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A SCIENCE PLAN FOR THE REGION

**Report on Existing or Planned Monitoring
Activities and Suggestions For Optimal
Modification (D6.1)**

by
S. Colpan Polat Beken
UNEP/MAP-MED POL



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Edited by

S. Colpan Polat-Beken
Mediterranean Action Plan / MED POL

Oksana Tarassova
Black Sea Commission

Kostas Nittis
Hellenic Center of Marine Research, Greece

Maria Capari
Mediterranean Action Plan / MED POL



REPORT ON EXISTING OR PLANNED MONITORING ACTIVITIES AND SUGGESTIONS FOR OPTIMAL MODIFICATION

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1. Current status of monitoring systems and programmes in the coastal and open waters of the Mediterranean and Black Sea

The task will be examined for three major characteristic groups; **water quality, biodiversity and fisheries**, since they were initially accepted -within IASON SSA- areas lack of information for coastal ecosystems of the Mediterranean and Black Sea.

Routine on-site monitoring activities will first be reviewed/analyzed for each of three groups and the current status of supporting application tools of remote sensing and operational oceanography for routine monitoring will also be examined.

1.1 Ongoing and planned monitoring systems/programmes at regional level within marine conventions

The monitoring systems established and/or planned within the Barcelona and Bucharest Conventions will briefly be presented in this section.

1.1.1 Barcelona Convention

The Barcelona Convention constitutes the legal framework of Mediterranean Action Plan (1975) which is a cooperative effort involving 20 countries and EU. MAP is the first Regional Seas Programme of UNEP whose objective is the creation of a healthier Mediterranean Environment, basing on the principle of sustainable development. UNEP/MAP (www.unepmap.org) comprises a Mediterranean Commission on Sustainable Development (MCSDD), a MED POL Programme for the Assessment and Control of Pollution and six Regional Activity Centers (RACs) around the Mediterranean. The whole MAP structure with its national focal points is responsible of implementation of the Convention and its 6 protocols.

Concerning the monitoring activities within the overall framework of MAP, they can be summarized in Table 1 making reference to policy requirements.

Table 1. Monitoring activities under Barcelona Convention

	Policy requirement	Area Concerned	Ask for Monitoring (Objectives)	Implementing bodies and status of implementation
Water Quality	<p>1. LBS Protocol (P1) and SAP-MED</p> <p>2. Protocol for preventing pollution from/at ships/cases of emergency (P2)</p>	<p>- MED Sea area as defined in BC (from Gibraltar to Dardanelles, marine waters) (P1,2)</p> <p>- Hydrologic basin of the MED sea area (P1)</p> <p>- waters on the landward side up to the fresh-water limit (P1)</p> <p>- brackish and coastal salty waters inc. marshes, coastal lagoons and ground waters communicating with the MED sea. (P1)</p>	<p><i>Art. 12</i> of BC, <i>Art. 8</i> of (P1), <i>Art.5</i> of (P2)</p> <p>Art 8 of P1 states that Parties shall launch mon.prog</p> <p>- to assess the levels of pollution along their coasts</p> <p>- to evaluate the effectiveness of action plans, programmes and measures</p> <p>Art 5 of P2 states that Parties shall develop and apply mon. act. To prevent/detect/combat pollution of the sea by oil, hazardous and noxious substances</p>	<p>Competent national authorities designated by the CPs .</p> <p>P1 :</p> <p>- MAP/MED POL is responsible of establishing a pollution monitoring system⁽¹⁾ (with common procedures and standards) at the regional level (1975- today)</p> <p>- 17/21 countries have monitoring programmes; 11/17 are MED POL/ NMPs</p> <p>- Annual reporting and submission of raw data</p> <p>P2: parties are responsible of achieving reporting obligations on incidents, spills etc. and transmit the required information to REMPEC/RAC.</p>
Biodiversity	<p>Protocol for SPA and Biological Diversity (P3) and</p>	<p>- MED Sea area as defined in BC (from Gibraltar to Dardanelles)</p> <p>- Seabed and its subsoils</p>	<p><i>Arts. 3, 1, 20</i> of (P3)</p> <p>Parties shall</p> <p>- identify/compile inventories of the</p>	<p>Competent national authorities designated by the CPs</p> <p>Reporting on SPAMI and</p>



	<u>SAP-BIO</u>	<ul style="list-style-type: none">- Waters, seabed/subsoils on the landward side up to the fresh-water limit- Terrestrial coastal areas including wetlands	components of biological diversity - identify/plan/undertake scientific/technical research/ monitoring programmes necessary for identification/protection of protected areas and species and assessing the effectiveness of management and recovery plans	species lists to SPA/RAC.
Fisheries ⁽²⁾				

(1) MED POL monitoring activities will be detailed below

(2) Within MAP framework policy/management/monitoring on fisheries is not available. Other international policies apply in the region.

An evaluation of each monitoring activities related with WaterQuality under MAP/MED POL

As realized from Table 1 the monitoring system established for the Mediterranean region has been focused more on pollution monitoring and the task has been dealt by the MED POL Programme of MAP since mid 70s. The first two decades of the programme had been more dedicated to research and monitoring whereas in the third phase (1996-2005) a shift to pollution control was made and the Strategic Action Programme (SAP) to support the policy requirements of the LBS protocol of BC was developed. Monitoring has become a component of SAP to present periodical assessments of the state of the environment in hot spots and coastal areas (needed to provide information for decision makers on the basic environmental status of the areas which are under anthropogenic pressures); to determine temporal trends of some selected contaminants in order to assess the effectiveness of actions and policy measures, and to enhance the control of pollution by means of compliance to national/international regulatory limits.

According to the above mentioned objectives of the programme following components of monitoring were developed and common guidelines, standards and criteria were provided for each (The monitoring activities mentioned below are subject to revision according to the principals of recently adopted MED POL Phase IV in November 2005 (UNEP(DEC)/MED IG.16/5/Annex III). The operational details of the new programme will be finalized during 2006 and be presented to the focal points in 2007 for approval).

1. Spatial and temporal trends monitoring of contaminants for state assessment
2. Compliance monitoring of effluents, bathing waters and shellfish waters
3. Assessment of loads from point and non-point sources of pollution and monitoring of them where required
4. Monitoring of biological effects (pilot)
5. Eutrophication monitoring (pilot)

DQA system has been run by IAEA/MEL for (1), WHO for (2), DISAV for (4) and by the Italian consortium (ARPA-ER, CRM, ICRAM) and IAEA/MEL for (5).

