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REVIEW OF IMPLEMENTATION OF MED POL PHASE III MONITORING ACTIVITIES

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1. INTRODUCTION

The present document, prepared for the second review meeting of MED POL Phase III Monitoring Activities, is expected to introduce and analyse the achievements and bottlenecks of the implementation of the different components of the Programme. In addition, issues recently included in the Programme's activities and those planned for the future are also presented and discussed in the document. The present Meeting is expected to identify concrete steps for the follow up of the Programme.

This document covers all the above aspects and provides both the analysis of the ongoing activities and the necessary background for the future ones. Chapter 2 of the document provides a detailed analysis of the ongoing monitoring activities including database and data management. The new Eutrophication monitoring programme is also dealt with in this Chapter. Chapter 3 presents the research activities carried out as part of MED POL Phase III and the cooperation established with other international bodies. Finally, Chapter 4 presents a number of conclusions prepared by the Secretariat that are expected to be the basis for discussion by the Meeting.

2. REVIEW AND ANALYSIS OF MONITORING ACTIVITIES

The MED POL Phase III Programme (1996-2005) was approved by the Contracting Parties to the Barcelona Convention in 1995. The general objectives of the approved monitoring activities can be summarized as follows:

- to determine temporal trends of some selected contaminants in order to assess the effectiveness of actions and policy measures;
- 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), and
- to enhance the control of pollution by means of compliance to national/ international regulatory limits.

Concerning the trend-monitoring component, its specific aim is to detect site-specific temporal trends of selected contaminants at hot spots and coastal/reference areas. Considering that several decades or more are usually needed to detect trends, long-term programmes are expected to be formulated with consistent monitoring strategies and solid data quality assurance programmes. Trend monitoring of loads aims to provide estimates of inputs of some major groups of pollutants (all listed in the Land Based-Sources Protocol) to the coastal marine environment via point (rivers, municipal and industrial effluents) and non-point (atmospheric) land-based sources. Trends in pollutant or contaminant levels, in general, are considered as "state" indicators of pollution and are included in most of the regional monitoring programmes to provide inputs to the assessments of the state of the marine environment.

Biological effects monitoring (monitoring with biomarkers) has been included in the monitoring programmes as a pilot activity to test the methodology as well as its utilization as an early-warning tool to detect any destructive effects of pollutants on marine organisms at the initial stage of exposures. Biomarkers, in general, are considered as "impact" indicators used for the evaluation of toxic effects of pollutants on coastal marine life. They can in fact be considered as the most direct method to assess exposure to, and effects of, chemical contaminants at very early stages (at cellular or organism level).

A new component recently added to the MED POL Phase III Programme is monitoring of Eutrophication. The monitoring sites are those where eutrophication phenomena are common and, in addition, potentially risk areas under the direct impact of anthropogenic nutrient and organic material inputs.

Compliance monitoring, referred to health-related conditions in bathing and shellfish/aquaculture waters, effluents and hot spots, represents the pollution control component. In order to fully achieve the objectives of this component, countries are encouraged to prepare compliance reports by comparing the results of the monitoring with the existing limit values of their national and/or the international and regional legislations.

The National Monitoring Agreements to be prepared by each country take into account the above objectives, are based on common monitoring criteria (parameters, matrices, sampling frequencies etc.) and include a list of pollution hot spots, coastal stations and the participating institutes. Since the monitoring criteria for the different components of MED POL Phase III monitoring activities were widely discussed and formally approved (see the list of background documents downloadable from www.unepmap.org), in this document they are summarized in Annex I.

Nine national programmes were finalized during the 1999-2003 period (Table 2.1). Six of these programmes were revised during 2002-2003 to avoid inconsistencies occurred during their implementation. Revisions will be made regularly. The programmes of four countries are still pending and will be finalized as priority.

Table 2.1 Status of Monitoring Agreements between MAP/MED POL and Mediterranean Countries

COUNTRY	Status of National Monitoring Programmes (MED POL Phase III)		
	Drafted	**Finalized**	**Revised**
Albania	1998	1999	2003
Algeria	2001	----	
Bosnia & Herzegovina			
Croatia	1998	2000	2002
Cyprus	1998	1999	2002
Egypt			
France			
Greece	1999	2000	2003
Israel	2002	2002	
Italy			
Lebanon	2000	----	
Libya			
Malta	2001	----	
Monaco			
Morocco	1999, 2003	----	
Serbia & Montenegro			
Spain			
Slovenia	1998	1999	2002
Syria	2000, 2003	2003	
Tunisia	2001	2001	
Turkey	1999	2000	2003

Unfortunately, the present status of implementation of the monitoring programmes does show an inadequate geographical coverage of the coastal waters and hot spots of the region. The responsibilities for such a situation has certainly to be shared between the Secretariat and the countries but it is obvious that countries have to give much more attention to the issue. In fact, countries were reminded and urged in many occasions (e.g. by the Meetings of National Coordinators of MED POL, Bureau, MAP Focal Points) to participate more actively in the MED POL monitoring activities and to establish their monitoring networks according to the common criteria provided by MAP/MED POL. It is however known that some of the countries not actively participating in the MED POL monitoring programme (mostly European) already have properly established and functioning networks and thus only small efforts would be needed to adapt their programmes to the MED POL requirements.

In reality, it seems that similar problems exist at a more global scale and that the existing mechanisms of preparation of regional and global assessments for the state of marine environment often fail in the preparation of regular assessments (e.g. GESAMP guidelines). It is not yet very well understood whether this reflects a lack of adequate information on the objectives of monitoring, for example of trends monitoring, a lack of scientific data which is validated and comparable or an absence of mechanisms for compilation of available data. These questions can be probably answered by sharing responsibility and strengthening cooperation within the region and by demonstrating how a common framework is an advantage to achieve the goals. Since the lack of properly functioning monitoring networks and of overall regular assessments can easily jeopardize the evaluation of the effectiveness of existing policies and measures for marine environmental protection, scientists, managers and policy makers should work together to avoid such a gap that is quite pronounced in the Mediterranean region.

The following sections of this Chapter will present the present status of implementation of the activities of the different components. In addition, Section 2.2 presents an evaluation of the first 4 years of implementation of the ongoing trend monitoring programmes made by an independent expert. The recommendations presented in the same section reflect the views of the expert.

2.1 Review of compliance monitoring activities of MED POL: achievements and problems

The compliance monitoring activities of MED POL Phase III have been planned as part of the pollution prevention and control strategies to be applied for the implementation of the Strategic Action Programme (SAP) to address pollution from land-based activities. In relation to this perspective, compliance monitoring basically aims (UNEP, 1999) to complete the baseline studies for the types and amounts of pollutants discharged/dumped to the marine environment, to compile and update an inventory of land-based sources of marine pollution, to carry out effluent quality control where criteria and standards already exist, to assess the control measures being implemented and also to compile the available data where control measures do not exist.

Monitoring of effluents is included within the monitoring activities of MED POL in order to carry out effluent quality control. This component aims at determining if adopted common measures (UNEP, 1995) related to concentration of contaminants in effluents are complied with or not. When national measures related to the selected contaminants (see Annex I) or other contaminants exist, they should be taken as reference for compliance control.

Monitoring at “hot spots” is also included in the compliance monitoring activities to verify whether the Environmental Quality Objectives (EQO) or limit values set in the relevant regulations are complied with (e.g. DDT in water). As widely known, EQOs define some desired state of the environment that can be met through the attainment of specific targets.

Although common EQOs do not exist in the Mediterranean, any national quality objectives available could be used for compliance monitoring at hot spots (basically in sea water and sediments).

Another type of monitoring as part of compliance monitoring activities is the monitoring of health-related conditions (e.g. sanitary quality of bathing waters, waters used for shellfish culture and aquaculture, quality of sea food) which has high significance at national level. Both adopted common measures at the regional level and the national limits provided in national regulations are expected to be verified regarding the quality control of these waters.

Since the control of pollution is one of the basic goals of MED POL Phase III, compliance monitoring activities are of vital importance at both national and regional levels. Table 2.1.1 summarizes the present status of participation by the countries to the different components of the programme whose monitoring criteria are given in Annex I. Countries are expected to submit their compliance reports to MED POL each year.

Table 2.1.1 Compliance monitoring activities participated by the Countries

COUNTRY	**Participation to the components of compliance monitoring**				
	Bathing waters	Shellfish/aquaculture waters	Effluents	Hot spots	Number of participating institutes
Albania	√				1
Algeria					
Bosnia & Herzegovina					
Croatia	√	√	√		8
Cyprus	√	√	√		3
Egypt					
France					
Greece	√	√	√	√	9
Israel	√			√	2*
Italy					
Lebanon					
Libya					
Malta					
Monaco					
Morocco					
Serbia & Montenegro					
Spain					
Slovenia	√	√			2
Syria	√		√		4
Tunisia	√	√	√		5
Turkey			√	√	1

*all the public health institutes considered as one group

Albania has recently included compliance monitoring of sanitary conditions for bathing waters in its programme and the first compliance report is expected for the year 2003. The Programme objectives are in line with the MED POL criteria.

Croatia has been implementing the programme since its inception and programme objectives are in line with MED POL criteria. Compliance reports for the quality of bathing waters and shellfish waters as well as quality of shellfish produced are available for the 2000-2002 period. Although compliance monitoring of effluents is included in the programme, compliance reports for effluents have not been submitted but only raw data for 2001.

Cyprus has been implementing the activities since the programme inception and has provided compliance reports for bathing waters for the 2000-2002 period. Data for shellfish waters including nutrients were made available but not compliance reports. Data for industrial effluents were submitted for the 2000-2002 period as well as the compliance report for the last two years. However, the data coverage (frequency, etc.) is not fully in line with the national monitoring programme objectives and MED POL criteria.

Greece has included all the components of compliance monitoring activities to their MED POL-III Monitoring Programme and only submitted a report on bathing water quality covering the period 1991-2000. The compliance with Directive 76/160/EEC for the respective years was also presented in the report.

Israel is expected to submit the first compliance reports during the 2003 data submission period.

Slovenia has submitted compliance reports for bathing waters for 2001-2002 period and raw data for the years 1999 and 2000 was made available with the national reports. Water quality of shellfish growing waters was basically monitored for nutrients, dissolved oxygen and some toxic phytoplankton species which are known as harmful for biota (mussels, fish etc) and human being.

Syria is expected to submit first compliance reports in 2004.

Tunisia has submitted compliance report for bathing waters for the year 2001 (only in comparison with EU criteria) and the raw data for effluents was provided for the same period. The data coverage for effluents was satisfactory in terms of sampling frequency.

Turkey has never submitted compliance reports, but raw data on effluents and hot spot areas has been provided together with national reports. The frequency of sampling of effluents is not fully satisfactory.

It should be stressed that countries implementing compliance monitoring activities should effectively prepare compliance reports as they are very basic for pollution control. These reports have to be submitted to MED POL annually within the framework of Monitoring Agreements made with MAP/MED POL. Additionally, they are also invited to provide this information to MED POL even if an agreement has not yet been finalized as it provides a very important input for the follow up of implementation of the SAP.

2.2 Trends monitoring activities: achievements and problems

In the framework of MED POL Phase III, the trend monitoring activities were planned to provide a continuous assessment of quality and quantity of pollution and its temporal trends. These activities were defined as follow:

Trend monitoring is a repeated measurement of concentrations or effects over a period of time to detect possible changes with time. This type of monitoring provides information which can be used for the assessment of the state of the environment and

the effectiveness of pollution control measures taken. If the effectiveness of measures is deemed inadequate, additional activities may be initiated such as the formulation of new measures or the revision of existing ones, etc.

The trend monitoring activities are basically designed for monitoring of contaminants in biota and sediment; however, monitoring of pollutant loads from land-based sources (effluents, rivers, atmosphere) are also considered as one of the related components. State monitoring in different environmental media (sea water, sediment and biota) is also covered within the activities as a complementary component for the regional marine environment assessment. Tables 2.2.1a and 2.2.1b provide the necessary information regarding the participation of countries in these activities. Station maps for different components are presented in Annex II. The consistency of the programme components with the agreed monitoring criteria and objectives can be roughly checked by comparing the information provided in Annex I and Table 2.2.1b. The details of the trends monitoring programmes designed for biota and sediment will be presented in the following sections below.

2.2.1 Consistency of the programmes

Statistical analysis for trends of MED POL Phase I and II monitoring data (Fryer, 1992) revealed that due to inconsistent collection, preparation and chemical analysis of samples, an objective investigation of between-year variation in contaminant levels is virtually impossible and, due to an insufficient number of pools on each sampling occasion and/or an insufficient number of years sampled, only very large trend in contaminant levels are likely to be detected.

For this reason, it was recommended to the countries in MED POL Phase III to design a trend monitoring programme that would be feasible and easy to maintain for a long period of time. That first implied a careful, detailed, specific and quantified expression of the objectives behind each series of measurement to be carried out.

All the countries, within their finalized programmes (Table 2.2.1a), agreed on the trend monitoring objectives that can be summarised as follow:

The objective is to detect a minimum linear trend of 10 % per year in 10 years with a 90% power.

This is actually a very generic objective that can be set in the pilot phase of the programmes and need to be tailored at the national and even at the more local level according to the needs of control measures taken (for example to assess the trends after reduction policies are applied to certain inputs of pollutants).

The sampling strategy is considered to be very important for the realisation of the statistical objectives of any trend monitoring programme. From the programme outlines of the involved countries it is evident that all countries accepted the suggested annual sampling frequency for biota (see Table 2.2.1b) which is at the pre-spawning period (or out of the spawning period) of the monitoring species. The only accepted and adopted sample/specimens strategy is when *Mytilus galloprovincialis* (MG) is used as a biomonitor (5 samples with 15 pooled specimens). Some of the countries, where MG is not available, use other species with slightly different strategies. When fish was used as a matrix (in our case *Mullus barbatus*) two strategies were used, with 8-30 samples with no pooling or 6 samples with 6 pooled organisms. Both are acceptable. However, in some ongoing programmes it is observed that the number of samples and specimens is very variable and not complying with the pre-set objectives (see Tables 2.2.2.1 and 2.2.2.2 as an example and Section 2.2.2).

From the trend monitoring point of view the best sampling strategy always leads with attaining the best information on the sampling variance and a precise determination of the underlying trend. Keeping that in mind, it is good to avoid pooling whenever it is possible. The suggested strategy for molluscs, being small in sample size and not always sufficient for all the chemical analyses, is to use 5 samples with 15 pooled specimens. If one sampled organism provides enough sample for all analyses, use from 15 to 25 samples with single specimen will be necessary if the underlying variances are not know. If the variance is known the programme optimisation effort will give the optimal number of samples to realise the declared objectives.

All the countries that are measuring the ratio of contaminants in sediments use annual frequency and one sample per station. Such a sampling strategy is not sufficient to address trends and can only be useful for state monitoring. The high inter-dependence of contaminant ratio and sediment grain size (especially for organic contaminants) indicate that a new sampling strategy has to be developed that is in accordance with the statistical needs related to trends evaluation.

2.2.2 Fulfilment of the signed programmes

As trend monitoring is a repeated measurement over a long period of time, the fulfilment of the signed programmes is critical in order to maintain their consistency. Slight changes or failures in carrying out the adopted sampling strategy can introduce additional variance to samples and fail in the realisation of the declared objectives. The fulfilment of the programme for each participating country is presented in Tables 2.2.2.1-8.

Albania

The data submitted to the database show serious problems in the realisation of the signed programme (Table 2.2.2.1). A change in sampling strategy which is not acceptable within the statistical objectives was noticed. One sample with a variable number of specimens between years is not sufficient to attain the declared objectives. During the programme realisation (in 2003) a technical problem emerged (AAS has not been operative since 2002). The accepted sampling strategy has to be maintained in order to detect an underlying trend with a suitable statistical power.

Croatia

The submitted data indicate that serious problems in the implementation of the programme exist (Table 2.2.2.2). The number of samples collected does not allow trend monitoring evaluation. The only exception is for the analyses of trace metals in biota (*Mytilus galloprovincialis*) during 2002 when an adequate number of samples and specimens were sampled. Data for the analyses of PAH in biota and sediments were never submitted to the database.

Cyprus

Cyprus has regularly submitted data to the database within the objectives of the programme with the exception of the trace metals in biota for which only 2001 data were submitted (Table 2.2.2.3). It is important to notice that the 1999 data was sampled at the end of the year, one month earlier than for 2000 and obviously could be treated as 2000 data, however, introducing higher variance to the sampling. 2002 data for trace metals will be submitted together with 2003 data.

Greece

From the database it is not possible to summarize the achievements of the programme carried out by the country (Table 2.2.2.4).

Israel

Israel finalised the programme during 2002 but has regularly submitted data to the MED POL database since 1999 (Table 2.2.2.5). The major issue to be addressed is a very variable number of specimens in pooled samples that introduce additional variance to the data.

Slovenia

Slovenia has regularly submitted data to the database and maintained the sampling strategy (Table 2.2.2.6). The only exception is the data for organic compounds (PAH, AH) in biota for 2000 and in sediments for 2000 and 2002.

Tunisia

Tunisia finalised the programme in 2001 and has submitted data for trace metals in biota only for 2001 (Table 2.2.2.7). The submitted data are in compliance with the programme objectives. Data for organic contaminants have not been submitted yet and expected to be included in 2002 data.

Turkey

Turkey partially submitted data to the database (Table 2.2.2.8). The data for trace metals in biota (*Mytilus galloprovincialis* and *Mullus barbatus*) represent a good data set for trend monitoring evaluation. It is to notice that the samples were not pooled and represent a solid base for the programme optimization. Data on organic contaminants have not been regularly submitted. It is available only for one year and does not comply with the trend monitoring objectives.

