The Commission on the Protection of the Black Sea Against Pollution

The European Commission
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Final Report for the Grant Agreement No 07.0204/2010/580913/SUB/D2

"Environmental monitoring of the Black Sea with focus on nutrient pollution" (Acronym: Baltic2Black)

Final Report

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Abbreviations used

AG – Advisory Group of the Black Sea Commission (subsidiary body)

BSC – Commission on the Protection of the Black Sea Against Pollution (Black Sea Commission)

BSC PS – Black Sea Commission' Permanent Secretariat

BSIS – Black Sea Information System

BSIMAP – Black Sea Integrated Monitoring and Assessment Programme

BSSAP – Black Sea Strategic Action Plan

HELCOM – Baltic Marine Environment Protection Commission (Helsinki Commission)

ICPDR – International Commission for the Protection of Danube River

LBS – Land Based Sources of Pollution

LBS AG – LBS Advisory Group

MSFD – EU Marine Strategy Framework Directive

RAC – Regional Activity Centre

PMA – Pollution Monitoring and Assessment

PMA AG – PMA Advisory Group

RDB-P – Regional Database on Pollution

WFD – Water Framework Directive

Executive summary

The report presents an overview of activities undertaken by the BSC PS jointly with HELCOM Secretariat in implementation of the EU project "Environmental monitoring of the Black Sea for nutrients" (Baltic2Black), Grant Agreement No 07.0204/2010/580913/SUB/D2 in the second year of the project.

Introduction

Eutrophication/nutrient-enrichment is recognized as one of the major threats to the marine environment of the Black Sea in the Strategic Action Plan (SAP) adopted in 1996 as well as in the revised SAP 2009. In SAP-2009, following long-term Ecosystem Quality Objectives (EcoQOs) are addressed to these issues: *EcoQO 3: Reduce eutrophication* and *EcoQO 4: Ensure Good Water Quality for Human Health, Recreational Use and Aquatic Biota*.

Regional environmental monitoring in the Black Sea is carried out in the framework of the Black Sea Integrated Monitoring and Assessment Programme (BSIMAP), implemented by the Black Sea Commission (BSC) since 2001 and revised in 2006. BSIMAP is addressed to the main transboundary environmental problems in the Black Sea region: eutrophication, water pollution and water quality, biodiversity change and decline, habitats destruction. Currently, a revised BSIMAP considering the approaches of MSFD in the marine environment monitoring and assessment towards reaching the good environmental status in the Black Sea was presented to the attention of the Black Sea Commission.

The Project Baltic2Black is a collaboration project between the Secretariats of the Black Sea Commission (lead partner) and HELCOM (partner) funded by the European Commission, DG ENVIRONMENT. The general objective of the project is to promote environment protection in the Black Sea area by improving the environmental monitoring. The secondary objective is to enhance the transfer of knowledge and good practices from Baltic Marine Environment Protection Commission (HELCOM) to the Black Sea Commission (BSC).The project deals with promoting measures to facilitate delivery of Black Sea Commission' integrated regional

monitoring and assessment products, with focus on nutrient pollution and eutrophication, including through transfer of related existing best practices from HELCOM in the Baltic Sea. Part of the funding is targeted at involving relevant experts of the Contracting Parties of the commissions. In the BSC Permanent Secretariat, in 2012 participants in the project were Mr. Volodymyr Myroshnychenko (from January to end of May) and Ms. Valeria Abaza, BSC PS Pollution Monitoring and Assessment (PMA) Officer. In the HELCOM Secretariat, the project is managed by the Professional Secretary, Ms. Maria Laamanen, and Ms. Miia Mannerla, who works half time as project researcher.

The implementation of the project is running in parallel with the relevant international legislation process providing wide possibilities for coordination and harmonization. Through improved regional eutrophication monitoring, compliance to requirements of the Marine Strategy Framework Directive (MSFD) of Black Sea EU Member States will be facilitated.

The project includes following Actions:

- A1. Management and reporting to EC
- A2. Creation of updated version of the Black Sea Information System (BSIS) in the public domain with links to European Information Systems
    - A2.1. Development of the online version of the Regional Database on Pollution (RDB-P)
    - A2.2. Assessment of eutrophication parameters and analysis of status of data collection/reporting/use
- A3. Elaboration of regionally agreed criteria for assessment of eutrophication
    - A3.1. Elaboration of the Black Sea reference and target concentration levels of eutrophication parameters
    - A3.2 Elaboration of a regional methodology on identification of water quality classes for eutrophication
- A4. Enhancing Black Sea monitoring efforts
    - A4.1. Enhanced use of satellite observations for monitoring of eutrophication
    - A4.2. Feasibility on usage of automated systems for monitoring of eutrophication parameters in Black Sea region
- A5. Initial stages of setting up a modelling tool, linking background pollutants triggering eutrophication in the Black Sea with requirements, set by the Black Sea Commission, for reducing input of nutrients, including riverine loads.
- A6. Transfer of best practices from HELCOM to BSC on eutrophication monitoring and assessments
    - A6.1. Organising of a series of seminars and workshops for knowledge transfer
    - A6.2. Secretariat-to-secretariat exchange and mentoring related to the topics of Tasks 2 to 5
- A7. Dissemination

PROJECT ACTIVITIES

1. Creation of updated version of the Black Sea Information System (BSIS) in the public domain with links to European Information System

The objective of this activity is to enhance the capabilities of the Black Sea Information System (BSIS) with respect to management of pollution monitoring data, particularly nutrients, and facilitating assessment of status of eutrophication in the Black Sea. The operational BSIS will allow to analyse and control data flow, identify bottlenecks in coordinated regional data on production/delivery/use and apply this information for improvement of regional monitoring and assessment programme and products.

1.1. Development of the new version of the Regional Database on Pollution

Development of the new version of the Regional Database on Pollution was carried out in framework of **Activity A2.1.**

The Regional Database on Pollution (RDB-P) is one of the components of the Black Sea Information System. It contains data on pollutants in water, sediments and biota collected in countries in process of implementation of the BSIMAP and annually reported to the BSC. The data on nutrients in seawater constitute the major part of the database. It also contains data on bathing water quality parameters included in the updated reporting format.

The new version of the RDB-P of BSIS was developed by the Ukrainian Scientific Centre of Ecology of Sea (UkrSCES), Odessa, Ukraine acting as Regional Activity Centre on Pollution Monitoring and Assessment (RAC PMA) of the BSC. The subcontract with UkrSCES was signed in May 2011 and activities included in the Terms of Reference cover the period 2011 - 2013. It includes the following tasks:

- Development of a new version of the RDB-P of BSIS with GIS-enabled Web interface in accordance with RDB-P requirements set by BSC PS;
- Loading historical pollution monitoring data reported to BSC since 2000, including eutrophication parameters, and priority pollutants in sea water, sediments and biota as defined in the BSIMAP;
- Creation of tools for Quality Control (QC) of data and fulfilling the QC and correction of data in the database;
- Development of tools for calculation of data statistics and indicators needed for assessment of status of eutrophication in the Black Sea;
- Performing analysis of trends of eutrophication parameters (transparency, total suspended matter, dissolved oxygen, nutrients, and chlorophyll-a) and their spatial variability;
- Preparation of an overview of monitoring data flows to the RDB-P, analyze their sufficiency for assessment of eutrophication and state of environment, and identify gaps;
- Preparation of RDB-P for sharing metadata with Pan-European marine data and information network SeaDataNet (http://www.seadatanet.org/) - setup the SeaDataNet tools for automatic generating of Common Data Index (CDI) files from the database;
- Maintaining the RDB-P during the contract duration and further in framework of the RAC PMA responsibilities performing:

➢ Regular loading of new data reported to BSC

➢ Quality control of new data

➢ Updating statistics

➢ Calculation of indicators

➢ Regular backup of the database

➢ Integration of RDB-P with GIS, etc.

The process of developing the database was interactive; at every annual meeting of the PMA AG the status of its development being presented by the developers and the members of PMA AG were invited to test it. During its 22nd annual regular meeting in September 2012, the PMA AG recommended to make the RDB-P working with multiple internet browsers (not only with Mozilla as it was initially designed), as different governmental institutions responsible with the implementation of the national monitoring programmes use different internet browsers. During 2012, the basic version of the RDB-P was significantly improved and more operational tools have been added. These tools will be briefly described below. The detailed reports provided by PMA RAC are available, too. The data on pollution monitoring up to 2011 were uploaded and the data collected by the BSC PS for 2012 were sent to the PMA RAC to be uploaded into the RDB-P. The server is publicly accessible online (http://rdbp.sea.gov.ua)(Fig.1).

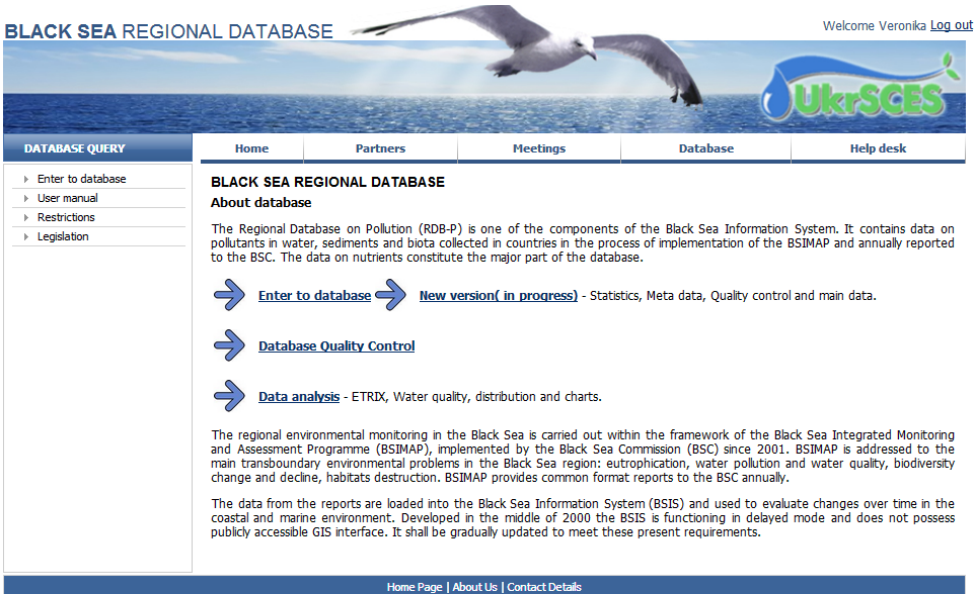


Fig. 1 – The website "Black Sea Regional Database" – home page

The structure of the database is described in detail in the final report (deliverable 1) provided by UkrSCES (PMA RAC). Online access to data and metadata is provided to the authorized users (based on log in and password) to the authorized users for input and edit the data.

- A local copy of RDB-P was installed on the BSC PS prototype server after the analysis of its configuration; a web interface code and relative paths to the BSC server was provided by the PMA RAC.

- An overview of the monitoring data flow to the RDB-P was performed by the RAC PMA in the general statistics chapter by country, organization, sampling stations, sample type, parameter group, number of parameters, in order to identify the gaps in data availability and its sufficiency for eutrophication assessment in the Black Sea.

Table 1 – RDB-P General Statistics (2000 – 2011) (source: http://rdbp.sea.gov.ua)

General statistics of Countries (number records - 7)| 5 |all | - items per page

	Country	Organizations	Stations	Samples	Samples Type	Parameter Groups	Parameters
1	Ukraine	3	162	17924	3	13	84
2	Romania	1	99	34656	4	14	64
3	Russia	1	69	11904	2	9	86
4	Bulgaria	3	13	2293	1	6	25
5	Turkey	1	92	74180	3	11	42
6	Georgia	1	14	1047	2	5	24
	ALL COUNTRY	10	449	142004	4	15	105

A detailed analysis on the data availability per country, per year and per sampled media (bathing water, sediment, biota and seawater) has been performed, showing the gaps for each country in reporting the monitoring data to the BSC (see the detailed report on deliverable 8 according to the Service Contract no.1/2011 attached). Following conclusions resulted from the analysis:

- The data for "Bathing water" are insufficiently reported by most of the Black Sea countries; by 2011 only Romania reported this type of sampling;
- The data for "Sediment" are poorly represented as well in the RDB-P; again Romania monitored and reported this media;
- The data for "Biota" were found to be poor as well in the RDB-P; the only country sampling and reporting this media is Romania, again;
- The best represented parameters in the RDB-P are those for "Water".

In order to improve the quality of data provided to the RDB-P by the countries, by the end of the project, the PMA National Focal Points (NFPs) were given the possibility to edit their own data and to upload the missing data, in close communication with the BSC PS and PMA RAC. At the 23rd PMA AG Meeting it was established that all countries will nominate experts to check the data uploaded in the RDB-P. A virtual workshop for training the potential users for the database was discussed during the 23rd PMA AG meeting on 7-8 October 2013 and organized a month later (November 2013). Experts from all Black Sea countries participated in this workshop and the results were presented during the 4th Baltic2Black workshop (27-28th November, 2013). The comments and observations made by the participants during the training were incorporated into the database.

- The tools for calculation of statistics and indicators applied to pollution monitoring data stored in the database were elaborated (the full report is included into the final deliverable provided by UkrSCES). The focus was on the calculation of the Trophic Index – TRIX (Vollenweider et a. 1998) that summarizes the relationship between the contribution of the direct indicators of the coastal waters productivity – actual productivity – and the nutritional factors – potential productivity.

TRIX values exceeding 6 units show the high productivity of coastal waters, when the effects of eutrophication are expressed through frequent episodes of anoxia in bottom waters. Values between 2 and 4 units characterize the coastal waters with lower productivity, while the values lower than 2 units are encountered usually in the open sea.

In order to be able to calculate the TRIX value using the data uploaded in the RDB-P, an analysis of the sufficiency of eutrophication parameters was performed (Table 2).

Table 2 – Statistics for sufficiency of the eutrophication parameters in the RDB-P for calculation of E-TRIX

Country	Sample Type	Year	Number of parameters	Parameters for ETRIX
Romania	Water	2009	6	N (NO_3), N (NO_2), Chl a, P total, O_2 %, N (NH_4)
Romania	Water	2010	6	P total, N (NO_3), Chl a, N (NO_2), N (NH_4), O_2 %
Ukraine	Water	2007	6	P total, N (NO_3), N (NH_4), O_2 %, N (NO_2), Chl a

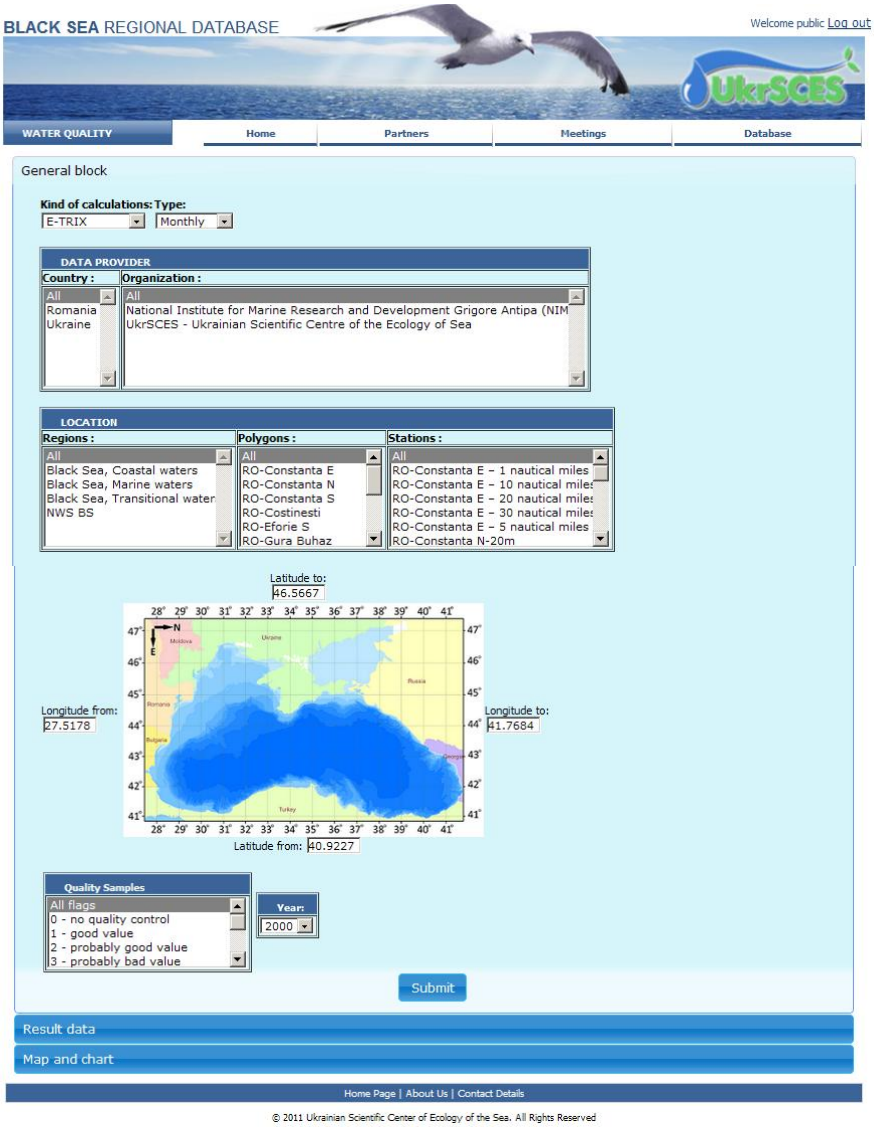
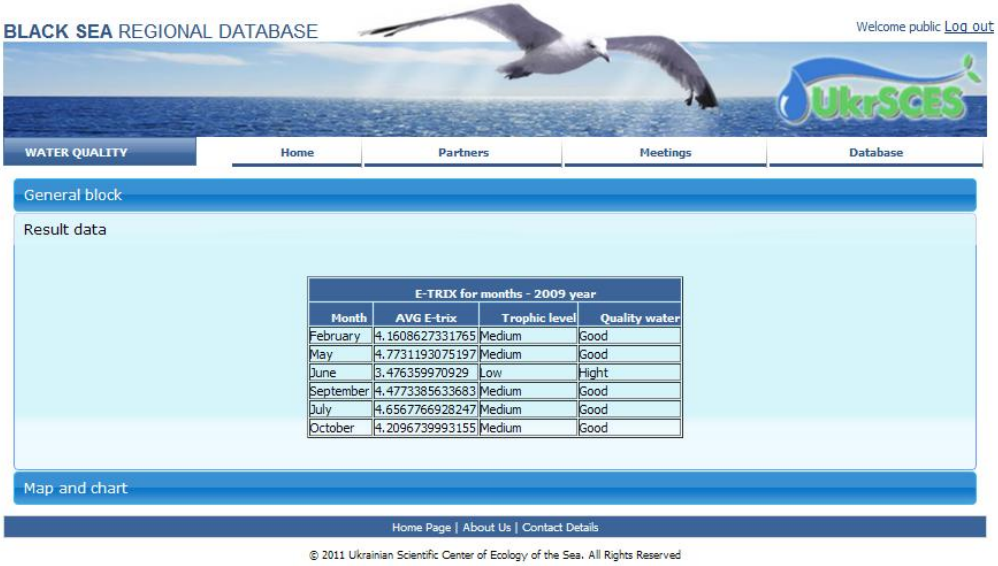


Fig. 2 – The Interface selection for Water Quality – E-TRIX-Monthly – showing location of data

The work with the RDB-P to determine the E-TRIX index is further described in the Report's Annex and presents the following:

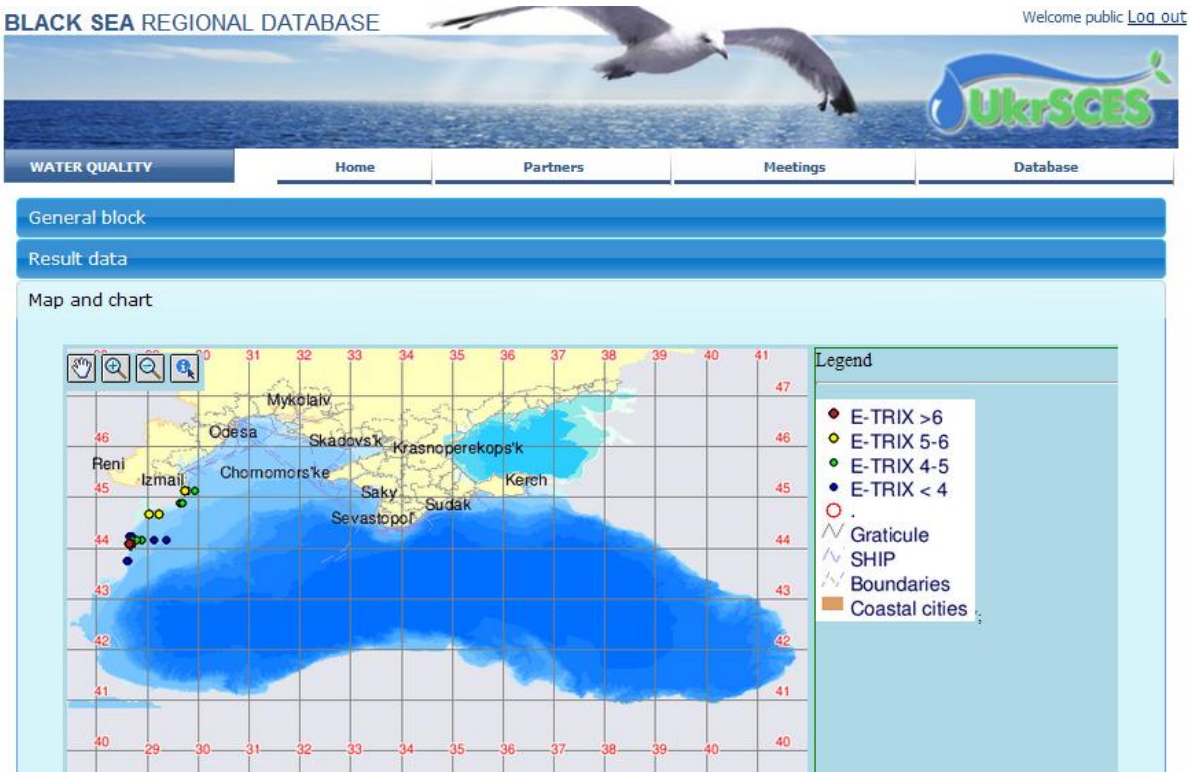
- Interface selection Water Quality – E-TRIX
- Results selection Water Quality – E-TRIX

Results on map and in graph format (see Fig. 2)



E-TRIX for months - 2009 year			
Month	AVG E-trix	Trophic level	Quality water
February	4.1608627331765	Medium	Good
May	4.7731193075197	Medium	Good
June	3.476359970929	Low	Hight
September	4.477338563683	Medium	Good
July	4.6567766928247	Medium	Good
October	4.2096739993155	Medium	Good

Fig. 3 – The interface selection for Water Quality – E-TRIX – Monthly – Table with data results



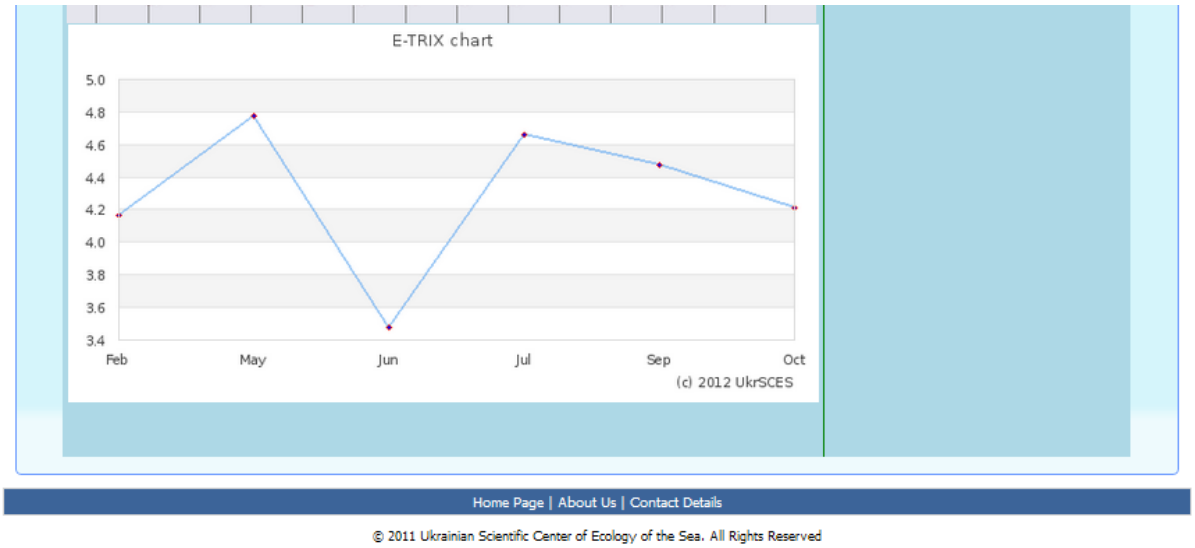


Fig. 4 – Results of calculation of E-TRIX Index on map and graph

- As example of determining the water quality classes, a special methodology developed for Ukraine in 2009, and named "The Ecological Standards for Marine Environment Quality" was introduced in the RDB-P.

The above-mentioned methodology was presented to the PMA AG in 2010 and proposed to be adopted and used at regional level, but the EU Member States from the Black Sea region objected that this is not really in accordance with the requirements of the Water Framework Directive and includes six quality classes unlike the five classes described in the WFD. The mentioned methodology for establishing the water and/or sediments quality developed by UkrSCES was quite successfully applied to the analysis of the state of marine environment and presented at various conferences, at both national and international levels. The results of its application are presented in annual reports to both the Ministry of Ecology and Natural Resources of Ukraine and Black Sea Commission. At the 23rd Meeting of the PMA AG (7-8 October 2013) it was agreed with UkrSCES that after the development of BEAST tool and the description provided, it will be incorporated into the database for pollution for immediate calculation of the eutrophication status of the Black Sea. As the work for the regional database will continue under the EMBLAS project, the integration of BEAST tool will be possible.

The application of the presented methodology is described in more detail in the report provided and it's workable with the same interfaces as the E-TRIX index:

- Selecting the interface Water Quality – Water Pollution
- Results of Water Quality – Water Pollution calculation
- Results of Water Quality – Water Pollution presented on the map and graphic format, as demonstrated in the figures below.

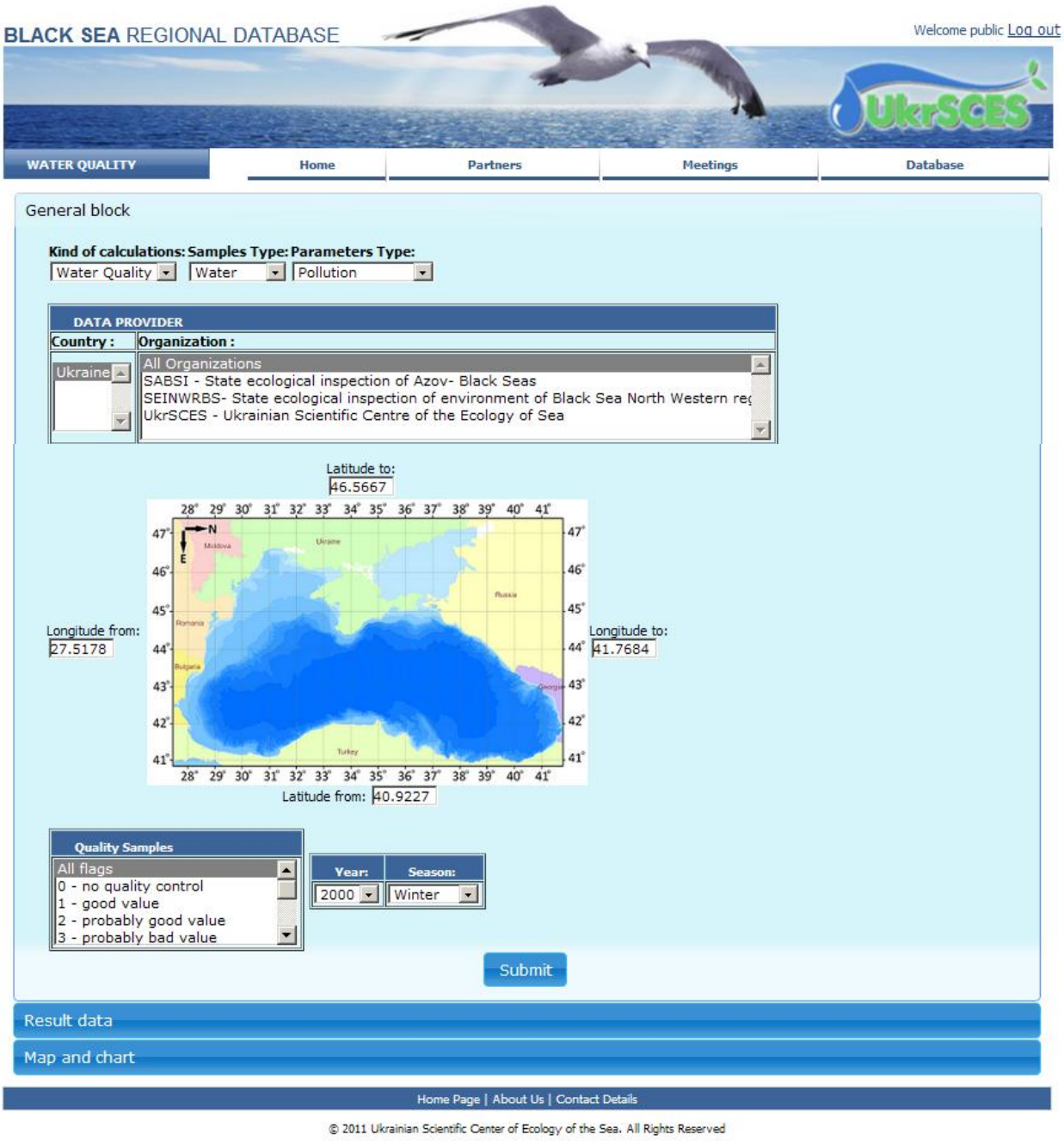


Fig. 5 – The selection of the interface Water Quality – Water Pollution

WATER QUALITY | Home | Partners | Meetings | Database

General block

Result data

Quality water (2010 year -Spring) for surface.

	Parameter	Unit	AVG Value	1-Hight	2-Good	3-Satisfactorily	4-Low	5-Bad	6-Critical	Class
1	Co	µg/l	0.0000	+						1
2	Pb	µg/l	0.0000	+						1
3	Hg	µg/l	0.0310	+						1
4	Cd	µg/l	0.0900	+						1
5	dieldrin	ng/l	0.2800				+			4
6	γ-HCH (Lindane)	ng/l	0.4400			+				3
7	α-HCH	ng/l	0.6100	+						1
8	β-HCH	ng/l	0.9400	+						1
9	Ni	µg/l	1.4000	+						1
10	Cu	µg/l	1.9000		+					2
11	HCH total	ng/l	1.9900	+						1
12	Cr	µg/l	3.5000		+					2
13	As	µg/l	4.0000	+						1
14	DDT total	ng/l	4.7900	+						1
15	Zn	µg/l	5.6000	+						1
16	TPHs	µg/l	15.3830	+						1
17	benzo(a)pyrene	ng/l	38.8000						+	6
				12	4	3	4	0	6	
SUM:				29						

1-Hight		2-Good		3-Satisfactorily		4-Low		5-Bad		6-Critical	
17	25	26	42	43	59	60	76	77	93	94	102

Integral quality class of marin water is 2 - Good

Fig.6 – Results of Water Quality – Water Pollution presented in table format (example)

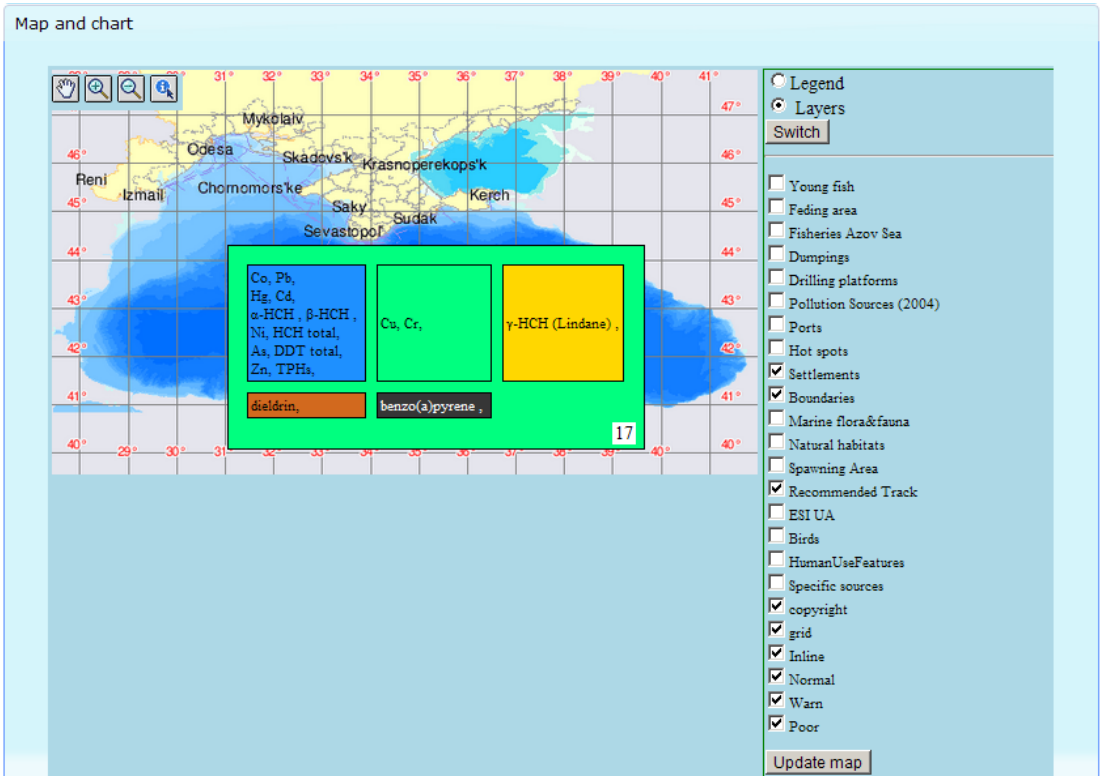


Fig.7 – The results of Water Quality displayed on the map (example)

The graphs produced working with the RDB-P are of different types and present in general the statistics for:

- Number of parameters per station

- Number of samples per parameter – this type of statistics is useful when checking for sufficiency of data to calculate different indices for eutrophication or pollution.
- Sample types per year
- Number of samples, parameters and stations per sample type
- Depth of the sampling stations

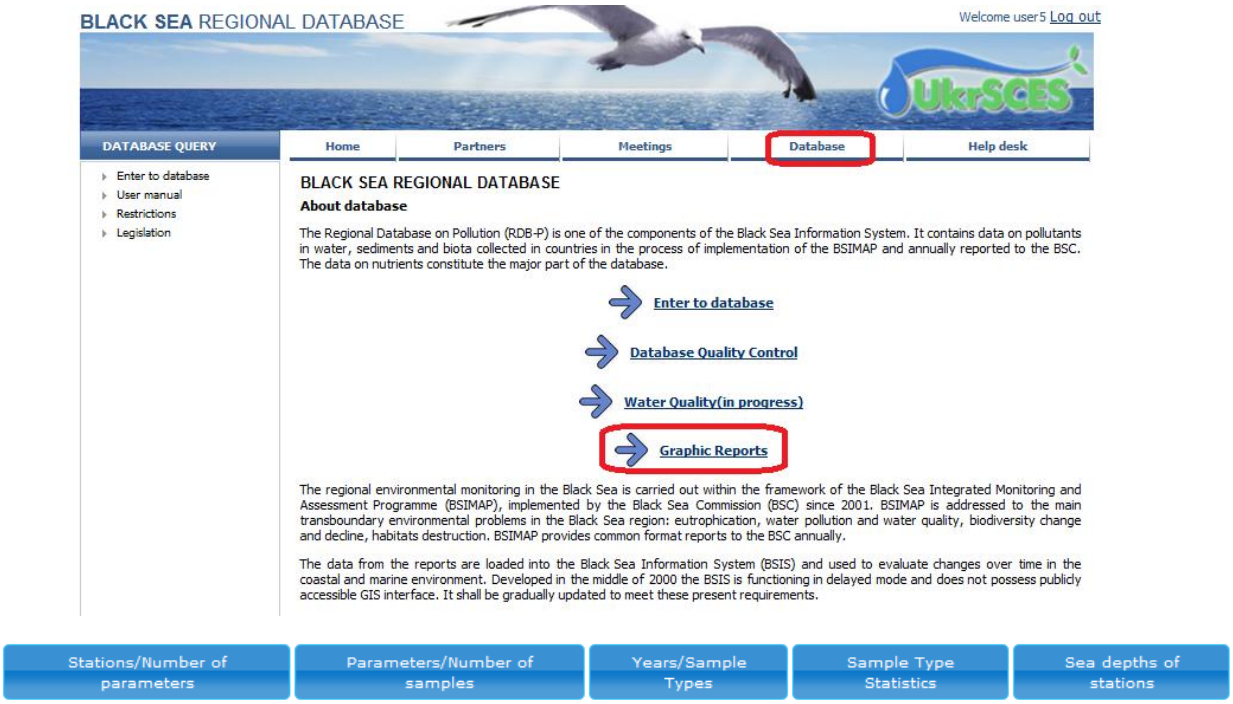


Fig. 8 – The main menu for graphic reports in the RDB-P

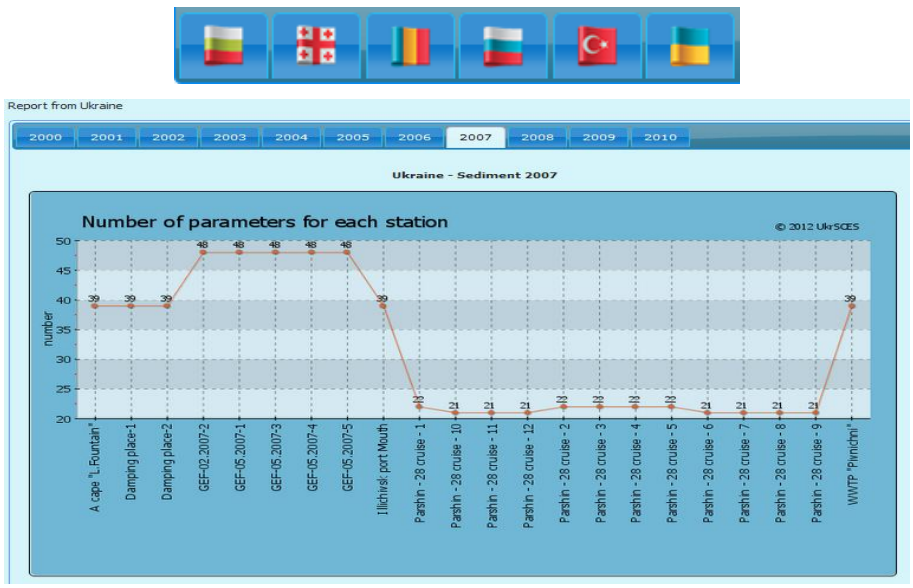


Fig. 9 – Example of graphic report on the number of parameters per sampling station in the RDB-P that can be calculated selecting the country of interest and the year