Table 2.a-c summarizes the mandatory/recommended criteria set for each component of the programme.

Table 2a. Sampling parameters/matrices and frequencies for trend, loads and biological effects monitoring components

	Levels and trends of contaminants at coastal waters including hot spots and reference areas		Loads from point and diffuse sources of pollution		Biological effects
	Mandatory	Recommended	Mandatory	Recommended	Mandatory (pilot)
Parameters (Matrices)	Hg and Cd (biota and sediment)	Other heavy metals, halogenated and chlorinated organic contaminants, PAHs	pH, T, Hg, Cd, TSS, BOD ₅ , COD, TP, TN, FC. (effluents, river water, air)	Other heavy metals, HH+, detergents, phenols etc. depending on the character of the input	LMS DNAx EROD MT Stress on stress (biota)
Sampling frequencies	At least once per year for biota at the pre-spawning period & annually or less frequently for surface sediments at the most stable hydrographic conditions		From weekly to seasonal depending on the matrix and the nature of the input (e.g. discharge character)		Quarterly or semi-annually inc. pre-spawning period

Table 2b. Sampling parameters/ matrices and frequencies for compliance monitoring component

	Bathing Waters	Shellfish Waters	Effluents
Parameters	MB (TC, FC, FS)	MB (TC, FC, FS)	BOD, COD, TSS, Nutrients (TP, TN) Heavy Metals (Hg, Cd, Pb, Cr, Zn etc.), Polycyclic Aromatic Hydrocarbons (PAH+), Halogenated Hydrocarbons (HH+) (be prioritized according to the type of industry and requirements of the national legislation)
Sampling Frequency	Fortnightly (Spring-summer)	Monthly (or) Seasonally	(according to the existing national legislation)
Sampling Matrix	Sea water	Sea water	Effluents

Table 2c. Mandatory sampling parameters and sampling strategy for eutrophication monitoring component

Temperature	Dissolved oxygen (measured and saturated)
pH	Chlorophyll “a”
Transparency	Total Nitrogen
Salinity	Nitrate
Orthophosphate	Ammonium
Total phosphorus	Nitrite
Silicate	Phytoplankton (total abundance, abundance of major groups, bloom dominance)
Frequency: Minimum 4/year, 6-12/year recommended.	
Station network: Coastal stations and at least 3 transects (min 3 sts at each) for each monitoring site	
Sampling depths: Intense surface sampling and vertical profiles at the possible max number of stations	
Purpose: To support TRIX index for surface waters, N/P ratios and trends, phytoplankton determinants.	

The first component of MAP/MED POL monitoring activities has dealt with site-specific temporal trends of pollutants (at hot spots; discharge areas, estuaries, bays, etc) as well as the monitoring of all coastal waters. The present status of this group of activities can be withdrawn from the public information available at <http://195.97.36.231/medpol/>. (It will be updated in November 2005 with 2004 country data and new information/data obtained from France). Together with the information and data of the well developed monitoring programmes in the European countries, MED POL monitoring database can serve for a complete picture for trends and status of pollution at the Mediterranean level. However, the national monitoring programmes within the framework of MED POL Programme are not complete to cover all the coastal areas with proper sampling station networks, therefore, should be cautiously handled with regard to the spatial coverage of data even at the local (national) level.

The first evaluation of long-term pollution data (1975-1996) was finalized in 2002 and the expert validated data published on the web (<http://195.97.36.231/medpol/>). Most of assessments based partially on the monitoring data were made available in MAP Technical Reports Series (<http://www.unepmap.org/>) or in joint reports prepared with EEA. First statistical evaluation of trend monitoring data obtained during Phase III was made in 2003 for 1999-2002 data (UNEP(DEC)/MED WG.243/3) and the second one was done in 2005 for the period of 1999-2004 (UNEP(DEC)/MED WG.282/3) and presented to the 3rd meeting of government designated experts to review the MED POL Monitoring Activities held in December 2005. The same meeting concluded that MED POL should publish the overall findings of the monitoring activities at the regional level for the period covered by MED POL Phase III based on the data collected in MED POL Database and in the national data sources made available to MED POL. The major goal of this effort is to prepare an assessment of the state of pollution of the coastal waters of the Mediterranean for 1996-2005 in accordance with Article 8 of the LBS Protocol.

The second group of activities (Table 2b), compliance monitoring of effluents, bathing and shellfish waters, has been implemented for inspection on compliance to national and/or international regulations/obligations. MED POL asks for compliance reports prepared by the national authorities to facilitate the activity as part of the established monitoring systems.

The third component of the programme (Table 2a) is the monitoring of inputs both from point and diffuse sources. Point sources of inputs cover the waste discharge points as well as inputs from rivers. In MED POL only river mouths are presently monitored to estimate the riverine loads. However, the content of the database is not fully satisfactory to estimate the river inputs basically for the areas like Adriatic, Aegean and Northeastern Mediterranean where information and data is needed because there are important riverine inputs in those areas but with scarce information (MAP Technical series, No 141).

In addition to this monitoring efforts on discharges, MED POL with the contribution of all Mediterranean countries has completed a work on baseline budget of inputs from discharges. A common methodology was used by all the countries to estimate the inputs from industrial and municipal wastes. A database is under preparation to present the collected data. However, the information still needs verification with actual monitoring data obtained from the sources. In reference to MED POL database, actual monitoring of atmospheric inputs and deposition is limited to only one country in the Eastern Mediterranean. However, cooperative assessment and research studies with WMO were made and published among the MAP Technical Reports. Estimation of diffuse inputs (model studies) from watersheds and agricultural areas has been dealt together with international initiatives like EUROHARB, IOC/NEWS.

Biological effects (monitoring with biomarkers, preferably with a battery of biomarkers) studies (Table 2a) are designed to establish an early-warning system for the possible impacts of pollutants at the organism/cellular level and the rationale behind is to provide direct management tools concentrating at the early signals of negative effects. The study is still implemented as pilot monitoring at the Mediterranean level and the research on the subject is going on. The two-tiers approach to organize the future activities will be further discussed and considered in MED POL Phase IV (UNEP(DEC)/MED WG.282/3 and 282/5).