Table 2.2.1a Participation in MED POL Phase III Trend Monitoring Programme

COUNTRY	Status of Monitoring Programme			Participation to the components of trends and state monitoring				
				Coastal areas and hot spots			Point and non-point sources	
	Drafted	Finalized	Revised	Trends monitoring in Biota	Trends monitoring in Sediment	State monitoring in different matrices	Monitoring of Loads	Total Number of participating institutes
Albania	1998	1999	2003	√		√		2
Algeria	2001	----						
Croatia	1998	2000	2002	√	√	√	√	4
Cyprus	1998	1999	2002	√		√	√	2
Egypt	----	----						
France	----	----						
Greece	1999	2000	2003	√	√	√	√	12
Israel	2002	2002		√	√	√	√	2
Italy	----	----						
Lebanon	2000	----						
Libya	----	----						
Malta	2001	----						
Monaco	----	----						
Morocco	1999, 2003	----						
Spain	----	----						
Slovenia	1998	1999	2002	√	√	√	√	2
Syria	2000, 2003	2003		√		√	√	5
Tunisia	2001	2001		√	√	√	√	2
Turkey	1999	2000	2003	√	√	√	√	1

Table 2.2.1b Participation in MED POL Phase III Trend Monitoring Programme

COUNTRY	Participation to the components of trends and state monitoring			
	# of monitoring areas and stations	Sample type (matrix)	Frequency	Parameters
Albania	3 areas 5 stations	BIO	Annual	TM, HH
		WAT	Semi-annual	BOP, NUT, Chl-a
Croatia	9 areas 36 stations	BIO, SED	Annual	TM, HH, PAH
		LOADS (river)	Monthly	BOD, COD, TSS, NUT etc.
Cyprus	6 areas 55 stations	BIO WAT	Annual Semi-annual	TM, HH BOP, NUT, TSS, BAC
		LOADS	Semi-annual for point sources	NUT, TSS, COD, BOD, BAC
			Weekly for atmospheric particulate matter and occasionally for TM	PM, TM
Greece	9 areas 127 stations	BIO, SED	Annual	TM, HH
		WAT	Semi-annual	BOP, NUT, Chl-a
		LOADS	Seasonal	BOD, COD, TSS, NUT etc.
Israel	2 areas 42 stations	BIO, SED	Annual	TM
		WAT	Annual	BOP, NUT
		LOADS	Daily, monthly or semi-annual for point sources	BOD, COD, TSS, NUT etc.
			Weekly for atmospheric source	TM, NUT
Slovenia	1 area 28 stations	BIO, SED	Annual	TM (for biota), HH, PAH
		WAT	Monthly, seasonal or annual	BOP, NUT, BOD, COD etc.
		LOADS	Semi-annual or annual	BOD, COD, TSS, NUT etc.
Syria	2 areas 20 stations	BIO, SED	Annual	TM, HH, PAH
		WAT	Semi-annual	BOP, NUT, BOD, COD etc.
		LOADS	Seasonal	BOD, COD, TSS, NUT etc. TM, PM for atmosp. loads
Tunisia	11 areas 20 stations	BIO, SED	Annual	TM, HH
		WAT	Annual or semi-annual	BOP, NUT
		LOADS	Monthly, seasonal	BOD, COD, TSS, NUT etc.
Turkey	13 areas 24 stations	BIO, SED	Annual	TM, HH, PAH
		LOADS	Seasonal	BOD, COD, TSS, NUT etc.

Table 2.2.2.1 Trend Monitoring Programme summary and fulfilment for Albania.

Matrix	Year	Species (Tissue)	Parameter	No.Station (Freq./year.) Programme	No.Station (Freq./year.) Sampled	No.Samples(Specimen) Programme	No.Samples(Specimen) Sampled	Data Submission to the Database	Comments
Biota	2000	MG (WST)	HM	2(1)	?	5(15)	?	-	
			HH		?		?	-	
	2001	MG (WST)	HM	2(1)	2(1)	5(15)	1(>89)	√	Average data submitted, Number of specimens not adequate for trend monitoring
			HH				1(>89)	√	
	2002	MG (WST)	HM	2(1)	2(2)	5(15)	?	-	Average data submitted, Number of specimens not adequate for trend monitoring
			HH				2(>70)	√	

Shaded are the years after the programme was drafted.
HM - Cd, Cr, Cu, Fe, HgT, Pb, Zn - from 2001 AAS not operative
HH - DDDP, DDEO, DDEP, DDTP

Table 2.2.2.2 Trend Monitoring Programme summary and fulfilment for Croatia

Matrix	Year	Species (Tissue)	Parameter	No.Station (Freq./year.)		No.Samples(Specimen)		Data Submission to the Database	Comments
				Programme	Sampled	Programme	Sampled		
Biota	1999	MG (WST)	HH	?	?	?	1(>10)	√	Number of samples not adequate for trend monitoring
	2000	MG (WST)	HM	6(2)	6(2)	5(15)	1(>10)	√	Number of samples not adequate for trend monitoring
			PAH				?	-	
			HH				1(>10)	√	
	2001	MG (WST)	HM	6(2)	6(1)	5(15)	1(>10)	√	Number of samples not adequate for trend monitoring
			PAH				?	-	
			HH				?	√	
	2002	MG (WST)	HM	6(1)	6(1)	5(15)	6(15)	√	-
			PAH				?	-	Number of samples not adequate for trend monitoring
			HH				1(>10)	√	
Sediments		**Sediment fraction**							
	2000	unknown	HM PAH HH	6(1)	?			-	
	2001	unknown	HM PAH HH	6(1)	?			-	
	2002	0-1 cm Not sieved	HM PAH HH	6(1)	6(1)			√ - -	

Shaded are the years after the programme was drafted.
HM - Cd, Cr, Cu, Fe, HgT, Pb, Zn; **PAH** – ??; **HH** (CP)- ALD, DDDP, DDEP, DDTP, DDTS, DIE, HCB, LIN; HH (CBC) – CB101, CB105, CB118, CB138, CB153, CB156, CB180, CB28, CB52, CBS, PCBA, PCBB, PCBT

Table 2.2.2.3 Trend Monitoring Programme summary and fulfilment for Cyprus

Matrix	Year	Species (Tissue)	Parameter	No.Station (Freq./year.)		No.Samples(Specimen)		Data Submission to the Database	Comments
				Programme	Sampled	Programme	Sampled		
Biota	1999	MB (FI)	HM	3(1)	2(1)	6(6)	6(6)	√	TM data has to be treated as 2000 data
			HH		2(1)		6(6)	√	
	2000	MB (FI)	HM	3(1)	?	?	-	-	Not submitted
			HH		3(1)	5(6)	5(6)	√	
	2001	MB (FI)	HM	3(1)	1(1)	5(6)	6(6)	√	
			HH		3(1)		5(6)	√	
	2002	MB (FI)	HM	5(1)	?	?	-	-	Not submitted
			HH		5(1)	5(6)	6(6)	√	

Shaded are the years after the programme was drafted.
HM - Cd, Cr, Cu, Fe, HgT, Ni, Pb, Zn; PAH – 14C14; **HH** (CP) - ALD, DDDP, DDEP, DDTP, DDTS, DIE, END, HCB, HEP, HOX, LIN; **HH** (CBC) – CB138, CB153, CB180, CB28, CB52, PCBA, PCBB

Table 2.2.2.4 Trend Monitoring Programme summary and fulfilment for Greece

Matrix	Year	Species (Tissue)	Parameter	No.Station (Freq./year.) Programme	No.Station (Freq./year.) Sampled	No.Samples(Specimen) Programme	No.Samples(Specimen) Sampled	Data Submission to the Database	Comments
Biota	1999	MB, BB(FI)	HM	?(?)	8(?)	5(15)	5(?)	√	
			PAH				?(?)	-	
			HH				2(?)	√	
	2000	?	HM	?	?	5(15)	?	-	
			PAH				?	-	
			HH				?	-	
	2001	MG(WST)	HM	4(1)	?	5(15)	?	-	
			PAH				?	-	
			HH				?	-	
		MB, BB(FI)	HM	4(1)	?	5(15)	?	-	
			PAH				?	-	
			HH				?	-	
	2002	MG(WST)	HM	4(1)	?	5(15)	?	-	
			PAH				?	-	
			HH				?	-	
		MB, BB(FI)	HM	4(1)	?	5(15)	?	-	
			PAH				?	-	
			HH				?	-	

Shaded are the years after the programme was drafted.
HM - Cd, Cr, Cu, HgT, Mn, Pb, Zn; **PAH** – ??; **HH** (CP)- DDDP, DDEP, DDTP, DDTS, LIN; HH (CBC) – CB101, CB105, CB118, CB138, CB153, CB156, CB180, CBS

Table 2.2.2.4 - continued.

Matrix	Year	Sedimentfraction	Parameter	No.Station (Freq./year.)		No.Samples(Specimen)		Data Submission to the Database	Comments
				Programme	Sampled	Programme	Sampled		
Sediment	2001	unknown	HM	12(1)	?	?	?	-	
			PAH				?	-	
			HH				?	-	
	2002	unknown	HM	12(1)	?	?	?	-	
			PAH				?	-	
			HH				?	-	

Shaded are the years after the programme was drafted.
HM - Cd, Cr, Cu, HgT, Mn, Pb, Zn; **PAH** – ??; **HH** (CP)- DDDP, DDEP, DDTP, DDTS, LIN; HH (CBC) – CB101, CB105, CB118, CB138, CB153, CB156, CB180, CBS

Table 2.2.2.5 Trend Monitoring Programme summary and fulfilment for Israel

Matrix	Year	Species (Tissue)	Parameter	No.Station (Freq./year.)		No.Samples(Specimen)		Data Submission to the Database	Comments
				Programme	Sampled	Programme	Sampled		
Biota	1999	MC,DT(WST)	HM	?	11(1)	?	8-16(2-14)	√	Variable specimens number
		MB(FI)			3(1)		8-14(1)	√	
	2000	MC,DT(WST)	HM	?	4(1)	?	3-6(2-9)	√	Variable specimens number
		MB(FI)			3(1)		8-11(1)	√	
	2001	MC,DT(WST)	HM	?	11(1)	?	8-16(1-14)	√	Variable specimens number
		MB(FI)			3(1)		9-12(1)	√	
	2002	MC,DT(WST)	HM	6(1)	?	8(?)	?	-	
		MB(FI)		1(1)		8(1)	?		
		Sediment fraction							
Sediments	1999	unknown	HM	?	22(1)			√	
	2000	unknown	HM	?	17(1)			√	
	2001	0-1 cm <250 µm	HM	?	20(1)			√	
	2002	?	HM	12(1)	?			-	

Shaded are the years after the programme was drafted.
HM - Cd, Cu, HgT, Mn, Pb, Zn

Table 2.2.2.6 Trend Monitoring Programme summary and fulfilment for Slovenia.

Matrix	Year	Species (Tissue)	Parameter	No.Station (Freq./year.)		No.Samples(Specimen)		Data Submission to the Database	Comments
				Programme	Sampled	Programme	Sampled		
Biota	1999	MG (WST)	HM	2(1)	2(1)	5(15)	1(1)	√	Number of samples not adequate for trend monitoring
			PAH		?		?	-	
			AH		?		?	-	
	2000	MG (WST)	HM	2(1)	2(1)	5(15)	5(15)	√	
			PAH		?		?	-	
			AH		?		?	-	
	2001	MG (WST)	HM	2(1)	2(1)	5(15)	5(15)	√	EOM not submitted
			PAH				5(10)	√	
			AH				5(10)	√	
	2002	MG (WST)	HM	2(1)	2(1)	5(15)	5(15)	√	EOM not submitted
			PAH				5(15)	√	
			AH				-	-	
		Sediment fraction							
Sediments	1999	unknown	PAH		4(1)			√	
			AH		4(1)			√	
	2000	unknown	PAH	7(1)	7(1)			-	
			AH					-	
	2001	unknown	PAH	7(1)	7(1)			√	
			AH					√	
	2002	unknown	PAH	7(1)	7(1)			-	
			AH					-	

Shaded are the years after the programme was drafted.
HM - Cd, HgT; **PAH** -1ETNA, 1MNPH, 1MPHE,1MPYR, 2MPHE, ANTHE, ANTHR, ANTY, ARO, BANTR, BAPYR, BBFRN, BGPER, BKFRN, CHRYS, DMPHE, FLRAN, FLREN, INPYR, NAPTH, PAH, PERYL, PHENA, PYREN; **AH** - ALI

Table 2.2.2.7 Trend Monitoring Programme summary and fulfilment for Tunisia

Matrix	Year	Species (Tissue)	Parameter	No.Station (Freq./year.)		No.Samples(Specimen)		Data Submission to the Database	Comments
				Programme	Sampled	Programme	Sampled		
Biota	2001	TD,MG (WST)	HM	6(1)	6(1)	5(15)	4(14-20)	√	
			HH				?	-	
	2002	TD,MG (WST)	HM HH	6(1)	?	5(15)	?	-	
		Sediment fraction							
Sediments	1999	unknown	HM	6(1)	?			-	
			HH		5(1)			√	
	2002	unknown	HM HH	6(1)	?			-	

Shaded are the years after the programme was drafted.
HM - Cd, HgT, Pb; **HH** - ??

Table 2.2.2.8 Trend Monitoring Programme summary and fulfilment for Turkey

Matrix	Year	Species (Tissue)	Parameter	No.Station (Freq./year.)		No.Samples(Specimen)		Data Submission to the Database	Comments
				Programme	Sampled	Programme	Sampled		
Biota	1999	MG(WST) MB(FI)	HM	1(1) 4(1)	1(1) 4(1)	5(15) 20(1)	22(1) 22(1)	- √	
	2000	MG(WST) MB(FI)	HM	1(1) 4(1)	1(1) 3(1)	5(15) 20(1)	14(1) 22(1)	√ √	
	2001	MG(WST) MB(FI)	HM	1(1) 4(1)	1(1) 3(1)	5(15) 20(1)	14(1) 30(1)	√ √	
		MG(WST) MB(FI)	PAH	1(1) 4(1)	? ?	5(15) 20(1)	? ?	- -	
		MG(WST) MB(FI)	HH	1(1) 4(1)	? ?	5(15) 20(1)	? ?	- -	
	2002	MG(WST) MB(FI)	HM	1(1) 4(1)	1(1) 3(1)	5(15) 20(1)	14(1) 30(1)	- -	
		MG(WST) MB(FI)	PAH	1(1) 4(1)	? ?	5(15) 20(1)	? ?	- -	
		MG(WST) MB(FI)	HH	1(1) 4(1)	? ?	5(15) 20(1)	? ?	- -	
	Sediment fraction								
Sediments	1999	unknown	HM PAH HH	11(1)	11(1) ? ?			√ - -	
	2000	unknown	HM PAH HH	11(1)	11(1) ? ?			√ - -	
	2001	unknown	HM PAH HH	11(1)	? ? 9(1)			- - √	
	2002	unknown	HM PAH HH	11(1)	? ? ?			- - -	

Shaded are the years after the programme was drafted.

HM - Cd, Cr, Cu, Fe, HgT, Ni, Pb, Zn; **PAH** –??; **HH** (CP) - ALD, DDDP, DDEP, DDTP, DDTS, DIE, END, HCB, HEP, HOX, LIN

2.2.3 Database

The database concept was finalised during 2002 and the data was first loaded at the beginning of 2003. During 1999-2000, data were submitted to MED POL in different formats. The revised and standardized data formats, in Excel, were used for data exchange only in 2002 and 2003.

The present trend monitoring data evaluation is still being developed since it lacks the most important step, i.e. data verification and validation. As a result, in the present phase of trend monitoring data evaluation, part of the variance could still be related to unverified data.

Trend monitoring evaluation was also done in order to identify the major sources of data errors generated during data transmission and data loading into the database. The problems identified during trend monitoring data evaluation can be divided in three categories:

a) errors introduced during the transfer of the data to the database;

b) missing and non consistent data; and

c) errors introduced due to not proper use of measurement units.

The first two errors can be solved through well defined validation and verification procedures. A simple approach to the problem is essential. The data originator has to be actively involved in that process.

Regarding the errors that have had happened in measurement units, clear, simple and standard expressions should necessarily be used instead of the terminology (e.g. pbb, ppt etc) restricted to only specific scientific community. The International System of Units (SI) and its rules can be used for this purpose.

2.2.4 Statistical analysis of the available data

In temporal trend monitoring of contaminants in biota, it is critically important to control sampling, analytical and seasonal variations to provide information on temporal patterns of changes. There are some ways of controlling the unwanted variations: e.g. sampling variations can be reduced by sampling more animals, analytical variations by doing replicate analyses or by improving analytical procedures and seasonal variation by taking samples at the same time of each year. The countries agreed to start a series of pilot programmes to find out how many samples are required and how good the analytical procedures must be to provide sufficient information about temporal trend in accordance with the statistical power set up in the programmes goals. For that purpose after three years of ongoing programmes a first evaluation of the measured data was made to identify the weakness of the defined strategies as to address the main problems towards the fulfilment of the defined goals. In this first exercise, simple statistical tools have been used to find out how power of the programmes is affected by sampling design and by different types and levels of variations in data.

Investigation of within- and between-year variances

In our case, a programme objective to detect a minimum linear trend of 10 % per year in 10 years with a power of 90% has been set. The power of the programme is the probability that the F-test rejects the null hypothesis. For the considered linear trend the F-test power depends on both *T* (number of years) and the signal-to-noise ratio |*b*|/*?*. Nicholson *et al.* (1998) calculated a very useful table for |*b*|/*?* corresponding to different powers as T varies from 5 to 25. For a 90% power and 10 years the signal-to-noise ratio is |b|/*?*=0,409. If we supposed the b=0.1 then the acceptable variance to fulfil the objectives is *?*=(0,1/0,409), with that *?*=0,244 and the acceptable programme variance is then *?*^{2}=0,060. Even if the underlying trend is not always linear, we can assume that if the within-year variance is below the threshold of 0,060 the programme objective will be fulfilled. This limit is correct, if we consider that the between year variance is always significantly lower than the within-year variance. In order to understand if the programme fulfils the designed objectives, in the pilot phase of the programme, the programme variance below the supposed limit will be considered sufficient. At this stage, since we have only one or two years of useful data in most of the cases, checking the within-year variance against the threshold can be accomplished. Only for few cases, between year variances will be investigated.

Croatia

Because of non-consistent sampling strategy the analysis of Croatian data can only be performed for the last data set submitted to the database (2002 data). Only trace metal mass fraction in *Mytilus galloprovincialis* can be analysed because of an acceptable number of samples. The underlying variance (Table 2.2.4.1) is in general acceptable according to the declared objective. Only at one station, variance for chromium mass fraction has exceeded the limit.

Table 2.2.4.1 Within year variance (*?*^{2}) for trace metal mass fractions in *Mytilus galloprovincialis* along the Croatian coast in 2002.

STATION	N	?^{2}				
		LOGCD	LOGCR	LOGCU	LOGHGT	LOGPB
GR	5	0,003	0,042	0,002	0,000	0,001
IN	6	0,003	0,003	0,020	0,002	0,003
LV	5	0,001	0,015	0,013	0,000	0,011
MA	6	0,007	0,038	0,023	0,000	0,005
SI	6	0,003	0,163	0,032	0,000	0,036
VR	6	0,023	0,005	0,012	0,001	0,016

Cyprus

Trace metals and chlorinated pesticides mass fraction in *Mullus barbatus* (Table 2.2.4.2) were analysed as two different data sets. The within year variances were low and acceptable for all parameters. Some problems were identified for two stations, FISH2 and FISH3, regarding chlorinated pesticides during 2000 and 2002 respectively. For those stations and years significantly higher variances were measured.

