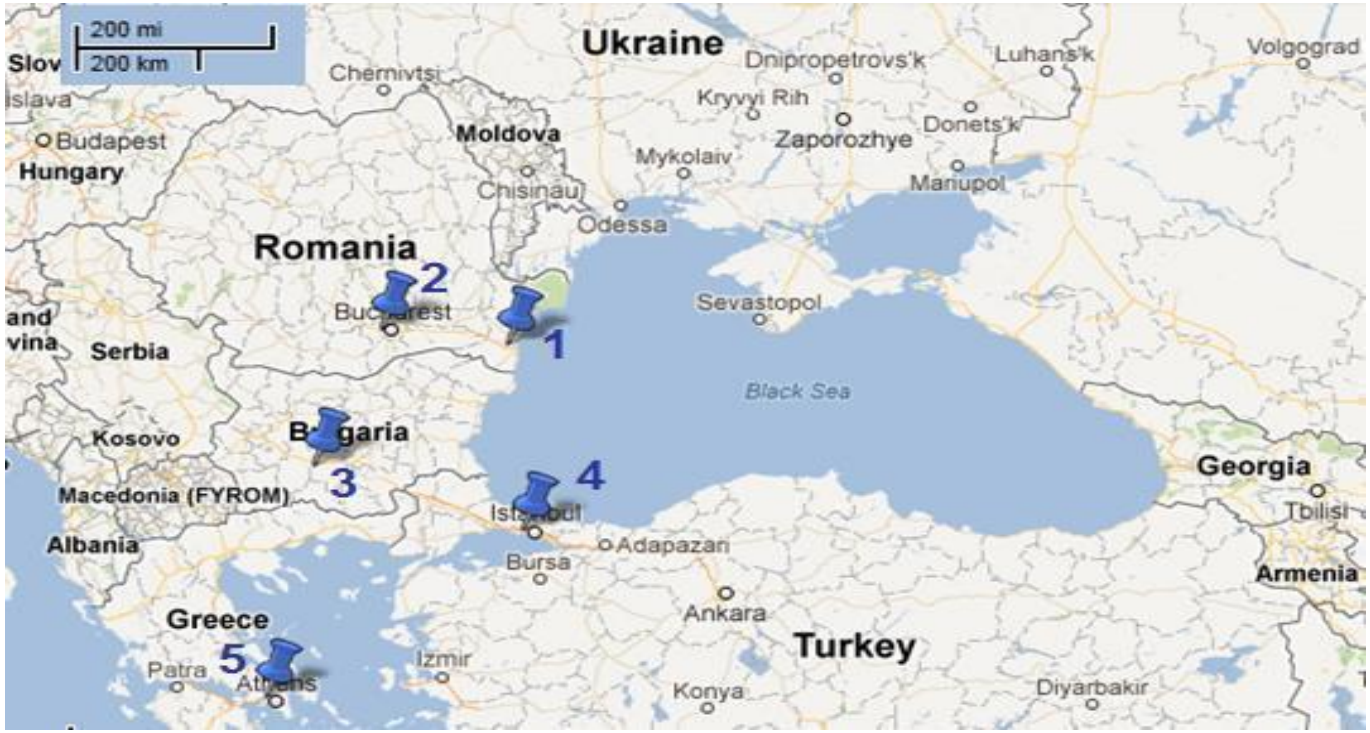
Molecular **A**pproaches for **R**apid and **Q**uantitative Detections of **Cy**anobacteria and their Toxins from Coastal Black Sea - **MARCY**

Project BS-ERA.NET 019

http://www.marcy-bs-era-net.ro/

PROJECT COORDINATOR & PARTNERS

MARCY is a consortium of 5 partners from the extended Black Sea region, financially supported by the *7th EU-Framework Programme* and the BLACK SEA ERA.NET project.