The eutrophication monitoring programme (Table 2c) supporting the TRIX index and the phytoplankton determinants has been recently initiated at a limited number of pilot sites with short term objectives of the programme (UNEP(DEC)/MED WG.231/14) to cover three coastal areas (Slovenian coastal area, Mersin Bay, Gulf of Gabes), one fish caging site (Limassol Bay, at the Tuna ranching cages) and one lagoon (Nador Lagoon). In the following two years, more pilot sites will be encouraged to be included in the national monitoring programmes. The preliminary list of eutrophication hot spots and sensitive areas will be updated in 2006 and a new assessment of eutrophication status of the Mediterranean has been planned to be published in 2007.

For the eutrophication programme, biological component will be developed including other trophic levels than that of primary producers which has already been included in the short-term strategy. The supplementary techniques (e.g. remote sensing) has been planned to be incorporated into the routine monitoring activities, however, concrete products has not been obtained yet.



An indicator system for 3 core sets (chemical, biological/ecosystem, biological effects/water&sediment quality) were developed within MAP/MED POL. Testing process has been partially achieved and will continue in 2005-2006. MED POL database as well as the national databases will be utilized for the analysis.

At the moment, MED POL has two databases on monitoring data (MED POL.mdb) and inputs data obtained from national baseline budgets (NBB.mdb). The web version of the former database (<http://195.97.36.231/medpol/>) provides information and a data inventory as well as some historical pollution data. MED POL-IS is under development.

An evaluation of biodiversity work under MAP

As recognized from Table 1, contracting parties of the Barcelona Convention report on SPAMIs and lists on endangered/ threatened species lists to RAC/SPA. They are also asked to establish inventories and monitoring activities on the components of biological diversity. The former activity has been handled by the parties and the responsible center quite smoothly and the work updating SPAMIs and species lists is going on. However, the inventorying and monitoring of biological diversity seems to be restricted with the national programmes basically of the European countries. A number of efforts at the project level has also been made by non-EU countries basically for SPAs where the parties have been strongly advised to enlarge the spatial coverage of such studies, however, budgetary constraints limit the work. Contracting Parties were also asked in 2002 to prepare national reports on the status of biodiversity and all the Mediterranean countries provided their reports to RAC/SPA. This information on biodiversity of Mediterranean has not been publicized as such. However, information gathered was elaborated to develop the SAP BIO (The SAP BIO document can be requested from UNEP/MAP Secretariat).

SAP-BIO considers the gaps of information and data that have appeared at the national and regional level and the consequent lack of actions (management and recovery plans) that should be taken aiming to provide a common and an operational framework for the Mediterranean. The developed programme will be supported by a GEF project at sub-regional level for the GEF-eligible countries. This effort together with the efforts of the European member states will provide a comprehensive picture on Mediterranean biodiversity.

A closer look on inventorying, mapping and monitoring of Mediterranean coastal and marine biodiversity under the SAP BIO is underneath:

General objective

“Contribute to achieving the WSSD targets concerning establishing by 2004 a regular process under the United Nations for global reporting and assessment of the state of the marine environment, including socio-economic aspects, both current and foreseeable, building on existing regional assessments”

Specific targets (target dates will be revised where needed)

- GIS-based mapping of sensitive habitats by 2008

- Mediterranean checklists of species by 2006
- Standard monitoring protocols for socio-economic impacts, global trade, endangered species, effectiveness of protected areas by 2004
- SAP BIO indicators by 2006

Priority actions

1. Make a complete and integrated inventory (by sub-region) of Mediterranean coastal, wetland, and marine sensitive habitats

Objectives

- a. Description and GIS-based mapping of the spatial distribution of the sensitive habitats
- b. Complete checklist of species associated with each sensitive habitat
- c. Long-term routine monitoring programmes, in order to define temporal variability of abundance, biomass and other assemblage variables within sensitive habitats
- d. Elaborate national checklists for marine and coastal species for all the Mediterranean countries

2. Establish a monitoring system of endangered and threatened species

Objectives

- a. Implement a monitoring system for endangered species at regional level
- b. Establish and update the health and risk status of endangered populations

3. Promote the adequate monitoring and survey of the effectiveness of marine and coastal protected areas

Objectives

- a. Implement sound scientifically-based monitoring programmes on the effectiveness of marine and coastal protected areas
- b. Improve methods of management planning, implementation and monitoring

4. Identify, develop, and validate adequate biological and socio-economic indicators to assess the ecological health of sensitive habitats and species, and to evaluate the effectiveness of management measures

Objectives

- a. Elaborate a regional strategy on SAP BIO indicators
- b. Elaborate a list of useful SAP BIO indicators
- c. Existing and new data collected to construct selected SAP BIO indicators
- d. Construct SAP BIO indicator set starting from the collected data
- e. Validate selected SAP BIO indicators

The specific actions for each objective above were identified in SAP-BIO including the scale level, actors etc.

1.1.2 Black Sea Commission

Under the framework Convention on the Protection of the Black Sea against pollution, signed in Bucharest in April 1992 (entered into force in 1994), the six coastal Black Sea States (Bulgaria, Romania, Georgia, Russian Federation, Turkey and Ukraine) commit themselves to individually and jointly take all necessary measures to prevent, reduce and control pollution (emanating from land-based sources, vessels, dumping, activities on the continental shelf, through atmosphere, and from transboundary movements of hazardous wastes) in order to protect and preserve the marine environment (inclusive of marine living resources) of the Black Sea . In the Annex to the Convention substances/matter whose discharge into the sea from any source is strictly prohibited are enlisted. Three Protocols on combating land-based resources, dumping and cooperation in emergency situations form an integral part of the Convention. The Protocols describe the pollutants concerned, the specific requirements for implementation such as permitting procedures, reporting etc. Immediately after the signing of the Convention project support was rendered by the GEF for the attainment of the objectives of the Convention. The initial pollution control approach evolved into a conservation and sustainable use approach, as evidenced by the adoption of the 'Strategic Action Plan for the Rehabilitation and Protection of the Black Sea' by its Contracting Parties.

The Strategic Action Plan for the Rehabilitation and Protection of the Black Sea (BSSAP) based upon the findings of the Black Sea 'Transboundary Diagnostic Analysis' (TDA) is a step in the process towards attaining sustainable development in the Black Sea region. Its overall aims are to enable the population of the Black Sea region to enjoy a healthy living environment in both urban and rural areas, and to attain a biologically diverse Black Sea ecosystem with viable natural populations of higher organisms, which will support livelihoods based on sustainable activities such as fishing, aquaculture and tourism in all Black Sea countries.