By analysing more carefully those data (Figure 2.2.4.1) it appears that during the 2000 sampling on station FISH2 two distinct set of data can be identified. The reason was that the 1999 and 2000 data were aggregated as a single sample because the two sampling were performed only one month apart (December 1999 and January 2000). It is impossible to understand if the two sampling were consistent because no data for fish length, weight and EOM mass fraction were submitted for the 1999 sampling.

The data for the station FISH3 during 2002 sampling showed another type of problem. From the relation of EOM mass fraction and fish length it is visible that during 2002 fish of smaller size and with very variable EOM were sampled introducing additional variance to the data.

Table 2.2.4.2 Within year variance for trace metal and chlorinated pesticides mass fractions in *Mullus barbatus* along the Cyprus coast in the period 1999-2002.

STATION	YEAR	N	?^{2}							
			LOGCD	LOGCR	LOGCU	LOGFE	LOGHGT	LOGNI	LOGPB	LOGZN
FISH1	1999	6	0,000	0,000	0,001	0,000	0,001	0,004	0,000	0,001
FISH2	1999	6	0,027	0,017	0,004	0,003	0,003	0,003	0,008	0,012
FISH2	2001	5	0,005	0,005	0,007		0,025			0,007

STATION	YEAR	N	?^{2}				
			LOGALD	LOGDDTS	LOGLIN	LOGPCBA	LOGPCBB
FISH1	2000	11	0,003	0,000	0,014	0,020	0,008
FISH1	2001	5	0,004	0,000	0,004	0,001	0,000
FISH1	2002	6	0,001	0,001	0,001	0,002	0,000
FISH2	2000	11	0,319	0,000	0,181	0,026	0,010
FISH2	2001	5	0,006	0,016	0,037	0,001	0,004
FISH2	2002	6	0,003	0,027	0,007	0,001	0,002
FISH3	2000	5	0,000	0,002	0,001	0,000	0,001
FISH3	2001	5	0,035	0,039	0,010	0,021	0,008
FISH3	2002	6	0,156	0,021	0,126	0,095	0,054
Ormidhia	2002	6	0,006	0,014	0,002	0,001	0,006
ZYGI	2002	6	0,018	0,005	0,010	0,008	0,000

Mullus barbatus

Cyprus

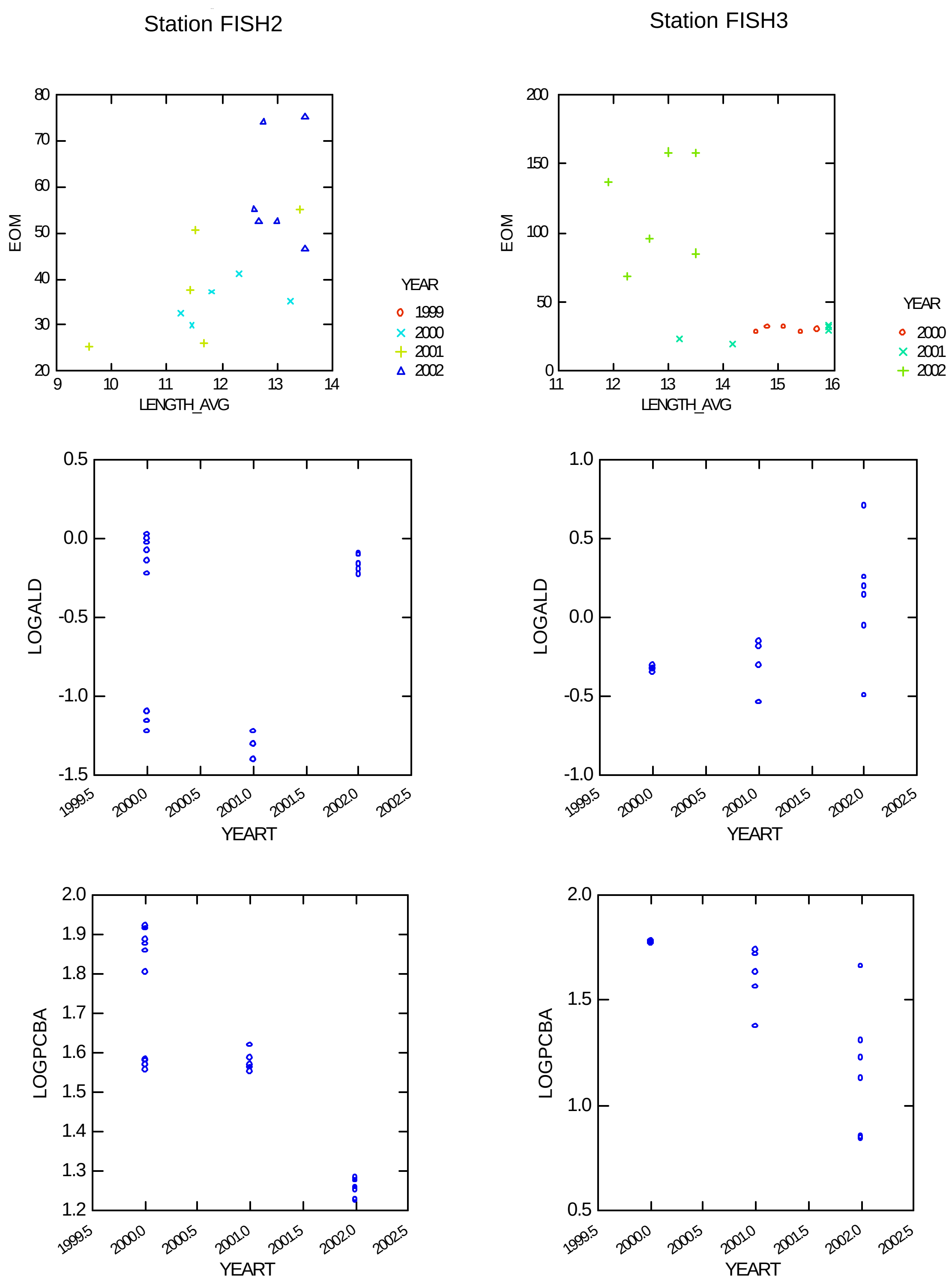


Figure 2.2.4.1 Logarithmic values of Aldrin and PCBA mass fraction by year at station FISH2 and FISH3 in Cyprus coastal waters.

Israel

The analysis of within year variance of Israel data concerning the mass fraction of trace metals in biota revealed a relatively inconsistent sampling strategy for the years that were available. A summary of analysis of the number of analysed samples (Table 2.2.4.3) showed a highly variable sampling strategy through the three consecutive years. More detailed analysis revealed also a change in the season of sampling with a high probability of organisms being sampled within their spawning period. Israel has finalized its MED POL programme in 2002 and data sets for that year are expected to be within the specified objectives of their programme. On the other hand, it seems from 2001 data that the number of samples was collected on a more regular base.

Considering the within year variances of trace metals mass fraction in biota (Table 2.2.4.4), we can notice that the change in variance is more pronounced for samples of *Mactra corallina* as also for the sampling during 1999. More detailed analysis showed that very high variances of data were encountered, close to two orders of magnitude. In Figure 2.2.4.2. data for log values of cadmium mass fraction in *Mactra corallina* is presented and the difference in the size fraction sampled during the two years is apparently seen.

Regarding the sampling of fish (*Mullus barbatus*), more than one size class was sampled (Figure 2.2.4.2) and the number of samples were not the same in all the sampling periods. The data have also shown that the contaminant/length relationship was not the same. During 2001 the relationship was more marked, but it is also evident that a significant increase in total mercury mass fraction in *Mullus barbatus* occurred. The variance for total mercury mass fraction was extremely high probably indicating that the relation to length is critical for that contaminant. The variances of other trace metals are in accordance with the declared objectives.

Table 2.2.4.3 Number of samples of *Donax trunculus* (DT), *Mullus barbatus* (MB) and *Mactra corallina* (MC) sampled on stations along the Israel coast in the period 1999-2001.

SPECY	TISSUE	STAT	YEAR	LOGCD	LOGCU	LOGFE	LOGHGT	LOGMN	LOGZN
DT	SO	ISRTMC18	1999	5	8	8	4	8	8
DT	SO	ISRTMC18	2000	0	8	8	8	8	8
DT	SO	ISRTMC18	2001	0	8	8	8	8	8
DT	SO	ISRTMC22	1999	6	6	6	2	6	6
DT	SO	ISRTMC22	2000	2	6	6	6	6	6
DT	SO	ISRTMC22	2001	10	10	10	10	10	10
DT	SO	ISRTMC39	1999	0	7	7	3	7	7
DT	SO	ISRTMC39	2000	1	6	6	3	6	6
DT	SO	ISRTMC39	2001	3	8	8	8	8	8
DT	SO	ISRTMH8	1999	0	7	7	7	7	7
DT	SO	ISRTMH8	2000	0	9	9	9	9	9
DT	SO	ISRTMH8	2001	3	9	9	9	9	9
MB	FI	HMF7	1999	7	8	8	8	8	8
MB	FI	HMF7	2000	4	20	20	20	20	20
MB	FI	HMF7	2001	0	9	9	9	0	9
MB	FI	HMF8	1999	1	16	16	16	16	16
MB	FI	HMF8	2000	6	12	12	11	12	12
MB	FI	HMF9	1999	9	19	19	14	19	19
MB	FI	HMF9	2000	7	13	13	9	13	13
MB	FI	HMF9	2001	0	22	22	22	0	22
MC	SO	ISRTMC14	1999	12	12	12	4	12	12
MC	SO	ISRTMC14	2001	11	13	13	12	13	13
MC	SO	ISRTMC18	1999	9	9	9	1	9	9
MC	SO	ISRTMC18	2001	5	10	10	9	10	10
MC	SO	ISRTMC22	1999	16	16	16	0	16	16
MC	SO	ISRTMC22	2001	0	16	16	16	16	16
MC	SO	ISRTMC23	1999	6	6	6	0	6	6
MC	SO	ISRTMC23	2001	0	3	3	1	3	3
MC	SO	ISRTMH1	1999	2	2	2	2	2	2
MC	SO	ISRTMH1	2001	3	18	18	15	18	18
MC	SO	ISRTMH10	1999	2	2	2	2	2	2
MC	SO	ISRTMH10	2001	4	12	12	9	12	12
MC	SO	ISRTMH12	1999	8	8	8	8	8	8
MC	SO	ISRTMH12	2001	7	14	14	10	14	14
MC	SO	ISRTMH2	1999	7	7	7	7	7	7
MC	SO	ISRTMH2	2001	8	15	15	12	15	15
MC	SO	ISRTMH8	1999	17	16	17	14	17	17
MC	SO	ISRTMH8	2001	2	16	16	16	16	16
MC	SO	ISRTMH9	1999	13	13	13	6	13	13
MC	SO	ISRTMH9	2001	3	16	16	16	16	16

Table 2.2.4.4 Within year variance for trace metals mass fractions in *Donax trunculus* (DT), *Mullus barbatus* (MB) and *Mactra corallina* (MC) sampled on stations along the Israel coast in the period 1999-2001.

SPECY$	TISSUE$	STAT$	YEAR			$?^2$			
				LOGCD	LOGCU	LOGFE	LOGHGT	LOGMN	LOGZN
DT	SO	ISRTMC18	1999	0,031	0,025	0,011	0,070	0,159	0,010
DT	SO	ISRTMC18	2000		0,002	0,027	0,002	0,076	0,007
DT	SO	ISRTMC18	2001		0,006	0,008	0,114	0,025	0,001
DT	SO	ISRTMC22	1999	0,043	0,009	0,010	0,005	0,033	0,000
DT	SO	ISRTMC22	2000	0,010	0,014	0,015	0,021	0,041	0,002
DT	SO	ISRTMC22	2001	0,017	0,016	0,006	0,009	0,015	0,003
DT	SO	ISRTMC39	1999		0,007	0,018	0,019	0,061	0,004
DT	SO	ISRTMC39	2000		0,005	0,010	0,051	0,237	0,032
DT	SO	ISRTMC39	2001	0,059	0,003	0,012	0,006	0,304	0,011
DT	SO	ISRTMH8	1999		0,006	0,009	0,028	0,059	0,006
DT	SO	ISRTMH8	2000		0,003	0,018	0,003	0,050	0,003
DT	SO	ISRTMH8	2001	0,017	0,012	0,013	0,007	0,021	0,004
MB	FI	HMF7	1999	0,078	0,008	0,007	0,259	0,005	0,018
MB	FI	HMF7	2000	0,005	0,005	0,014	0,285	0,013	0,003
MB	FI	HMF7	2001		0,005	0,003	0,012		0,002
MB	FI	HMF8	1999		0,028	0,009	0,183	0,009	0,013
MB	FI	HMF8	2000	0,026	0,004	0,009	0,275	0,027	0,002
MB	FI	HMF9	1999	0,014	0,007	0,018	0,192	0,024	0,016
MB	FI	HMF9	2000	0,016	0,003	0,014	0,038	0,014	0,004
MB	FI	HMF9	2001		0,009	0,014	0,045		0,003
MC	SO	ISRTMC14	1999	0,129	0,063	0,123	0,065	0,111	0,018
MC	SO	ISRTMC14	2001	0,185	0,041	0,079	0,013	0,040	0,012
MC	SO	ISRTMC18	1999	0,018	0,057	0,099		0,110	0,012
MC	SO	ISRTMC18	2001	0,048	0,026	0,040	0,010	0,089	0,006
MC	SO	ISRTMC22	1999	0,015	0,023	0,028		0,031	0,035
MC	SO	ISRTMC22	2001		0,001	0,003	0,010	0,022	0,003
MC	SO	ISRTMC23	1999	0,004	0,019	0,045		0,034	0,028
MC	SO	ISRTMC23	2001		0,000	0,024		0,004	0,006
MC	SO	ISRTMH1	1999	0,010	0,104	0,000	0,211	0,204	0,073
MC	SO	ISRTMH1	2001	0,032	0,010	0,026	0,013	0,047	0,018
MC	SO	ISRTMH10	1999	0,011	0,014	0,011	0,004	0,001	0,000
MC	SO	ISRTMH10	2001	0,040	0,014	0,092	0,005	0,135	0,029
MC	SO	ISRTMH12	1999	0,019	0,023	0,056	0,075	0,140	0,045
MC	SO	ISRTMH12	2001	0,095	0,016	0,041	0,006	0,053	0,011
MC	SO	ISRTMH2	1999	0,288	0,107	0,182	0,409	0,169	0,042
MC	SO	ISRTMH2	2001	0,049	0,033	0,067	0,025	0,167	0,014
MC	SO	ISRTMH8	1999	0,067	0,035	0,162	0,203	0,098	0,027
MC	SO	ISRTMH8	2001	0,124	0,018	0,036	0,017	0,044	0,010
MC	SO	ISRTMH9	1999	0,034	0,018	0,066	0,105	0,064	0,018
MC	SO	ISRTMH9	2001	0,050	0,016	0,029	0,007	0,062	0,009

Israel

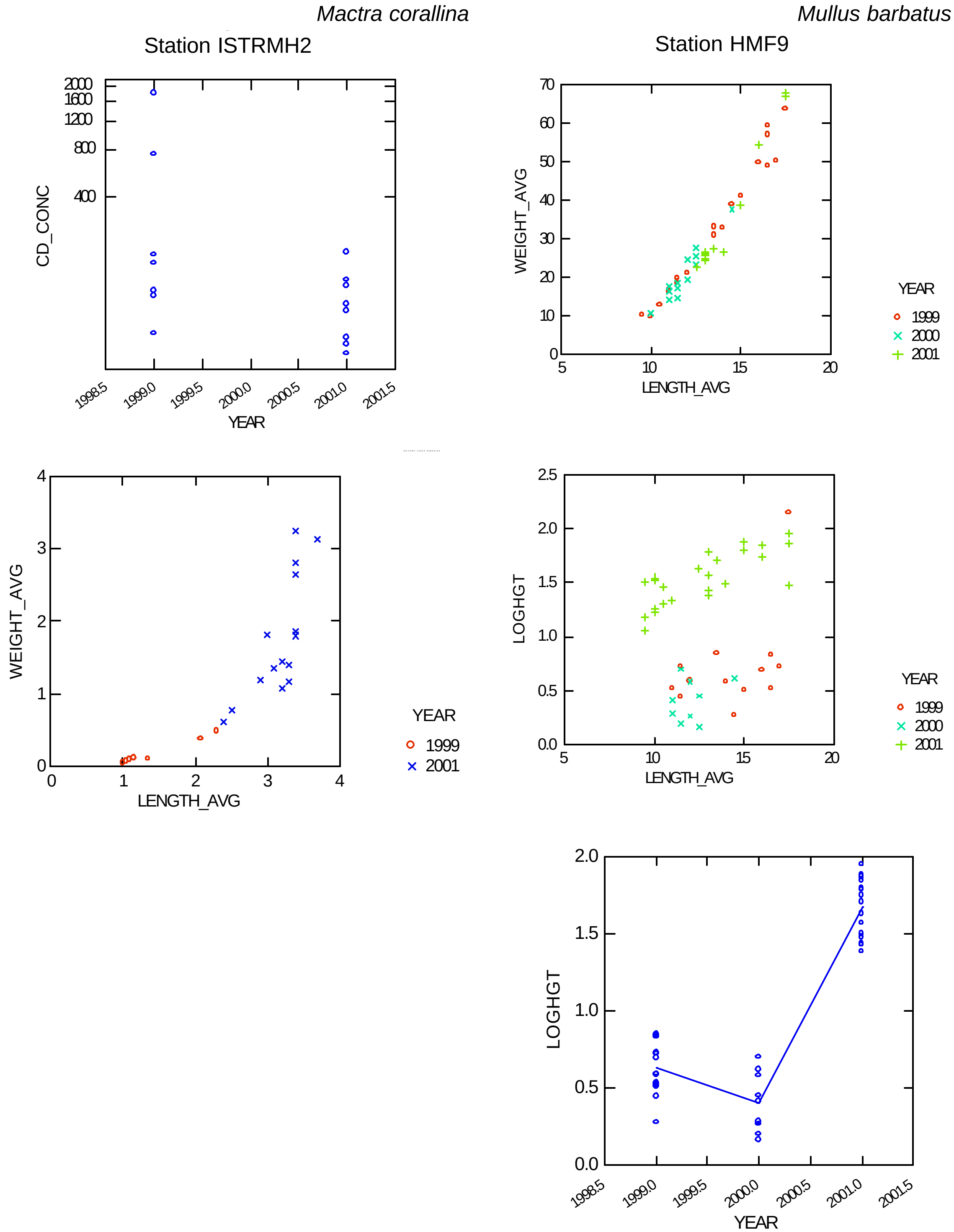


Figure 2.2.4.2 Logarithmic values of cadmium and total mercury mass fraction in *Mactra corallina* and *Mullus barbatus* respectively by year at stations ISRTMH2 and HMF2 in Israel coastal waters.