PROJECT COORDINATOR

National Institute for Marine Research and Development "Grigore Antipa" Constanta, ROMANIA (NIMRD), *www.rmri.ro*

- subunit of the National Institute for Research - Development in Environmental Protection Bucharest

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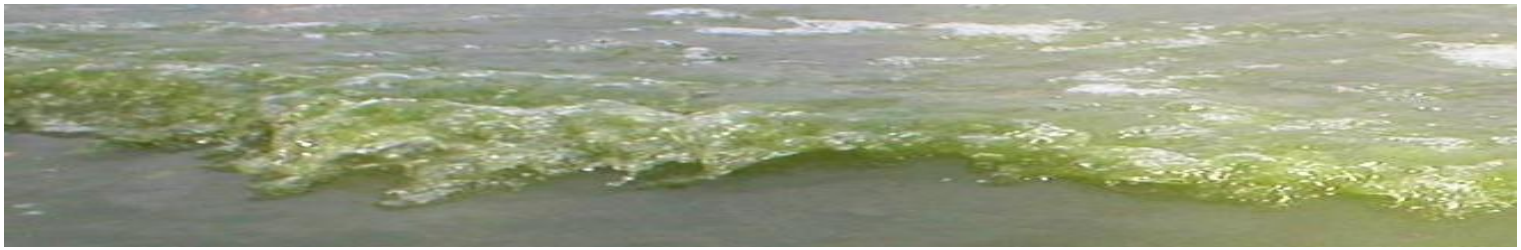
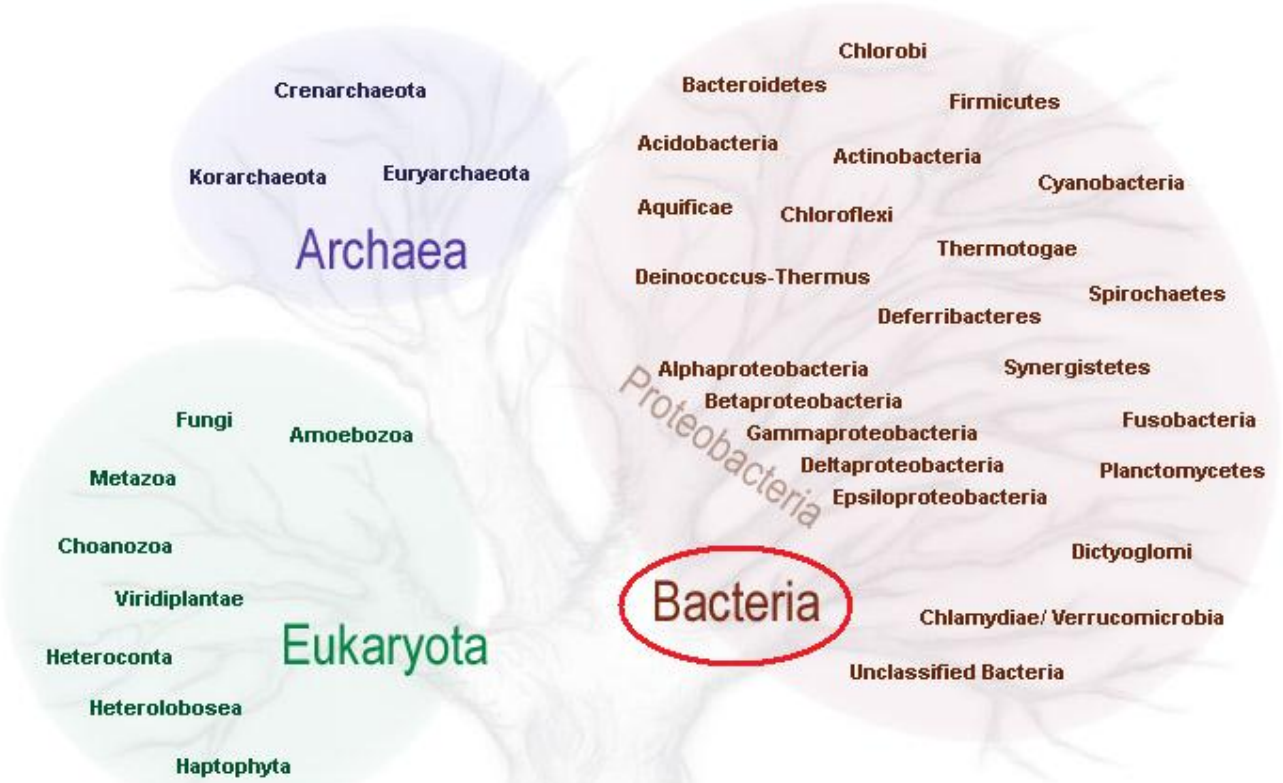
PROJECT SUMMARY

This project focus on a timely, major unsolved problem related to the coastal ecosystems and human health.