An evaluation of monitoring activities related with Water Quality under BSC

The BSSAP provides tools for the establishment of a Black Sea Monitoring System based upon measurement of key contaminants and biological effects; A uniform bathing water quality measurement technique will be developed and implemented with results published; data for actual/assessed discharges from point, non-point sources and rivers will be compiled and freely exchanged; New marine and coastal conservation areas will be designated on the national and regional scale.

The regional division of the Black Sea for the monitoring and assessment purposes is proposed having in mind future extension to central part of the Black Sea as soon as delimitation of the economic zones will be completed by all Black Sea countries. At the moment the areas of concern for monitoring are territorial waters of the member states and the open Black Sea.

Black Sea Monitoring and Assessment Programme (BSIMAP, pilot phase:2001-2005, <http://www.blacksea-commission.org/BSIMAP.htm>) is based on OSPAR model and tested in the Black Sea as a first approach to set up BSIMAP. This programme incorporates all ecosystem components, with sets of mandatory and optional parameters.

The BSIMAP Programme has recently been re-adopted by the 13th Meeting of the BSC for the period of 2006-2010 and the monitoring and assessment components were grouped addressing identified problems and certain policy matters. The new programme considers six policy issues to set up monitoring activities at the regional and national levels with specific objectives and identified assessment criteria. Table 3 summarizes the mandatory and optional monitoring parameters to address identified issues which are;

Policy question 1(PQ1): Are the regional effort to combat eutrophication effective and properly reflected in concentration of nutrients in the Black Sea? Purpose: Trend analysis in nutrient levels. Assessment criteria: No or decreasing trend for nitrogen and phosphorus compounds.

PQ2: What are priority pollutants in the Black Sea and their impact on ecosystem and human health? Purpose: Control of background values, trend analysis if any. Assessment criteria: Background values. Media: Water

PQ3: Does pollution reduction in hazardous substances occur? Purpose: Trend analysis
Assessment criteria: Background values. Media: Bottom sediments

PQ4: Is bathing water quality in the Black Sea safe for human health?

PQ5: What is response of biodiversity on main pollution and destruction of habitats?

PQ6: Does pollution of biota exceed the human consumption safety limits?
How does pollution and eutrophication affect the major stocks of marine living resources?

Table 3. BSIMAP Mandatory and Optional Parameters and Sampling Frequencies as re-adopted by the 13th Meeting of the BSC

Mandatory monitoring parameters / sampling frequencies	Optional monitoring parameters
Water (PQ1, PQ2 and PQ3)	
Temperature, Salinity, pH, O ₂ (saturation and dissolved), Secchi / 4/year TSS, BOD5, PO4-P, TP, NH4-N, NO3-N, NO2-N, TN, SiO ₃ / 4/year Satellite images at regional level	H ₂ S, TOC, Events of hypoxia Satellite images at national level
Petroleum Hydrocarbons / 4/year Cd, Cu, Hg, Pb / 1/year	Oil slicks, Lindane, Phenols (volatile & chlorinated), detergents, PAHs Cr, Mn, Co, Fe, Zn, ¹³⁷ Cs, ⁹⁰ Sr
	Total coliforms, E.Coli, Fecal Streptocci, Visual observations
Bottom Sediments (PQ 4)	
Particle size, description of sediments Cd, Cu, Hg, Pb, DDT, DDD, DDE, Lindane, PCBs, Hydrocarbons total(1/year or every 6 years as recommended by WFD)	TOC, total P, calcination losses Co, Cr, Fe, Zn, Al, Ni, Phenols(chlorinated), PAHs, ¹³⁷ Cs, ⁹⁰ Sr, total radioactivity Any new substance qualified as priority for the Black Sea
Biota (PQ5 and PQ6)	
Chl-a, phytoplankton, mesozooplankton, biomass of Noctiluca / 4/year Macrophytobenthos, Macrozoobenthos, Fish landing(annually)/ 1/year	Fish stocks (annually)
Pollutants in biota {bivalves, fish meat) : Cd, Cu, Hg, Pb, DDT, DDD, DDE, Lindane, PCBs	Pollutants in biota {bivalves, fish meat) : Co, Cr, Fe, Zn, Al, Ni, Phenols (chlorinated), PAHs, Cs, Sr, Tr, total radioactivity

The following activities for the establishment and efficient implementation of BSIMAP were accepted by the BSC institutional network

1. the common principles and platform for the elaboration of regionally coordinated monitoring and assessment system (COAST, WFD principles, OSPAR-JAMP)
2. establishment of an initial affordable monitoring program in order to harmonize assessment methodologies, analytical techniques, commonly agreed reporting formats and other relevant components important for the harmonization of the monitoring and assessment of the Black Sea environment. In the pilot phase of the BSIMAP, collection and validation of the historical information on the State of the Black Sea Environment was conducted. The validated information will be published in 2006. Formulation of national monitoring programmes according to the BSIMAP objectives and criteria is the step forward.
3. process of the harmonization of assessment methodologies and analytical techniques to be compatible on the regional level. In order to set up harmonized assessment methodologies with EEA, OSPAR and HELCOM, cooperation with EEA, JRC (for remote sensing technology) and IAEA/MEL has been established and certain steps have been accomplished
4. approaches to elaboration of environmental quality criteria/objectives
5. mechanisms of integration scientific results into the assessment process (ARENA, IAEA, other scientific projects)
6. elaboration of mechanisms and procedures for quality assurance and quality control. BSIMAP programme details was planned to be finalized in 2005 including set of operational manuals and setting up QA/QC system. IAEA/MEL has taken a role to establish the QA/QC system.
7. elaboration and maintenance of the Black Sea Information System for supporting decision making process of the Black Sea Commission . Development of the Black Sea information system (BSIS) and GIS will be finalized in 2005-2006. The main databases of the BSIS organized according to the thematic division of the BSC Advisory Groups and includes the followings:
 - Pollution monitoring and assessment PMA DB
 - Biodiversity Conservation CBD DB
 - Fisheries and Aquaculture FOMLR DB
 - Integrated Coastal Zone Management ICZM DB
 - Land-based pollution sources LBS DB
 - Environmental aspects of shipping ESAS DB

The information flow in the BSIS is provisioned for each article of the BSSAP including policy and managerial measures. The data entry into the PMA DB and FOMLR DB are being processed. Work on other databases are going on.