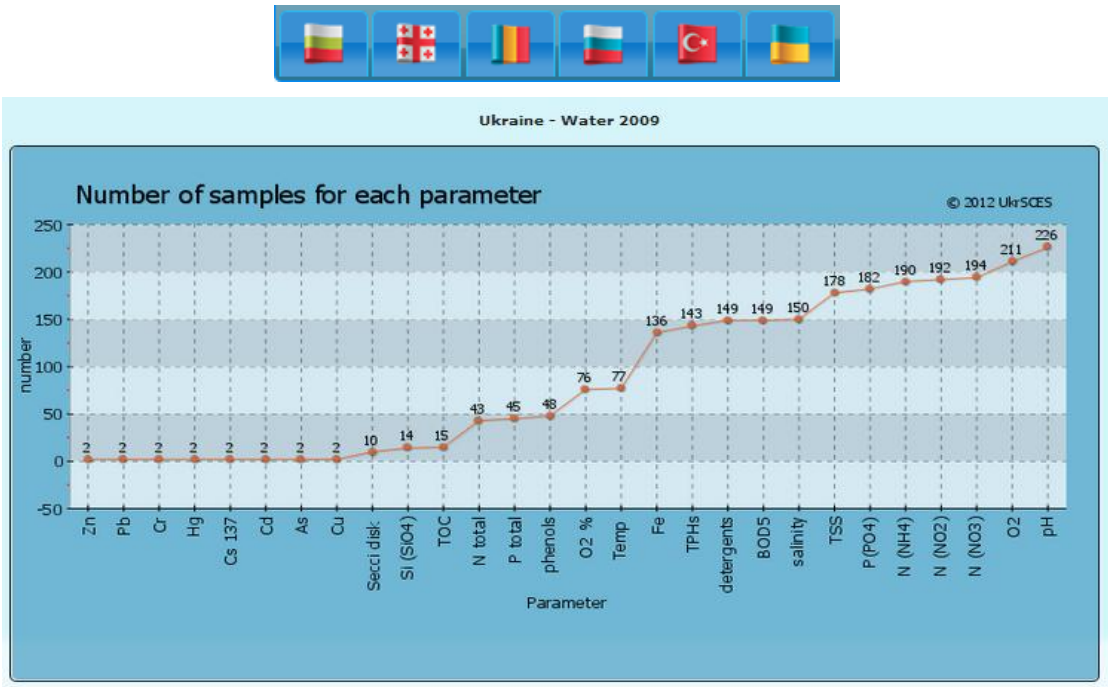


Fig. 10 – Example of graphic report on the number of samples per each parameter in the RDB-P that can be visualised selecting the country and the year

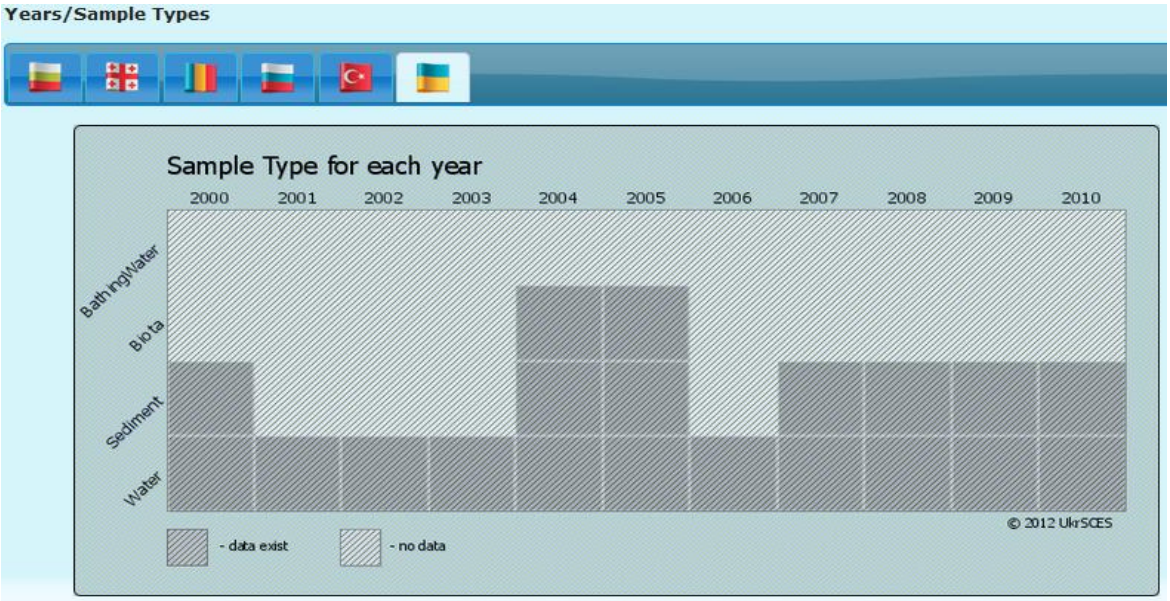


Fig. 11 – Example showing the sample types per year reported to BSC and uploaded in the RDB-P available also selecting the country and the year

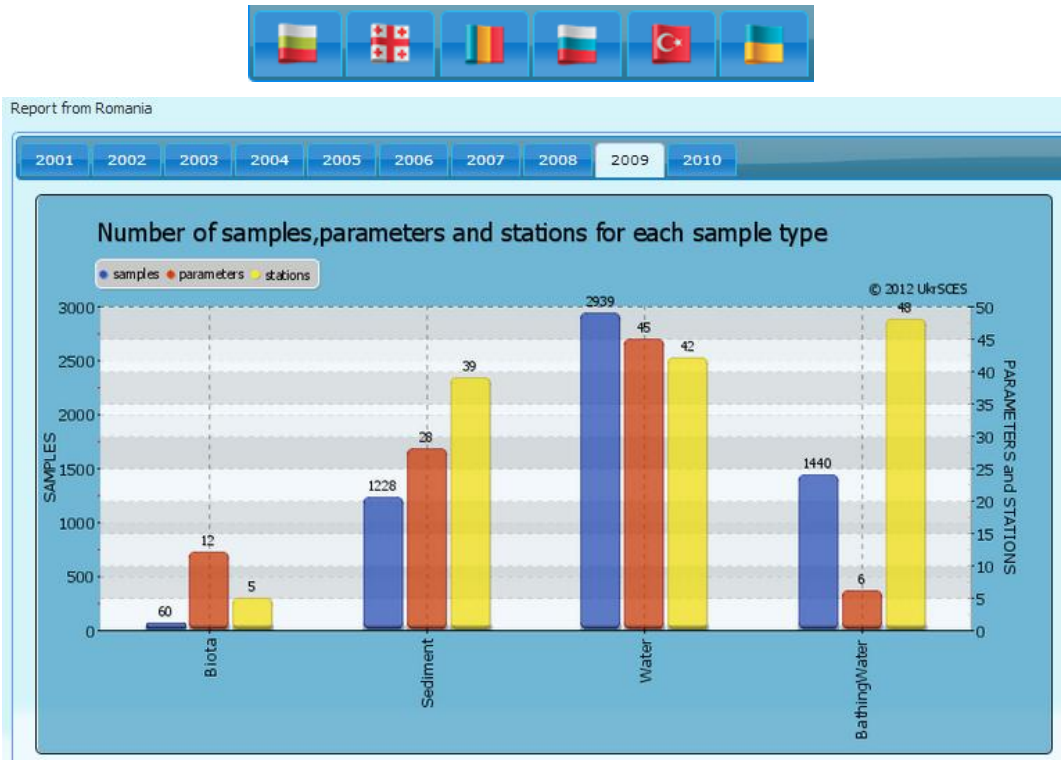


Fig. 12 – Example showing the number of samples, parameters, and stations per sampling media in the RDB-P, per year and country

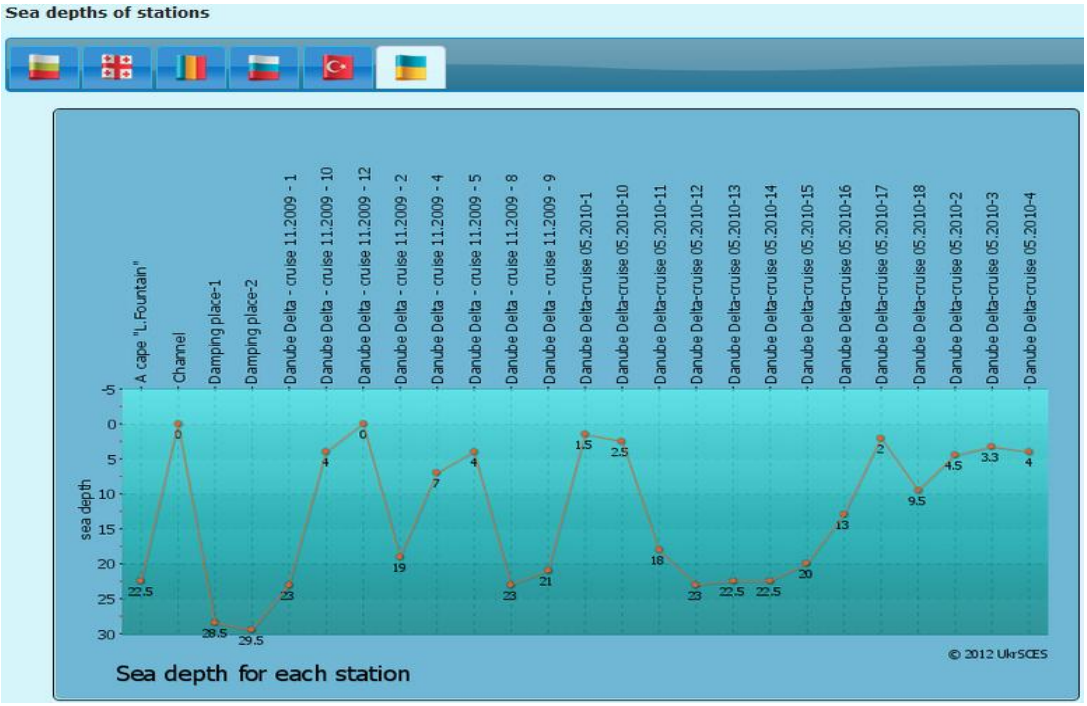


Fig. 13 – Example of graphic report on the depth of sampling stations per country and per year

- A forum called "Help Desk" was also included in the RDB-P in order to communicate any problems in working with the database (see Fig. 14)

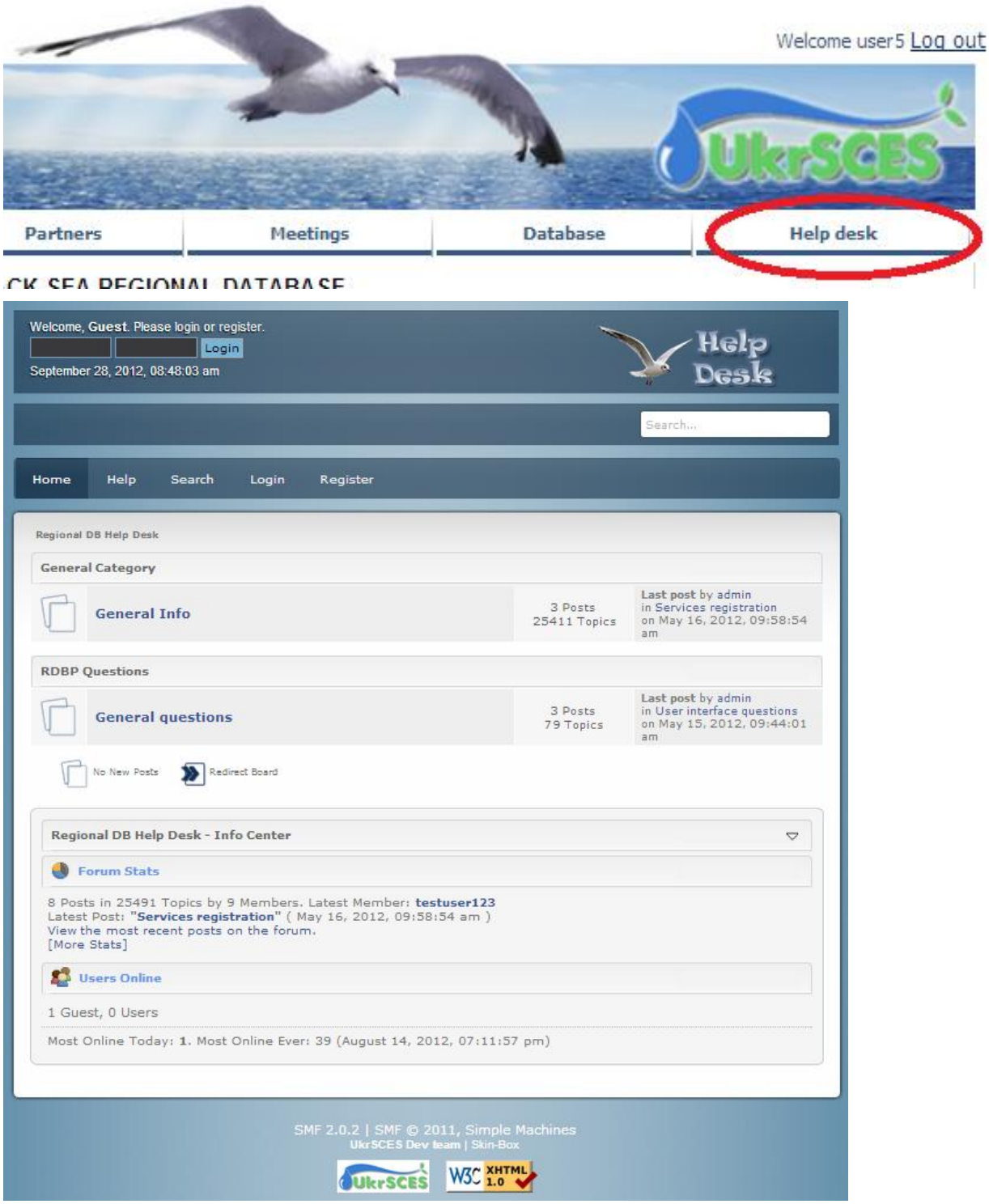


Fig. 14 – Help Desk Interface in the RDB-P

In the regional database for pollution, a system based on interactive visualization of data was developed. The advantages of the system, as presented by developers include extensive hardware scalability capabilities and ability to work with different software platforms (Windows, Unix-based systems). The system can be assembled in high-performance cluster which enables the system to stay "live" during the failure of one or more nodes. Considering that the system is essentially the development environment, there is a possibility for: reconfiguration; programming using web-based programming languages such as PHP, Java, ASP, etc; integration with Oracle, Sybase, MySQL, PostgreSQL and other databases; the ability to integrate with the Google Maps API; the output contains a high-quality cartographic material through support of TrueType fonts, scalable signature graphic pointers, colourings, and export to various bitmap formats.

The user interface of the interactive mapping system consists of three main components: navigation panel, layer/legend switch panel and a main map window.

Examples of common view of user interface, identification of function result, and legend switch function are presented in the figures 15, 16 and 17 below.