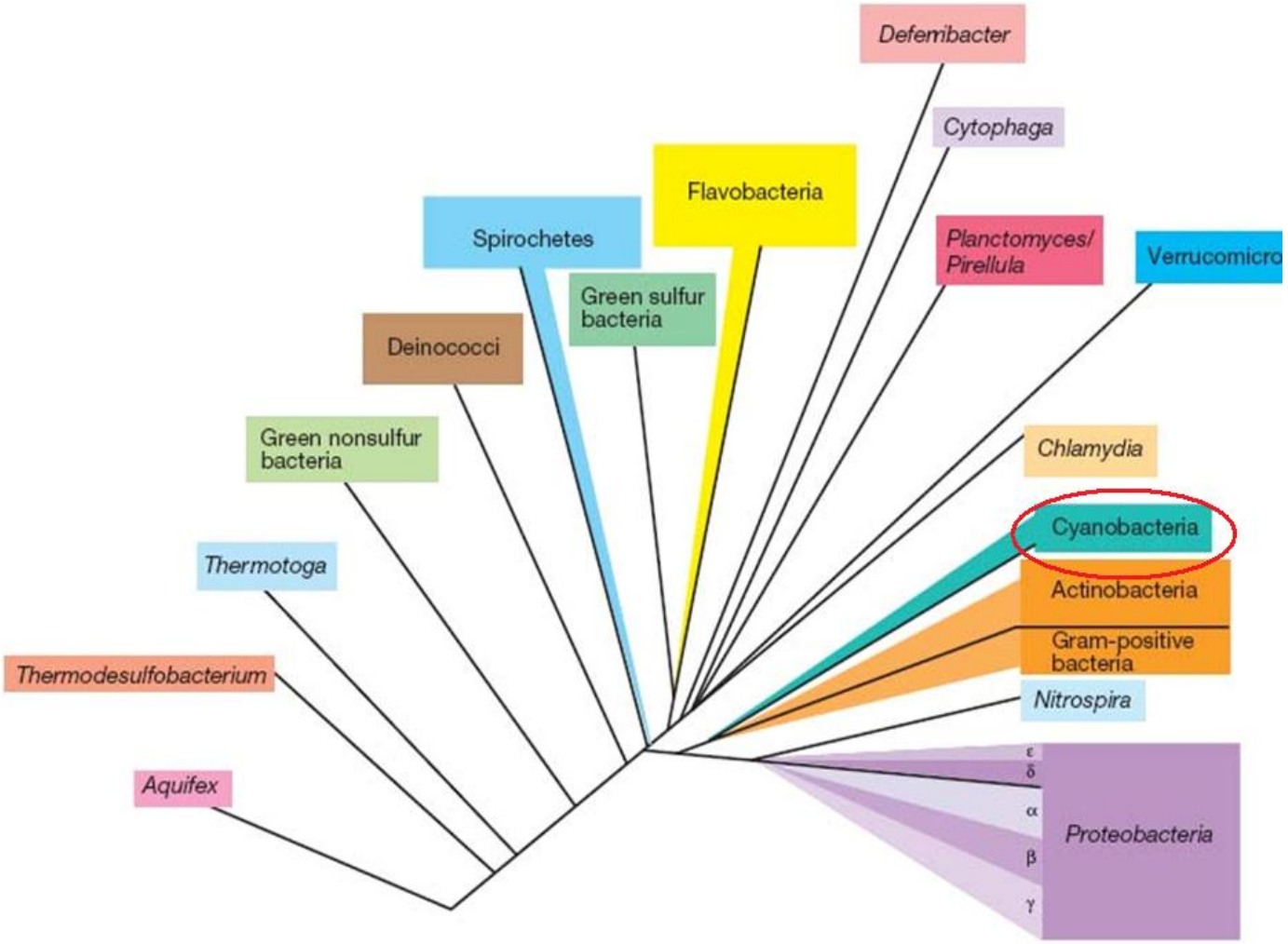
Cyanobacteria, formerly called **"*blue-green algae*"** or ***cyanophytes***, are ancient (2.7 billion years old) photosynthetic autotrophic **bacteria** currently found worldwide in inland and seawater environments.