Slovenia

The within-year variance for Slovenian data (Table 2.2.4.5) is below the objective limit. The only exception is the PAH mass fraction in year 2002. When the PAH mass fraction is examined versus EOM, a clear relationship can be seen (Figure 2.2.4.3.) For that purpose the measurement of EOM became critical when PAH is concerned. Normalization of PAH data with EOM probably will show better results. Unfortunately, EOM data for previous years were not submitted.

As Slovenian data have shown very low within-year variances and even if there is only three year of sampling, a linear trend was identified (Figure 2.2.4.4). A substantial change in the cadmium mass fraction in *Mytilus galloprovincialis* is clearly seen at station 24 and a linear trend can be identified. From a general linear model approach, 77% of the changes can be attributed to the differences between years and the overall variance of the programme is ? 2=0,002. This value is far below the 0.060 threshold and even after only three years of measurements the power was higher than 90% that was set in the programme objectives. At the very beginning of the data analysis the substantial difference between years was attributed to a change in the weight/length ratio (Figure 2.2.4.5) during 2002, however when the original data is examined it has been realized that a wrong data set on the weight of organisms was submitted to the database. During 2002 weight of the shell and not of the soft tissue was submitted. It highlights the importance of data verification.

The following results are for:
STATION$ = 0024
5 case(s) deleted due to missing data.

Dep Var: LOG10CD N: 16 Multiple R: 0.879 Squared multiple R: 0.772

Adjusted squared multiple R: 0.756 Standard error of estimate: 0.050

Effect	Coefficient	Std Error	Std Coef	Tolerance		P(2 Tail)
CONSTANT	3.225	0.041	0.000	.	79.317	0.000
YEAR	-.093	0.013	-0.879	1.000	-6.887	0.000

Analysis of Variance

Source	Sum-of-Squares	Df	Mean-Square	F-ratio	P
Regression	0.118	1	0.118	47.433	0.000
Residual	0.035	14	0.002		

*** WARNING ***
Case 21 is an outlier (Studentized Residual = -2.593)

Durbin-Watson D Statistic 1.225
First Order Autocorrelation 0.136

Table 2.2.4.5 **Within year variance for trace metals and PAH mass fractions in *Mytilus galloprovincialis* (MG) sampled on stations along the Slovenian coast in the period 1999-2002.**

STATION	YEAR	N		$?^2$	
			LOGCD	LOGHGT	LOGPAH
24	1999	1			
24	2000	5	0,001	0,002	
24	2001	5	0,000	0,000	0,004
24	2002	5	0,003	0,001	0,010
TM	1999	1			
TM	2000	5	0,000	0,003	
TM	2001	5	0,002	0,002	0,011
TM	2002	5	0,002	0,001	0,074

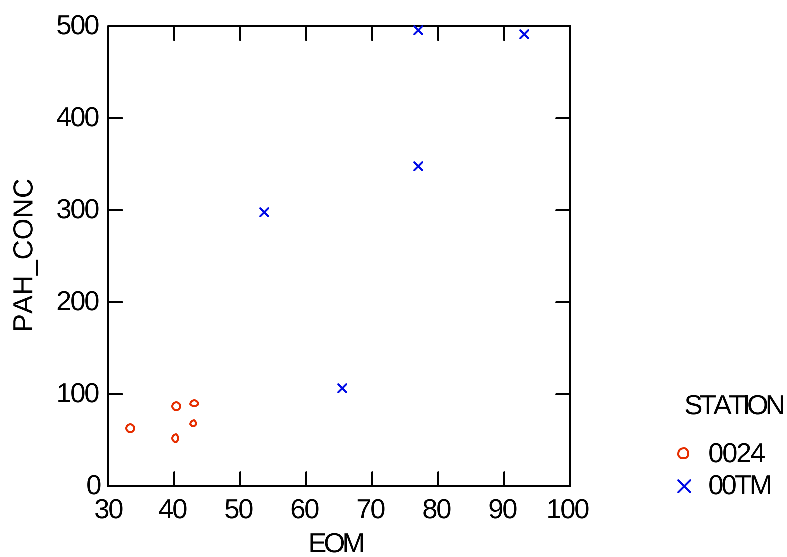


Figure 2.2.4.3 PAH and EOM mass fraction in *Mytilus galloprovincialis* for year 2002 at two stations in Slovenian coastal waters.

Slovenia *Mytilus galloprovincialis*

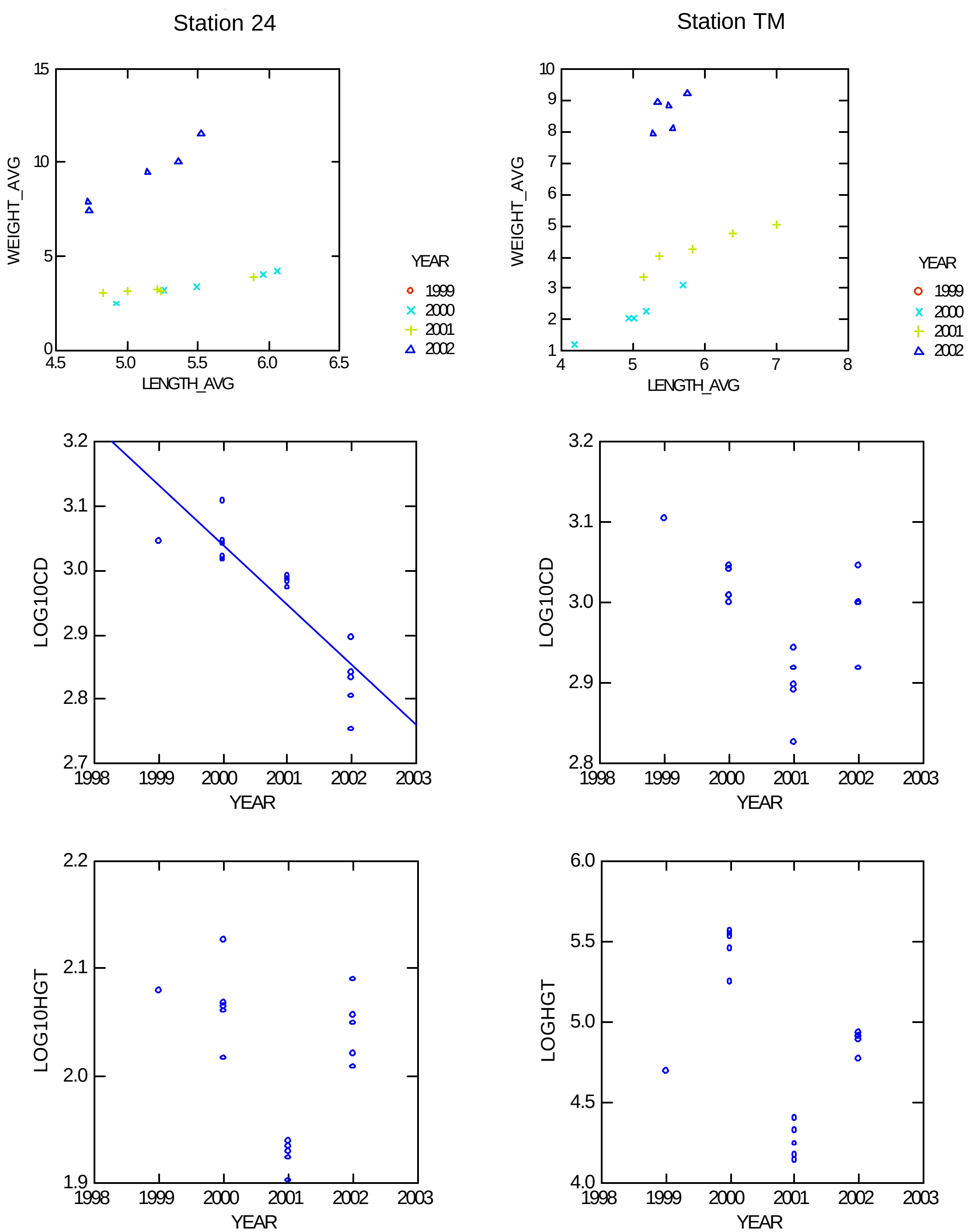


Figure 2.2.4.4 Logarithmic values of cadmium and total mercury mass fraction in *Mytilus galloprovincialis* (MG) by year at station 24 and TM in Slovenian coastal waters.

Tunisia

Tunisia submitted data only on trace metal mass fractions in *Mytilus galloprovincialis* (MG) and *Ruditapes decussatus* (RD) for 2001. The underlying variance (Table 2.2.4.6) is generally acceptable for the declared objective.

Table 2.2.4.6 Within year variance (*?*^{2}) for trace metal mass fractions in *Mytilus galloprovincialis* (MG) and *Ruditapes decussatus* (RD) along the Tunisian cost during the year 2001.

STATION	SPECY	N	? ^{2} LOGCD	LOGHGT	LOGPB
B3	MG	5	0,001	0,002	0,008
B3	RD	6	0,002	0,006	0,036
G1	RD	5	0,004	0,003	0,016
M1	RD	6	0,000		
S2	RD	6	0,001	0,001	0,006
T2	RD	6	0,003	0,003	0,005

Turkey

Turkey submitted two very useful data sets. The first is for trace metals mass fraction for *Mytilus galloprovincialis* and the second is for *Mullus barbatus*. It is the only data set with five years of sampling and analyses available for *Mytilus galloprovincialis* where the sampling was performed with a single specimen.

The within year variance (Table 2.2.4.7) regarding trace metal mass fractions in *Mytilus galloprovincialis* (MG) at Izmir station showed very high variances through the all sampling period. When the size of sampled organisms is examined, two classes can be identified (Figure 2.2.4.4), i.e. lower and higher than 6.3 cm. If the within year variance is recalculated for those two classes, the variance is still very high. Probably a change in the sampling strategy has to be established and additional steps have to be taken to understand why so high variances were present. The analytical performance has also to be analysed.

For the data set of *Mullus barbatus*, the within year variance is very variable (Table 2.2.4.8). The highest variances were present in the 2000 data probably because a very large size class was sampled (Figure 2.2.4.5). Usually the size classes were not homogeneous between years and certainly a part of the variance can be attributed to these variations in the sampling strategy. When the log values of total mercury mass fraction were compared to the length of organisms (Figure 2.2.4.5) no relation was observed. Usually these two parameters are well correlated, however, in our case the variance contained even a very large size class sampled. A significant upward trend was detected at station GOKSU and 90 % of the changes can be explained with years. The trend is of 0,8 on a log base and is close to a change of nearly one order of magnitude by year.

The following results are for:

STATION$ = GOKSU

Dep Var: LOGHGT N: 54 Multiple R: 0.946 Squared multiple R: 0.894

Adjusted squared multiple R: 0.892 Standard error of estimate: 0.188

Effect	Coefficient	Std Error	Std Coef	Tolerance		P(2 Tail)
CONSTANT	-1625.980	77.658	0.000	.	-20.938	0.000
YEAR	0.814	0.039	0.946	1.000	20.960	0.000

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	15.507	1	15.507	439.301	0.000
Residual	1.836	52	0.035		

Durbin-Watson D Statistic 1.804
First Order Autocorrelation 0.087

Table 2.2.4.7 Within year variance (?^{2}) for trace metal mass fractions in *Mytilus galloprovincialis* (MG) at Izmir station from 1998-2002, for different size classes.

YEAR	N	?^{2}			
		LOGCD	LOGCU	LOGHGT	LOGZN
All data					
1998	10	0,097	0,140	0,072	0,189
1999	12	0,031	0,095	0,135	0,139
2000	22	0,060	0,143	0,078	0,131
2001	14	0,021	0,128	0,073	0,126
2002	25			0,030	
Length <6,3 cm					
1998	5	0,188	0,117	0,041	0,306
1999	6	0,030	0,072	0,033	0,144
2000	11	0,121	0,167	0,070	0,181
2001	7	0,022	0,200	0,051	0,169
2002	15			0,046	
Length >6,3 cm					
1998	5	0,015	0,109	0,075	0,065
1999	6	0,011	0,096	0,104	0,105
2000	11	0,005	0,120	0,061	0,082
2001	7	0,022	0,051	0,062	0,062
2002	9			0,004	

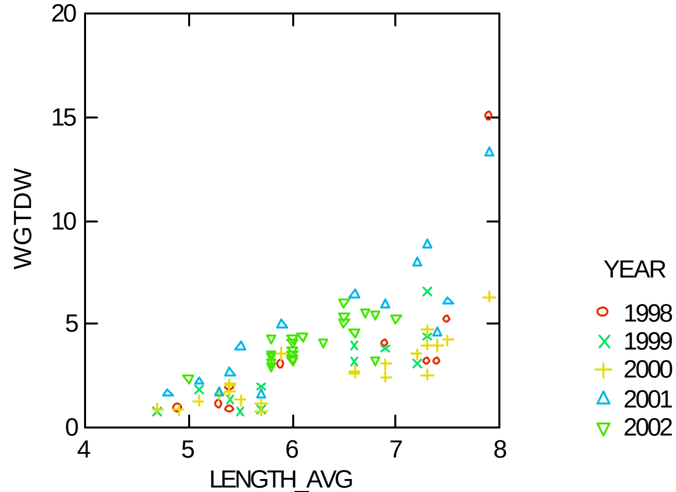


Figure 2.2.4.4 Dry weight (WGTDW) in grams and length of *Mytilus galloprovincialis* in cm at Izmir station during the period 1998-2002.

Table 2.2.4.8 Within year variance (*?*^{2}) for trace metal mass fractions in *Mullus barbatus* (MB) at stations along the coast of Turkey in the period 2000-2002.

STAT$	YEAR	N	? ^{2}			
			LOGCD	LOGCU	LOGHGT	LOGZN
CEYHAN	2002	5			0,002	
GOKSU	2000	30	0,084	0,123	0,036	0,064
GOKSU	2001	19	0,057	0,033	0,032	0,068
GOKSU	2002	5			0,035	
MERSIN	2000	23	0,042	0,089	0,026	0,024
MERSIN	2001	35	0,043	0,250	0,114	0,014
MERSIN	2002	5			0,003	
TIRTAR	2000	22	0,299	0,127	0,144	0,116
TIRTAR	2001	30	0,055	0,040	0,023	0,010
TIRTAR	2002	5	0,059	0,019	0,025	0,014

Turkey *Mullus barbatus*

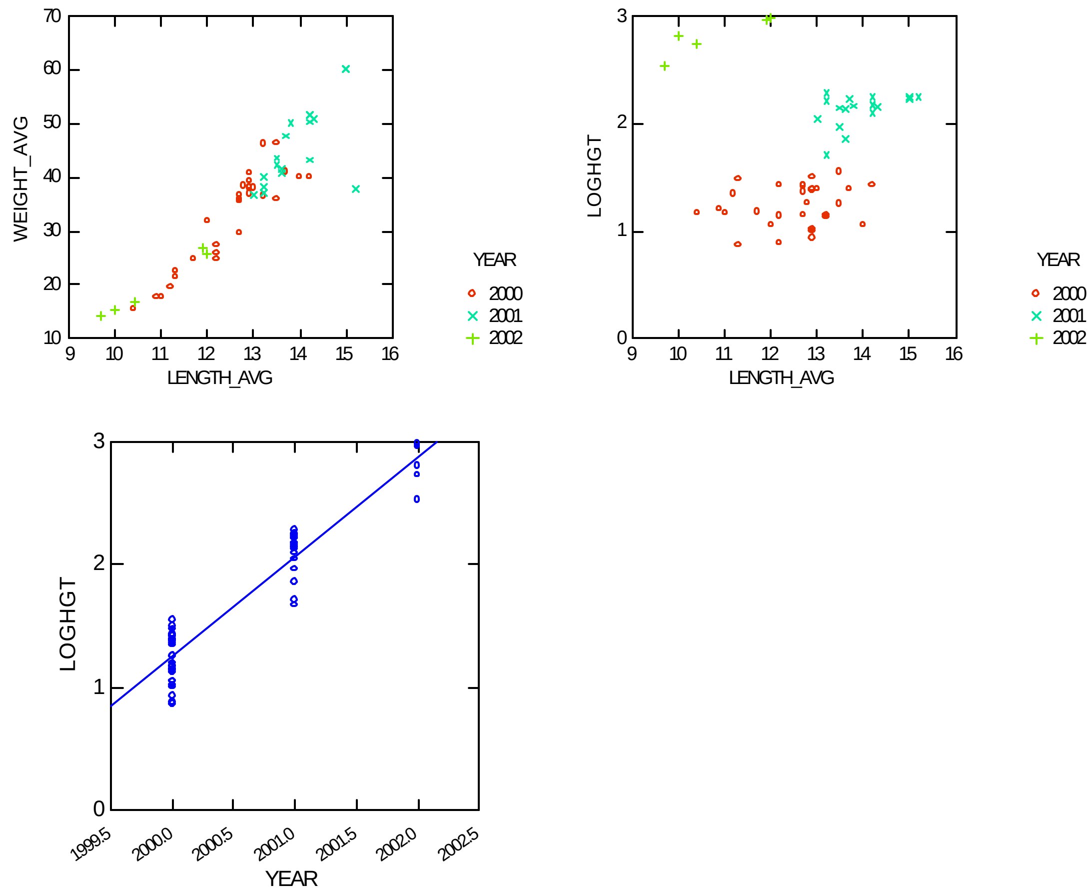


Figure 2.2.4.5 Logarithmic values of total mercury mass fraction in *Mullus barbatus* (MB) by year at station GOKSU in Turkish coastal waters.

Investigation of analytical variances

During the pilot phase of programmes it is essential to understand the data quality, and hence, the ability to fulfil the monitoring objectives. In the present analysis, the optimal design does not exist, instead through a system of experimental performances the critical points (sampling variance and analytical variance) are investigated and later an evaluation process is applied for optimisation. It is essential to put more efforts to achieve the best analytical performance during the pilot phase even if the analytical variance is always smaller than the sampling variance.

Only four countries partially submitted data on analytical performance (Croatia, Israel, Slovenia and Turkey). Croatia submitted analytical performance data with replicates only for 2002. On the other hand, Israel submitted data from their analytical chart but without replicates. Slovenia submitted aggregated analytical data only for 2002. Turkey provided analytical data for the period from 1999-2003 with 2-5 replicates.

Under these circumstances, the analytical variance can be calculated only for Croatia and Turkey. The calculated variances (Table 2.2.4.7-8) for both countries are quite low indicating a good analytical practice and are far below the variances accounted by the sampling part. In the case of Turkey, it can also be noticed that the variance is decreasing with years indicating even a better analytical practice in the last years.