8. setting up preparatory process for compilation of the State of the Black Sea Environment report which has been initially planned for 2007

An evaluation of biodiversity work under BSC

One of the major required actions on biodiversity in the Black Sea as derived from the Black Sea SAP commitments is the finalization of the Strategy and Action plan for the Conservation of Biological Diversity (2003). In the Draft Strategic Action Plan for the Black Sea Biodiversity and Landscape Conservation Protocol (www.blacksea-commission.org) a Biodiversity and Landscape Monitoring and Assessment Programme has been foreseen with the following objectives:

- a) Develop and implement the Biodiversity and Landscape Monitoring Programme as an integral part of the BSIMAP with particular attention for the development of proper indicators and harmonized methodologies for assessments and analyses of status and trends in species, ecosystems, habitats and landscapes
- b) Formulate and implement program of scientific research on biodiversity and ecosystem functioning for attracting targeted international and national funding
- c) Prepare and publish thematic chapters on the status and trends of Black Sea biodiversity, habitats and landscapes to the annual and five years reports of the Black Sea Commission

As clearly understood, the monitoring effort on biodiversity has been planned to be the integral part of BSIMAP and some components have already been incorporated as optional monitoring parameters.

Other related work handled by the BSC are

- Finalization of the Strategy and Action Plan for the Conservation of Biological Diversity (2003)
- Promotion of the implementation of the Strategic Action Plan for the Conservation of Biodiversity
- Finalization of the Strategy and Action Plan for the Conservation of Landscape Diversity drafted in 1995
- Revision of the Black Sea Red Data Book on Rare and Endangered Species
- Establishment of Advisory Group on the Management of Marine Mammals
- Promotion of accession to ACCOBAMS of those Black Sea States that are not already members
- Completion of Regional Assessment of Black Sea marine mammals in cooperation with ACCOBAMS (2003-2004)
- Prediction and control of mass mortality events of cetaceans: systematic study of the life cycles of cetacean parasites and the features of morbillivirus infection
- Development of a strategy for the reduction of by-catches of marine mammals
- Drafting of a proposal on a feasibility study for regional cetacean rehabilitation centers
- Monitoring of the number of stranded and by-caught harbor porpoises and dolphins, including regular collection of data for the Sea of Azov

An evaluation of fisheries work under BSC

The major required actions in the Black Sea with regard to fisheries as derived from the Black Sea SAP commitments are:

- Finalization, adoption and prompt ratification of the Fisheries Convention (2004)
- Revision, updating and according legal status to the list of rare and endangered species based on Annex II to the Protocol on Biological and Landscape Conservation (2005)
- Coordination and implementation of a regional assessment of fish stocks
- Inventorying and assessment of the conditions of migratory routes, spawning and feeding grounds for important anadromous species of the Black Sea and preparation of a regional project for their rehabilitation and protection (2002-2004)
- Preparation and implementation of a regional strategy on sustainable fisheries in cooperation with the FAO and promotion of FAO Code of Conduct for Responsible Fisheries in the Black Sea
- Identification of coastal areas to be included in the regional protected areas network; development of criteria applicable to the Black Sea
- Development and agreement upon the assessment methodologies for the impact of fisheries on the environment and effects of environmental conditions on the biodiversity, stocks, and health of fish populations and other marine living resources in the Black Sea
- Establishment of a regional procedure for the identification of endangered fish species and the assessment of endangered fish stocks
- Conduction of a regional feasibility study for the rehabilitation of Black Sea lagoons and their use for fish breeding and aquaculture
- Conduction of a regional feasibility study on the economic options of the development of the fisheries sector

1.1.3 A synthesis of monitoring activities in both regions

Monitoring and assessment activities organized in both convention areas are both addressing certain policy issues and needs. MED POL activities as in its Phase III for the period of 1996-2005 has been reviewed and the procedure of work to revise the programme according to the MED POL Phase IV principles (2006-2013) has been conducted. As expectedly the mandate of the MED POL monitoring activities will still be attached to the needs of LBS Protocol and the related SAP which will continue to exclude the biodiversity and fisheries issues. The overall integration of the monitoring and assessment activities could only be possible after necessary institutional arrangements are made within the MAP system. The BSIMAP of BSC with its recently adopted content addresses six different policy issues raised in its formal texts and the operational features for each have been developed.

At present, the proposed systems by MED POL and BSIMAP for monitoring the coastal (and open) areas of the Mediterranean and the Black Sea are based on two different approaches. On one hand, the MED POL monitoring activities designed basically for monitoring of levels, trends and biological effects of pollutants at designated hot spots and sensitive areas in the coastal waters

including the monitoring of land-based sources. Only with the addition of eutrophication component of the programme, activities were enlarged to include also the other ecosystem components. MED POL provides common strategies and methods only for the inshore and near-shore coastal waters and open Mediterranean sea has not been covered with the present objectives although covered by the Convention protocols. The mandates of the two MAP/RACs; REMPEC and SPA/RAC, can partially fill the gaps at monitoring/registering the pollution of the open sea and ecosystem components, respectively. However, within the framework of longer term implementation of the ecosystem approach in the Mediterranean, all MAP programmes and bodies will need to be integrated to establish a comprehensive monitoring and assessment system which will operate the adaptive management in the region. On the other hand, BSIMAP offers an integrated monitoring and assessment system to include all the ecosystem components as well as monitoring of pollution for the Black Sea territorial and open sea waters.

The implementation of both programmes have got their own bottlenecks. BSIMAP programme is quite new and has not been efficiently operational yet. Although the institutional networks together with the advisory groups are well established, the BSC might have doubts for the implementation phase since the recommended programme is huge and financially not sustainable. On the other hand, the MED POL Programme has a long experience on programme implementation steps and in its Phase III the objectives of the programme were more focused on pollution control rather than research and monitoring for marine state assessments and monitoring was handled only for limited areas applied with common methodology and supported by a QA/QC system.