The Tree and Domains (Eukaryota, Bacteria Archaea) of Life

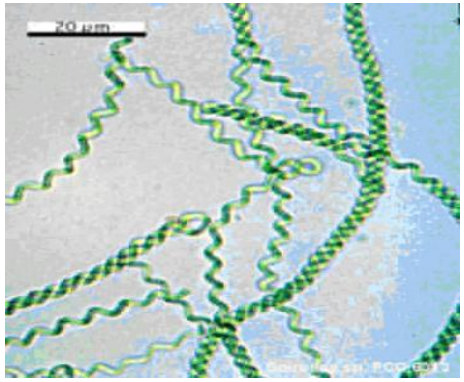
(drawing by *Leila Hornick*)



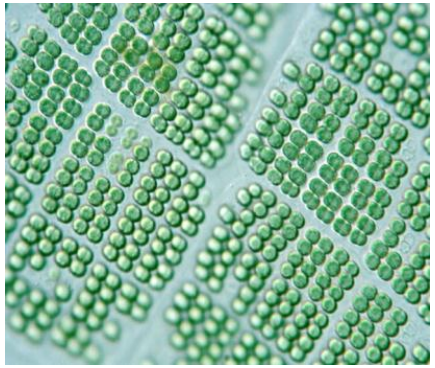
Domain Bacteria includes Cyanobacteria

Cyanobacterial diversity

Gloeocapsa

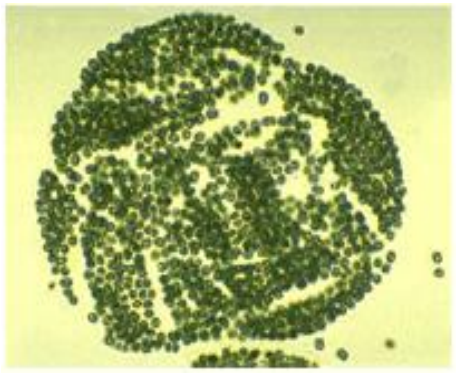


Spirulina



Merismopedia

Anabaena



Microcystis

Oscillatoria

THE BENEFITS OF CYANOBACTERIA

Cyanobacteria **were the first organisms on Earth to do modern photosynthesis; they appeared about 2.7 billion years ago, producing the first O_2 and changing the Earth's atmosphere.**

Still alive today, cyanobacteria are one of the largest and most important groups of bacteria on Earth, found in bodies of water around the world.

Main functions of modern-day cyanobacteria:

- **Total primary production (carbon fixation)**
- **Mediate biogeochemical cycle of N and regulate climate**
- **Represent base of food-web**

THE DOWNSIDES OF CYANOBACTERIA

In some water-bodies, especially with high levels of nutrients, cyanobacteria proliferate extremely and form so-called *cyanobacterial blooms*.

Cyanobacteria are able to synthesize numerous *toxins* (*cyanotoxins*) with differing chemical structures.
Production of *cyanobacterial toxins* is human and animal (zooplankton, fish, shellfish, domestic animals) health hazard, which can result in risk of illness and mortality at environmentally relevant concentrations.

THE DOWNSIDES OF CYANOBACTERIA

Cyanobacterial blooms **have severe impacts on** ***ecosystem functioning*****:**

- **changes of biodiversity, light conditions, pH values**
- **cause hypoxia and anoxia leading to fish kills**

Cyanobacterial blooms**, particularly blooms of toxic cyanobacteria (*****Cyanobacterial Harmful Blooms or CHABs*****), can create** ***significant water quality problems*****:**

- **odor and taste problems**
- **aesthetic problems**
- **loss of recreational and fishing value of affected waters**