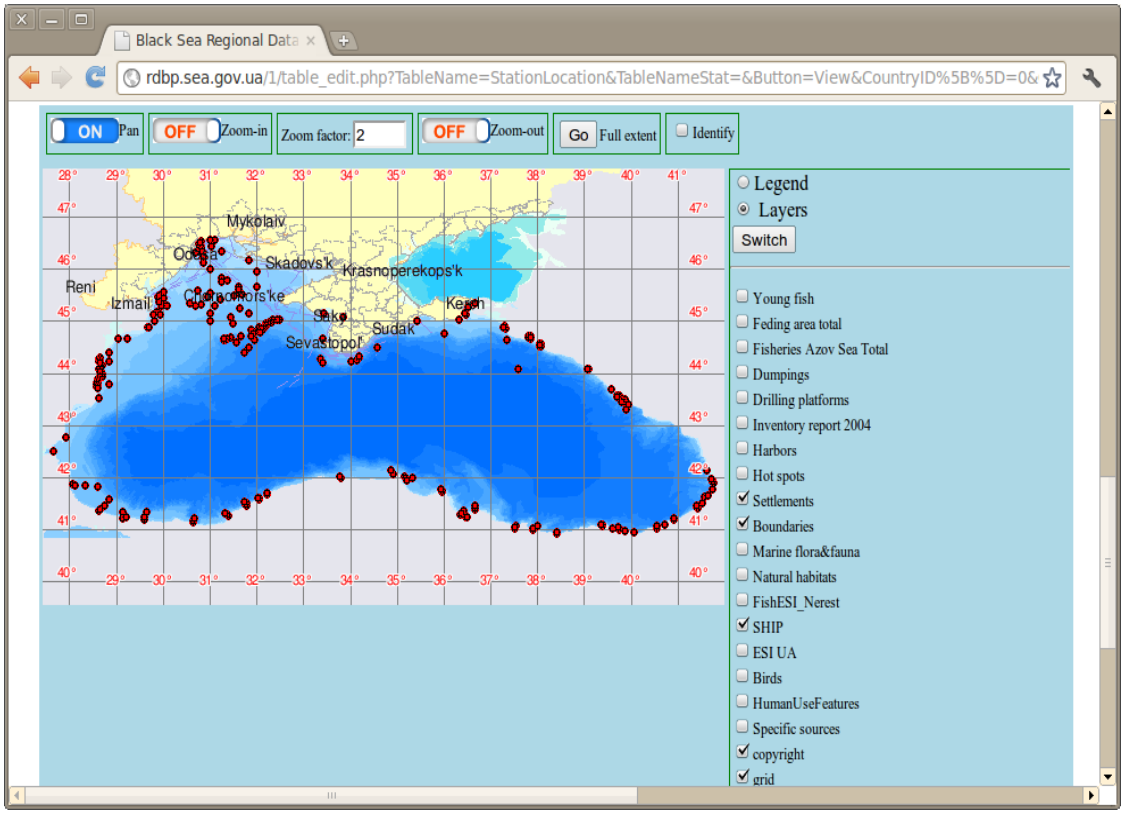


Fig. 15 – Common view of user interface in GIS mapping

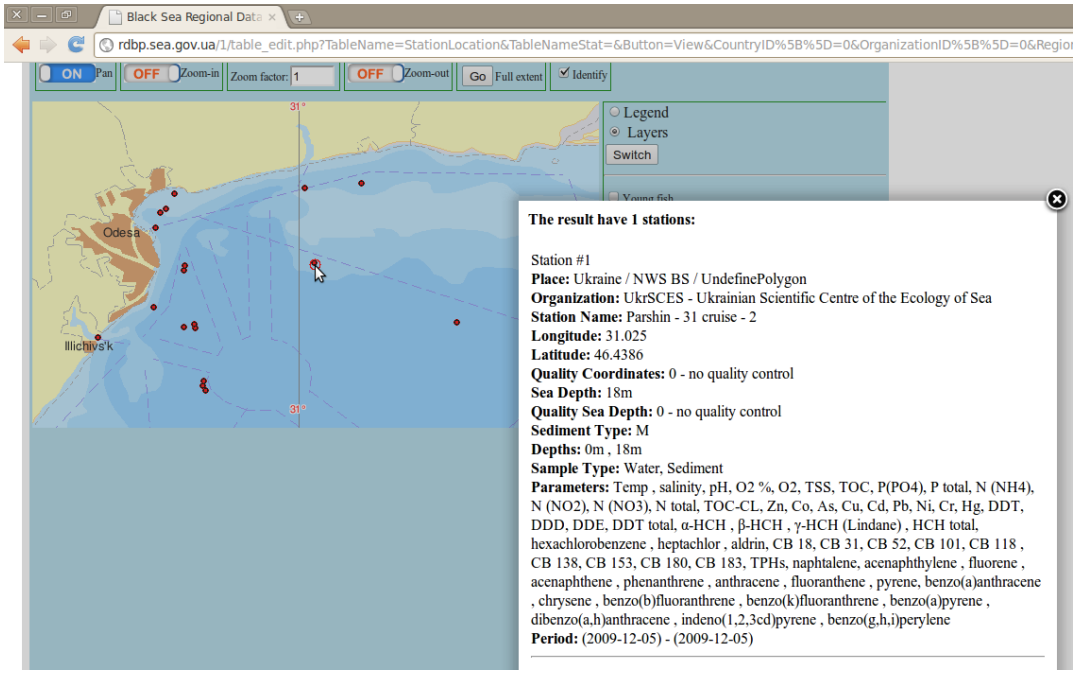


Fig. 16 – Example of site identification

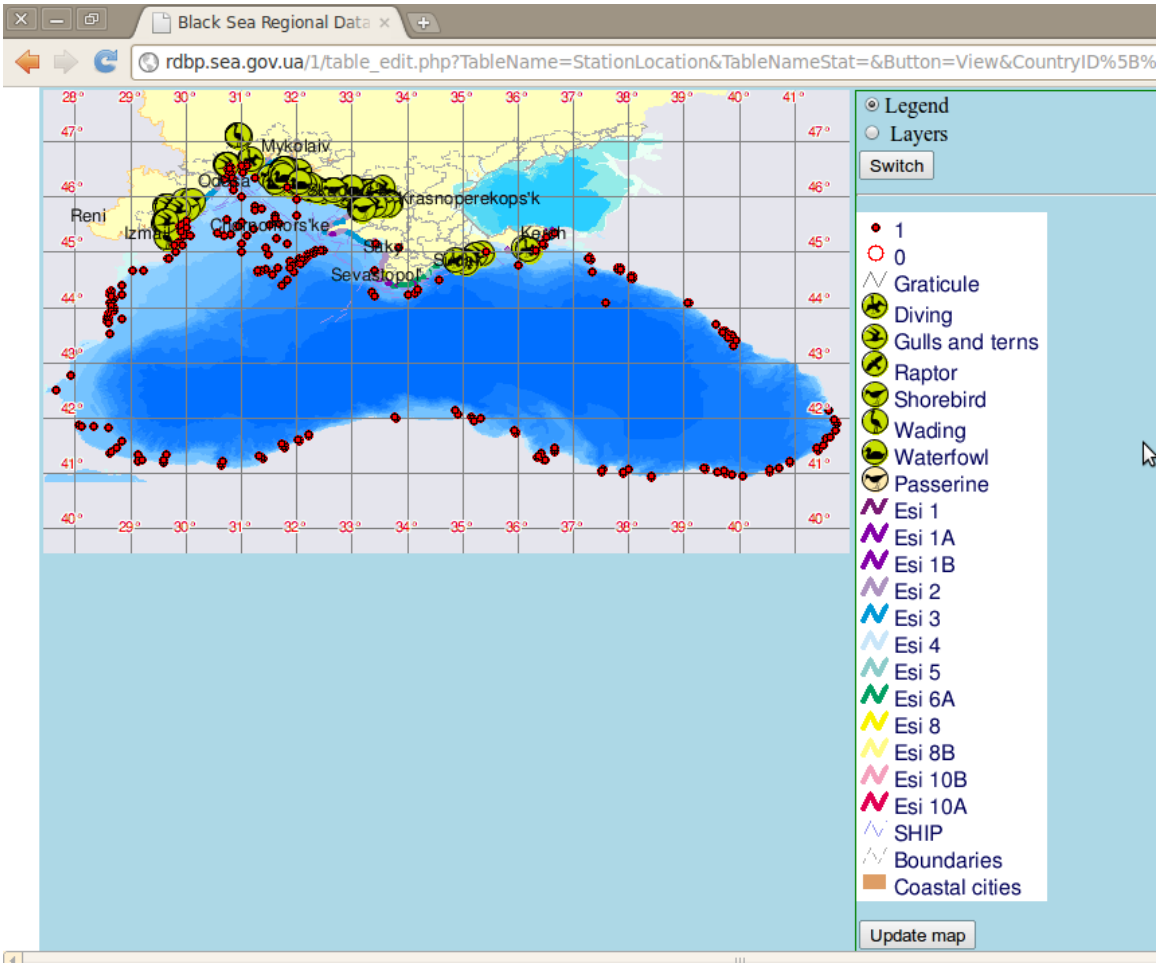


Fig. 17 – Example with legend switch function of database

Another task for developers of the Regional Database for Pollution was setting up the interoperability tools for sharing metadata with European marine information networks. In this respect, the database was structured to ensure the exchange of metadata with the Pan-European network for oceanographic and marine data and information management (SeaDataNet http://www.seadatanet.org); more specific the tables with information about instruments, parameters, organizations, units, etc., which were supplemented with SeaDataNet codes (for common vocabularies).

Based on the comments received from the Permanent Secretariat and PMA and LBS Focal Points, some changes were introduced in the interface and the presented information and statistics. An online training session with the PMA AG members was organized and the feedback was incorporated into the system. The data was verified by the PMA AG members. The final report was accepted by the Permanent Secretariat and the final contractual payment was made.

The tasks included in the Terms of Reference for the RDB-P were completed 100%, as follows:

- Development of a new version of the RDB-P of BSIS with GIS-enabled web interface;
- Acquisition of a high-performance server able of hosting the RDB-P and respective web and GIS applications;
- Install the server hosting the RDB-P and above-mentioned applications and provide online access to the RDB-P via its web interface;
- Upload historical pollution monitoring data reported by all Black Sea countries to the BSC from 2000 to 2011, data for 2012 will be also uploaded after the quality check;
- Create tools for Data Quality Control (DQC) taking into account the regionally agreed DQC procedures developed within the EC FP 7 UPGRADE Black Sea SCENE project (http://www.blackseascene.net/);

- Fulfil DQC and correct the data in the database;
- Prepare RDB-P for sharing metadata with the Pan-European marine data and information network SeaDataNet (http://www.seadatanet.org/) – set-up the SeaDataNet tools for automatic generating of Common Data Index (CDI) files in the database;
- Maintain the RDB-P during the project lifetime and beyond in the framework of the RAC PMA responsibilities, as follows:

- Regular upload of new data reported to the BSC;

- Quality control of the new provided data;

- Update of statistics;

- Calculation of indicators;

- Regular back-up of the database;

- Development of the manual for uploading and downloading the PMA monitoring data/metadata/information into/from the RDB-P.

1.2. Assessment of eutrophication parameters and analysis of status of data collection/reporting/use

This activity corresponds to the A. 2.2 in the project description and it was assigned also to PMA RAC (UkrSCES) under the ToR to their service contract. A full report on the analysis of the sufficiency of data for assessment of eutrophication and state of the marine environment was provided to the BSC PS; the gaps were identified and some solutions to solve the situation were proposed. The results of analysis of the parameters uploaded into the RDB-P per country and years were presented in detail in the report. The data available from countries are unequally represented in the RDB-P, showing the problems had in organising monitoring programmes at national level. For nutrients, the statistics per countries were presented separately, while the analysis of some eutrophication parameters, such as Chl-a, water transparency (Secchi disk values) and total suspended solids (TSS) were presented together, making the comparison between countries easier (Table 3).

Table 3 – General statistics for Chl-a, Secchi disk and TSS

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Bulgaria	Chl a	-	-	-	-	-	-	-	-	-	-	24	-
	Secchi disk	-	-	3	-	-	-	-	-	-	-	-	8
	TSS	-	35	34	37	35	19	11	-	-	-	-	-
Georgia	Chl a	-	-	-	-	-	-	-	-	-	-	-	-
	Secchi disk	-	-	-	-	-	-	-	-	-	-	-	-
	TSS	-	-	-	-	-	-	-	-	-	-	22	-
Romania	Chl a	-	-	-	-	-	-	67	-	-	59	61	-
	Secchi disk	-	-	-	-	89	51	88	88	104	68	37	51
	TSS	-	16	-	-	-	-	54	57	72	51	58	-
Russia	Chl a	-	-	-	-	-	-	-	-	-	-	-	-
	Secchi disk	-	-	-	-	-	-	-	-	-	-	-	-

	TSS	-	-	6	5	-	84	-	104	96	-	88	-
Turkey	Chl a	-	-	13	117	375	370	773	424	350			-
	Secchi disk	-	-	12	3	415	125	131	65	161	62	53	48
	TSS	-	-	-	153	415	832	860	473	1199	429	460	-
Ukraine	Chl a	-	-	-	-	2	4	-	20	-	-	-	-
	Secchi disk	-	-	-	-	-	-	-	20	-	10	46	22
	TSS	1	-	9	96	86	75	82	182	73	178	254	-

As it can be seen from the table above, the gaps concerning the data on eutrophication parameters are quite serious and it looks impossible to fully implement the proposed index (E-TRIX) that was already included in the RDB-P. The main recommendation made after this analysis was to countries to include the Chl-a among the parameters to be reported to the BSC and make sure that all necessary parameters are taken into consideration by national monitoring programmes.

Based on the comments received from the Permanent Secretariat and PMA and LBS Focal Points the data was analysed for its suitability for calculation of eutrophication indicators. During the online training session with the PMA AG members feedback related to eutrophication parameters was incorporated into the system.

The following conclusions and recommendations were made in the final report on development of the RDB-P:

1. The RDB-P development was initially discussed during the BSC PMA AG meeting in 2011. In parallel, the PMA data/information reporting format (Excel) and the format for the annual report (Word) of this group to the BSC were amended. In the amended PMA data/information reporting format (Excel), there is a sheet which gives the detection limits (DL) of each parameter (mandatory and optional) observed in water and sediment. The PMA group agreed on the following: parameters values below the DL should appear as 0 (zero), and not with the sign "<" or in words abbreviated (nd). The data quality check showed that the database of the BSC contains the following errors and inconsistencies:

• Not all countries reported Detection Limit (DL) for a number of parameters. Probably a meeting of experts to discuss this matter should be organized.

• For those parameters values identified as DL, the reporting sheets collected until 2008 contain '<' or wording. All these DLs must be corrected to 0 (zero) as agreed.

• In units applied there were inconsistencies. In the new reporting format the concentration of a number of parameters is given in µmol/l. However, in the old reporting format (prior to 2008) concentrations were expressed in µg/l or mg/l. They need to be converted in µmol/l as agreed and for the purpose of comparison/statistics.

• There are cases where the concentration of total nitrogen was lower than the amount of mineral forms, which is an obvious error. These data must be either removed or where possible corrected sending it back to the originator.

• The number of significant figures in the values of the concentrations of some parameters exceeds the precision of the method for determining and requires appropriate checks and has to be fixed.

2. The insufficiency of Chl-a data in BSIS (and RDB-P respectively) hampers the correct calculation of the indicator E-TRIX, which characterizes the trophic status of waters. Satellite data might be collected by UkrSCES and incorporated in the RDB-P (taking into consideration the changes in satellites and the need to develop a new regional algorithm). Besides, the Diagnostic Reports of the BSC has shown the availability of Chl-a data outside of the official flow of reporting of states to the BSC. Where possible, the BSC is recommended to negotiate the delivery of these data so that to improve the regional assessments of BS eutrophication (e.g. in the 5-yearly BS SoE reports).

3. For the future work on calculation of statistics, indicators, and trends the «background and MAC» values of parameters need to be specified by all countries.

4. Organizations representing their country, can view their own data, which are up to date in the RDB-P incorporated. If there is evidence that for some reason some data were not provided to the Black Sea Commission and uploaded into the RDB-P, the data provider in each country can do this directly into the RDB-P using the on-line mode.

5. The most important thing at present is to ensure a robust control on the data uploaded by the experts from each country of the Region responsible for the national data reporting to the BSC. The UkrSCES team provided preliminary data quality control when uploaded the BSC historical data for the period 2000-2011. In the RDB-P interface there is a function RDB Database Quality Control. However, the final DQC should be the responsibility of the data providers. For instance, the monitoring data of Ukraine, reported to the BSC, were checked by the experts of UkrSCES (Yuriy Denga and Volodymyr Ukrainsky). The data from Russian Federation were checked by the expert of SOI, Moscow (Alexander Korshenko), who is responsible for the PMA data reporting to the BSC. Therefore, to make the RDB-P fully operational (including DQC), the BSC should develop a procedure, where the rules of data upload, DQC and where necessary additional verification/revision of data, and use of data and data products generated should be specified and agreed by the contracting parties.

6. At the last meeting of the AG PMA (18-19th September, 2012), upon the request of the AG PMA, UkrSCES experts reported on the full functionality of the developed Help desk (forum). This Forum where interested visitors can post questions about the RDB-P is functioning since 25th September, 2012 and has to be used by visitors to the RDB-P for their help.

7. As the Baltic2Black Sea Project ended in 2013, the RDB-P database further development is going to take place in the EMBLAS Project ("Improving Environmental Monitoring in the Black Sea", funded by EC DG Devco). EMBLAS includes an activity where the RDB-P, as a component of BSIS, is going to be upgraded to a web-based Black Sea Water Quality Database (initially as a prototype, then in EMBLAS II it will become fully operational). EMBLAS plans to also develop a regional Phytoplankton data base and to further develop the existing regional *Mnemiopsis* data base, both of them as parts of the BSIS. Compatibility/interoperability of the BSC data base components with WISE-MARINE, SEIS, SeaDatNet, EmodNET and other data infrastructures will be developed or enhanced.

Within EMBLAS the role of the BSC PS is important, since the BSC PS is responsible for annual compilation of data from the Black Sea countries and preparation of different regional reports.

It will be important to set-up the rules for the database usage, e.g. what kind of information from the Database can be available for the data providers, the authorship, etc. Many existing databases are not for public use and it is difficult to obtain data from them.

The Bucharest Convention envisages free exchange of data. Thus, after final quality control of the data, BSIS will be opened for the wide public. Some of the project partners have good experience with web-based databases (e.g. UkrSCES), that are also publicly available.

One of the options could be that the database should not make the raw data available, but only the analytical presentations, products that are ready for use – maps, graphs, etc.; not only the data collection, but also data presentation. It has been suggested, that at the initial stage of developing the database it will be necessary to hold a meeting with a wide range of experts to discuss the issues mentioned above.

The existing database of the BSC (developed by and based in UkrSCES) contains a lot of data. The software of the database should provide the ability to statistically analyze the data and prepare reports - charts, graphs, maps, etc. UkrSCES has also extensive experience in international projects (FP6 and FP7 scheme, INTERREG) and intercomparison exercises. It has been suggested, that the EMBLAS Project (http://blacksea.iwlearn.org) should cooperate with or use the results of BlackSeaSCENE, UpGradeBSSCENE, EMODNET, SEADATA NET, enviroGRIDS, PERSEUS, CoCoNet, Baltic2Black, MISIS

(http://www.misisproject.eu/), PERSEUS, COCONET, in improving the BS data bases.

8. There was a proposal to organize a Focus virtual workshop with the BSC and members of AG PMA for checking the functionality of the RDB-P.

The virtual workshop was organized in November, 2013 and the PMA AG members participated to learn how to work with the data stored in the database.

2. Elaboration of regionally agreed criteria for assessment of eutrophication

2.1 Reference and target concentration levels

Ideally, the reference value for a given parameter (in this case for those of eutrophication) represents a natural state that has not been affected by any human activity. In practice, however, reference values are usually based on observations made in areas that have experienced some slight human impact. In some cases, historical data, model-based estimates or even expert judgment are used.

In relation to the reference values the target values for the same parameters are higher, as they represent a gradual tendency towards desired good ecological/environmental status.

The reference and background concentration levels of eutrophication parameters and pollutants of sea water were discussed one more time during the 22nd PMA AG meeting organized back-to-back with the 2nd Workshop on Eutrophication in the frame of the present project. As the fact that the reference concentrations of pollutants are site specific was already admitted by the PMA AG members, it was proposed to prepare projects aiming for screening of pollutants from different areas of the Black Sea, in order to properly determine the background concentration.

Despite that the two EU Member States, Bulgaria and Romania have established their reference conditions under the WFD, presently it might be necessary that these are revised in order to fulfil the requirements of the MSFD for eutrophication and pollution of water and sediments. For the assessment of the reference conditions, the historical data archives, scientific literature and expert judgment (as the data were obtained by different working methodologies, most of them not comparable between each other) were used. The work is on-going in these countries as well for establishing the target concentration for pollutants in water, sediments and biota.

Romania is the first EU country from the Black Sea region establishing the Good Environmental Status of its waters under MSFD, at least for the D5 – Eutrophication, taking into consideration the reference conditions set up for the WFD and considering the indicators for Eutrophication from the Decision COM 2010/477/EU. Analysing the report prepared by Romania on GES, specifically on D5-Eutrophication, it resulted that the GES was established for the eutrophication indicators following values of “good” and “very good” ecological status from the WFD for their transitional, coastal and marine waters. Nevertheless, the target concentrations at least for eutrophication indicators are not very specifically set. Concrete targets were set up for the ***ratio N/P***, where to reach GES, the optimal ratio should be maintained...”near to optimal value, i.e. higher than 10”; for the water ***transparency***, that should be maintained within the limits 3-9 m, or above. For other parameters, the GES look vaguer, as for example: GES for the “chlorophyll a concentration in water column” is considered...”through the reducing of the actual concentration (the percentage is not specified!), especially during the summer, in areas under the influence of the land-based sources of pollution, where the nutrient input is higher”... Another attempt for GES was undertaken by RO under the D8 – Contaminants; again it was stated that: “the progress towards a good environmental status depends on progressive elimination of pollution, i.e. contaminants in marine environment and their effects on biota are maintained within acceptable limits, and thus to ensure that there are no significant effects on marine environment”...

Bulgaria reported to EU on IA and GES later in 2013. An official notification on the submitted reports was sent to the BSC PS by the BG member of the BSC. Analysing the BG report it can be seen that there were difficulties in both determination of the reference conditions and setting the targets for some parameters due to lack of data. For the **D5-Eutrophication**, based on the available data, targets were established for: ***nutrients*** (phosphates, nitrates and ammonia), ***nutrients ratio (N/P and Si/P)***, ***chlorophyll*** in water column, and ***water transparency*** (Secchi disk). Thus in case of ***nutrients*** the thresholds have been determined separately for phosphates, nitrates and ammonia for coastal, shelf and open sea areas for spring and summer. The target in this case was defined as “reduction of the concentration of nutrients in the coastal area and reduction of the nitrogen in the shelf area in accordance with” the calculated thresholds. For the nutrients’ ratio, the comparison between different areas using the data collected between 2008 and 2010 showed the increase of the ratios Si/P and decrease of N/P in both open sea and shelf areas, whereas in the coastal the situation is opposite.

The approach in determining the GES for ***chlorophyll*** was similar to that used in the classification system for water quality according to WFD requirements. The GES in this case was defined as "the physical, hydrological and chemical conditions are suitable for long-term maintenance of the concentration of chlorophyll on a level not affected by human activity". Criteria for progress in achieving GES: within a 6 year period 95 percentile of the monthly values of chlorophyll concentration should not exceed the threshold values more than 10% in the spring season and 5% of the monthly values in the summer. The trend should indicate improvement. The thresholds for chlorophyll concentrations range between 1.2-1.7 mg/m3 in coastal area (spring) to 0.15-0.2 in open sea (summer).

For ***water transparency*** (Secchi disk), the target was defined in a similar manner as for the chlorophyll: "the physical, hydrological and chemical conditions are suitable for long term maintenance of the transparency of water at a level unaffected by human activity". Criteria for progress in achieving GES: within a 6 year period the 95 percentile of the monthly values for Secchi disk should not exceed the threshold values in more than 10% of the cases in spring, and 5% in the summer. The improvement trend should be maintained. Similar to nutrients and chlorophyll, the thresholds are different from spring to summer for coastal, shelf and open sea areas, ranging between 4.5-7 m in coastal area in spring time and 18-20 m in open sea in summer.

As could be seen from above, even though the framework is set by the MSFD, the approaches of the two countries in determining the GES and defining the targets are quite different from each other.

Within the MSFD Grant to BSCPS, the issue of good environmental status of the Black Sea started to be discussed by both PMA and LBS AGs. It was considered though in the revision of the Black Sea Monitoring and Assessment Programme prepared under the above-mentioned Grant Agreement that will be discussed and supposedly approved by the BSC in its 30th Regular Meeting that will take place on 19-20th November, 2014.

Ukraine established the background concentrations for a specific set of pollutants in water and sediments; the Russian Federation adopted in 2010 Maximum Allowable Concentrations (MACs) for a large set of chemical parameters for its waters. Georgia has also MACs established for pollutants in their waters. All these values (reference concentrations, background values or maximum allowable concentrations) were collected from the BS countries and compiled together in a table to compare the differences and similarities. The results of this comparison showed that not all the parameters were considered by all the BS countries and here is where the future work should focus on.

Nevertheless, the limits or the concentrations for either "good ecological status" (according to WFD) or "good environmental status" (MSFD) were not defined.

Elaborating the target concentration of eutrophication parameters and pollutants as well is a very challenging task for the Black Sea countries. This will only be possible after the elaboration of the reference conditions by all countries and most probably, the non-EU countries will use as much as possible the experience of the EU countries in this respect.

The BS countries that are EU Member States encountered some difficulties in defining the GES for their national waters, fact that was not envisaged when the project proposal was prepared and submitted to EC for financing. Therefore the elaboration of targets for eutrophication and pollution for the Black Sea would be difficult at this stage; it will be only possible to propose a preliminary set of reference and target values for eutrophication parameters and continue working on this issue, in the same time improving the data collection.