The assessments methodologies used by the two convention areas have also differences. The common features are TDAs, assessment of land-based inputs and a number of others regarding water quality and partially covering ecosystem quality. Indicators as assessment tools are also being developed in two regions. The further development of the indicators through expert meetings, testing of them and continuous update of indicator fact sheets through actual monitoring data have to be tackled by both programmes in their process of monitoring and assessment. Besides, the assessment criteria for at least some of the policy issue has been identified by the BSC (basing on trends and background values). The quality classification of coastal waters according to chemical and ecological status and the development of EQOs as required in the WFD, has being tackled by the BSC. Recently, UNEP/MAP, in cooperation with the EU, has initiated a new project for the Mediterranean to develop a road map for the implementation of the ecosystem approach in the region. The project also aims to provide guidance for the development of EQOs which would be the backbone of the organization of future monitoring and assessment activities in the Mediterranean. Nevertheless, approaches for defining good environmental status and for setting EQOs and their thorough elaboration are required in both regions.

1.2 Surveys and other initiatives at sub-regional and regional scale for coastal and open waters of Mediterranean and the Black Sea

In order to improve the knowledge and fill the data gaps at the regional scale on pollution and ecosystem status, conduction of regional or sub-regional surveys would be complementary to what has been done and planned within the national monitoring programmes. This approach has

been recently adopted by the Mediterranean countries. The MYTILOS project that had been launched for the baseline contamination level of the Mediterranean coastal waters for about 40 contaminants including new chemicals was examined with interest by MAP/MED POL. The Mytilos/Rinbio methodology developed by IFREMER is the backbone of the initiative which uses a common biomonitoring mussel deployed in cages for three months of contaminant accumulation period. While the application of the method, the obtained biometric parameters of mussels could also lead to a complete characterization of coastal waters in terms of trophic level. The first leg(s) of the project was completed during 2004-2005 for the coastal area of Spain, France and Italy (western coast). The second leg is planned to cover Morocco-Algeria-Tunisia coastal area for 2006 and MAP/MED POL has been involved in the organization of it. In order to complete the whole Mediterranean area with such regional surveys, new projects have been searched for and a proposal for the Aegean and North Levantine Sea has also been developed. Similar project proposals for the Adriatic Sea and the South East Mediterranean still need to be looked for.

It is very well known that CIESM (www.ciesm.org) has been running a mussel watch programme since 2002 for the reliable baseline levels of radionuclides in the Mediterranean and the Black Sea with the use of a common bioindicator. The first results obtained for ^{137}Cs for both regions have been displayed at the web site since late 2005.

An other CIESM initiative -zooplankton indicator programme – aiming to develop and provide data on zooplankton as environmental indicator, in order to assess and forecast ecosystem changes in the Mediterranean and Black Seas, has established a network of scientists from the Mediterranean and the Black Sea and planning to organize spatial surveys to collect information. A Medzooplankton website and the databank is under preparation.

The CIESM Atlas of Exotic Species was finalized and published in 2004 and it is the first attempt to provide a comprehensive, group by group, survey of recent marine "immigrants" in the Mediterranean.

The prior programmes and projects implemented in the Black Sea area are

- Co-operative Marine Science Programme for the Black Sea (CoMSBlack),
- Ecosystem Modelling as a Management Tool for the Black Sea: A Regional Programme of Multi-Institutional Co-operation (NATO Sfs TU Black Sea),
- The Interactions between River Danube and the north-western Black Sea (EC / EROS 2000),
- Biogeochemical Interactions between the Danube River and the north-western Black Sea (EC / EROS 21),
- Black Sea Mussel Watch Pilot Study (IOC / Plymouth Marine Laboratory, UK)
- Regional Danube River Project (2004 –2007).

A number of pilot studies and surveys were also conducted in the Black Sea between 1994-1997 for water quality and fisheries.

The first BSERP pilot monitoring exercise has recently been accomplished in 2003 and a new one is planned for 2005-2006 as well as a research cruise on nutrient fluxes for the same period.

The well-known and respected EU network of excellence on Marine Biodiversity and Ecosystem Functioning, MARBEF (<http://www.marbef.org/>), is a platform to integrate and disseminate knowledge and expertise on marine biodiversity, with links to researchers, industry, stakeholders and the general public. It provides information and data on marine biodiversity for both regions. Among other facilities, it provides links to European Marine biodiversity projects and has established a data system where biogeographic data sets are also submitted.

1.3 Observation and forecasting systems

The concept of operational oceanography and the development of monitoring and forecasting systems have been promoted globally through global/regional IOC/GOOS activities to support the sustainable development of the regional sea areas. EuroGOOS, MOON, MedGOOS, AfricaGOOS and BlackSea-GOOS are relevant initiatives to promote and implement observing and forecasting systems in the Mediterranean and the Black Seas. Networking, capacity building and raising awareness are also among the responsibilities. Other international bodies (EU, NATO) have also supported such activities at the project level. Table 4 provides brief information on the available operational systems as well as research/technology development and networking efforts in the area.

Although the first initiatives were all concerned with oceans and open seas, monitoring and forecasting systems for the coastal waters of concerned regions have also been developed and RTD efforts to improve the methods are in progress. The shelf and coastal marine environment is in many respects more complicated than the open sea, mainly due to the large number and diversity of driving forces (natural and anthropogenic) and the associated pressures on its state/health. The monitoring and forecasting requirements are far more challenging than those of the open ocean and have to be adapted to the characteristics and problems of each specific coastal environment. Up to now, the range of parameters that could be monitored and predicted operationally with acceptable accuracy, was confined to the physical characteristics (temperature, salinity, currents, sea level, waves). Biochemical sensors (dissolved oxygen, chlorophyll, nutrients, pH, light characteristics) and satellite remote sensing (ocean color) have only recently started to produce reliable time series under a sustained operation. The availability of these data is also critical for the development of marine ecosystem models that are still in an early stage; they have been tested and calibrated for different areas but their transition to an operational mode requires a continuous data flow for routine assimilation and validation.

The COOP panel of GOOS has recently published “An Implementation Strategy for the Coastal Module of the Global Ocean Observing System” (GOOS report #148, 2005) in which the requirements and characteristics of coastal observing and forecasting systems are described. Coastal areas are the major interest for environmental protection agencies at the local and regional level to ensure healthy coastal ecosystems and achieve ICZM objectives. In this respect, the needs of Barcelona and Bucharest Convention areas are tremendous in terms of environmental and risk assessments, decision-making, predicting the future after actions and measures taken for pollution reduction, rehabilitation and protection of ecosystems. The COOP

report recognizes the needs of such Conventions and suggests observing strategies that could partially meet these requirements in the short to medium term.