CYANOBACTERIA: The Bad and Ugly

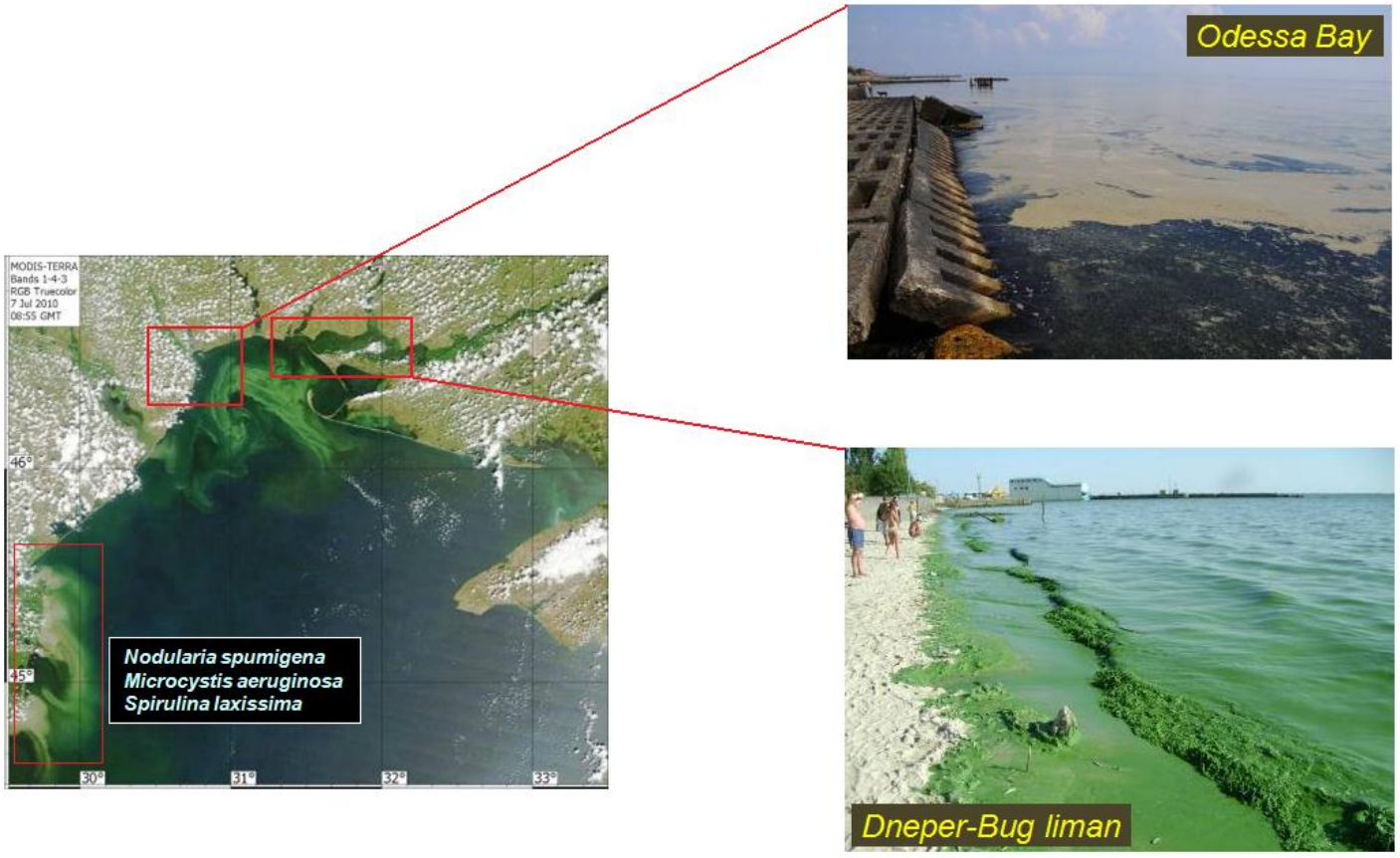
Despite of the economy's collapse in Central and Eastern Europe, and large Danube water protection programmes have led to a decrease in nutrients discharge and a decrease in the eutrophication, *cyanobacterial blooms are common events in many locations in coastal zone around the Black Sea*, coinciding frequently with death of huge numbers of fish and other marine organisms, as well as the disturbances of recreational activities.

***Microcystis*, notorious dominates the Black Sea plankton community often forming extensive summer cyanobacterial blooms, particularly in shallow eutrophic ecosystems.**

CYANOBACTERIA: The Bad and Ugly

Fish kills associated with summer blooms in Mamaia Bay, Romania (*Sources: NIMRD Constanta and GeoEcoMar*)

CYANOBACTERIA: The Bad and Ugly



Cyanobacterial blooms **in coastal zone and limans of the Northwestern Black Sea during 2010: blooms of toxic *Nodularia spumigena* (Odessa Bay) and *Microcystis aeruginosa* (Dneeper – Bug liman).** (Sources: Borys Aleksandrov -The 2009/2010 assessment of the Black Sea state)

CYANOBACTERIA: The Bad and Ugly

Fish kills in coastal zone and limans of the Northwestern Black Sea during 2010 (Sources: Borys Aleksandrov - *The 2009/2010 assessment of the Black Sea state*)

There is a lack of knowledge about toxic species and toxicity of cyanobacteria in the Black Sea, mainly due to the limitation of currently used detection methods.