For this purpose, the Permanent Secretariat prepared contracts with experts from the Black Sea countries whose tasks were to prepare and propose a set of reference and target values for eutrophication parameters. As per the end of December 2013 the experts from Bulgaria, Romania and Ukraine have submitted their deliverables. Due to some delays in data availability in the Russian Federation, Georgia and Turkey an extension to the project was requested, which was granted. Deliverables by the national experts from the Russian Federation, Georgia and Turkey were submitted by the end of the granted three months period. The results are presented below.

Proposed reference and target concentrations of eutrophication parameters

North-western and Western Black Sea

According to geomorphological features the Black Sea is divided into eastern, western and north-western areas. The north-western part of the Black Sea is under the influence of the flow of the three major rivers (the Danube,

Dnieper and Dniester). River runoff has a significant impact on both formation of surface water masses, and biochemical features of the shelf. Mixing the river water with sea water is uneven; there are frontal plumes with high salinity gradients and other specific features, as well as areas with relatively uniform characteristics.

In elaboration of reference conditions, the experts used in general historical data to the possible extent, the time-series data collected from reference sites (where available), scientific literature, reports and where very few data were available they used expert judgment.

Ukraine

Although the water bodies in this country were not defined according to the WFD, the identified areas can be assimilated to the three major water bodies: **transitional** (Dnipro, Dnistr and Danube, even the mixing area shown in the Fig.18), **coastal** (Karkinit, Kalamit, SW Crimea and SE Crimea) and **marine** (W deep-sea and E-deep-sea). Because these areas are in both western and eastern sub-basins, displaying different hydrochemical and hydrological characteristics, the reference values and targets considered all these areas and did not simplify the assessment to the three types of water bodies only (Table 4).

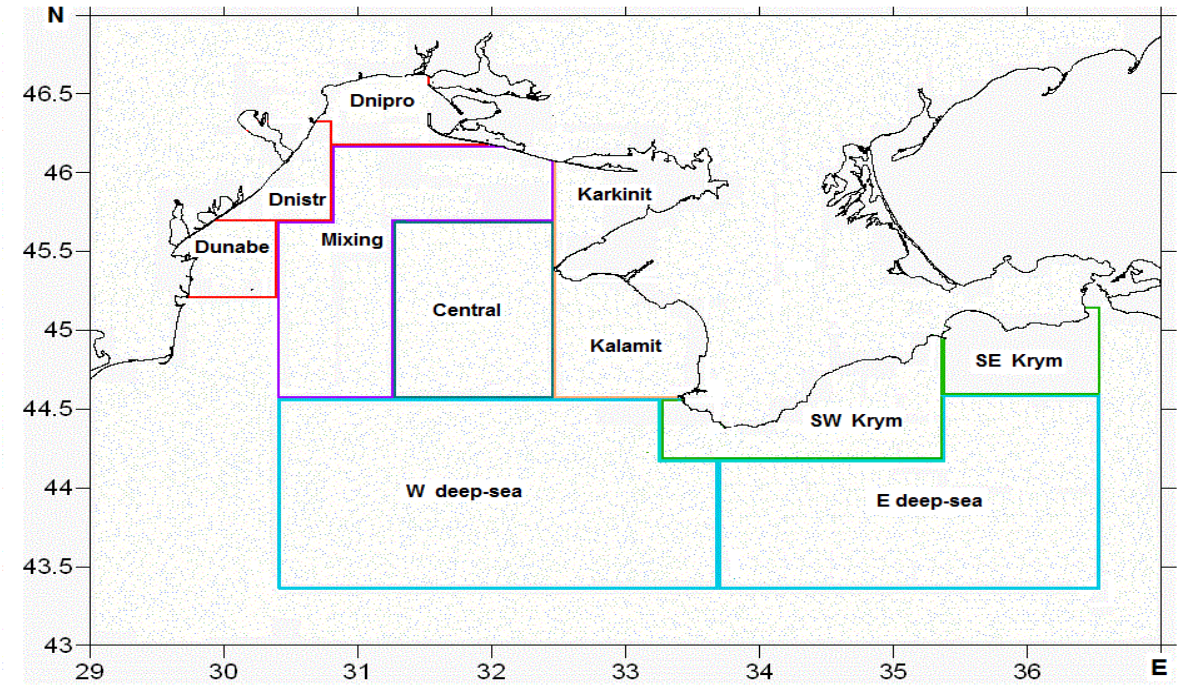


Fig. 18 – Zoning of the NW and N Black Sea waters (Ukraine) for elaboration of reference conditions and targets for eutrophication parameters

Table 4 – Reference and target concentrations of eutrophication parameters for the Ukrainian waters (NW and N Black Sea)

Parameter	Dniester (transitional)		Dnieper (transitional)		Danube (transitional)		Karkinit (coastal)		Kalamit (coastal)		Mixing		Central		SW Crimea		SE Crimea		W Deep sea (marine)		E Deep sea (marine)	
	Ref	**Targ**	**Ref**	**Targ**	**Ref**	**Targ**	**Ref**	**Targ**	**Ref**	**Targ**	**Ref**	**Targ**	**Ref**	**Targ**	**Ref**	**Targ**	**Ref**	**Targ**	**Ref**	**Targ**	**Ref**	**Targ**
DIP (µmol/l)	0.336	0.504	0.313	0.471	0.462	0.694	0.123	0.184	0.094	0.142	0.203	0.307	0.184	0.278	0.107	0.161	0.126	0.190	0.077	0.116	0.065	0.097
DIN (µmol/l)	1.528	2.292	1.749	2.627	3.641	5.462	0.457	0.685	0.593	0.892	0.514	0.771	0.371	0.557	0.493	0.742	0.436	0.657	0.364	0.550	0.328	0.493
Chl-a	0.8	1.2	0.6	0.9	1.2	1.8	0.6	0.9	0.45	0.7	0.5	0.8	0.45	0.7	0.45	0.7	0.5	0.8	0.2	0.3	0.2	0.3
O_2 (µmol/l)	312.5	250.0	318.8	256.3	306.3	243.8	300.0	240.6	284.4	228.1	293.8	234.4	287.5	231.3	290.6	231.3	293.8	234.4	287.5	231.3	290.6	231.3
O_2 %	102	82	106	84	104	84	101	81	101	81	101	81	101	81	101	81	102	81	101	81	102	81
Secchi (m)	7.4	6.0	8.3	6.6	6.1	5.2	12.7	10.1	15.0	12.0	11.5	9.2	13.4	10.7	14.8	11.9	11.6	9.2	15.2	12.2	15.9	12.7
TSS (mg/l)	1.0	1.5	1.0	1.5	1.5	2.25	1.0	1.5	1.0	1.5	1.0	1.5	1.0	1.5	1.0	1.5	1.2	1.8	0.4	0.6	0.4	0.6

Table 5 – Reference and target concentrations of eutrophication parameters for the Romanian waters (NW Black Sea) strongly influenced by the Danube input

Parameter	Transitional		Coastal		Marine	
	Reference	**Target**	**Reference**	**Target**	**Reference**	**Target**
DIP (µmol/l)	0.3	0.45	0.2	0.3	0.15	0.23
DIN (µmol/l)	25	37.5	9	11.25	7	10.5
Chlorophyll a (µg/l)	3.9	5.85	2.05	3.08	2.05	3.08
Dissolved Oxygen %	80	60	80	60	80	60
Transparency (m)	3.0	2.3	7.5	5.6	9.0	6.8

The parameters for which the reference and target values were determined for Ukrainian waters are the following: nutrients (expressed in Dissolved Inorganic Phosphorus – DIP – and Dissolved Inorganic Nitrogen – DIN - for the purpose of application of the eutrophication assessment tool, BEAST); chlorophyll-a, water transparency, dissolved Oxygen – DO - (both concentration and saturation), total suspended solids (TSS) and even other biological indicators (phytoplankton biomass). The analyses made for all these parameters can be found in the report prepared by Ukrainian expert. For harmonization purposes, the phytoplankton biomass was not included into the Table 1, Ukraine is being the only country considering this indicator.

Romania

The assessment took into consideration the delimitation for the transitional and coastal water bodies done for WFD. Due the significant influence of the Danube river state which accumulates all the pressures from its catchment, the Romanian coastal waters were included in the Danube's hydrographic district with 807.827 km^2 surface. The Black Sea Romanian littoral length is 244 km, representing 6% from the total Black Sea shore including 128 km of marine transitional waters (RO_TT03 – located between Chilia and Periboina) and 116 km of coastal waters (RO_CT01- shallow coastal waters with sandy bottom located between Periboina and Cap Singol, RO_CT02- shallow coastal waters with mixed bottom located between Cap Singol and Vama Veche) (ANAR, 2009). The assessment was done on the data reported by Romania to the Black Sea Commission (Pollution Monitoring and Assessment Group Romania's reports – surface waters) for the interval 2004-2012 (no data for 2005) based on 36 seasonal cruises. The network of the monitoring stations consists of 36 sites between Sulina and Vama Veche (depths within 5-50m), covering the entire Romanian coast (Fig. 19). The results were compared to the historical data and where data was missing, expert judgment was used.

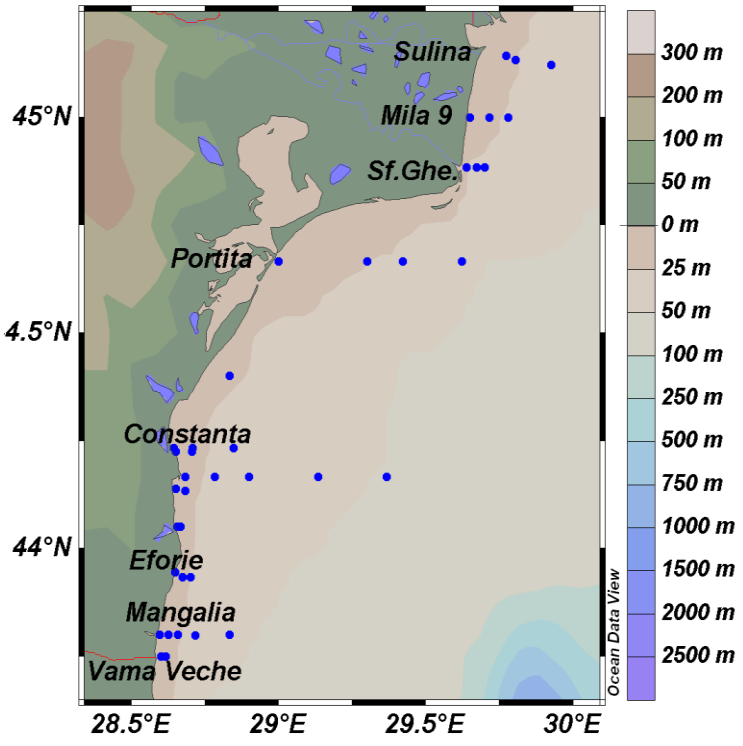


Fig. 19 – Romanian monitoring network used for defining the reference and target concentrations of eutrophication parameters

The analyzed parameters (DIP, DIN, chlorophyll-a, transparency, DO – saturation only) and the proposed values can be seen in Table 5. Detailed analysis can be found in the attached Romanian report.

Bulgaria

Bulgaria defined only coastal and marine waters in the Black Sea, not transitional. Being an EU Member State, Bulgaria reported on Initial Assessment (IA) and Good Environmental Status (GES) (elaboration of environmental targets) according to the requirements of Marine Strategy Framework Directive. The water bodies were classified according to three factors: wave exposure, sediment structure and depth. According to the above-mentioned criteria, for coastal area six types and 13 water bodies were identified. Also, Bulgaria identified potential reference locations, aiming to support establishment values of reference conditions on the biological quality elements (chlorophyll-a is part of them). The determination of these sites is based on the analysis of human impacts: review and identification of areas with little or no pressure and impact of coastal origin (agriculture, point and diffuse sources, etc.) and from activities, causing morphological changes (dredging, deepening, disposal, etc.). As result of the analysis two potential reference sites were identified (Fig. 20).

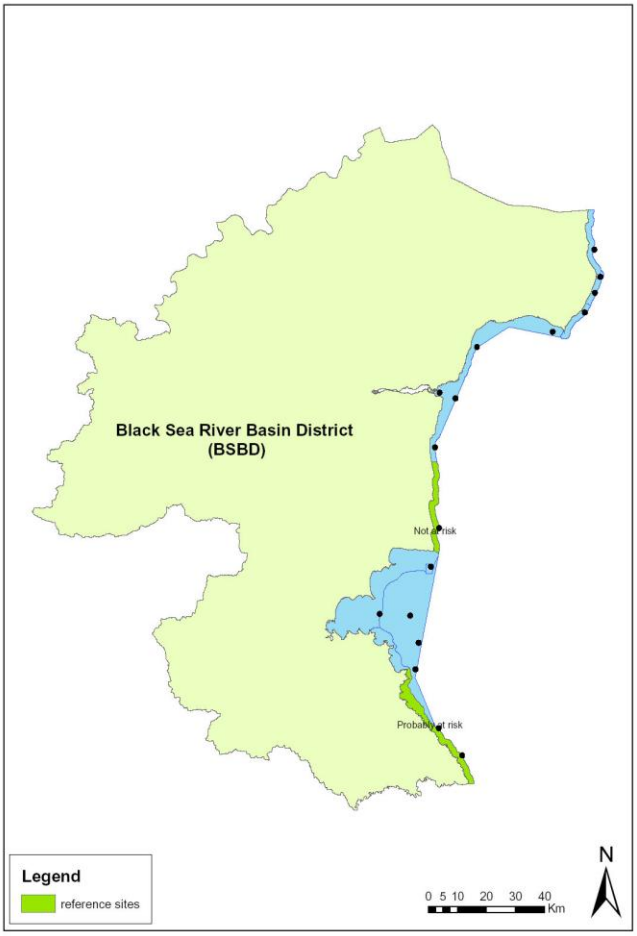


Fig. 20 – Reference sites and water bodies in the Bulgarian coastal area (W Black Sea)

For deriving the reference conditions for Bulgarian coastal waters different data sources were used: historical data, Usunov report (2005), EVD-project (2006) and the results of the project "Assessment of the impact of land-based sources on the marine and coastal environment, ecosystems and biodiversity".

As in many other countries, reliable data of the “pristine” period (before the 1970s) collected with the methodologies as used today are not (sufficient) available for Bulgarian coastal waters. There is a lack of data for high status sites because the focus for monitoring programs has historically been centred on polluted areas. Furthermore a major part of the historical data is not accessible in a database format, as it only exists in paper version. The reference values and classification systems for assessment (developed for biological elements and selected metrics) were developed by the Institute of Oceanology, Bulgarian Academy of Sciences (IO-BAS). Reference conditions and classification systems are developed for two group types, depending on the impact of the factors used in determining the types - depth and wave exposure. Nevertheless, the analysis took into consideration the coastal waters only. For marine waters, the data was very limited and were not considered in the assessment. As the conditions are different in different seasons, the reference and targets concentration of eutrophication parameters were elaborated for every season. The considered parameters were: nutrients (phosphates, nitrates, nitrites, ammonia), dissolved oxygen (both concentration and saturation), chlorophyll-a and water transparency (Table 6). The total suspended solids (TSS) were not considered relevant for eutrophication and not included into the assessment. Detailed analysis is presented in the report submitted by Bulgaria (attached).

Table 6 – Proposed reference and target concentrations for eutrophication parameters in Bulgarian waters (W Black Sea)

Parameter	**Coastal waters**	
	Reference	**Target**
Phosphate ($P\text{-}PO_4$) (µmol/l)	0.7-2.3*	1.2-3.3
Nitrate ($N\text{-}NO_3$) (µmol/l)	1.14-7.14	2.86-9.64
Nitrite ($N\text{-}NO_2$) (µmol/l)	0.43-0.71	0.71-0.93
Ammonia ($N\text{-}NH_4$) (µmol/l)	0.57-2.14	1.57-3.00
Chlorophyll a (µg/l)	0.8-2.0	1.35-2.9
Dissolved Oxygen (saturation) %	100-106	90-94
Dissolved Oxygen (µmol/l)	260-381	250-394
Transparency (m)	4.5	3.7

* Both reference and target values for all parameters, except for water transparency were elaborated for every season (detailed explanations in the Bulgarian report)

South-western and south-eastern Black Sea

Turkey

Turkey, as an accession country to the EU just started the work on defining the water bodies in their part of the Black Sea according to the EU legislation. The studied area for which the preliminary set of reference and target concentrations of eutrophication parameters was elaborated and is presented in the Fig. 21.

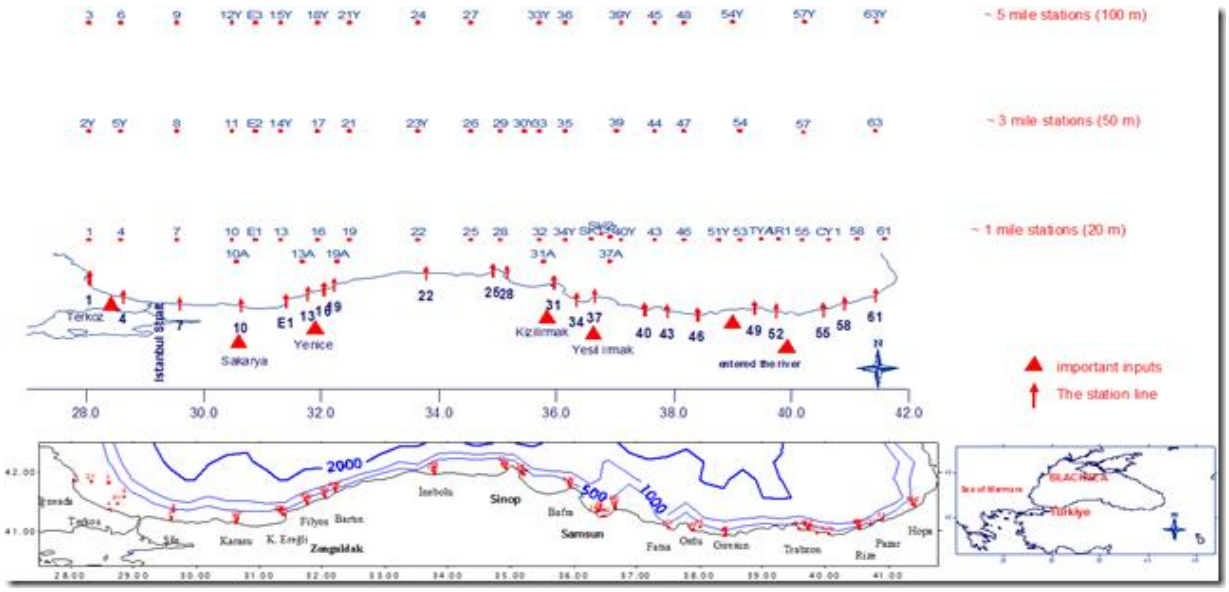


Fig. 21 – Monitoring network in the Turkish Black Sea (SW, S and SE Black Sea)

Hydro-chemical data were obtained seasonally/annually by Middle East Technical University-Institute of Marine Sciences (METU-IMS) from the SW and SE sub-basins of the Black Sea, extending from coastal to the central part of the basin, in the spring-autumn period of 1986-2013 Eutrophication monitoring program. Very limited winter data were available.

In addition to METU-IMS data, winter data obtained by Istanbul University' Institute for Marine Sciences and Management (IU-IMSM) only from the coastal zone (1-5 miles offshore) of the southern Black Sea in winters of 2010 and 2011 are evaluated separately in the D-1 report which also includes the comparison of these date sets to assess temporal and regional variability in the nutrient contents of the coastal and offshore water bodies in the eastern and western coastal sub-basin of the Southern Black Sea.

The reference and targets were proposed for the following parameters: nutrients (phosphate, nitrate + nitrites, silicate) including the nutrient ratios (N/P; Si/N), chlorophyll-a and dissolved oxygen. There were no available data for water transparency. For silicate, Si/N and chlorophyll there are different values proposed for the two sub-basins: SW and SE Black Sea (Table 7). Detailed presentation of statistical data analysis and results can be found in the attached Turkish report.