An important initiative that aims to coordinate integrated monitoring of the environment (terrestrial, atmospheric, ocean) on a European level is GMES (Global Monitoring for Environment and Security, www.gmes.info). It is a joint effort of the EU and ESA (European Space Agency) with the ambition to combine remote sensing, in-situ observations and numerical models, through coordination of national and European infrastructures, in order to deliver structured information products to end users for environmental protection, civil security and support of European policies. The maturity and importance of Marine applications has been recognized and “ocean” is one of the “fast track” services of GMES. Eutrophication, Harmful Algae Blooms (HABs) and oil spills are currently the three main applications of GMES marine services but the portfolio is likely to be enriched in the future and include more aspects of Marine Environmental Health. GMES is considered the European contribution to GEOSS (Global Earth Observation System of Systems, <http://earthobservations.org/>). The GEOSS 10-Year Implementation Plan, endorsed by nearly 60 governments and the European Commission on 16 February 2005, is designed to qualitatively improve our understanding of the Earth system, markedly enhancing global policy- and decision-making abilities to promote the environment, human health, safety, and welfare.

The regional approach used by GOOS is expected to be followed by GMES and GEOSS and thus specific implementations for the Mediterranean and Black Seas are to be developed for the two basins. All three initiatives have a strong scientific basis but are in the same “user oriented” and recognize sustainable development as one of their main goals. Especially in the Mediterranean and the Black Sea, the goals and objectives of the two communities (scientists & managers or “providers” & “users”), are quite well coupled and based on that cooperation has been evolved in both seas. It is recognized that the present scientific and technological capabilities of operational oceanography cannot fulfill all the monitoring requirements in the two basins but the gaps are progressively filled through marine RTD. It is, therefore, important to continue a continuous dialogue between the two communities and periodically revisit the emerging capabilities and re-design the monitoring strategies. All the initiatives/projects listed in Table 4 should be considered as milestones for the improvement of systems and techniques towards achieving a full end-user profile making use of science based management of coastal areas and open seas of the Mediterranean and the Black Sea.

Table 4. Observation and forecasting systems available for the two regions

System ID	Region	System definition and capabilities	Access to information and products
MedGLOSS	Med. & BS 1996- Global/Regional initiative	Sea level observation system operating with NRT monitoring network	http://medgloss.ocean.org.il/
MedARGO	Global/ Mediterranean	Global T/S profiling floats providing NRT data to describe the evolving state of the upper world oceans and the patterns of ocean climate variability	http://doga.ogs.trieste.it/WP4/
Mediterranean Multisensor Moored Array buoy system (M3A)	Mediterranean	NRT monitoring of physical and relevant biochemical and optical parameters	http://www.poseidon.ncmr.gr/M3A/
Mediterranean ocean Forecasting System: Toward Environmental Predictions (MFSTEP)	Med Project – continuation of MFSP	Constitutes observation system and a modeling system for forecasts System improvements, technology development	http://www.bo.ingv.it/mfstep/
POSEIDON	Med- Greek	Operational monitoring system with observational buoys equipped with a variety of sensors to support physical, optical and bio-chemical parameters	http://www.poseidon.ncmr.gr/
MARCOAST	European-Med	Operational detection of oil spills through R/S (SAR) and dispersion forecasting.	http://marcoast.hcmr.gr
ADRICOSM	Med-Adriatic	NRT monitoring system and a NRT basin-shelf marine forecasting system inc. a test case coupling a river basin modelling system and the	http://www.bo.ingv.it/adricosm/



		hydrodynamic modelling of coastal areas	
Mediterranean network to Assess and upgrade the Monitoring and forecasting Activities in the region (MAMA)	Mediterranean	Networking and capacity building	http://www.ifremer.fr/mama/ http://www.mama-net.org
A Regional Capacity Building and Networking Programme to Upgrade Monitoring and Forecasting Activity in the Black Sea Basin (ARENA)	Black Sea	Networking and capacity building	http://www.arena-blacksea.net/
Black Sea Observation and Forecasting Systems	Black Sea		www.ims.metu.edu.tr/nato/ccms_bsofs.htm
Black Sea Observation and Prediction Research Project: Initiation of the Black Sea Regional Component of GOOS	Black Sea		www.ims.metu.edu.tr/black_sea_goos/

1.4 Ongoing and planned monitoring systems/programmes at national level

MeDir-OP (A Mediterranean Directory for Operational Oceanography, <http://www.capemalta.net/mama/wp1interface/index.html>) developed within the MAMA project of MedGOOS, presents country profiles including institutes and monitoring and research activities. The directory is very useful to extract country information for ongoing monitoring programmes at the Mediterranean level. An inventory of trend monitoring, ships of opportunity, sea level observations, marine buoys, waves and moorings as well as hydrographic surveys and other programmes are covered. The MED POL institutes and activities (<http://195.97.36.231/medpol/>) could be evaluated in parallel with the Directory to draw up a more complete and detailed picture on certain activities.

Most likely, one of the most important area of concern is the Turkish Straits System (Dardanelles-Marmara Sea-Bosphorus Strait) which comprises a two-layered exchange system between the Black Sea and the Mediterranean. The area is not covered by the two Conventions (Barcelona and Bucharest), therefore, the only information could be extracted from national projects and databanks and from the international/national publications on hydrography, sea level observations, biogeochemistry, ecosystem studies, modeling efforts etc.

An other topic of great importance might be the existing (ecosystem) time-series studies at fixed station networks functioning at the local level. This information has not been searched for yet for the present document.

Contributions of partners at national/ institutional level

SSC RAS: Hydrobiological, hydrochemical and oceanographical research in the basins of the Azov and Black Seas has being carried out for almost 100 years. Since the middle of 50s and till the end of 80s of the past century the major part of investigations has been made, since 1970s of the past century research activities shifted to a monitoring-like character.

Since 1997 the Azov and Black Seas were included in the field of interest of MMBI KSC RAS. From the beginning of its activities in the basins of these seas till now, MMBI (after 2003 – jointly with SSC RAS) carried out 26 sea and 19 coastal expeditions, over 2000 oceanological stations has been visited. A monitoring system of sampling cites in the Azov Sea has been founded, including Taganrog gulf and Kerch Strait. A list of observations available in database of MMBI and SSC includes the folowing parameters and characteristics: meteorological observations, hydrochemical research (O₂, ion composition, biogens, chlorophyll), geochemical research of the sea ecosystem components (radioactive nuclids, heavy metals, pesticides), data on water sounding using oceanological sondes for vertical and horizontal profiling (thermohaline characters of the water masses), primary production research, lithologic research, phyto- and zooplankton, phyto and zoobenthos, ichthyology, ornithology (water and near-water birds), theriology (sea mammals).