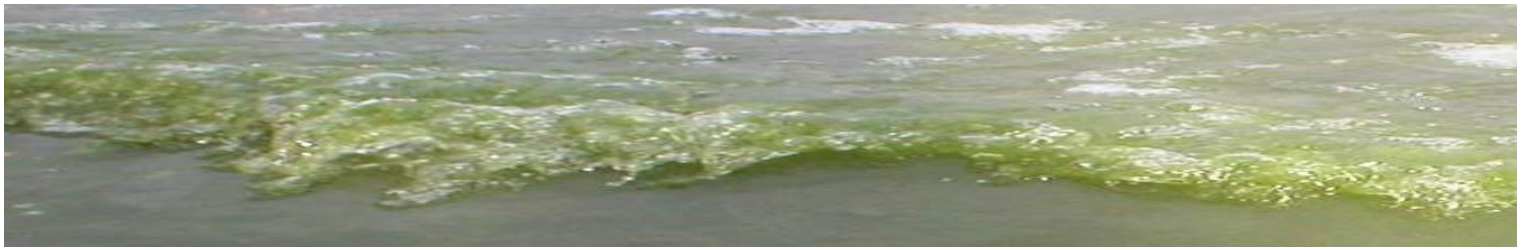
Monitoring of cyanobacteria in the Black Sea waters is currently achieved using traditional botanical approach, based on the morphological identification by microscopy.
However, Cyanobacteria consist on an intricate group of organisms, usually difficult to recognize only through morphologic and cytological criteria.
Moreover, identification of a cyanobacterial species by microscopic morphology does not indicate the potential for toxin production.

Thus, improving methodological approaches for identification of the Black Sea cyanobacterial species and their toxins are critically needed.

PROJECT OBJECTIVES

The *overall goal* of MARCY project is to improve detection systems of cyanobacteria & cyanobacterial toxins for a good pollution monitoring and control in coastal waters of the Black Sea.

For this purpose, MARCY aims to implement for the first time contemporary research methods for rapid and efficiently detection of cyanobacterial hazards in coastal areas of the Black Sea.

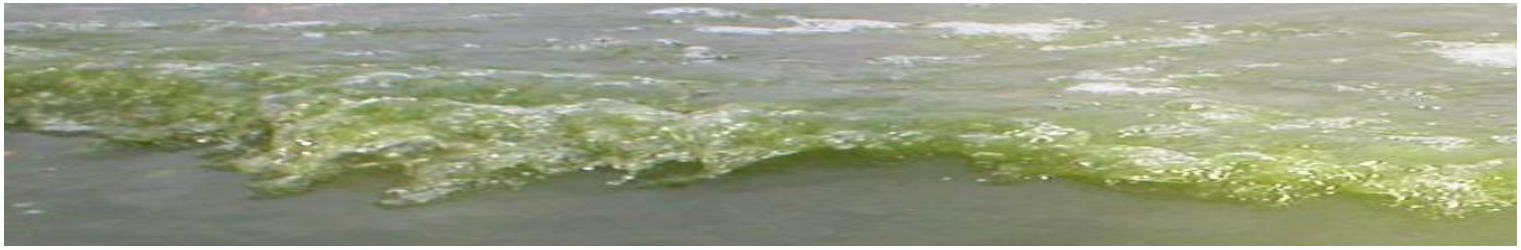


SPECIFIC OBJECTIVES

Objective 1: Assessment of distribution and occurrence of toxigenic cyanobacteria and their toxins in coastal ecosystems of the Black Sea by using molecular and immunochemical methods.

Objective 2: Identification of suitable methods for early-monitoring of cyanobacterial blooms with toxin producing potential.

Objective 3: Estimation of environmental factors responsible for cyanobacterial growth and blooms formatting in coastal Black Sea.



EXPECTED OUTCOMES & IMPACTS

For the first time, detailed and very precise information of cyanobacterial species in Black Sea will be provided.

Toxigenic cyanobacterial species will be identified with certainty and data utilized in correct estimation of causes of coastal water quality alteration (including recreational) and mass mortality associated with the summer blooms at the Black Sea.

State-of-the-art methods for early-monitoring of cyanobacterial blooms with toxin producing potential in the Black Sea will be develop .

EXPECTED OUTCOMES & IMPACTS

The original scientific results will have a great impact to the Black Sea environment, contributing for *setting up a knowledge-based policy measures for control of factors leading to algal bloom development and economic loss* through their negative impacts on recreation activities and tourism.

In the longer term, the project will be the basis for *generating a common monitoring system for harmful and toxic species of cyanobacteria all around the Black Sea countries*.