Table 2.2.4.7 Analysis of analytical variance in SRM2976 CRM (*Mytilus galloprovincialis* tissue) for data submitted by Croatia.

Year	2001		2002	
		Log(?)		Log(?)
?(HgT)·10^9	62,0	1,792	59,0	1,771
	60,0	1,778	58,0	1,763
			66,0	1,820
Variance		0,00010		0,00093
?(Cd)·10^9	680,0	2,833	817,7	2,913
	800,0	2,903	836,5	2,922
	750,0	2,875	847,4	2,928
			859,2	2,934
			975,2	2,989
			986,5	2,994
Variance		0,00126		0,00126

Table 2.2.4.8 Analysis of analytical variance in DORM-2 CRM (Dogfish muscle by NRCC) for data submitted by Turkey.

Year	1999		2000		2001		2002		2003	
		Log(?)		Log(?)		Log(?)		Log(?)		Log(?)
?(HgT)·10^6	4,29	0,63	4,50	0,65	4,40	0,64	4,60	0,66	4,64	0,67
4,64±0,26*	4,41	0,64	4,60	0,66			4,50	0,65	4,51	0,65
Variance		0,00007		0,00005				0,00005		0,00008
?(Zn)·10^6	25,47	1,41	20,40	1,31	20,60	1,31	27,30	1,44		
25,6±2,3*	23,99	1,38	24,50	1,39	29,50	1,47	25,30	1,40		
	23,70	1,37	24,00	1,38	24,20	1,38	23,60	1,37		
	24,94	1,40								
	24,76	1,39								
	24,40	1,39								
Variance		0,00013		0,00190		0,00610		0,00100		
?(Cd)·10^6	0,05	-1,35					0,04	-1,40		
0,043±0,008*	0,04	-1,42					0,04	-1,38		
Variance		0,00270						0,00022		
?(Cu)·10^6	2,59	0,41	2,16	0,33	2,80	0,45	2,33	0,37		
2,34±0,16*	2,73	0,44	2,02	0,31	2,13	0,33	2,31	0,36		
	2,42	0,38	2,74	0,44	2,35	0,37	2,29	0,36		
Variance		0,00069		0,00484		0,00362		0,00001		

* reference values

2.2.5 Conclusions and recommendations for trends monitoring with biota

After working on the design of consistent trend monitoring programmes and taking into account the previous negative attempts to perform statistical analyses for trends, MED POL is now trying to assess if the trend monitoring programmes undertaken under MED POL phase III by the countries were designed as to give results according to the declared objectives and if they can be easily maintained for a long period of time.

The present evaluation identifies a number of problems and suggests possible solutions.

The first point is that all finalized programmes practically declared with very similar statements of trend monitoring objectives indicating that all involved countries don't have an active environment monitoring programme finalised to manage the environmental resources and problems, but rather a programme to assess generally declared problems. **In future more specific objectives are expected and encouraged to be implemented.**

Most of the problems identified during the data analysis are related to the inconsistencies occurred in the implementation of declared sampling strategies. Since all involved countries are in the pilot phase of their programmes, the maintenance of accepted sampling strategy is very important for the optimisation of the ongoing programmes. From the trend monitoring point of view, the best sampling strategy always leads to attaining the best information on the sampling variance and the underlying trend. Keeping that in mind it is good to avoid pooling whenever possible. **The suggested strategy for molluscs, since they are small in size, is to use 5 samples with 15 pooled specimens. If one sampled organism provides enough sample for all analyses the use of 15 to 25 (preferred) samples is suggested if the underlying variances are not know. The sample should be collected in a length stratified manner.** If the variance is known the programme optimisation effort will give the optimal number of samples to realise the declared objectives.

Trend monitoring evaluation was also done in order to identify the major sources of data errors generated during data transmission and data load to the database. The problems identified during trend monitoring data evaluation can be divided in three distinct classes: error introduced during data transfer to data base; missing and non consistent data; and errors introduced due to improper use of measurement units. The first two errors can be solved through well-defined validation and verification procedures. A simple approach to the problem is essential. The data originator has to be actively involved in that process. Regarding the third type of errors (not proper use of measurement units) International System of Units (SI) and its rules can be proposed to be used. **An additional effort has to be introduced in accepting SI as a standard in countries participating to the MED POL Phase III and with small changes to the database structure the significant error generating source could be eliminated.**

The problems identified during the evaluation of the consistency of programmes, fulfilment and submission of data to the MED POL database indicate that all the involved countries have problems with trend monitoring activities. Some of the problems are of technical nature (difficulties in sampling, instrumentation, data exchange etc.) others are more connected to the countries organization structure (many laboratories involved, participants change with time etc.). **To overcome these problems involved countries are encouraged to write a detailed programme manual where all issues regarding a successful programme realisation will be addressed. The manual has to deal with objectives and detailed methodological approach to successfully maintain the programme over time (positioning, sampling, methods, and data elaboration, exchange and presentation).**

In this phase of the statistical data analysis the essential part, the data verification and validation, has still not terminated. Some errors and problems have to be solved with an active participation of the involved countries, mostly dealing with the data verification and submission of missing data sets. In relatively short period this effort has to be terminated and after that the final report on trend monitoring statistical data analysis will be produced with country tailored problem addressed.

2.2.6 Trend monitoring of contaminants in sediments

The theory behind the use of sediments as a tool in environmental monitoring is the knowledge that the finer particles in the sediment originate from the suspended particulate matter, and that these particles are the carriers of non-soluble contaminants. Fine material (inorganic and organic) and associated contaminants are preferentially deposited in areas of low hydrodynamic energy, while in areas of higher energy, fine particulate matter is mixed with coarser sediment particles which are generally not able to bind contaminants. This dilution effect will cause lower and variable contaminant concentrations in the resulting sediment. Obviously, grain size is one of the most important factors controlling the distribution of natural and anthropogenic components in sediments. It is, therefore, essential to normalize for the effects of grain size in order to provide a basis for meaningful comparisons of the occurrence of substances in sediments of various granulometry and texture within individual areas, among areas or over time. OSPAR/ICES guidelines for trend monitoring of contaminants in the sediments are seriously considering the normalization process as essential for a successful trend monitoring.

Usually the sediments for contaminants analysis are collected in areas close to the sources of contamination (rivers, outfalls) were the sedimentation rate is very variable and replicate samples has to be taken. Again, the OSPAR/ICES guidelines suggest 5 replicates collected randomly within a specific radius of the sampling point (50 m at offshore intermediate sites and 20 m for estuarine sites).

All the countries participating to the MED POL Phase III that are measuring the ratio of contaminants in sediments use annual frequency and one sample per station. **Such a sampling strategy is not sufficient to address trends. The high dependence of contaminant ratio and sediment grain size indicate that a new sampling strategy has to be developed in accordance with the statistical needs related to trends evaluation**. Great care has to be dedicated to the sediment quality analysis (grain size distribution, clay mineral and organic carbon content). The critical factor is to ensure that once a size fraction is selected for a location, this fraction is clearly recorded in the programme design for that location, and that the fraction does not vary from year to year.

In the context of temporal trend surveys, normalization is a process that reduces the variance of the data set by taking account of differences in grain size distribution and mineralogy (gross sediment composition) between samples. Both the selected trace metals and the organic contaminants will co-vary strongly with such factors and grain size, clay mineral and organic carbon content. Differences in these co-factors between samples will often be reflected in differences in the concentrations of the target contaminants.

2.2.7 Data Quality Assurance activities for Trends Monitoring

Quality assurance of data is compulsory for all monitoring programmes, but it takes on an additional dimension of importance when multiple laboratories are involved in assessing the environmental quality of a common region. Environmental monitoring data for the MED POL programme is transmitted from a variety of laboratories, thus the accurate identification and interpretation of pollution trends rely on the consistency, reliability and comparability of the data generated by these laboratories. Overall quality assurance for the MED POL programme therefore comprises extensive external quality assessments and activities, including intercomparison exercises, production of new reference materials, organization of training programmes, and customized technical assistance to National Laboratories through visits.

Intercomparison exercises have served as effective external performance tests for MED POL laboratories. These exercises have been organized by IAEA-MEL within the DQA activities of the MED POL Phase III Programme, and they are the main criteria for validating the data of a participating MED POL laboratory. The subject material of many of the intercomparison exercises is a previously uncharacterized material, often representative of the MED POL region. As the exercise will result in the characterization of this material, one of the very useful products of such an exercise is the creation of a new representative reference material, which can be used in subsequent analyses to assist in verifying data quality.

The following information provides some examples of recent intercomparison exercises, and includes some technical specifications of the distributed materials, participation of MED POL labs to these exercises and briefly discusses the performance achieved by the laboratories.

During the 2002-2003 biennium, two new materials, IAEA-432 and IAEA-433, were distributed, and the preparation of a new sample to be distributed in the first quarter of 2004 has been started. In the same period, three performance evaluation reports were finalized for the intercomparion exercises: IAEA-417, MA-MED POL-6/TM and IAEA-407. IAEA-417 and IAEA-407 were ultimately classified as reference materials for organics and trace metals, respectively.

IAEA-417 was a sediment sample from Venice Lagoon and prepared for the analysis of organochlorines/chlorinated compounds and petroleum hydrocarbons. After preparing the sample and verifying acceptable homogeneity, the samples were distributed world-wide in January 2001. Of the 75 Mediterranean institutes that were invited to participate in this exercise, only 12% of them (17% including the draft programmes) were MED POL designated laboratories. Of the MED POL laboratories that participated in the exercise, 80% returned their results by the specified deadline. Most of the laboratories (8 out of 9 labs) submitted results for organochlorines, whereas participation was not as extensive for chlorinated compounds (3 labs) and petroleum hydrocarbons (4 labs). Performance of the laboratories (as assessed by the Z-scores obtained) was nearly completely satisfactory for organochlorines. This material was later classified as a reference material and is therefore suitable as an accuracy check during the analysis of coastal sediments for petroleum hydrocarbons and chlorinated compounds (IAEA, 2002a).

IAEA-407 was a fish homogenate and composed of fish collected from the North Sea. After testing for homogeneity and stability, samples were distributed to 41 Mediterranean laboratories from 16 countries in September 2000 as part of a world-wide exercise for the analysis of trace elements and methylmercury. Forty percent (more than 50% with draft programmes) of the invited laboratories from the Mediterranean were MED POL designated; these laboratories represented 9 countries) and about 50% of them participated in the exercise. It has been reported that >75% of all the submitted values by all the participating laboratories (world-wide) were acceptable (IAEA, 2003). These results were impressive considering the relatively low concentration levels of trace elements in the sample matrix. However, a separate evaluation for only MED POL designated laboratories has not yet been performed, but is extremely needed. Making a preliminary evaluation for the performance of mandatory parameters (Hg, Cd) achieved by MED POL laboratories, Hg results are more agreeable than Cd; most of the laboratories that submitted Hg results (6 out of 7) obtained acceptable scores.

MA-MED POL-6/TM exercise was organized to assess analytical performance of MED POL designated laboratories. In May 2001, a mussel reference material (*Mytilus galloprovincialis* from Mediterranean coast of France) was packaged under blank cover and distributed to 46 laboratories in the Mediterranean and 35% of them (47% including the draft programmes) were MED POL designated laboratories. The participation in this exercise was low and remained at the level of 30% for the MED POL designated laboratories of 5 countries. Overall, 73% of the data were determined to be acceptable (IAEA, 2002b). The results for cadmium, generally considered a difficult element, were highly satisfactory. Despite limited participation, the MED POL designated laboratories obtained 80% and 60% good scores respectively for Cd and Hg. Other metals were analyzed at more than 90% success by 3 laboratories out of 5.

Two new materials for the analysis of organic and inorganic contaminants, IAEA-432 (mussel homogenate) and IAEA-433 (sediment), were distributed to Mediterranean laboratories by late 2002. Eight MED POL designated laboratories from 6 countries submitted their results for IAEA-432 and 7 labs from 6 countries for IAEA-433. Both exercises have finished accepting data, and the data is currently being evaluated. The final reports for both studies are expected to be completed by the end of 2003.

Finally, a fish homogenate (Tuna) is being prepared to be used in 2 concurrent exercises (both organic and inorganic contaminants) and is expected to be distributed in 2004. It is known that the preparation of a fish homogenate is rather difficult and may take more than a year to make the sample suitable for distribution. As tuna is generally found in more remote areas of the Mediterranean, the expected concentrations for most contaminants are expected to be low. If so, the material might be appropriate as a background control reference material. Therefore, it should be considered as a rare intercomparison, so all MED POL laboratories are strongly encouraged to participate in both exercises.

Unfortunately, it has been observed that the participation of MED POL designated laboratories in the intercomparison exercises is not fully satisfactory. The reasons for that should be reviewed by all responsible parties in order to avoid collection of trends monitoring data without any external validation. At the same time, intercomparison exercises are only one facet of data quality assurance, and should be supported by regular analysis of certified reference materials and production of analytical quality control charts by the laboratory (UNEP, 1990). As alluded to in the previous sections, trend analysis of the collected data can only be made by applying appropriate statistical methods to calculate both sampling and analytical variances. The only way to illustrate the latter is the replicate analyses of certified reference materials or of an in-house working reference material, and to include these results when submitting trend monitoring data to MED POL. A full catalogue of IAEA reference materials is available from the IAEA website (http://www.iaea.org/programmes/aqcs) which is also linked with MED POL web pages (direct URL: http://62.68.74.75/medpol/).

A report on data quality review for MED POL Phase III since is needed, and this issue must be clarified in the near future so that a report covering a period of 1996-2003 can be published in 2004. The report will present a comprehensive evaluation of the analytical performance of MED POL.

2.3 Biological effects monitoring: achievements and problems

Within the framework of MED POL Phase III monitoring activities, biological effects monitoring has been implemented through pilot programmes. This activity is crucially important for MED POL since it is the only component of the monitoring activities that will provide direct information on the impacts of the pollutants to marine life. The initial monitoring criteria set for the programme is given in Annex I. Table 2.3.1 shows the participation of countries in the programme.

Table 2.3.1 Level of participation of Mediterranean countries to the pilot monitoring activities of MED POL Phase III

COUNTRY	Participation in the biological effects monitoring			
	Biomarkers for General Stress	Biomarkers for Specific Stress	Other biomarkers	Number of participating institutes
Albania	√	√		2
Algeria				
Croatia	√	√	√	1
Cyprus				
Egypt				
France				
Greece	√	√	√	3
Israel				
Italy				
Lebanon				
Libya				
Malta				
Monaco				
Morocco				
Spain				
Slovenia	√	√		1
Syria	*	√		1
Tunisia	√	√	√	2
Turkey				

* A general stress biomarker will be included to the Programme

Four of these countries (Croatia, Greece, Slovenia and Tunisia) have submitted data to MED POL. A general evaluation of data has been performed and a full expert analysis will also be done.

The technical/scientific coordination of the activity has been made, on behalf of MED POL, by the University of Alessandria, Italy, which is also responsible for the quality assurance programme. The report prepared for the activities held in 2001-2003, together with a short description of future working prospects, is presented below. It is also highlighted in the report that, a number of additional laboratories are ready to launch the biological effects monitoring considering the expertise they gained during the training courses organized during the first years of implementation of the programme.

Report on 2001-2003 activities

It is well known that marine pollution in the Mediterranean Sea, in particular along the coasts, may represent in numerous areas a relevant problem in term of negative effects on marine life and also for its possible consequences on human health.

In the past years a program was realised in the framework of MED POL with the aim of assessing the level of toxic chemicals present in the marine environment and accumulated in the tissues of the organisms. The technologies in the field of analytical chemistry in fact enable us to identify the pollutants and determine their concentrations at a pico-nanomolar level.

However it must be stressed that it is difficult to obtain a full picture of all the contaminants (more than 40.000 different pollutants have been estimated to be present in the marine environment and potentially accumulated in the organisms) and to extrapolate from the chemical data the biological effects of the toxic chemicals. As a result, in recent years a biomonitoring program was launched by MED POL with the target of evaluating the toxic effects of pollutants on the marine organisms living along the Mediterranean coasts.

It must be noted that the complex interactions of the different toxic chemicals present in the marine environment may produce different effects on the organisms (additive or synergic/antagonistic effects); moreover different organisms may show different biochemical pathways to "metabolize" inorganic and organic compounds and pollutants may have a different bioavailability in the different organisms (from protist to vertebrate) also in relation to their specific habitat.

The MED POL Phase III Biomonitoring Program was organized taking into account three main aspects.

The first was the selection of the sentinel organisms i.e. molluscs (lamellibranch molluscs) and fish (Mullus species). This choice was determined by the fact that mussels (*Mytilus galloprovincialis*) are often utilized in biomonitoring program and are considered the best organisms as a bioindicator. However, although largely geographically diffused, these organisms are not present along all the Mediterranean coasts and therefore, where absent, different lamellibranch molluscs have been selected.

For what concerns fish, Mullus species are widely diffused and, due to their ecological characteristics, life stile, their ability to accumulate high levels of pollutants and the fact that they are highly responsive to toxic chemicals, these organisms were suggested to be utilized as sentinel organisms in biomonitoring program. It is important to underline that for their characteristics lamellibranch molluscs and Mullus species were utilized in the past years as bioaccumulators in the MED POL chemical monitoring programs as well.

A second important point is the use of a set of biomarkers to evaluate the level of the stress syndrome induced by pollutants in the selected organisms. As known, a biomarker is a biological parameter that may vary in response to the effects of pollutants and therefore it may be used to detect a stress syndrome induced by toxic chemicals.

Biomarkers are usually categorized in two classes:

- stress biomarkers (they reveal a stress syndrome by integrating the effects of a wide range of environmental pollutants) such as: lysosomal membrane stability, micronuclei frequency, lipofuscin lysosomal accumulation, neutral lipid accumulation, etc...
- exposure biomarkers (they reflect the response of the organisms to particular classes of toxic chemicals) such as EROD activity, induced by organic aromatic xenobiotics (PAH, PCBs, etc...), metallothionein content, metalloproteins with high affinity for heavy metals induced by metal cations such as Cd, Cu, Zn, Hg, etc.

The third aspect that characterized the MED POL Biomonitoring Program was the development of a Quality Assurance Program (Q.A.).

The Q.A. program was characterised by:

a) the distribution of a "UNEP/MAP manual" for biomarker utilization;
b) the diffusion of a video realized by RA.MO.GE. in collaboration with UNEP/MAP showing how to utilize the biomarker methodologies;
c) the organization of a series of training courses to prepare the researchers to participate to the biomonitoring program;
d) the organization of an "Intercalibration Program": the first, that has ever been realised in the region to achieve a standardization of biomonitoring data (Viarengo, A.; Lafaurie, M.; Gabrielides, G.P.; Fabbri, R.; Marro, A.; Roméo, M. Marine Environmental Research Volume: 49, Issue: 1, February, 2000, pp. 1-18).