As a result of monitoring and research efforts, a description of modern state and development trends of the Azov and Black Seas' ecosystems is available. Connection of ecosystem's functioning to climatic phenomena and anthropogenic pressure is described. Major ways of the plankton and benthic communities structure changes are showed, in accordance with global climatic changes as well as with human activities' impact. Modern levels of pesticides', heavy metals' and radioactive nuclids' accumulation in water, sediments and biota are disclosed. Evaluation of pollutants' impact on the Azov Sea ecosystem's functioning is given.

2 Gaps and proposed system requirements

Experience of monitoring in the two basins have pointed out that considerable geographical gaps in data at both regional and local scale are (or might continue to be) evident in both regions, thereby posing an obstacle to addressing specific environmental problems threatening coastal ecosystems. In addition, the obtained or proposed temporal resolution of data (sampling frequencies of on-site monitoring activities) is not usually adequate to understand the real status of the environment and to support models. Furthermore the inclusion of sites representative of all coastal waters and open seas in routine monitoring efforts (usually restricted to inshore and near shore areas), is virtually impossible. Yet another critical point is the nomination by local experts and authorities of monitoring sites (often limited in number and scale) intended to reflect areas that are usually under direct anthropogenic pressure whose choice of site and station however may not always be appropriate for the task. Finally, even if the programmes are designed for ideal conditions (good sampling design, including all necessary ecosystem components etc), no entity can ensure their smooth implementation. Therefore, the proposed system for monitoring and assessment of environmental and ecosystem quality should consider these gaps.

The GOOS objectives and the regional development of GOOS-related activities are already considering these facts and consequently developing products for different end-user requirements. The generally accepted approach is to use a downscaling strategy moving from global, to regional, shelf seas and coastal scales. This applies to both the observing systems (from basin scale to coastal monitoring) and modeling components (through sequential nesting procedures that increase the spatial resolution and improve initial and boundary conditions). The value of this approach has been demonstrated in various systems and is extremely relevant for the Mediterranean and Black seas that have, in general, narrow shelves which means that coastal systems are directly influenced by the open sea processes. The downscaling strategy has been followed in the Mediterranean by both the MFS (basin scale) and POSEIDON (Eastern Med – Aegean) observing and monitoring systems that have developed the basis for operational oceanography in basin, regional and shelf sea scales. However, there are still a lot needed for an integrated observing – forecasting system for the coastal waters. The main problems to be addressed are related to the limited range of biochemical sensors, their accuracy and long term stability. Based on MFS and POSEIDON, that provide the larger scale information, an initial coastal observing system could first be developed, as a test case, and its capacity to meet the monitoring requirements could be evaluated. Such a system would also help to explore sustainability and operational issues related to resources limitations (funding, infrastructures, expertise etc.).

In order to fill the gaps in data and information for the basin wide assessment efforts two major issues could be recommended:

- To further explore the available tools of GOOS related activities and projects in both regions and promote the further development of such activities to address the monitoring requirements of the regional conventions.
- To promote the organization of regional or sub-regional surveys at project level to complete the data and information gaps evident in both seas to support state assessments with actual and recent data as well as to support various models

Regarding the efforts of monitoring and inventorying of biodiversity in the region, it is widely accepted that considerable work has been carried out and is planned in both the Mediterranean and Black Seas, despite the absence of a consistent monitoring system with clear objectives and criteria.

In this direction, drawing from existing comprehensive scientific overviews (e.g MARBENA e-conference reports; <http://www.vliz.be/marbena/>), the essential requirement that prevails is that all opportunities are to be taken and used to monitor biodiversity changes, through the use of individual species that are easy to survey (big macrofauna or macroflora species, charismatic or invasive, and so on), indicator species, or communities. We should have a very good knowledge of:

- ⇒ the exact taxonomic (and eventually genetic) signature of the used organisms;
- ⇒ their ecological role;
- ⇒ reliable previous data on which to base the comparison.

Monitoring the boundaries and seeing what is shrinking and widening could be an other approach to complement to the taxonomic one which necessitates mapping of habitats.

This in turn implies the following:

- ⇒ promoting existing efforts to elaborate national or regional floras and faunas, and encourage them if these efforts do not exist already.
- ⇒ fostering taxonomy, be it conventional (based mainly on morphology) or more recently developed (molecular and genetic techniques).
- ⇒ encouraging the compilation of long term series of data , from plankton inventories to photographic censuses of benthic communities, from commercial fish catches to weather conditions and hydrographic data.

The nature of these monitoring efforts implies that there is to be a previous knowledge, be it in the form of specialists on the different taxonomic groups, or on the ecological functioning of the littoral or marine communities to be surveyed, or on long term series of data on plankton, benthos, fish catches and so on. Thus the active participation of marine research institutes and experts on these areas is mandatory in these monitoring efforts.

Some national or international efforts already in force should be encouraged, such as those aimed at monitoring hard bottom benthos as a tool to detect biodiversity changes; or the long-term monitoring of protected areas in different countries, as a very useful by-product of these rather pristine areas. This encouragement should take place both at the national and regional level, and with special care to include the southern and eastern, non-European Mediterranean and Black Sea countries where most of the biodiversity resides. Special attention for instance has to be paid to continuous monitoring of the effects of the Suez Canal and Lessepsian migration and the Aswan Dam on the communities of the eastern Mediterranean.

Monitoring to detect the impact of coastal constructions and urban sprawl also deserves to be addressed as a priority, in addition to monitoring to detect the impact of fishing gear on biodiversity, through comparative studies of protected areas in relation to fished areas in specific habitats.

Regarding the monitoring of invasive species, among the proposed priorities and actions, special attention is to be given to the following:

- ⇒ an understanding of invasion patterns: evaluations of described records, collection of specimens, field surveys, targeting habitats and areas which are most closely linked with known introduction vectors, and molecular analyses
- ⇒ monitoring, modelling and predicting the behaviour of an invasive species in the recipient ecosystem and its effect on its food web
- ⇒ comparative analysis of the variability of species diversity, dominant species in space and time and environmental processes in the Mediterranean and Black Sea in the context of global climate oscillations and their effect on regional climate variations and the presence of exotic species