CURRENT STATUS OF THE PROJECT

Start of the project: October, 2011

Stage 1 Technical and scientific fundamentation of the project (preparatory Phase) – *completed in 2011*

Activity 1.1 Official launches of MARCY Project

Activity 1.2 Data collection for establishing short and long term needs: identification, inventory and interpretation of actual and historical existing data regarding cyanobacterial-related hazard in the Black Sea.

Activity 1.3 Creation of internet-based network to promote better knowledge transfer within the cyanobacterial research community across the Black Sea region

Activity 1.4 Acquisition of Research Equipment and Materials

Activity 1.5 Practical training on molecular & analytical methods

Activity 1.6 Creation of the Project website; Elaboration and reporting of the first report on project progress

CURRENT STATUS OF THE PROJECT

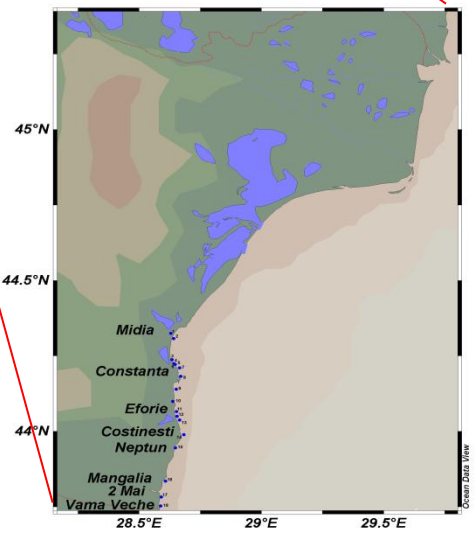
Stage 2 Field sampling campaign along the western and southern coastal regions of the Black Sea – *completed in 2012*

Activity 2.1 Site selection and documentation; establishing coastal monitored area and station networks, according to the objectives (field sampling plan design)
Activity 2.2 In situ measurements of physico-chemical parameters (CTD measurements)
Activity 2.3 Ship-board collection of environmental samples (water, sediment) for DNA, phycological and chemical (toxins, nutrients and chlorophyll) analyses (monthly between May-October 2012)
Activity 2.4 Acquisition of Research Equipment and Materials
Activity 2.5 Web page updating; elaboration and reporting of the second report on project progress

CURRENT STATUS OF THE PROJECT

Romanian Field Campaign & Sampling Stations

(May - October 2012, monthly)



CURRENT STATUS OF THE PROJECT

Romanian Field Sampling

CURRENT STATUS OF THE PROJECT

Bulgarian Field Campaign & Sampling Stations

(May - October 2012, monthly)

1 - Sinemorets

2 - Primorsko

3 - Nesebar

4 - Kamchiya

5 - Gold sands

6 - Shabla.

CURRENT STATUS OF THE PROJECT

Bulgarian team

Dr. Ivanka Teneva
(**Team Leader**)

From left : Prof. Balik Dzhambazov, PhD
Prof. Rumen Mladenov, PhD
Ass. Prof. Plamen Stoyanov (young scientist)
Asoc. Prof. Detelina Belkinova, PhD

CURRENT STATUS OF THE PROJECT

Turkish Field Campaign & Sampling Stations
(May - October 2012, monthly)

St.1 - İğneada shore
St.2 -Riva river vicinity
St.3 - Sakarya river vicinity
St. 4 - Kızılırmak river vicinity
St. 5 - Yeşılırmak river vicinity

CURRENT STATUS OF THE PROJECT

Stage 3 Laboratory analysis of environmental Black Sea samples: physical, chemical & biological parameters – *(outgoing; to be completed in 2013)*

Activity 3.1 CTD data processing and interpreting by using Seabird CTD processing software

Activity 3.2 Microscopic analysis of phytoplankton communities and dominated cyanobacterial species morphology

Activity 3.3 Nutrients and chlorophyll assessment from seawater samples collected in the cruise

Activity 3.4 Data analysis and preparing first publications on these results; conference attending

Activity 3.5 Acquisition of Research Equipment and Materials

Activity 3.6 Web page updating; elaboration of the third project progress report; the 2nd meeting for analysis and evaluation of project progress (Istanbul, Turkey)

FUTURE WORK

Stage 4 - Molecular analyses of environmental Black Sea samples (2013)

Stage 5 - Immunochemical analysis of environmental Black Sea samples; Results dissemination (2014)

End of the project: October, 2014