To maintain and further develop the Biomonitoring Program in the last three years a training course and three intercalibration exercises were organized.

The training course realised in the laboratory of Interuniversity Research Centre of the Genova University (Italy) was attended by researchers from 16 Mediterranean countries (Turkey, Palestinian Authority, Tunisia, Malta, Syria, Croatia, Slovenia, Israel, Algeria, Egypt, Morocco, Greece, Lebanon, France, Monaco, Italy).

During the training course all the methodologies to utilise the proposed biomarkers (lysosomal membrane stability, both cytochemical and neutral RED techniques, micronuclei frequency, metallothioneines, EROD) were carefully described and the researchers were able to practically start to utilise the different techniques. In addition, lipofuscin and neutral lipid lysosomal contents and perossisomal proliferation as well as stress on stress methods were showed as biomarkers of future interest.

The training course was realised mainly utilising the expertise of the researchers of the Interuniversity Research Centre of the Genoa University who have been involved in this activity for many years. Prof. Steve George of the University of Stirling (United Kingdom), dr. Iban Cancio of the Bilbao University (Spain) and dr. Roger Rahmani from the Laboratory of cellular and molecular pharmaco-toxicology of INRA (Antibes, France), internationally acknowledged experts, were also invited to participate to enhance the scientific level of the training course.

It is important to point out that during the training course the importance of a standard protocol for animal collection and transport, storage of biological sample, biomarker utilisation and data transmission was also stressed.

The success of the training course appears clear when the results of the intercalibration activity of the 2001 are analysed.

The data of three biomarkers such as lysosomal membrane stability, metallothionein content and Erod activity are reported in Figures 2.3.1.1-3. The results clearly show the good quality and the comparability of the data collected by the Mediterranean laboratories participating to the MED POL/UNEP MAP Biomonitoring Program.

It should be mentioned that at the intercalibration activities organised at the Di.S.T.A. (Alessandria, Italy) and at the Interuniversity Research Centre of the Genova University have also contributed Prof. Rahmani of the INRA Research Centre of Antibes (France) by preparing the PAH treated fish samples utilised for the EROD intercalibration.

Figures 2.3.1-3 Results of intercalibration activity of 2001

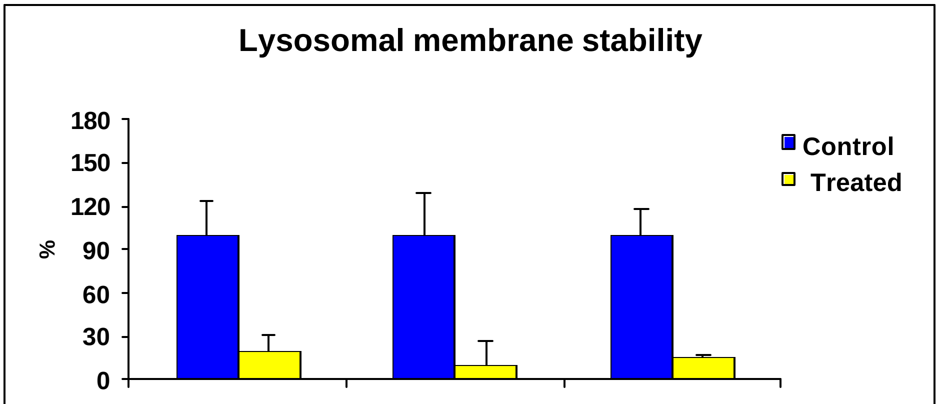


Fig.1

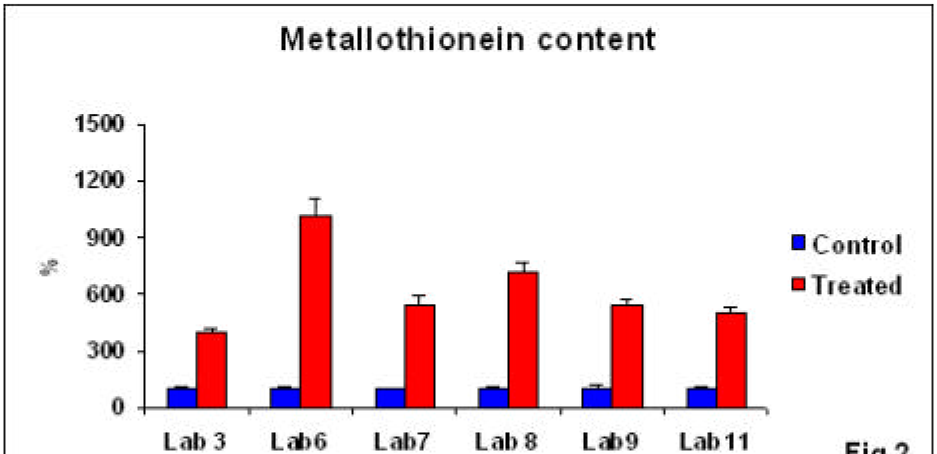


Fig.2

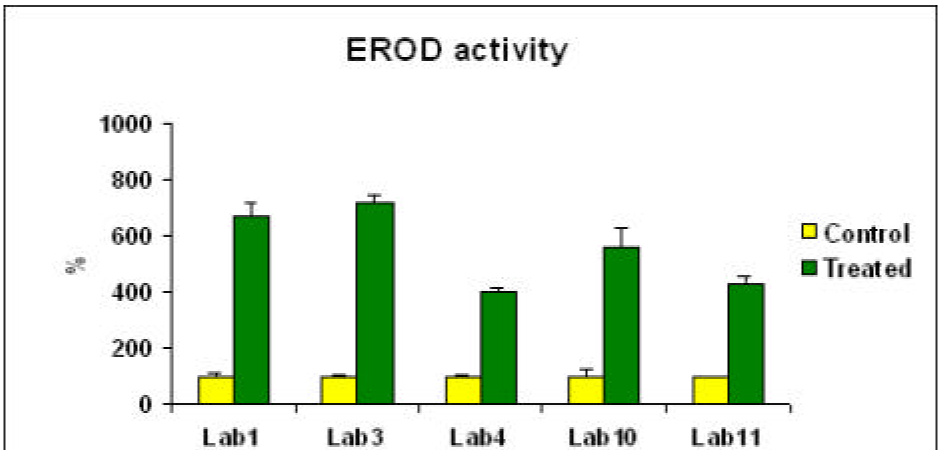


Fig.3

However, it must be mentioned that in the intercalibration activity developed during the last year, two of the eleven laboratories involved in the evaluation of metallothionein content failed to identify 50% of the samples and only four labs were involved in the Erod intercalibration activity.

On the other hand, five laboratories were involved in the evaluation of the lysosomal membrane stability.

It is of interest to mention that in order to better evaluate some cytochemical results (and eventually indicate some problem of sample storage) the slides were obtained back from some laboratories and re-analyzed by the researchers of Di.S.T.A. in Alessandria utilising an image analysis computerized system to validate the obtained results.

All together, the presented data seem to indicate a good quality of the biological data collected during the programme. A continuous growth of the programme may be better achieved by the organisation of additional training courses to better prepare the researchers involved and to enhance the interest of the participating institutions for the Mediterranean Biomonitoring Programme.

Possible future developments

The results of the 2001 training course and of the intercalibration activity may be summarized saying that in the last three years we have had a continuous increase of the biomonitoring activities along the Mediterranean coast.

In particular, the case of the development of the biomonitoring programme in Tunisia may represent an example showing a possible way to further develop the programme as a whole. In fact the support of Monaco and of Italy (Di.S.T.A., Alessandria) in term of developing of a fruitful scientific collaboration in the field of cellular and molecular effects of pollutants on marine organisms has in fact substantially enhanced the implementation of the biomonitoring activity along the Tunisian coasts.

On the basis of these positive results, and in collaboration with Prof. J. P. Narbonne of the Bordeaux University (France), an active scientific collaboration was started with a research laboratory in Morocco. In the same time two laboratories from Croatia and Algeria were invited to the laboratory in Alessandria to verify the possibility to enhance their activities through the realisation of common research programmes on the biological effects of pollutants.

Although the development of common research programs also depends on the possibility to obtain adequate financial support, these initiatives may represent an interesting opportunity to further develop the Mediterranean Biomonitoring Programme.

In this context, the scientific Institutions having a leader position in the marine environmental research in the region may be invited to realize “twinnings” with other less developed laboratories to contribute to the further development of the studies of the effects of toxic chemicals on marine life in the region.

Concerning the possible development scenario of the MED POL Biomonitoring Programme, it is important to point out that a group composed of UN international experts has recently established new biomarkers of stress and exposure that should be useful to utilize to integrate the set of biomarkers utilised previously selected.

This will render necessary to prepare a second part of the manual for the correct use of the biomarkers and possibly to prepare a second video (or better a CD) showing how practically realise the different analysis: this kind of activity may be realised as in the past years in collaboration with RAMOGE.

Probably the best way to rationalize the growth of the biomonitoring programme should be the utilization of a web site in which every participant may find all the information for the field and laboratory activities, biomarker methodologies, biomarker videos, statistic instruments and the database related to the different activities.

An important point should be to integrate the biological data with the results of the chemical analyses (also emphasizing the importance of collecting the two data on the same sample or, at least, in the same sites and at the same time).

It must be mentioned that during the past three years a large European biomonitoring research programme (BEEP: Biological Effects of Environmental Pollution in marine coastal ecosystems) was initiated with the support of the European Union. It is interesting to notice that most of the core biomarkers selected by the European Programme are the same utilised in the MED POL Biomonitoring Program thus allowing an easier integration of the possible future common activities. An important role in this direction was played by RAMOGE in the past years; RAMOGE has always developed an important activity attempting to integrate the Mediterranean experience to the European approach.

Among the recent research acquisitions of interest to the MED POL Biomonitoring programme it is important to consider that an “expert system” was developed able to integrate information of different biomarker data and therefore to rank the level of the stress syndrome affecting the organisms living in polluted waters. The model and the software were developed at the Department of Sciences and Advanced Technologies of Alessandria and, when opportunely tested, will be available for biomarker data treatment in the MED POL Programme. This way, the Med Pol Unep/Map and the National Agencies involved in control management would receive as result of the biomonitoring activities not a set of results of complicate cellular and molecular data but a simple index (the index ranks the physiological status of organisms in a five threshold scale, ranging from unaltered to pathologically altered status) suitable to easy clarify the environmental condition of a particular coastal area through the health status of the organisms living in the studied ecosystem.

Finally, as new frontiers in this research field, it is important to mention some aspects of science that may become in the next future of great interest to the programme.

Proteomic represents a research field of secure interest: the possibility to identify the proteins which concentration changes as an effect of toxic chemicals may represent a fundamental tool in the field of cellular/molecular ecotoxicology. In addition, it is important to point out that new equipments, such as Maldi/ESI-Q/TOF, are able to identify the proteins by analysing the triptic peptide profile and to evaluate, in a single analysis both the amino acidic sequence of the protein and its post transductional modifications rendering the proteomic approach extremely powerful.

A second aspect is related to the study of pollutant effects at genomic level. The study of the promotors of gene coding for proteins involved in stress response is today in great development. From a technological point of view, the development of the real time quantitative PCR and the recent possibility to utilize low and high density DNA microarrays to study the profile of gene activation in stress response may represent a new and revolutionary approach for its potentiality in the evaluation of stress syndrome in pollutant exposed organisms. In this regard it is important to say that a low density DNA microarray for mussels has been developed at Di.S.T.A. laboratory and it will be therefore possible in the next three years to try to utilise it in some preliminary way in the MED POL Biomonitoring Programme in parallel with the usual set of biomarkers.

2.4 Eutrophication monitoring programme and strategy for implementation

Background

It is widely accepted that excess loads of nutrients (both inorganic and organic) and organic matter (as organic carbon) from various sources (anthropogenic sources or natural processes) may cause eutrophication in the marine environment, basically in coastal and inshore waters.

The Mediterranean is considered a low productivity ecosystem and does not possess pronounced eutrophication symptoms at the basin scale. It is also known that the concentration levels of nutrients and chlorophyll-a decreases from west to east and north to south of the basin. Increased fresh water consumption has also resulted in a decline in nutrient enrichment of the specific areas in the eastern Mediterranean. However, even some large areas of the Mediterranean such as the Adriatic Sea -mostly northern Adriatic-, the Gulf of Lions and the northern Aegean Sea are considered as areas affected from the consequences of eutrophication. In addition to them, there are many records of different eutrophication phenomena all around the Mediterranean at the local level (enclosed bays, coastal lagoons, estuaries etc).

Keeping in mind the threats posed by eutrophication to the region, the MED POL Programme was asked to prepared an indicator-based monitoring strategy which would be commonly applied at the Mediterranean scale through the launching of pilot programmes. The details of the programme and the background evaluation can be found in document UNEP(DEC)/MED WG.231/14. Here below you will find a summary of the monitoring strategy approved by the Mediterranean countries to be implemented in a short-term period of time with some minimum common requirements and also the criteria for the prospected mid- and long- term monitoring activities.

MED POL Strategy of Eutrophication Monitoring in Mediterranean coastal waters

Short-term strategy

The first and fundamental step of the implementation of the short-term strategy is the identification of the monitoring sites in the Mediterranean as eutrophic or sensitive to eutrophication. For this, MED POL has proposed 3 different site typologies (an affected marine site together with a reference site, an off-shore fish farm and a coastal lagoon), to provide a common basis for the site selections. Countries should analyse those options together with a number of criteria such as:

- being representative at national level related to the back lying catchment areas, receiving loads from rivers, direct discharges of domestic and industrial wastes, loads from mariculture activities and/or diffuse sources;
- being sensitive to eutrophication phenomena (enclosed coastal bay and estuaries, shallowness, limited water recycling, etc.), in order to be able to distinguish-as much as possible- between natural fluctuations and anthropogenic pressures;
- having the main morphological characteristics that should be well described together with drivers, pressures, meteorological and hydrodynamic parameters;
- having the historical records of ecological events and socio-economical trends in land use.

The monitoring parameters adopted were selected as to fulfil the minimum necessary scientific requirements and also to support the EEA's state indicators as well as the TRIX index. The mandatory monitoring parameters are summarized in Table 2.4.1

Table 2.4.1 Mandatory monitoring parameters for the eutrophication programme

Temperature (C°)	Dissolved oxygen (mg/L, %#)
PH	Chlorophyll "a" (µg/L#)
Transparency	Total Nitrogen (N µmole/L)*
Salinity (psu)	Nitrate (NO_3-N µmole/L, µg/L#)
Orthophosphate (PO_4-P µmole/L, µg/L#)	Ammonium (NH_4-N µmole/L, µg/L#)
Total phosphorus (P µmole/L, µg/L#)	Nitrite (NO_2-N µmole/L, µg/L#)
Silicate (SiO_2 µmole/L)	Phytoplankton (total abundance, abundance of major groups, bloom dominance)

***** not mandatory, only recommended regarding the methodological difficulties
# units supporting TRIX index

As to the sampling strategy, frequency and spatial coverage should be established according to the minimum requirements presented below:

- The mandatory monitoring frequency for the above variables will be minimum 4 times per year (seasonal). Considering the fact that sea water concentrations of chemical variables may change even instantly and the biological variables within a week or two, it is strongly recommended to sample once a month or to achieve more frequent sampling in highly variable seasons and less frequently during more stable periods.

- The samplings station networks should be set as transects; each transect having minimum 3 stations to achieve an optimum spatial coverage for the selected site. For each monitoring station, vertical profiles with minimum three depths (surface, intermediate and bottom) have to be performed.

- For the proper application of TRIX index on an annual basis, it would be necessary to collect at least a minimum of 48 surface data both for the affected and the reference area. The combination of sampling design and frequency has to meet this minimal requirement. (*Example 1*: If the sampling frequency is seasonal –4 times/year-, selection of 4 transects with 3 sampling stations is recommended as a minimum requirement for the affected site and the reference site that is totally providing a data set of 96 records for each parameter supporting TRIX index. *Example 2*: If the sampling frequency is monthly- 12 times/year, selection of at least 1-2 transect with 3-4 stations both for the affected and reference areas)

Medium/Long term strategy

For a medium/long term strategy the development of new biological parameters/indicators of eutrophication was proposed. It is basically needed to introduce biological parameters both for the phytoplankton population dynamics and for the benthic component of the coastal ecosystem.

The eutrophication monitoring programme need to be supported by remote sensing techniques and the technical tools/scientific products of operational oceanography (refer also to Section 3.2).

Since eutrophication is a long-term process, historical data would be useful in order to reconstruct the story of the site and support the assessment and management of the area according to ICZM approach. The collection of historical data is therefore strongly suggested but not considered mandatory.

<u>Implementation Phase of the Short-term Strategy</u>

- *Quality assurance activities initiated*

Considering the absolute n eed to organize data quality assurance activities before even starting the short-term monitoring programme, a QA programme has been organized for both the mandatory chemical (basically nutrients) and the biological (chlorophyll-a and phytoplankton) parameters.

As a first step, a reference methods manual has been prepared by IAEA/MEL including pre-analysis steps and analytical methods for the nutrient and chlorophyll analysis (UNEP(DEC)/MED WG.231/Inf.9).

A training course for technical operators of the eutrophication monitoring programme was organized on 9-13 June 2003 in Cesenatico (Italy, Emilia-Romagna region). The course was organized, on behalf of MED POL, by three Italian institutes (ICRAM, CRM and ARPAER) and the activity was coordinated by ICRAM. Researchers from eight countries (Albania, Algeria, Croatia, Israel, Morocco, Slovenia, Syria and Tunisia) attended the training course.

The training programme was a comprehensive one and a summary of its content is presented below:

Lectures performed on :

- Coastal waters eutrophication problem
- Present EU legislation in the field of water policy- WFD

- Seawater analysis for chemical parameters, phytoplankton taxonomy and species identification and algal biotoxins
- Data processing and statistical elaborations

Practical work included:

- On board sampling and data acquisition with *R/V Daphne* along a transect of the long-term eutrophication monitoring network of the region
- Laboratory studies for nutrient analysis (with two different methods), phytoplankton speciation and algal biotoxins. An intercalibration exercise was also organized among the participants for phytoplankton speciation.

The following documents and supplementary material were distributed:

- Document for MED POL's Eutrophication Monitoring Strategy
- Handbook for *Marine Coastal Eutrophication* (eds. R.A. Vollenweider, R. Marchetti and R.Viviani)
- Copies of Power Point presentations of the lecturers
- Methods of nutrient analysis
- Methodological reviews for phytoplankton and phytotoxins
- Manual for marine diatoms
- Manual for marine dinoflagellates
- Technical documentation regarding the instruments used and data compilation made on board

A second training programme is planned to be organized by ICRAM in 2004.