Table 7 – Proposed reference and target concentrations for eutrophication parameters in Turkish waters (SW and SE Black Sea)

Parameter	**Coastal waters**		**Marine waters**	
	Reference	**Target**	**Reference**	**Target**
Phosphate ($P\text{-}PO_4$) (µmol/l)	**0.06**	**0.09**	**0.06**	**0.09**
Nitrate + Nitrite (NO_x) (µmol/l)	**0.15**	**0.23**	**0.15**	**0.23**
Si(µmol/l)	**≥4.0** SW sub-basin **3.0** SE sub-basin	**≥2.5** SW sub-basin **2.0** SE sub-	**≥4.0** SW sub-basin **3.0** SE sub-basin	**≥2.5** SW sub-basin **2.0** SE sub-

		basin		basin
N/P ratio	**7.0**	**10.0**	**7.0**	**10.0**
Si/N ratio	**15.0** SW sub-basin **10.0** SE sub-basin	**10.0** SW sub-basin **7.0** SE sub-basin	**15.0** SW sub-basin **10.0** SE sub-basin	**10.0** SW sub-basin **7.0** SE sub-basin
Chlorophyll a (µg/l)	**0.35** SW sub-basin **0.25** SE sub-basin	**0.5** SW sub-basin **0.38** SE sub-basin	**0.35** SW sub-basin **0.25** SE sub-basin	**0.5** SW sub-basin **0.38** SE sub-basin
Dissolved Oxygen (µmol/l)	**80.0**	**≥ 50.0**	**80.0**	**≥ 50.0**

The main conclusions from the Turkish data analysis can be summarized as follows:

- The reduction of N, P emissions from external sources should not only lead the Black Sea photic layer ecosystem to "new" reference nutrient conditions, to improvement of optical properties, and reduction in algae production and biomass, but also increase the thickness of well oxygenated + oxygen gradient zone (oxycline).
- There were no sufficient winter data, other than the those from coastal zone of southern BS between 2008-2011, for trend analysis of the surface nutrient concentrations and their molar ratios, which are essential for assessment of the new reference and threshold concentrations of nutrients and the ratios, biomass (in term of Chl-a), dissolved oxygen profiles in the suboxic waters under changing winter conditions and chemical fluxes.
- For the achievement of GES objectives in the Black Sea, DIN inputs from both rivers and precipitation should be reduced to the threshold levels that can only be estimated by N-P-Si coupled 3D ecosystem model. Simulation of reliable model results to reach GES targets highly needs basinwide winter and late summer data sets, and systematic measurements in the major rivers and precipitation. Then, the experts can use both models results and observations to assess the "new" reference concentrations for different water bodies of southern Black Sea.

North-eastern and Eastern Black Sea

Georgia

For the eastern Black Sea there were small amount of historical data available, especially for Georgian waters. Therefore, after a summary analysis of the available chemical data, the Georgian expert proposed for the start to consider the values identified for Russian and Turkish (SE Black Sea) waters. Based on the very limited analyzed data, a very preliminary set of values were proposed as reference for the coastal waters only. At closer analysis the proposed reference values for chlorophyll-a and transparency are questionable, considering the hydrological and hydrochemical features, as well as the reduced riverine input in the eastern part of the Black Sea (Tab.8).

Table 8 – Proposed reference values for eutrophication parameters in Georgian coastal waters (E Black Sea)

Parameter	**Coastal**	
	Reference	**Target**
Phosphate ($P\text{-}PO_4$) (µmol/l)	0.5	-
Nitrite ($N\text{-}NO_2$) (µmol/l)	0.5	-

Silicates (Si)	7.14	
Chlorophyll a (µg/l)	4	-
Dissolved Oxygen (saturation) %	105	-
Dissolved Oxygen (µmol/l)	281.25-312.5	-
Transparency (m)	5	-

The values are just preliminary and further work is necessary. Most important is the strengthening of national monitoring programme for collecting necessary and reliable data.

The Russian Federation

For elaboration of the first proposed set of the reference and target concentrations of eutrophication parameters that later on will be used for eutrophication assessment of the NE and E part of the Black Sea by using the BEAST tool, several data sources were used: raw data from the state routine monitoring system, historical Soviet data and scientific literature.

The raw data for the Russian Black Sea waters were obtained by two institutions of Roshydromet involved into the Russian state monitoring programme: Hydrometeorological Bureau of Tuapse (HMBT Tuapse) and Special Center on Hydrometeorology and Monitoring of Environment of the Black and Azov Seas (SCHME BAS, Sochi).

Historical data: This source of data could be obtained from the database "SeaBase UkrSCES" (Odessa, Ukraine) and from data-base of YugNIRO (Kerch, Ukraine). The amount of records of measurements in the coastal waters of Russia is rather limited.

Literature: The main source of data for nutrients in the Caucasian coastal waters is the monograph of the Series "Seas of the USSR", Vol. IV, Issue 2 and "Seas of the USSR", Vol. IV, Issue 1.

Additionally, standard satellite images in the visible spectrum were used for the calculation of chlorophyll concentration in the surface waters.

As the Russian Federation didn't divide the water bodies into transitional, coastal and marine, in the presented analysis, the estuarine waters were assimilated to transitional type (details in the attached Russian report). The proposed values for most of parameters (nutrients – phosphate, nitrite and ammonia – chlorophyll-a, and dissolved oxygen are the same for all water types, except for transparency (Table 9).

Table 9 – Proposed set of reference and target concentrations of eutrophication parameters in Russian waters (NE and E Black Sea)

Parameter	Transitional (estuarine)		Coastal		Marine	
	Reference	Target	Reference	Target	Reference	Target
Phosphate ($P\text{-}PO_4$) (µmol/l)	0.255	0.384	0.255	0.384	0.255	0.384
Nitrites ($N\text{-}NO_2$) (µmol/l)	0.214	0.321	0.214	0.321	0.214	0.321
Ammonia ($N\text{-}NH_4$)	2.898	4.384	2.898	4.384	2.898	4.384

(µmol/l)						
Chlorophyll a (µg/l)	0.9	1.35	0.9	1.35	0.9	1.35
Dissolved Oxygen (µmol/l)	221.88	178.13	221.88	178.13	221.88	178.13
Transparency (m)	4.0	3.2	4.0	3.2	12.0	9.6

The extensive analysis of the available data for eutrophication parameters for the difficult task of elaboration of reference conditions and targets for achieving the Good Environmental Status of the Black Sea lead to a conclusion agreed by all experts: **there is a need for improvement of the spatial coverage of the national monitoring networks and more accuracy in data collection**; this will contribute to the future revision of the proposed reference and target values for eutrophication parameters.

Considering the above information, we may conclude that this activity was completed for the project (see D3.1 – activity summary - and full reports provided by the contracted experts).

2.2. Elaboration of a regional methodology on identification of water quality classes for eutrophication

The preparation of a regional methodology on identification of water quality is a second task under the contracts which the Permanent Secretariat prepared and signed with experts from the Black Sea countries.

Water quality standards defined and adopted through different legal normative by all the BS countries were established using different methodologies. In the decisions adopted by the PMA AG in its 22nd Meeting (Sep. 2012) it was stated that "...each country should send to PMA RAC the national methodology used for setting the background/reference values for pollutants in waters, sediments and biota and a short description of the classification system used for the marine environment quality..." and to involve experts in working further with the provided information to have a compilation of the national methodologies to be discussed in its next meeting. The PMA AG gave this task to the PMA Regional Activity Centre.

Nevertheless, at least four of the countries (BG, TR, UA, and RO) are using TRIX index to assess the eutrophication status of territorial waters. Romania tested it for its available data on water bodies identified under WFD.

The expert workshops organised during the project implementation, which dealt with eutrophication assessment and monitoring issues, were extremely useful for the Black Sea experts, all the countries being interested in testing the HEAT tool elaborated for the Baltic Sea with their own data. In this respect, the central theme of the Second Expert Workshop "Eutrophication assessment in the Black Sea and experiences from the Baltic Sea" (21-22nd September, 2012, Istanbul, Turkey) was to present the results of the application of HEAT to the available sets of parameters to assess the eutrophication status in the Black Sea (see the section 5) and to compare the results obtained through different tools: using e.g. TRIX and HEAT. Seeing the high interest of the Black Sea experts in this particular tool, Dr. Jesper Andersen from the Aarhus University, Denmark (HELCOM expert) supported this activity and prepared a method of assessment of eutrophication (BEAST1.0) based on chemical and biological parameters (phytoplankton, macrophytes, zoobenthos), derived from the HEAT tool used in the Baltic. The version 1.0 of this new tool was provided to the BSC PS at the end of January 2013 and was sent immediately to the experts from the countries to test it. It is expected that in the next report of PMA AG to the BSC this tool may be used. The results were presented in the 4th Expert Workshop on Eutrophication and Nutrient Pollution organized on 27-28th November, 2013 in close coordination with HELCOM Secretariat. In any case, it's extremely important to work further to have a harmonised and agreed set of reference and target concentration of eutrophication/pollution parameters, as they have to be taken into consideration in the further development of BEAST.

All the national experts (contracted under A2.1) tested the methodology by preparing the case studies using their own data, and compared the results with those obtained when applying the TRIX index. Based on the results, the experts made some recommendations for further improvement of the BEAST assessment tool, which will be listed below. During the 23rd Meeting of the PMA AG, the participants discussed about the utilization of BEAST for eutrophication assessment in reporting to BSC. But the real validation of BEAST will be based on the results of BEAST testing by all countries. Nevertheless, the national experts who tested the methodology, recommended it for the assessment of the Black Sea eutrophication status, the best occasion for this being the preparation of the five-years regional report – State of the Environment of the Black Sea.

The description of BEAST tool is attached as deliverable D3.2. Also, the tool software is provided.

There were different recommendations made as result of testing the methodology; they can be summarized below:

- There is a need to further develop the BEAST.
- A user-friendly handbook, describing the function and giving guidance on the use of BEAST 1.0 is needed. So the tool will be easier to use and more affordable by more specialists not only at regional level but also on a national level.
- There is a need to further work for correct and clear definition of the weights on the indicators within criteria.
- It is necessary to define and set: target confidence (EUT_T-score) and confidence for each indicator (EUT_S-score) so to be received information about Final confidence rating of the eutrophication status. This will allow better usability of the instrument and provide more complete information.
- Seasonality of data: Difficult to identify the productive and less-productive seasons. Winter data is important both for nutrients and primary production where there are high chlorophyll concentrations during winter too. Therefore, it is recommended to set reference and/or target values for both seasonal periods and also to increase the monitoring efforts during winter period.
- Reference/target values: Since there is not enough data for long term trends of nutrients, it is not possible to find the reference values with this method. Modelling is the best approach to identify the reference conditions; however, at present the existing efforts are not enough to identify them. Final approach might be the aggregation of data in assessment units and seasons and to use simple statistical tools to analyse the data. Based on that, median values might either be set as reference or target values. Initially, setting the medians of data groups as target values in BEAST might help to assess the present status with the implementation of one-out-all-out principle.
- Indicator groups / confidence level of overall analysis: In order to increase the final confidence rating of a BEAST exercise, all indicator groups (C1: nutrient levels, C2: direct effects, C3: Indirect effects) need to be presented in BEAST analysis at least with 2 indicators in each. Lack of C3 group indicators decrease the confidence rating (<50%).
- Eut-T-Score / Eut-S-Score levels: They are set for the scaling of the confidence, respectively, to the set target values and the measured values. The scaling is at 3 levels: High, Moderate and Low. The final rating comes with expert discussions/judgement and this also effects the final confidence of the overall assessment.
- Weight of indicators in each indicator group: This is also an important decision to be made while implementing BEAST. The experts using the tool should use their full knowledge on the ecosystem dynamics of almost each assessment unit to decide on the weighted role in the analysis (total weight of inds=100%).

- Finally, in the light of above, initial use of BEAST for TR-monitoring data made for winter period at 5 assessment units (each splitted in coastal and open waters). Median values were set as "target" values for GES which ended up with "moderate" quality waters. However, this approach needs to be studied further.

- BEAST is based on the reference conditions and target values. It is obviously that, in terms of eutrophication, the recovery of the ecosystem is not done on the same pathway like its deterioration so, are the 60's levels available/reliable or enough nowadays to be used as reference values? Hence, the information on Ref. Con. must be as reliable as possible, established by expert judgment.

- In order to use BEAST as a regional tool to assess the Black Sea eutrophication, experts should establish a core set indicators and their weighting.

- The authors should revise BEAST in order to make the field of the indirect effects effective.

- BEAST could be easily adapted to the MSFD requirements, in terms of two quality classes: GES and non-GES.

- BEAST appears to be more significantly correlated (than TRIX) with parameters related to eutrophication.

- Despite of BEAST, TRIX do not assess the influence of the seawater temperature on the eutrophication state.

- BEAST is a good tool for the assessment of the eutrophication if the input is well documented and established by experts.

And finally all of those testing the first BEAST 1.0 fully agree that "a perfect assessment tool do not exist… but some tools, including BEAST, are very useful".
This task is fully completed. Further development of the proposed assessment tool for eutrophication will be done when sufficient gaps and needs are identified working on the data.

3. Enhancing the Black Sea Monitoring efforts

3.1. Enhanced use of satellite observations for monitoring of eutrophication (Activity A4.1)

In order to implement this task, first BSCPS analysed the capacities of the Black Sea scientific community for the implementation of this task: identified the institutions and experts dealing with processing and interpretation of satellite ocean colour data in the Black Sea; communicated with relevant experts; invited experts to participate in the project workshops and elaborated the ToR for preparation of report on usage of satellite chlorophyll data for eutrophication indicators. The task was quite difficult, as all experts were not available to take it over.

The institutions dealing with processing and interpretation of satellite ocean colour data in the Black Sea region are as follows:

- P.P. Shirshov Institute of Oceanology, Russian Academy of Science, Russian Federation (SIO RAS)
- Marine Hydrophysical Institute, National Academy of Science of Ukraine (MHI NASU)
- Institute of Biology of Southern Seas, National Academy Of Science of Ukraine (IBSS NASU)
- Middle East Technical University, Institute of Marine Sciences, Turkey (IMS METU)
- Institute of Oceanology, Bulgarian Academy of Science (IO BAS)
- National Institute for Marine Research and Development "Grigore Antipa", Romania (INCDM)

High chlorophyll concentration is one of the primary symptoms of direct effects of eutrophication. It is well known that obtaining reliable Chl-a concentration values from satellite data requires regional approach. Regional algorithms for calculation of Chl-a based on the satellite data were elaborated in Russian Federation (SIO RAS) and Ukraine (MHI and IBSS) for both open sea and coastal waters.

The maps showing spatial and temporal variability of Chl-a are available at the following websites:

- http://optics.ocean.ru/maps.html (SIO RAS, regional algorithm);
- http://blackseacolor.com/index.htm (MHI NASU, regional algorithm);
- http://dvs.net.ua/mp/ (MHI NASU, standard algorithm);
- http://www.ims.metu.edu.tr/SeaDataNet/indexsat.asp?doc=pageChl-A.htm (IMS METU standard algorithm)

The Black Sea satellite data satellite data and parameters obtained with standard algorithms can be extracted from NASAOceanColorWEB (http://oceancolor.gsfc.nasa.gov), ESA MERIS products website (http://www.enviport.org/meris/lv3_main.htm) and GMES MyOcean website (http://www.myocean.eu/).

Regional models based on satellite data for monitoring of indicators (Chl, Phytoplankton Biomass, Primary Production) were developed by IBSS NASU. All previous scientific results on verification of the satellite chlorophyll concentrations in the Black Sea were obtained from the Sea-viewing Wide Field-of-view Sensor (SeaWiFS) in the period 1998-2010. The mission of the SeaWiFS came to an end in February 2011 due to instrument failure. As a result, earlier elaborated algorithms and related methodologies became unusable for future applications, requiring adjustment to other instruments in use (MODIS and MERIS).

In its effort to accomplish this task, the BSC PS continued the inquiry among the identified experts from the Black Sea research institutions. Another round of negotiations was carried out with the same experts contacted in the first year of the project. The reason for declining the offer was that the work on a regional algorithm for operation missions for calculation of Chl-a based on satellite data is on-going due to the situation explained before and the results should be published first. Regarding these kind of studies, BSC PS was seeking for synergy with relevant activities in the region. In this respect, in the region the NATO Science for Peace project "Bio-Optical Characterization of the Black Sea for Remote Sensing Applications" was implemented (http://natosps.io-bas.bg/) having among its objectives the development of regional algorithms for MODIS to be completed. The Black Sea Commission is end-user of this project's results and therefore, an expert working for this project was contacted to work for the Baltic2Black; but at that time the inquiry was unsuccessful.

Nevertheless, the expert willing to analyse the in-situ data provided by countries in their annual report to the BSC against satellite data and available algorithms for different water bodies (coastal, transitional, open sea) was identified and the contract concluded. The report on results of verification of satellite chlorophyll concentration and their applicability for eutrophication indicators was provided in April 2013. The empirical equations for satellite bio-optical algorithm were derived by applying statistical regression for the radiance-*in situ* Chll *a* data set, which was obtained in the Atlantic Ocean (O'Reilly et al. 1998, 2000). Application of these equations for another water body showing different relationships between absorption of phytoplankton pigments and colored dissolved organic matter (so-called "yellow substances") may result in appreciable errors. Based on this, it was obviously that a special algorithm for estimation of the Black Sea chlorophyll concentration was needed and it was developed by MHI (SeaWiFS) and published in 2008 (Suslin, Churilova & Sosik) using a much larger data set that available in the BSIS. Same experts are working presently in perfecting the regional algorithm that considers separately the shelf waters and deep waters. Same was concluded by the expert that verified the chlorophyll in situ data available in BSIS with satellite data using available algorithms. It was shown a better correlation of the data collected from open waters with satellite data; the data collected from shallow waters were not correlated with satellite chlorophyll, which makes the use of satellite chlorophyll data inappropriate to be used for the eutrophication monitoring for the moment.

The concluded contract was finalized. The Permanent Secretariat received and approved the final report (concluded with Ms. Tülay Çokacar).

The results obtained on satellite chlorophyll data analysis and comparison with in-situ data were presented and discussed at the final project workshop, which took place on 27-28th November, 2013 and the recommendations elaborated are included in the final report provided by the consultant.

The study recommends delineating the water bodies based on geographical, geomorphological, physical and biological features. This approach would be beneficial from two perspectives: from one hand, the satellite retrievals from the water bodies with different optical properties would be grouped together and the accuracy of the retrievals would be checked for each region separately. In this way, the performances of satellite retrievals can be evaluated for every region. On the other hand, having the reference values for Chlorophyll for every region, it will be possible to use remote sensing chlorophyll retrievals as indicator for eutrophication for the Black Sea similar to that applied for the Baltic Sea.

There are many potential applications of ocean colour data, even though the bio-optical algorithms are still under improvement. For example, the standard algorithm failed in the NW Black Sea due to the high content of coloured dissolved organic matter (CDOM) and suspended matter; therefore the research was oriented towards the development of new algorithms that should allow more accurate estimation of the Chlophyll-a.

3.2. Feasibility on usage of automated systems for monitoring of eutrophication parameters in the Black Sea region (Activity A4.2)

According to the Work Plan for 2012 presented in the 1st Progress Report of the project, the following activities were undertaken in 2012:

- Terms of Reference were prepared,
- the negotiations were carried out,
- the consultant for the elaboration of the report was contracted based on the experience in participation in the projects on using the automated systems in marine monitoring.

The report reviews the usage of automated systems for marine monitoring tested for the Black Sea in different project implemented in the region using both fixed platforms and drifters. Also, the comparison with the systems used in other seas was made. The most relevant pan-European programmes and data tools, such as EMECO, EMODNET, SeaDataNet, Euro ARGO and GMES/My Ocean were presented and compared to find the most suitable and cheapest solution system for the remote monitoring of the eutrophication parameters in the Black Sea. Also, in preparing the report, the conclusions and recommendations made in the “Diagnostic Report” to guide improvements to the regular reporting process on the state of the Black Sea environment (2010) were used and followed.