- *Pilot monitoring programmes to be established*

MED POL is planning to start the implementation of the short-term strategy during 2004 through the launching of a number of pilot programmes. Such programmes will be formulated in line with the adopted programme objectives and criteria. Although priority will be given to the countries proposing sites exhibiting clear eutrophication symptoms, the ultimate goal of MED POL is to gradually include all the eutrophication hot spots (affected areas) within this regional programme starting from 2004.

As an example, the formulation of a pilot programme will have to go through the following steps:

For a marine site and an off-shore fish farm:

- Select hot spot site(s)- i.e. affected area showing some of the eutrophication symptoms- according to the criteria of the adopted strategy. The sites could be river estuaries, enclosed bays, waste discharge areas, fish farms etc. at a local or larger scale;
- In parallel, choose a reference site to implement the same monitoring strategy;
- Set up a stations network to cover at least the minimum requirements of the adopted strategy for spatial coverage; one transect and three stations (locations of the stations should be decided according to the bottom typology) for both affected and reference site, sampling through water column;

- Adopt the mandatory monitoring parameters and arrange for your participation in all the DQA activities provided by MED POL and by other international bodies;
- Ensure data collection in line with the required frequency of sampling.

For a coastal lagoon:

- As a first step, prepare an inventory of national lagoons and chose at least one site considered important at national level;
- As a second step, prepare an assessment for the selected lagoon covering the following: information on general hydrology and morphology, information on water basin use and frequency of dystrophic events, measurements of salinity on a seasonal basis and dissolved oxygen (24 hours cycles in warm season) at least at one representative station, mapping the distribution of submersed vegetation (sea grass and seaweed) on an annual basis;
- Prepare a monitoring plan specific to the selected lagoon whose trophic state is known after the achievement of the second step.

The pilot country programmes can be designed to include any of the above mentioned site typologies or even all three of them. Expert consultations to assist the countries in the implementation of the programmes will be organized during the programme formulation and if needed during the first year of implementation.

- *Supplementary studies*

As mentioned before, the MED POL eutrophication monitoring programme foresees the inclusion of more biological indicators as well as the inclusion of some tools of operational oceanography and remote sensing as feasible and available.

As complementary to the monitoring activities, MED POL provides support to some research programmes whose objectives are related to eutrophication phenomena (see Section 3.1).

2.5 Database Management and Data Flow

Background

MED POL started working on the re-structuring of its Database in 2001 mainly to increase its data storage and management capabilities according to the needs of MED POL Phase III and to achieve Internet access to the Database. As a first step, the needs and requirements were identified and the conceptual model of the new database was developed (2001). The model was thoroughly discussed during an expert consultation meeting (2002) and the document titled “Conceptual Design of the MED POL Phase III Database” (UNEP(DEC)/MED WG.202/2, rev.9/4/2002) was approved to be used as a basis for the development and finalization of the Database. Later in 2002 and in the first half of 2003, the database and its modules were developed and tested and the available monitoring data for the 1999-2002 period was loaded to the database. Basic errors in data loading were identified and additional information were requested from the data originators and the data were re-loaded according to the feedbacks obtained. In early 2003, an internet version of the database was also published and updated several times with new incoming information and data. An expert evaluation of the data loaded to the database (without data verification/validation procedure) was also performed, especially for trends monitoring data, as presented in Section 2.2.

In the meantime, the standard data reporting formats were also provided (from 2001) to those countries with ongoing monitoring activities to ensure standard entries to the database.

The specific objectives of the new MED POL Database are:

- to increase the data storage capacity and management capabilities of the database;
- to establish routine data loading after each data submission period and to apply a data verification/validation procedure accordingly;
- to provide frequently updated information on monitoring activities and a data inventory to be published in the internet;
- to provide a set of basic reports to be able to make a quick assessment of the database, hence, that of monitoring programmes and their results;
- to provide validated monitoring data on trends and status for regional assessments and to achieve a well functioning data flow.

The Database

Microsoft Access was chosen as Data Base Management System for the MED POL Database (MEDPOL.mdb). The Database structure is based on about forty interrelated tables and the links established between the tables are presented in Annex III. The Database has two basic modules. Data Management and Administration module consists of a set of VBA modules which provide the functions of data loading and export, data browsing for stations and samples, data editing, selection of data on different criteria, and visualization of data. Since MS Access doesn't possess the necessary tools for drawing maps, a special map module was also developed for data management. The second module of the Database is the Internet Module which covers both static HTML pages (designed for the presentation of monitoring programmes and MED POL monitoring objectives etc.) and dynamic active server pages (for presenting an inventory of MED POL Database). With the functioning of the Internet Module, free access to the Web site was provided for internet users through the links of UNEP/MAP web site (www.unepmap.org). The direct URL for MED POL database website is http://62.68.74.75/medpol/ .

Status of monitoring programmes and data submitted to the Database

MED POL Phase III monitoring programmes are designed to cover basically two different types of marine sites, i.e. hot spots and coastal/reference areas. *Hot spots* are defined as intensively polluted or high risk areas which are under the direct impacts of land based sources of pollution. Monitoring of these areas is necessary at the sub-regional level and closely linked with the control measures taken. Therefore, the data generated is expected to be used to take management decisions at the national level. On the other hand, it is aimed with the monitoring of *coastal and reference areas* to contribute to the assessment of trends and the overall quality status of the Mediterranean Sea through a regional network of selected fixed stations. These areas are expected to be representative for less or unpolluted marine waters, away from the direct impacts of pollutants.

Samples are collected from different environmental media. The mandatory monitoring matrices for MED POL programme are biota and sediment for hazardous substances. In addition, it has been recommended to include also sea water quality parameters (like nutrients) and basic oceanographic parameters to supplement the programmes and the regional assessments. As mentioned in Section 2.4, sea water has recently became a mandatory monitoring media for the eutrophication monitoring programmes that are going to be established.

The programme also covers the collection of data on land based inputs from point and diffuse sources. Therefore, countries are recommended to establish monitoring for river and effluent discharges as well as for atmospheric loads.

The ongoing monitoring activities provide data on different parameter groups. For hazardous substances, trace metals (Total Hg, Cd, etc.) and organic contaminants (halogenated hydrocarbons, poly aromatic haydrocarbons etc.) are included. Total mercury and cadmium are the only mandatory parameters; however, most of the national programmes contain more than those recommended. A full list of parameters for which data has been loaded is provided in Annex III. However, this list cannot provide any information on the volume of data available for each parameter in the Database. However, Table 2.2.1b summarizes the obligations at the national level. The set of mandatory parameters for direct discharges, rivers and atmospheric loads are also summarized in Annex I.

Countries are obliged to submit their monitoring data annually. The data on trends and state monitoring should be submitted as raw data. Internal laboratory quality data is also required in order to check the analytical variances. As mentioned above, the monitoring data loaded to the Database in 2003 were those of the 1999-2002 period. Some more data was provided in the last few months of the current year and are at present available in original data files. Since standardized data reporting formats were utilized since 2001, data for previous years were in free format and did create a lot of difficulties during data loading. At present, data in the database is not yet validated in view of the fact that database has became operational very recently. However, in most cases, physical errors on formatting, units etc. have been identified and corrected. A full data verification/validation procedure is expected to function in 2004 (see below) and will be applied both for the 1999-2002 and new data for the year 2003.

Overall and country based detailed yearly statistics on data submission are presented below. The only missing set of data in the below tables is the 2002 data of Turkey and Israel. Both countries have submitted their data after data loading was done.

Yearly Statistics

Year	Number of Stations	Number of Samples	Number of Parameters	Number Of Values
1998	4	4	2	8
1999	185	1198	99	6943
2000	140	1023	111	6968
2001	204	1270	77	7506
2002	80	522	48	3936
Total	*305**	*4017*	*164**	*25361*

*Only unique stations and parameter are counted

Item	*Country*	*1998*	*1999*	*2000*	*2001*	*2002*
Number of parameters	Albania				11	3
	Croatia		8	94	8	16
	Cyprus	2	38	20	37	32
	Greece		37	10		
	Israel		10	10	22	
	Slovenia		63	32	30	23
	Tunisia				16	
	Turkey		5	10	23	
Total Number of parameters (Only unique parameters are counted)		*2*	*99*	*111*	*77*	*48*

Item	*Country*	*1998*	*1999*	*2000*	*2001*	*2002*
Number of samples	Albania				4	4
	Croatia		47	180	117	67
	Cyprus	4	115	52	161	149
	Greece		443	17		
	Israel		346	360	313	
	Slovenia		135	299	332	302
	Tunisia				229	
	Turkey		112	115	114	
Total Number of samples		*4*	*1198*	*1023*	*1270*	*522*

Item	*Country*	*1998*	*1999*	*2000*	*2001*	*2002*
Number of stations	Albania				2	2
	Croatia		27	33	25	18
	Cyprus	4	37	39	72	43
	Greece		47	4		
	Israel		32	23	23	
	Slovenia		27	20	23	17
	Tunisia				40	
	Turkey		15	21	19	
Total Number of stations		*4*	*185*	*140*	*204*	*80*

Item	*Country*	*1998*	*1999*	*2000*	*2001*	*2002*
Number of values	Albania				22	12
	Croatia		171	2213	297	465
	Cyprus	8	597	286	669	1028
	Greece		2342	100		
	Israel		2197	2226	1988	
	Slovenia		1188	1682	3151	2431
	Tunisia				753	
	Turkey		448	461	626	
Total Number of values		*8*	*6943*	*6968*	*7506*	*3936*

The tables below summarize the country-based statistics for different station types and monitoring activities. Trend monitoring tables for coastal/reference areas and hot spots present statistics mostly on biota stations where trend monitoring sampling objectives are applied. The rest of the stations for biota, sediments and sea water are presented together within the state monitoring activity and statistics provided for both water types.

Country Statistics

Station Type: Coastal or Reference
Monitoring Activity: Trend Monitoring

Country	*Number of stations*	*Number of stations not in Program*	*Stations without data*	*Number of stations without coordinates*	*Number of samples*	*Number of parameters*	*Number of values*
Albania	1	0	1	1	0	0	0
Cyprus	5	1	0	0	84	27	1229
Greece	19	3	13	0	64	14	373
Israel	23	17	0	0	588	16	3625
Slovenia	3	0	0	0	333	40	1873
Tunisia	4	0	0	0	31	7	61
Turkey	6	1	3	0	162	16	704
Total	***61***	***22***	***17***	***1***	***1262***	***75****	***7865***

*Only unique parameters are counted

Country Statistics

Station Type: Hot Spot
Monitoring Activity: Trend Monitoring

Country	*Number of stations*	*Number of stations not in Program*	*Stations without data*	*Number of stations without coordinates*	*Number of samples*	*Number of parameters*	*Number of values*
Albania	2	0	0	0	8	11	34
Croatia	8	0	0	0	132	26	578
Greece	10	9	0	8	176	27	1062
Israel	9	0	0	0	331	16	2100
Tunisia	1	0	0	0	2	4	4
Turkey	2	0	0	0	41	18	173
Total	***32***	***9***	***0***	***8***	***690***	***51****	***3951***

*Only unique parameters are counted

Country Statistics

Station Type: Loads / Effluents or Loads / Rivers
Monitoring Activity: Trend Monitoring

Country	Number of stations	Number of stations not in Program	Stations without data	Number of stations without coordinates	Number of samples	Number of parameters	Number of values
Croatia	8	0	0	0	32	80	1685
Cyprus	15	3	2	0	32	35	152
Greece	13	0	13	8	0	0	0
Israel	13	0	13	0	0	0	0
Slovenia	4	0	0	0	40	25	723
Tunisia	35	6	4	6	181	9	645
Turkey	10	3	2	2	34	9	144
Total	***98***	***12***	***34***	***16***	***319***	***99***	***3349***

*Only unique parameters are counted

Country Statistics

Station Type: Coastal or Hot Spot or Reference
Monitoring Activity: State Monitoring

Country	Number of stations	Number of stations not in Program	Stations without data	Number of stations without coordinates	Number of samples	Number of parameters	Number of values
Albania	1	0	1	0	0	0	0
Croatia	21	0	3	0	229	26	808
Cyprus	68	29	7	3	215	33	776
Greece	74	0	46	10	196	20	875
Israel	36	18	0	0	911	16	5725
Slovenia	17	1	0	1	844	55	6963
Tunisia	2	0	1	0	2	4	4
Turkey	12	2	0	0	64	18	328
Total	**231**	**50**	**58**	**14**	**2461**	**91***	**15479**

*Only unique parameters are counted

A need for a standard data verification/validation procedure

As mentioned in the analysis of trends monitoring activities (Section 2.2), a standard data verification/validation procedure was not performed during the first data loading to the database. The priority was in fact given to the loading of all the available MED POL Phase III data submitted with different formats and thus to establishing a standard way of data storage within the database and to its testing. However, errors occurred during loading of each data file were identified and requests were sent to the data originators to provide corrected data files against those errors. In most cases feedbacks were obtained and data were re-loaded.

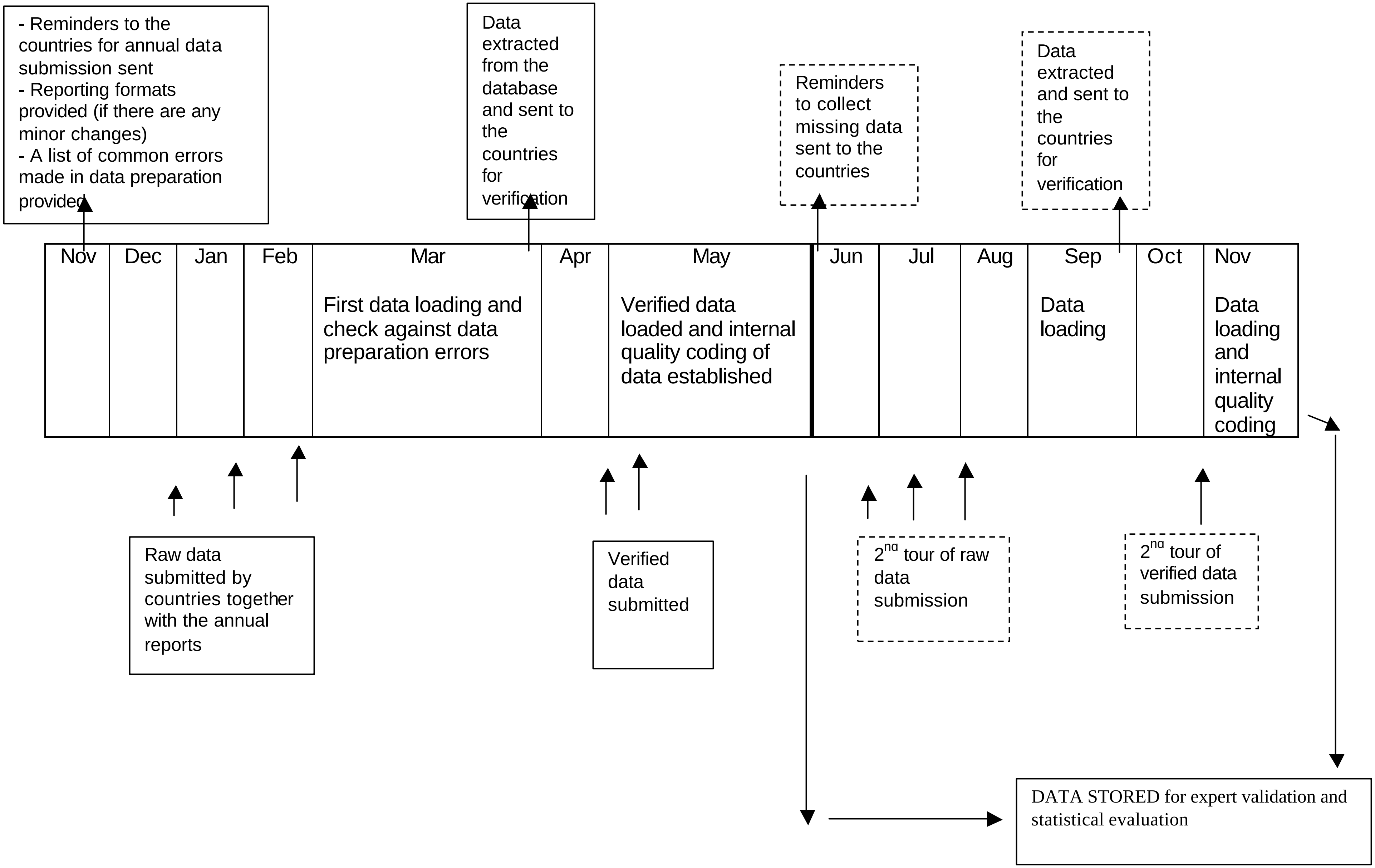
It is now the major task in front of us to establish a standard data verification/validation procedure which can be smoothly operated during the next data submission period. The following steps of data verification/validation are proposed as standard.

1. First data loading and finding out errors made during data preparation (e.g. formatting, coding, typing, unit errors etc)
2. Extraction of loaded data and forwarding it to the data originators together with the list of errors (if any) ASK FOR COUNTRY VERIFICATION =**1st level of data validation (country level)**
3. Reloading of verified data and INTERNAL QUALITY CODING OF DATA (flags 11-15) **= 2nd level of data validation**: This will be done according to standard min&max values for at least some selected parameters/matrix, according to the outliers …etc. With this step data will be flagged
4. VALIDATION AT EXPERT LEVEL(flags 1-10) = **3rd level**

The same procedure will more or less be applied for the data already loaded to the Database with the exception of first step. The data will be extracted from the database and be sent to the data providers for verification. It is hoped that this can be done in a very short period and the internal quality coding can be completed accordingly. This would also provide the completion of the expert validation step which has partially accomplished for trends monitoring biota data.

Timetable

The time frame of data submission, loading and validation is given in the flow diagram below (Figure 2.5.1). After re-loading of country verified data (1st level of validation), the data could be exported to other data banks for overall assessments to be made.