After the extensive review performed, there were recommended three real time platforms that should constitute an automated monitoring system for operational monitoring of eutrophication in the Black Sea:

- ARGO
- Ferry boxes
- Moorings and platforms

Also it was recommended that additionally, gliders might be used as possible alternative of research cruises. These emerging or already existing platforms are complementary to each other and could provide spatial-temporal range of application and specific potential as well as expandability. Integrating all the elements, sustaining and improving the systems to meet the increasing needs for social benefits is imperative for marine observing systems. Although each of these systems can operate separately, their integration will achieve as result a “system of systems” with adequate spatial and temporal coverage capable of operating in rigorous, robust and sustainable manner, as well as to disseminate data to users timely and to support generation of knowledge as a decision support tool.

Assembling the sea-basin pictures requires collaboration between countries and across disciplines. System integration on data level with data access through single internet portal would be an effective solution. Implementation of a centralized data management system with strict control of formats, quality control procedures, accuracy and precision standards, and data products —certification is the most effective way to build reliable in situ observing system. The Black Sea Data and Information Management System should be developed based on contribution of the national authorities, marine research institutes and organizations and national oceanographic data centres in the Black Sea region.

The efficiency of the operational monitoring programme for eutrophication parameters in the Black Sea should take into consideration the following:

- Avoiding of resources overlapping
- Interoperability of sub-systems
- Harmonisation of operational processes and qualification of quality standards
- Compliance with the highest European services
- Added value to ocean-related users and marine service providers at national, regional and European levels

The costs of the systems for a period of four years has been estimated according to the market prices, which included the delivery, installation, communications, acquisition of spare parts and maintenance (Table 10). The costs involving the maintenance of the BSIS were not considered in the presented analysis.

Table 10 - Estimated cost of the systems

PARAMETER	**TYPE OF SYSTEM**		
	ARGO	**FerryBox**	**Buoys**
Sensors	CTD/FLU/TU/DO	T/S/FLU/DO/NUTR	T/ S/ DO/FLU/TU
Communication	IRIDIUM	GSM/GPRS	IRIDIUM/GPRS
Numbers of Platforms	15	2	10
Years of operation	4	4	4
Units of data collected	Profiles	Transects	Daily time series
	4380	300	14000
Estimated cost of the system [EUR]			
Equipment	750 000	300 000	1 000 000
Communication	20 000	20 000	40 000
Maintenance	-	70 000	320 000
Spare parts& consumables	-	50 000	160 000
Reference analysis	-	80 000	80 000

Evaluation of raw data	80 000	30 000	50 000
TOTAL COST	850 000	550 000	1 650 000
Cost per unit of data	194	1 833	118

In implementation of the proposed system, the international cooperation is crucial for the success of the Black Sea eutrophication monitoring programme. Several good examples of regional examples of collaboration in the BS region apart from the environmental collaboration in the frame of the Bucharest Convention were presented: Black Sea Regional Committee of IOC, Black Sea GOOS and ODINBlackSea and common international projects: ARENA, ASCABOS, Black Sea Scene, ECOOP, MyOcean, SeaDataNet, etc. that succeeded to develop operational oceanography and data management capacity in the region.

It was pointed out that there are several important issues to be solved in order to organize an effective basin scale monitoring. It is known that Black Sea is totally divided into Exclusive Economic Zones (EEZ) of the bordering countries. According the Law of the Sea and national legislation, the neighbouring countries should obtain permission to do measurements and to take samples in other countries' EEZ. This process is difficult when using instruments crossing marine borders like ARGO floats etc. Another obstacle is that national legislation limits the free exchange of operational data in real time.

The report underlines that in order to organize an effective regional automated monitoring system these issues should be solved. A regional international agreement between the Black Sea countries will be a good solution and will allow developing an effective instrument to assess the eutrophication in the Black Sea, which will provide reliable information for decision making process.

Some recommendations were made to the Black Sea Commission that should play a crucial role in building the monitoring system for eutrophication and promote the initiative among its contracting parties.

All the recommendations made in the report were presented to the BSC at its 28th Regular Meeting held on 21-22nd November, 2012 in Istanbul. The BSC took note on the recommendations made; these recommendations will be taken into consideration in the revised BSIMAP for the next five years.

4. Development of the implementation plan on setting up a modelling tool for reducing input of pollutants (nutrients, including riverine loads) in line with the 2009 Strategic Action Plan for the Environmental Protection and Rehabilitation of the Black Sea (Activity A5)

To implement this activity, the BSC PS analysed the existent capacities in the Black Sea scientific community for environmental modelling. The Institute of Marine Sciences – Middle East Technical University (IMS-METU) Erdemli, Turkey was identified as a research institution with long experience in environmental modelling for the Black Sea and their participation in many EU FP7 projects involving modelling issues in assessing the environmental changes occurred in the Black Sea.

The Terms of Reference for this specific task of the project were prepared, negotiations with identified expert from above-mentioned institution were undertaken and the contract agreed. The METU was selected preliminary due to their extensive experience in modelling. The exchange visit to the Baltic Nest Institute to learn from their experience on the modelling activities and the decision-support tool developed for the implementation of the Baltic Sea Action Plan, initially planned with the experts by the end of 2012, was postponed and agreed with the BNI experts for 2013. Experts in modelling from the Black Sea area, Mr. Sinan Arkin and Mr. Baris Salihoglu from the Institute of Marine Sciences at the Middle East Technical University, visited the Baltic Nest Institute in Stockholm, Sweden, on 3-5th June, 2013. The visit was intended to enhance knowledge transfer between the Baltic and the Black Sea experts in modelling in order to develop the initial stages of a modelling tool for the Black Sea. For the future modelling tool to be used in the Black Sea region the models developed and used for the Black Sea watershed (MONERIS and SWAT) were analysed. The visit was coordinated by the Black Sea Commission and the HELCOM secretariats, and

was hosted by the BNI Sweden, particularly Mr. Bo Gustafsson and his colleagues who have developed the NEST system. The NEST system is a decision support system aimed at facilitating adaptive management of environmental concern in the Baltic Sea, and also for revising the environmental targets established in the Baltic Sea Action Plan (BSAP). A similar decision-support tool is necessary for the Black Sea region as well, especially that in the BSSAP there were not established quantifiable targets.

The experts who visited the BNI, participated in the First Expert Workshop of the project, "Assessment of eutrophication and nutrient pollution in the Black Sea and experiences from the Baltic Sea" held on 6-7th September, 2011 in Istanbul, Turkey and the third one. The first workshop involved a presentation on the NEST system given by Mr. Bo Gustafsson continued with the development of the nutrient reduction scheme in the Baltic Sea on the principles of the NEST Model in the third workshop.

In the full report provided to the Secretariat an initial assessment of the available models was made to understand the current capacity in the Black Sea to develop the modelling tool. First the general framework of the modelling tool is defined (see D5.1). The tool should be able to calculate the required actions needed to reach the politically agreed targets for the Black Sea environment. Reducing the nutrient input to the sea and thus decreasing the negative environmental impacts is a politically prioritized area of international cooperation. Therefore the main focus of the model should be on eutrophication and the flows of nutrients from land to sea. This can only be achieved by modelling the entire drainage area.

The general framework of the model should include:

- an **atmospheric model** that would produce atmospheric forcing functions (surface fluxes of momentum, heat and mass);
- a **watershed model** to forecast the discharge rates and the nutrient fluxes into the sea from the Black Sea catchment area; and
- a **coupled physical–ecological-biogeochemical ocean model** for the Black Sea. Below, several candidates for these models and state their required inputs and outputs were listed.

In the report, the results of the model sensitivity analyses of nutrient enrichment and reduction scenarios applied in the Black Sea are presented and explained. The proposed model framework uses approximations based on limited nutrient observations from rivers and it does not include any atmospheric deposition. Therefore, without the coupling of potential watershed and atmospheric deposition models proposed, the analyses presented in section 2 of the report stays at a level of sensitivity study. Coupling of watershed and atmospheric deposition models with ocean circulation and ecosystem models is imperative for creating a decision support tool.

By applying the proposed model using chlorophyll data, it was observed that despite the increase in primary production, chlorophyll-a concentrations typically respond weakly to changes in nitrate availability. This indicates that an increase in productivity is closely mirrored by increased grazing. This is confirmed by an increase in zooplankton biomass. **It is important to note that for this reason simulated chlorophyll concentration is not a good indicator of eutrophication in the Black Sea.**

It is appreciated that he existing databases for the Black Sea region would be extremely useful for the model framework if the scattered structure is removed and the data is merged under one database. **The modelling system needs data both to force the models (such as river input) but also to evaluate the results.** Forcing fields should be provided close to near real time to achieve more realistic model forecasts. **There are two major weaknesses identified in the existing databases:**

i) Most of data is from coastal areas whereas Black sea basin functions as a whole and the national monitoring systems should be extended to include open ocean observations,

ii) Although there is ample amount of reported physical and chemistry data, the biological data (even at the level of Chl) is rather limited. Therefore, an accurate assessment of the impact of eutrophication/pollution cannot be made.

Some considerations on funding requirements were made. First, it was suggested that a long-term research programme for the Black Sea is necessary. Indeed, the Strategic Research Agenda, comprising the needs for the

Black Sea in term of research priorities, based on the identified gaps was elaborated. In this respect we may say that there is a research programme available. What is missing is the Black Sea region, is a dedicated funding scheme and/or organization. It was suggested to use as example the model of the Baltic Nest Institute (Sweden) which is responsible for modelling activities in the Baltic and by using the Nest model provides the needed support for decision-making in the HELCOM. For the moment, EU was identified as the main funding source through its dedicated research programmes.

5. Transfer of best practices from HELCOM to BSC on eutrophication monitoring and assessment

5.1. Organising of a series of seminars and workshops for knowledge transfer (Activity A6.1)

The first project Workshop titled "Assessment of eutrophication and nutrient pollution in the Black Sea and experiences from the Baltic Sea" was organized by Secretariats of the BSC and HELCOM on 6-7th September, 2011 in Istanbul, Turkey with participation of PMA AG, LBS AG and experts from Black and Baltic Sea regions.

HELCOM (Baltic2Black project partner) has been coordinating monitoring activities and compiling assessments on the pressures to, and the status of the Baltic Sea for decades, including eutrophication. The 2007 Baltic Sea Action Plan (BSAP), prepared under HELCOM, sets a strategic goal to have 'a Baltic Sea unaffected by eutrophication'. The agreement defines, especially in the case of eutrophication, "good status" of the Baltic marine environment and commits the Baltic coastal states to nutrient input ceilings and a suite of actions to reach such a status by 2021.

The indicator-based HELCOM Eutrophication Assessment Tool (HEAT), developed to support the BSAP, has proven to be successful in classifying eutrophication status in the Baltic Sea. The tool allows for direct comparisons between different parts of the sea despite variations in monitoring activities. Such harmonized tools have not yet been applied in the Black Sea (see section 2.1).

The NEST model, hosted by the Baltic Nest Institute (BNI) is a decision support system aimed at facilitating adaptive management of environmental concern in the Baltic Sea. NEST is used to calculate required actions needed to attain politically agreed targets for the Baltic Sea ecosystem, and it has played an instrumental role in identifying the needed nutrient reductions (Maximum allowable nutrient input) to achieve "Good environmental status" as defined by international decision makers in HELCOM.

The First Expert Workshop (6-7th September, 2011) focused on creating a dialogue between the experts of the Black Sea and Baltic Sea regions. The main topics of the meeting were the methods used for region-wide assessments of eutrophication status, including development of indicators with state targets, and monitoring of nutrient loads from land-based sources by making use of the HELCOM experience. The workshop hence allowed BSC experts and scientists from the Black Sea region to learn from experiences of the experts who have worked under the HELCOM umbrella for a number of years to create these methods and carry out assessments.

During the two-day workshop, altogether 19 presentations were given by experts from both regions. These presentations provided an overview of the eutrophication status in the Black Sea and the Baltic Sea, the key principles of the nutrient load reduction scheme of the HELCOM BSAP, and demonstrations of the on-line decision support tool NEST and the HELCOM HEAT. The HEAT tool and the NEST model were demonstrated by experts who have been involved in their development. The experts had been invited to the meeting by the HELCOM Secretariat.

Initially it was planned to have separate workshops for LBS and PMA experts, but in order to highlight strong links between processes in watershed and state of Black Sea environment and needs for developing ecosystem modelling it was decided to organize joint workshop with participation of both groups.

Overall, the key proposal from the workshop was to set up longer-term scientific collaboration between the two regions that would deal not only with the nutrient reduction scheme and ecosystem modeling, but also with creating a roadmap for the regional assessment of eutrophication and the development of common guidelines for quantifying nutrient loads into the Black Sea.

The elaborated set of recommendations to be presented to attention of the Black Sea Commission:

- Recommend to make the work of BSC more transparent by sharing data and country reports to scientists and public;
- Recommend to consider experience of HELCOM in environmental monitoring for better implementing of BSIMAP for period 2015-2020 aiming to attain a more coherent set of monitored parameters for proper assessment of state of the Black Sea ecosystem;
- Baltic2Black to organize more focused workshops of Black and Baltic Sea experts and scientists to consider drafting a roadmap or steps needed to :
    - create Black Sea ecosystem modelling for estimating maximum allowable loads and nutrient reduction needs,
    - carry out Black Sea eutrophication assessment with regionally approved tool (such as HEAT tool, or TRIX or other validated indicator if any), and
    - develop common guidelines for quantifying nutrient loads into the Black Sea including diffuse sources and atmospheric deposition, using the HELCOM experience;
- Set up long-term scientific collaboration between two regions:
    - Identify priority scientific tasks related to the Black Sea environmental problems,
    - Draft a "modelling and monitoring strategy" for the Black Sea to be presented to BSC for adoption,
    - Applying for joint research/applied projects focused on eutrophication.
- Harmonize modelling methodologies for assessment of loads from all Black Sea rivers

The recommendations were brought to attention of the BSC at its 27th regular meeting on 22-23rd November, 2011 (full report available).

The Second Expert Workshop, "Eutrophication assessment in the Black Sea and experiences from the Baltic Sea", was organised in cooperation by both BSC and HELCOM secretariats in Istanbul, Turkey, on 20-21 September 2012 with the participation of the PMA AG and experts in eutrophication from both regions.

The 2-day workshop focused on eutrophication assessment and use of remote sensing and "human sensors" for indicator development. Also the regional database in the Black Sea and experiences from the Baltic Sea were briefly presented. The first day of the meeting consisted of lectures by both the Black Sea and Baltic Sea experts dealing with these issues and the second day was a learning-by-doing workshop.

The selection of the topics was based on the discussions in the first Expert Workshop (6-7 September 2011) where it was recommended for the project "to organise more focused workshops of Baltic and Black Sea experts and scientists to consider drafting a roadmap or steps needed to carry out the eutrophication assessment with regionally approved tool (such as HEAT, TRIX or other validated indicator if any)".

The first day of the workshop consisted of presentations given by the experts involved in eutrophication monitoring and assessment. In total, nine presentations were given. Mr. Urmas Lips, Chair of HELCOM MORE, Estonia, presented the unattended in situ measurements in eutrophication monitoring. Mrs. Valeria Abaza, PMA Officer, BSC PS, gave an overview of the Black Sea Integrated Monitoring and Assessment Programme – priorities for the next period in PMA component. Mr. Juha-Markku Leppänen, SYKE, Finland, presented the monitoring and assessing eutrophication for the implementation of the MSFD. Mr. Atanas Palazov, IO-BAS, Bulgaria introduced the Black Sea in situ automated observation system use in eutrophication assessment. Mr. Seppo Kaitala, SYKE, Finland gave a presentation on the use of human sensors in monitoring eutrophication effects. Ms. Tulay Cokacar, Turkey, gave background on the remote sensing in the Black Sea and its use in the eutrophication monitoring. Mr. Saku Anttila, SYKE, Finland, presented the development of joint eutrophication indicators derived from remote sensing. Mr. Joni Kaitaranta, HELCOM, Finland, introduced HELCOM data flows related to eutrophication. Mr. Richard Lisovsky, UkrSCES:, gave a presentation on the development of the regional database for eutrophication in the Black Sea. After each presentation and at the end of the day there were discussions based on the topics of the presentations. Special impact on the participants from the Black Sea region had a presentation on the use of human sensors in monitoring the effects of eutrophication in the Baltic Sea given by Mr. Seppo Kaitala (SYKE, Finland) when presenting the use of the mobile phone sensors for observations of algal blooms, including observations on jelly fish among other remote systems in use in the Baltic Sea.

The second day was a “learning by doing” workshop, Mr. Jesper Andersen, the developer of the HEAT tool in the Baltic Sea acting as a consultant throughout the day, via Skype Conference. Mr. Andersen gave an opening speech explaining the principles of the HEAT tool, and his vision of developing a Black Sea Eutrophication Assessment Tool (named by him BEAST). He informed the meeting participants on the new developments on the tool (HEAT 2.0 and HEAT 3.0), and explained that ideally BEAST could be an improved version of HEAT.

The national experts of Romania, Bulgaria and Ukraine had prepared case studies to test assessment methods on their eutrophication data with TRIX, and Romania also presented the results of comparisons between HEAT and TRIX. Turkey had a case study of the Marmara Sea.

Mr. Andersen listened to all four Black Sea presentations, and replied to questions and gave comments after the presentations. Specific aspects of dealing with the data, especially in the light of applying the HEAT were discussed in each case (e.g. the number of classes to use, how to set reference conditions etc.) and also it was discussed what are the next steps. Mr. Andersen suggested that a preliminary BEAST tool could be developed during the coming fall and winter, providing that data will be submitted from all Black Sea countries.

Apart from the presentations and discussions on eutrophication assessment tool, Mr. Georg Martin (Estonian Marine Institute) gave a presentation on Estonian marine monitoring programme and the scheme for ecological quality assessment of coastal waters including the choice of indicators, which also raised the interest of the Black Sea experts, willing to learn more in the further development of the eutrophication indicators.

After the presentation and discussion of the case studies, the following recommendations were discussed and accepted by the participants:

Acknowledging that the experiences from the Baltic and the Black Sea, respectively, show the importance for having harmonized approaches that give comparable results on eutrophication status, the Meeting recommends that such harmonized approaches, utilizing common tools, should be applied in both sea areas.

The Meeting highlighted the importance of the specific and common features as well as the challenges of the two semi-enclosed brackish regional seas that the Black Sea and Baltic Sea share, and recommends to make use of the increasing prominence of semi-enclosed brackish water seas in other fora, including the EU and global fora that often place a high emphasis mainly on oceanic environment protection.

The Meeting emphasized the importance of new thinking in developing monitoring programmes. In order to increase the quality and cost-efficiency of the programmes; it is recommended to jointly plan and coordinate the monitoring campaigns between countries.

The Meeting also recommends that, in the international context, sharing of monitoring facilities, such as research vessels, unattended measuring systems as well as laboratory facilities is enhanced, and to make use of analytical specialization.

The Meeting recommends that the emphasis should be put to share the workload among the countries by making use of the specialised skills of the institutes in producing indicators. In this process a full open access to data is crucial.

The Meeting recommends to better integrating fisheries and environmental monitoring,

The Meeting recommends using human sensors, i.e. observations made by public, since it is a huge potential to increase the number of environmental observations and at the same time to increase the public awareness concerning the marine environment.

The Meeting recommends to use the knowledge base achieved from various international research projects and regional observation services on operational oceanography and networks, such as Alg@line, FerryBox, BOOS and Black Sea GOOS, to implement an operational observing system for eutrophication monitoring and assessment tailored for the Baltic and Black Seas, respectively. It is recommended that such a system should be based on jointly agreed core variables/indicators and integrated sub-systems, such as remote sensing, ship-of-opportunity, coastal stations, fixed platforms, moored buoys, floats, gliders, human sensor-approach, and research vessel observations.

The Meeting recommends to promote extensive international collaboration to avoid resource overlapping, to harmonize operational processes and quality standards, in order to reach reliable, robust, sustainable and efficient monitoring system which is compliant with the highest European services and to bring value to ocean-related users and marine service providers on duty at national, regional and European levels.

The Meeting recommends that HELCOM in the Baltic Sea and the BSC in the Black Sea, respectively, should actively provide overall guidance for an operational eutrophication monitoring and analysis system and to promote intergovernmental/institutional arrangements to make the current and future sub-systems integrated, sustainable and fully operational.

The Meeting emphasized the value of the joint Baltic/Black Sea expert workshops and the case study carried out to test the eutrophication assessment tools and recommends to jointly continuing the development of harmonized assessment tools based on the commonly adopted conceptual model of eutrophication (nutrients, direct as well as indirect effects).

The Meeting was of the opinion that the further development of a harmonized tool for eutrophication assessment requires a common data set covering the Black Sea area adequately. The Meeting recommends to test the HEAT 3.0 on the delivered data for the Black Sea and to start developing a specific eutrophication assessment tool for the Black Sea. Feedback on presented case studies is important for future activity.

The workshop recommendations were brought to the attention of the BSC at its 28th Regular Meeting on 21-22nd November, 2012. They were also reported to the HELCOM Monitoring and Assessment Group at the 17th Meeting held in Gothenburg, Sweden, on September 20-21, 2012. The recommendations made during the workshops organised in the frame of the Baltic2Black project will be taken into consideration in the revision of the BSIMAP for the next period.

The third workshop initially planned for early October 2012 was postponed to the beginning of 2013. The 3rd Expert Workshop on monitoring and reducing nutrient loads to the Black Sea was organised on 31st January – 1st February, 2013 with the participation of LBS AG, experts from Baltic and Black Sea regions and International Commission for the Protection of Danube River (ICPRD). Also, the representatives of the EU FP7 Project EnviroGRIDS participated in the workshop, presented the results of the project found in its final stage and SWAT model used for the Black Sea watershed.

The aims of the workshop were to take steps towards developing a decision-support tool for reduction of nutrient inputs to the Black Sea making use of the Baltic Sea experience and to work towards finalizing the hotspot methodology for the Black Sea. In order to meet these goals, presentations by the Black Sea and Baltic Sea scientists/experts on the following topics were given: monitoring and assessment of nutrient loads to the sea; activities to reduce nutrient loads to the sea and evaluating nutrients in the sea. In total there were 18 presentations from both sides on the mentioned topics. Each topic was discussed. The approaches used and the gaps in current knowledge were assessed and suggestions were made for future work.

At the end of the workshop, 12 important questions were raised and the suggestions to solving these questions were made by the participants that will be summarised below:

1. How to ensure availability and compatibility of monitoring data, both input and output – to be used for assessments, modelling, etc.?

- Quality assurance elements needed (EU requirements could be used as a basis, but going beyond them could be a goal at the conventions' level, including set up of requirements for obtaining more detailed data)
- Data gaps in the Black Sea watershed will be further assessed in the final workshop of the FP7 EnviroGRIDS project at the University of Geneva on 21-22 March 2013

2. How to harmonize and avoid duplication of data reporting?

- EC reporting schemes could be used as a basis and harmonised in order to help the Black Sea countries to fulfil their commitments

- Countries could divide the monitoring task among them (shared efforts) to strive for cost-efficiency of data collection – suggestion made after the second workshop, too

3. How to select best available models to suit for specific purposes?

- It should be kept in mind that models cannot replace proper monitoring and time series, therefore a pre-condition for any modelling work is availability of good quality data

- Testing of different models is important, as suitability is case specific

- Several models have been tested in the Baltic Sea Region and in the European Union in general (e.g. see results of EUROHARP Project) and their applicability depends on local conditions

4. How to choose suitable source-apportionment methods?

- Description of approaches/models used within HELCOM framework is available in the PLC Guidelines and in the recent PLC-5 Report and could be used as example for the elaboration of source apportionment for the Black Sea, as well.

- It is recommended to test different approaches (see also EUROHARP reference above) to choose most suitable for a specific conditions

5. Is it feasible to set up regional nutrient reduction targets for the BSC?

- it was discussed briefly that introduction of a regional nutrient reduction scheme would be an essential step in the work of Bucharest Convention, however the regular collection of quality controlled data, based on a harmonized data collection and reporting procedure is crucial

6. How to measure the progress in reaching objectives/targets and monitor the performance of specific pollution sites?

- This could be performed through establishment of a procedure for following the progress, e.g. on annual basis reporting on the status of the hot spots against criteria for their deletion and/or through development and application of indicators of progress, or use of already established state/pressure indicator schemes (as could be seen in Baltic Sea Environment Fact Sheets and HELCOM Core Set indicators)

7. How to set up efficient site-specific criteria for hotspots?

- Setting up minimum harmonized requirements/ criteria is crucial

- development of site-specific criteria is subject to thorough assessment in coordination with national authorities

- development of very specific and detailed criteria at general level may be complicated and laborious and therefore it is recommended to avoid too much detailed criteria at this level

- one of the indicators could be pollution prevention or pollution abatement potential, especially if certain pollution reduction targets are set

8. Is the “blame-and-name” approach still a workable, efficient instrument?

- "blame-and-name" approach is becoming less efficient in case of harmonizing the pollution prevention requirements, e.g. for industrial sectors implementing common BAT, and hence promoting good examples, that are going beyond commonly set standards is becoming more efficient strategy

- The "fame-and-name" approach can be seen as the future approach, given the harmonization of pollution abatement level across specific region, however it may also require development of a procedure for implementation

- When moving towards this approach it is important to keep in mind that some hotspots are still very problematic and the process of deleting them is not yet in progress

9. How to ensure that the designation of hotspots is prioritized in the national/regional remediation programmes?

- it depends on a type/category of a hot spot, e.g. municipal and industrial hotspots are much easier prioritized in national policy than non-point source agricultural sites.

- prioritization needs to be linked to implementation of specific policy requirements, e.g. waste water treatment, waste handling, BAT application, etc.

10. How to address new, earlier unknown, sources of pollution?

- this requires thorough investigation at national level and perhaps also consideration of similar sites across the region

11. How to add/designate new hot spots?

- In the designation of hotspots interregional cooperation can be useful: e.g. sharing knowledge of "Best Environmental Practices" (BEP) and "Best Available Technologies" (BAT)

12. How to address water quality aspects in trans-boundary water management?

- Basin approach, e.g. set in EU WFD or in UNECE Convention on Transboundary Watercourses and International Lakes should be applied, including introduction of joint transboundary management plans and joint management bodies, e.g. Water/Basin Councils (e.g. Danube Commission, Odra Commission, etc.)

The 4th Expert workshop was prepared by the two Secretariats, deciding on the agenda content, on the experts to be invited by both organizations, the presentations to be given and the preparation of the way forward in order to continue the collaboration between the two organizations.

The 23th PMA AG and the 18th LBS AG Meetings (7-9th October, 2013), reviewed the project deliverables, the updates and changes to the design and interface of the regional database, which were approved by the PMA and LBS AGs. The above-mentioned meetings also prepared for the 4th Expert Workshop, organized on 27-28th November, 2013.

During the expert workshop group discussions took place to assess the project results, lessons learnt and the way forward to continue the collaboration between the two regions and stimulating the cooperation inside of the created expert network. The conclusions and recommendations are available in the final Workshop's report, as well as the group's discussion outcomes. All participants agreed that the collaboration between the secretariats of the two regional sea conventions as well as the experts from the Baltic and the Black Sea should continue. The following possible topics were suggested by the three discussion groups:

GROUP 1

- Parallel efforts to produce holistic assessments
    - Methodology, processes, themes…
- Invasive species
    - database construction, indicators, methodology, hot spot monitoring

- Assessment of inputs of nutrients
    - inclusion of nutrient loads from all sources,
    - especially diffuse sources, methodology and guidelines
- Oil pollution
    - detection and assessment of inputs, state and impacts
- Standards for measurements + joint criteria for mandatory core set of parameters

GROUP 2

- holistic assessment of the Black Sea ecosystem:
    - invasive species;
    - linking pressures and impacts;
    - core indicators (eutrophication, hazardous substances and biodiversity)

GROUP 3

- Modeling should be incorporated in the future cooperation work: Input, hydrology, chemistry to an integrated modeling study and to use modeling study for developing reference conditions, targets and maximum allowable inputs. Sufficient data should be received by integrated monitoring (cf. MSFD).
- For example Horizon2020 calls could be addressed with an application for further Black Sea research (multiple stressors) and for further cooperation with the Baltic Sea with the involvement of Secretariats of both Commissions.
- Organizing the networks of scientists and research agencies in the region is necessary (cf. BONUS for Baltic Sea research agencies). So are also regional arrangements for data storage and handling.
- Ecosystem services is a ”hot” topic and could be further addressed also in association of developing ecosystem-based management, taking also into account socio-economic aspects of measures, including costs and benefits.
- Environmental awareness could be one of the themes to be addressed.
- Future cooperation between the regions could address development of holistic integrated assessment since both regions are developing their assessments. Additionally, it would be helpful to focus on specific themes that could involve further transfer of knowledge between the regions, e.g. core indicators with targets, identification of hot spots, non-indigenous species. Modeling cooperation and further work in the Black Sea region could help on all of these themes.
- Measures: how to devise them and to share with the Black Sea Commission the measures lists from HELCOM.
- New monitoring programme, the revision should address also open sea and deeper layers, as well as winter period. That would be helpful also for setting targets (e.g. sub-oxic conditions). To reconsider mandatory parameters of monitoring programme.
- Stable and continuous cooperation between the Black and Baltic Sea Commissions would be useful – projects are helpful but don’t guarantee sustainable basis of activities.

5.2. Secretariat-to-secretariat exchange (Activity A6.2)

In 2012 there were planned two visits of the experts to the BSC PS to HELCOM Secretariat. These visits were organised as follows: (1) a secretariat-secretariat exchange visit of the BSC PS to the HELCOM Secretariat, Helsinki, Finland, on 2-3rd April, 2012, and (2) a visit of the Pollution Monitoring Officer of the PSC PS, Ms. Valeria Abaza, to the HELCOM TARGET Meeting, 7-8 May, 2012, HELCOM Secretariat, Helsinki, Finland. The aim of the visits was to provide first hand transfer knowledge of working practices and organising of work and information systems from the HELCOM Secretariat to the BSC PS. The aim was met.

First one, the secretariat-to-secretariat visit of the BSC PS staff to the HELCOM Secretariat, was organised on 2-3rd April, 2012 in Helsinki, at the premises of the HELCOM Secretariat, Helsinki, Finland.

The participants in this meeting from BSC PS were Ms. Valeria Abaza, PMA Officer and Mr. Volodymyr Myroshnychenko, project expert; on behalf of the HELCOM Secretariat, Ms. Maria Laamanen, Professional

Secretary, Mr. Joni Kaitaranta, Data Administrator, Ms. Johanna Laurila, Information Secretary, Mr. Mikhail Durkin, Professional Secretary HELCOM LAND, Ms. Miia Mannerla, Project Researcher, Mr. Samuli Korpinen, Project Manager of HELCOM CORESET, Mr. Håkan Blomberg, ICT Administrator, and Ms. Minna Pyhälä, Professional Assisting Secretary.

Ms. Minna Pyhälä presented an overview of HELCOM monitoring and assessment activities, including indicators, obligations of parties, coordination and reporting. Mr. Joni Kaitaranta gave an overview of the information system of HELCOM including components, dataflow and administration and maintenance. Mr. Samuli Korpinen spoke about the involvement of the scientific community in the HELCOM activities, and presented the approach used in the HELCOM CORESET Project. Mr. Håkan Blomberg demonstrated the use of technical tools in the day-to-day work of the HELCOM Secretariat. Additionally, Joni Kaitaranta demonstrated the use of the HELCOM Map Service. The Black Sea Commission visiting staff was offered the opportunity to ask any further questions from any of the HELCOM staff members.

The following activities were envisaged in the first visit of the BSC PS representatives to the HELCOM Secretariat:

- HELCOM work practices that included: structure, scope of activities and general working practices, such as planning and organising activities and events, day-to-day work and progress assessment
- Communication and coordination of work with contracting parties
- Monitoring activities in the Baltic Sea: obligations of contracting parties, coordination and reporting
- Research activities in the Baltic Sea region
- Information system in the Baltic Sea region: components (databases, GIS, products, web services), data flow, integration with reporting system, indicators and assessment, administration and maintenance

Further discussions went around the Baltic2Black Project implementation: planning the activities for 2012, including the workshops, fixing the dates for the scheduled meetings, including the exchange visits, content of workshops to be organised in 2012, discussion on project management, including reporting needs for the project.

Also, during the meeting it was discussed and decided that Ms. Valeria Abaza will participate the HELCOM TARGET Meeting (7-8 May, HELCOM Secretariat), and this served as the second visit of the BSC staff to the HELCOM Secretariat. It was seen from both the HELCOM and the BSC side, that this would be beneficial, because it would offer an even more practical and hands-on working approach for the Black Sea staff to learn about the HELCOM working practices.

The third planned visit of HELCOM to the BSC, originally scheduled for the year 2012 was suggested by both Secretariats to be moved to the final year of the project implementation (2013).

Prior to the 4th Expert Workshop (27–28th November, 2013), a shorter meeting was held (26 November) between the members of the HELCOM and BSC Permanent Secretariats and key experts from the Black Sea region to discuss the project achievements and agree on a way forward. Detailed information is in the Meeting Report.

6. Progress in the project activities at the end of the project

The situation of the completion of the project activities as described in the Grant Agreement is presented on the next page (Table 11).

Table 11 – Overview of Project Progress and completed percentage as per 31 March 2014

Task No.	Task Title	Action (Activity)	Deliverable	% complete as per 31 March 2014
A1	Management and reporting to EC	A1.1. Management and reporting to EC	Technical and financial reports	100%
A2	Creation of updated version of the Black Sea Information System (BSIS) in the public domain with links to European Information Systems	A2.1. Development of new version of the Regional Database on Pollution	D2.1. Operational RDB-P accessible through web in public domain	100%
		A2.2. Assessment of eutrophication parameters and analysis of status of data collection/reporting/use	D2.2. Tools for calculation of statistics and indicators incorporated in RDB-P	100%
			D2.3. Report on assessment of eutrophication parameters	100%
A3	Elaboration of regionally agreed criteria for assessment of eutrophication	A3.1. Elaboration of the Black Sea reference and target concentration levels of eutrophication parameters	D3.1. A draft set of reference and target concentration levels of the eutrophication parameters	100%
		A3.2. Elaboration of regional methodology on identification of water quality classes with respect to eutrophication parameters	D3.2. Elaborated methodology on identification of water quality classes with respect to eutrophication	100%
A4	Enhancing Black Sea monitoring efforts	A4.1. Enhanced use of satellite observations for monitoring of eutrohication	D4.1. Report on results of verification of satellite chlorophyll concentrations and their applicability for eutrophication indicators	100%
		A4.2. Feasibility of usage of automated systems for monitoring of eutrophication parameters in the Black Sea region	D4.2. Report of analysis of temporal and spatial variability of satellite data	100%
			D4.3. Report on the results of the feasibility	100%
A5	Initial stages on setting up a modelling tool linking background pollutants	A5.1. Development of implementation plan on setting up a modelling tool	D5.1. Initial stage of modelling – the implementation plan on setting up a	100%

	triggering eutrophication in the Black Sea with requirements for reducing input of pollutants (nutrients, including riverine loads) in line with the 2009 Strategic Action Plan for the Black Sea	linking background pollutants triggering eutrophication in the Black Sea with requirements for reducing input of pollutants (nutrients, including riverine loads) in line with the 2009 Strategic Action Plan for the Black Sea	modelling tool, linking background pollutants triggering eutrophication in the Black Sea with requirements for reducing input of pollutants (nutrients, including riverine loads) in line with the 2009 Strategic Action Plan for the Black Sea	
A6	Transfer of best practices from HELCOM to BSC on eutrophication monitoring and assessment	A6.1. Organising of a series of seminars and workshops for knowledge transfer A6.2. Secretariat to secretariat exchange and mentoring related to topics of Tasks 2 to 5	D6.1. Reports on the seminars and workshops conducted D6.2. A report on the exchange periods with observations and recommendations	100% 100%

7. Dissemination

The progress on Baltic2Black project activities were published in the Black Sea Commission newsletter "Saving the Black Sea" issue no. 14/2012, available in electronic format at http://www.blacksea-commission.org/_publ-Newsletter14.asp. Also, the article on the joint Second Expert Workshop on Eutrophication assessment in the Black Sea and experiences from the Baltic Sea was published on the BSC website (http://www.blacksea-commission.org/ (News section)). In the issue no 15/2013 of the newsletter "Saving the Black Sea" the progress of Blatic2Black project was again presented together with the latest expert workshop organized and their results and recommendations (http://www.blacksea-commission.org/BSC_NewsLetter_15_web.pdf).

On the HELCOM website all presentations given during all Expert Workshops organised so far are available in the section dedicated to the projects at http://meeting.helcom.fi/web/projects. HELCOM has informed on the progress of the project in the Monitoring and Assessment Group (HELCOM MONAS 17).

A presentation on the progress of the Baltic2Black project was given during the celebration of the International Black Sea Day, held on October 31st, 2012 in Batumi, Georgia. The information is available on the BSC website at http://www.blacksea-commission.org/_bsday2012.asp . Another presentation with the latest results was given during the celebration of the Black Sea Day on 31st October 2013 in Constanta, Romania (see: http://www.blacksea-commission.org).

Also, the progress in the implementation of the Baltic2Black project together with the outcomes and recommendations of the 2nd Expert workshop on eutrophication assessment was presented to the Black Sea Commission at its 28th Regular Meeting held in Istanbul on 21-22nd November, 2012.

The feasibility on usage of automated systems for monitoring of eutrophication parameters in the Black Sea region was presented at the Black Sea Day 2013 (Constanta, Romania) as well as all the achievements of the project.

Project information, especially the results of the 4th Expert Workshop was uploaded on the Black Sea Commission's and HELCOM's web pages.

The results of the BEAST testing in Romanian Black Sea waters were presented at the PERSEUS Project Scientific Workshop (29 – 30 Jan 2013, Athens, Greece).

The progress in implementation of the Baltic2Black project and the outcomes and recommendations of the 3rd expert workshop were presented to the Black Sea Commission at its 29th Regular Meeting organized on 20-21st November, 2013 in Istanbul.

Conclusions

In general, the implementation of the Baltic2Black project went according to the project document and work plans established annually. Due to delays occurred in elaboration of the reference and target values for the eutrophication parameters with the participation of all Black Sea countries, a three months extension was requested to EC and granted. All contracts concluded with institutions and experts were successfully finalized and deliverables were provided to the BSC Permanent Secretariat.

Work on the regional database for pollution was finalized at this stage and a virtual workshop for training the potential users was conducted. The RDB-P database further development is going to take place in the EMBLAS Project ("Improving Environmental Monitoring in the Black Sea", funded by EC DG Devco). EMBLAS includes an activity where the RDB-P, as a component of BSIS, is going to be upgraded to a web-based Black Sea Water Quality Database (initially as a prototype, then in EMBLAS II it will become fully operational). EMBLAS plans to also develop a regional Phytoplankton data base and to further develop the existing regional *Mnemiopsis* data base, both of them as parts of the BSIS. Compatibility/interoperability of the BSC data base components with WISE-MARINE, SEIS, SeaDatNet, EmodNET and other data infrastructures will be developed or enhanced.

All Black Sea countries' contracted experts did their best to contribute at the elaboration of the reference values and targets for eutrophication parameters. A preliminary set was elaborated and included in the summary report for the deliverable 3.1. With the valuable contribution of the Baltic Sea experts, the BEAST methodology for the eutrophication assessment in the Black Sea was elaborated. The methodology was successfully tested by the Black Sea experts and the methodology will be presented to the Black Sea Commission for approval.

The modelling possibilities in the Black Sea region were explored, using the experiences in the Baltic and a similar system to NEST was proposed for the Black Sea. As funding source for supporting the modelling activities in the Black Sea, the EC research programmes (Horizon 2020, others) were identified.

Four expert workshops were organized in good conditions, relevant experts from both Black Sea and Baltic Sea regions participated, provided interesting presentations, had interesting discussions among themselves, and established contacts for future cooperation in research projects. Exchange visits were made by both secretariats for getting acquainted with each other activities and work practices: organization of meetings, preparation of the meeting documents, etc.

During the last period of the project implementation more attention for better coordination and collaboration among the Black Sea countries and experts was paid.

Based on the recommendations provided by the project, the BSC should decide on the follow up steps to be taken by the Black Sea countries and the BSC to improve the monitoring activities.