- Reminders to the countries for annual data submission sent
- Reporting formats provided (if there are any minor changes)
- A list of common errors made in data preparation provided
Data extracted from the database and sent to the countries for verification
Reminders to collect missing data sent to the countries
Data extracted and sent to the countries for verification
Nov
Dec
Jan
Feb
Mar
First data loading and check against data preparation errors
Apr
May
Verified data loaded and internal quality coding of data established
Jun
Jul
Aug
Sep
Data loading
Oct
Nov
Data loading and internal quality coding
Raw data submitted by countries together with the annual reports
Verified data submitted
2nd tour of raw data submission
2nd tour of verified data submission
DATA STORED for expert validation and statistical evaluation

3. RESEARCH ACTIVITIES AND COOPERATION

3.1 Research Activities

For several years since its inception, MED POL Phase I and II funded a large number of research projects related to the different aspects of marine pollution. Later in Phase III, MED POL refocused its programme shifting its activities more towards the managerial aspects of pollution control and prevention. In this new context, the national monitoring programmes, aimed at contributing to the assessment of environmental status and the effectiveness of control measures, continued to play a fundamental role and received financial assistance from the Secretariat. In spite of the fact that, as a result of the above, MED POL no longer has a direct budget line for research as such, there are still some financial tools in Phase III to support research on emerging environmental issues, and participation to, and organization of, conferences, workshops etc.

In this context, some topics have been handled as priority by MED POL during 2002-2003, especially those closely linked to eutrophication phenomena like the impact of mariculture activities and fish farming on the marine environment, atmospheric deposition of nutrients and export of nutrients from watersheds to the coastal waters. In addition to them, research on marine antifoulants (e.g. TBT and its derivatives) and on bio-invading species and its possible use as a bio-monitor were also supported.

The titles of some of the research projects and workshops supported are:

- Influence of fish farming on coastal marine sediment in Slovenia (Piran Bay, northern Adriatic)
- Environmental impacts of mariculture and possible mitigation strategies-Workshop;
- *Pinctada radiata*: an invading bioindicator in the Mediterranean;
- Marine antifoulants levels and distribution along the Mediterranean coast of Turkey (through IAEA/MEL)

UNEP/MAP has also collaborated with UNESCO/IOC to produce initial export models of nitrogen and phosphorus from Mediterranean watersheds to the coastal marine waters. The initial phase of the study has been completed and the report is presented in Annex IV.

3.2 Cooperation with MedGOOS

Background

The Global Ocean Observing System (GOOS, http://www.ioc.unesco.org/goos/) was created in 1991 in response to the desire of many nations to improve forecasts of climate change, management of marine resources, to mitigate natural hazards, and improve utilisation and environmental protection in the coastal zone.

The primary objectives of GOOS are: 1. to specify the marine observational data needed to meet the needs of the world community of users of the oceanic environment; 2. to develop and implement an international co-ordinated strategy for the gathering, acquisition, and exchange of these data; 3. to facilitate the development of products and services based on the data, and widen their application in the use and protection of the marine environment; 4. to facilitate the means by which less-developed nations can increase their capacity to acquire and use marine data according to the GOOS framework; 5. to co-ordinate the ongoing operations of the GOOS and ensure its integration within wider global observational and environmental management strategies.

The planning of GOOS is well established, and many countries have set up inter-departmental or inter-agency national GOOS Committees. There is a collaborative supervisory system linking the sponsor agencies at the UN level (IOC of UNESCO, WMO, and UNEP) and ICSU.

The legal basis for proceeding is defined by various international Conventions and Action Plans, including: the Convention on the Law of the Sea; the Framework Convention on Climate Change; the Biodiversity Convention; Agenda 21 (agreed at the United Nations Conference on Environment and Development in Rio in 1992); the Global Plan of Action for the Protection of the Marine Environment from Land-Based Activities; the London Dumping Convention; the Agreement on Highly Migratory and Straddling Stocks; and others summarised in this Prospectus.

The regional implementation of GOOS is fostered by 13 GOOS Regional Alliances (GRAs). MedGOOS is the GRA addressing the implementation of GOOS in the Mediterranean basin. Institutions in Mediterranean coastal states are participating also in EuroGOOS and Africa GOOS. The member states of the Barcelona Convention are also members of those GRAs (refer to http://www.ioc.unesco.org/goos/ key3.htm#reg). Therefore, common objectives and possible mutual collaborations between MAP (and its components like MED POL) and primarily MedGOOS need to be sought in order to provide operational ocean services to the Mediterranean countries considering their needs at the national level and obligations to the Barcelona Convention.

<u>Present collaboration (within the framework of MAMA / MedGOOS project</u>**)**

MAMA (<u>M</u>editerranean network to <u>A</u>ssess and upgrade <u>M</u>onitoring and forecasting <u>A</u>ctivity) is a 3-year EU-funded project, with a partnership from all the riparian countries and the related international organizations, and aims to establish the multi-national network and regional platform for routine marine observations and forecasts in the Mediterranean. It focuses on the trans-national pooling of scientific and technological resources in the basin, through the sharing of experiences and the transfer of expertise, to bring capacities in operational oceanography at comparable levels.

MAMA interacts with end-users, stakeholders and relevant international organisations, to stimulate awareness on the benefits of operational oceanography, disseminating results and demonstration products. The MAMA consortium will provide guidance to the Mediterranean states to shape an integrated effort towards the planning and design of the long term sustained ocean-monitoring system in the region.

<u>The specific objectives of the MAMA project are:</u>

- To build the basin-wide institutional network for ocean monitoring and forecasting, linking all the Mediterranean countries, broadening and strengthening the network already established by the MedGOOS partners;

- To identify the gaps in the existing monitoring systems and in the capability to measure, model and forecast the ecosystem, taking stock of past and current RTD projects as MFSPP, MEDAR/MEDATLAS, MERSEA and MFSTEP, and of the EuroGOOS, MedGOOS and Africa GOOS activities;
- To build the regional capacity for expertise for managing observing platforms and data, modelling and forecasting the ecosystem;
- To design the initial forecasting system, inter-comparing experiences and standardising practices, towards the co-ordinated upgrading of the observing and forecasting capabilities in all Mediterranean countries;
- To raise awareness on the benefits of routine ocean observations and forecasting at local, regional and global scales, involving all stakeholders, and
- To disseminate results, proto-type products and demonstration applications to show the benefits of GOOS in the region.

The MAMA project is operated with eight work packages. Detailed information for all the specific work packages can be found in MAMA web site (http://www.mama-net.org).

The present cooperation of MAP/MEDPOL with MedGOOS within the MAMA project is mostly operated through the work package AWARENESS lead by MAP/MED POL. The general objective of this work-package is to run a campaign of awareness on the benefits of ocean forecasting in the Mediterranean. The campaign aims to gain the support of key players, policy-makers, decision-makers, service providers, end-users and the general public, to obtain commitments from governments for the implementation of the Mediterranean Global Ocean Observing System.

MEDPOL might also provide input to and get feedback from MAMA work package OBSERVING SYSTEM. This work package is assessing existing observing systems in the region able to contribute to scientifically sound and cost effective real time coastal data acquisition systems, fully integrated to the basin scale system. The initial observing system will deal with limited number of parameters to fill the gaps of transport of nutrients, and its effects on primary production levels.

Preliminary results of the present scheme for trends monitoring programme and data sets of MEDPOL have shown that the selected sampling sites and the sampling frequency are not appropriate inputs to the planned observing system.

The development of proto-type value-added products of MAMA (WP8 DISSEMINATION & PRODUCTS) is also of interest for MEDPOL. In situ and satellite data are merged to provide information on the status and trends of the coastal marine environment such as temperature, salinity, oxygen, nutrients concentration. This product provides an example of ‘near real time’ information to managers and the general public.

<u>Other contributions to GOOS in the Mediterranean</u>

Routine marine observations using automated systems in the Mediterranean are conducted on a national scale in several shelf sea areas along the northern perimeter of the basin. Furthermore

RTD projects, mainly funded by the EC have also contributed to develop pilot basin-scale monitoring activities. A summary of these activities is given Annex V.

Possible areas for future collaboration

Since the outputs of "operational" monitoring might meet the specific objectives of regional programmes like MAP/MED POL and may even ease the implementation of the programmes eliminating gaps, the following question could be an important starting point: Can MED POL and "operational monitoring" jointly act for the water quality monitoring of the coastal waters? Would it be technically possible and feasible?

In fact, the XXII IOC Assembly has already called for strengthening the co-operation between GOOS and the UNEP Regional Sea programme. In the Mediterranean the monitoring activities identified in MAMA might contribute to the specific objectives of MAP/MED POL.

Considering the MED POL water quality monitoring objectives, monitoring of eutrophication at some selected sites with operational methods could be an initial exercise to observe some eutrophication events that happen in short time scales that are not possible to monitor with the pre-set sampling frequencies of the on-site monitoring programmes.

The ferry-box system, cheaper and reliable, is one option (UNEP (DEC)/MED WG.218). The system can be installed to any ship traveling in a routine regular route and it can be controlled remotely with mobile telephony. The system is currently used in a number of monitoring programmes (http://www.ices.dk/marineworld/ferries.asp). The variables measured are: temperature, salinity, turbidity, oxygen, pH, chlorophyll fluorescence, nutrients (ammonium, nitrate/nitrite, phosphate, silicate), and main algal classes. All these variables might be accepted as basic eutrophication indicators and also included in the eutrophication monitoring strategy of MED POL. Automatic buoys (fixed and drifting platforms of real time measurements) are another option. As proposed in the MEDPOL eutrophication monitoring programme, buoy can be used to measure daily variations in the dissolved oxygen profile together with profiles of temperature, salinity, chlorophyll-a and nutrients at the critical season.

A framework for a possible collaboration is also mentioned in the MAMA draft report on 'Capabilities in pre-operational ocean forecasting in the Mediterranean' where it is stated that the Mediterranean Forecasting System (MFS), could provide assistance for the compliance to the Barcelona Convention.

Prediction of the ecosystem. The MedGOOS community is involved in the development of the 21st generation science and technology for the prediction of the ecosystem. This will be the step after the end of the MAMA project in 2005. Innovative numerical models are presently developed to address the prediction of the first level of the marine ecosystem. The pilot experience developed specifically to address the pollution issues might be participated by MED POL providing support for the compliance with international conventions and indications on future needs. MedGOOS can provide input to MED POL on the underpinning science for monitoring and forecasting.

Link between the Mediterranean marine interagency network and UNEP MAP/MED POL. MedGOOS, as well as EuroGOOS are interagency networks to promote the implementation of GOOS. The agencies involved are either operational agencies or marine research institutions. MED POL operates mainly at governmental level and it has also direct links with government designated laboratories and experts implementing the programme. Both deal with national environment agencies. The stakeholders of the two communities are overlapping, but not completely. The MED POL / MedGOOS co-operation can enlarge the stakeholder basis, and the effectiveness, of both organizations for the benefit of the Mediterranean community.

4. CONCLUSIONS AND RECOMMENDATIONS

Compliance monitoring activities, being the major link to the pollution control component of MED POL and its Strategic Action Programme (SAP), need to be implemented more widely by the Mediterranean countries. Compliance reports prepared for bathing and shellfish/aquaculture waters as well as for effluents with respect to regional common measures and/or national legislation have to be transmitted to the MED POL Secretariat annually. Countries, which do not have a current monitoring agreement with MAP/MED POL, are also requested to provide their compliance reports to MED POL.

Concerning trends monitoring activities, all the countries those have not initiated a trends monitoring programme yet are urged to formulate/finalize their programmes as priority and start to implement the programmes. The sooner the measurements begin, the sooner the trends will be apparent since the trends can only be detectable after long-term implementation.

The preliminary statistical analysis of the available data for trends monitoring in biota has been performed for examining the sampling and analytical variances and to investigate the inconsistencies occurred in sampling strategies. The major goal to establish this evaluation is to assist the countries/laboratories to optimize their programmes after 3-4 years of implementation. The analysis has shown that most of the countries have had difficulties to implement the trend monitoring programmes with declared sampling objectives. In order to overcome these difficulties, it is recommended to the countries to prepare clear and stepwise programme implementation manuals to be referred by each implementing unit during sampling, application of laboratory methodology etc. The within year sampling and analytical variances has to be checked systematically against thresholds of the statistical power of the programme.

It is worthwhile to mention that some countries have successfully achieved the declared sampling objectives since the inception of the programmes or the revision of them. It is also encouraging to notice that nearly all the countries with ongoing programmes are implementing trend monitoring without any gaps in sampling periods/frequencies and submit data annually. The major difficulties created gaps at the country level have been attempted to overcome by capacity building activities of MED POL.

Trends monitoring criteria of MED POL for sediments has to be revised. The present monitoring activities held for sediments is only adequate for state assessment at a limited level.

Regarding the quality assurance of trends monitoring data, participation to intercomparison exercises should certainly be improved by the MED POL designated laboratories. An overall performance report on data quality review should be prepared to cover the period of 1996-2003. However, a preliminary evaluation of the performances of MED POL laboratories participated to the last several exercises has shown that the results obtained are promising and at acceptable levels for most of the hazardous substances.

As a result of training activities organized within the quality assurance programme of biological effects monitoring, a number new laboratories are ready to launch the programme and necessarily should be involved in national MED POL monitoring programmes. The results obtained in intercalibration exercises are quite satisfactory at each laboratory level. The quality of data achieved on field samples is also good; however, all the results have to be coupled with chemical analysis data of the same sample or at least with the data gathered at the same sampling date and site. An overall detailed expert evaluation of the whole data set gathered within biological effects monitoring studies is still needed.

New biomarkers of stress and exposure recently established by UN international experts could be integrated with the present set of biomarkers of the MED POL programme.

The short-term strategy of the new eutrophication monitoring programme of MED POL is ready to be launched for a number of priority sites selected by the countries. The first step would be to establish a list for affected areas within the definition of three different site typologies mentioned in the MED POL programme. The mandatory criteria will later be used to formulate the pilot programmes. The second training course for eutrophication monitoring is planned for the year 2004 with a very similar content appeared in the first course which was quite comprehensive.

The work initiated for the establishment of the new MED POL Database has nearly been finalized and the only major step that has to be accomplished is launching a standard data verification/validation procedure. A three-step procedure is proposed and will be introduced very soon for 2003 data submission period. On the other hand, the same procedure will be used to complete the missing steps of verification of 1999-2002 data.

As commonly agreed scientific research, observations and management issues have to be considered as interdependent elements of pollution control and prevention. MED POL is also keen on the synthesis of these elements, hence, will continue to support research activities and to get part in regional and international projects and initiatives related to its specific objectives and needs.

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ANNEX I

Trend (and State) Monitoring Criteria for MED POL Phase III

	Coastal / Reference areas and Hot Spots		**Loads (from point and diffuse sources)**		**Biological effects**
	Mandatory	Recommended	Mandatory	Recommended	Mandatory (pilot)
Parameters (Matrices)	Total Hg and Cd (in biota and sediment) Basic oceanogra. parameters(in sea water)	Other heavy metals, HH^+, PAH^+ (in biota and sediment)	Flow rate, pH, T, Total Hg and Cd, TSS, BOD_5, COD, TP, TN, HH^+, FC (in effluents, river water, air)	Other heavy metals, PHC, detergents, phenols,…	DNAx EROD MT LMS (in biota)

	Coastal / Reference areas and Hot Spots	**Loads (from point and diffuse sources)**		**Biological effects**
	Mandatory	Mandatory	Recommended	Mandatory (pilot)
Sampling Frequencies	Annually for biota at the pre-spawning period & annually for sediments at the most stable hydrographic conditions	Seasonally, weekly (for air)	Monthly for effluents and rivers	Quarterly or semi-annually

Trend (and State) Monitoring Criteria for MED POL Phase III

	Coastal / Reference areas and Hot Spots		**Biological effects**	
	Mandatory	Recommended*	Mandatory (pilot)	
Species (Tissue)	MG (whole soft tissue) MB (fillet)	ME, PP, DT or MC (whole soft tissue) MS or UM (fillet)	EROD, DNAx	MT, LMS
			MB, if not available Mugil sp., DL for caging (Liver)	MB, if not available Mugil sp., DL for caging (Liver) Mytilus sp. if not available Patella sp. (digestive gland, hepatopancreas for limpets)

* if the mandatory species are not available

	Coastal / Reference areas and Hot Spots	**Biological effects**
	Recommended (pilot) *	Recommended (pilot)
Number of samples/ specimen	Min. 5 parallel samples for the selected species. Min. 15 specimens to be pooled in each sample for MG.	Min. 5 parallel samples for the selected species

* Depends on the statistical design of the trend monitoring programme.

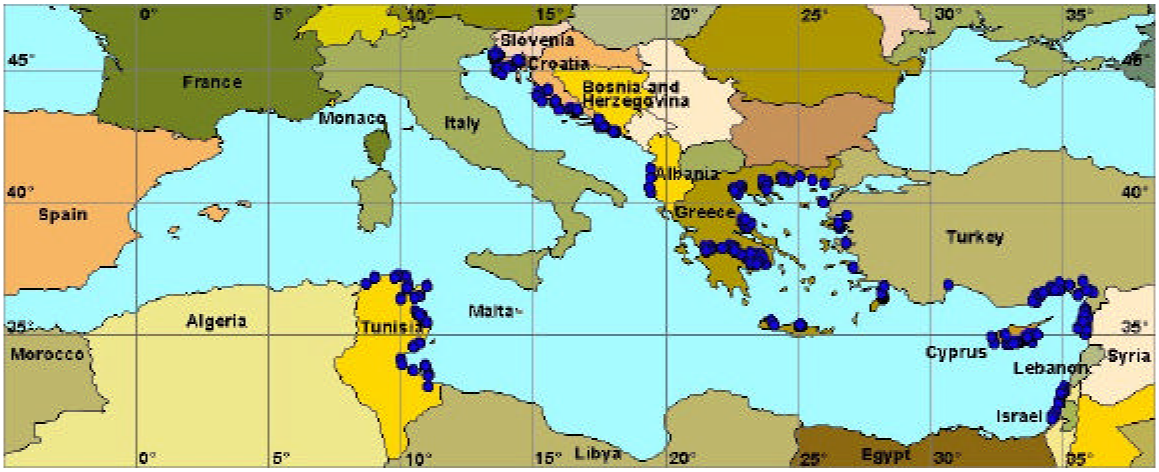
Compliance Monitoring Criteria for MED POL Phase III

	BATHING WATERS	**SHELLFISH WATERS**	**EFFLUENTS**	**HOT SPOTS**
Parameters (1)	MB (TC, FC, FS)	MB (TC, FC, FS)	BOD, COD, TSS, Nutrients (TP,TN) Heavy Metals (Hg, Cd, Pb, Cr, Zn etc.), Polyaromatic Hydrocarbons (PAH+), Halogenated Hydrocarbons (HH+)	Nutrients (TP, TN), TSS, HH+, PAH+
Sampling Frequency	Fortnightly (Spring-summer)	Monthly (or) Seasonally	(2)	(2)
Sampling Matrix	Sea water	Sea water	Effluents	Sea water and sediment

(1) depends on national legislation requirements and analytical capabilities
(2) according to the existing national legislation

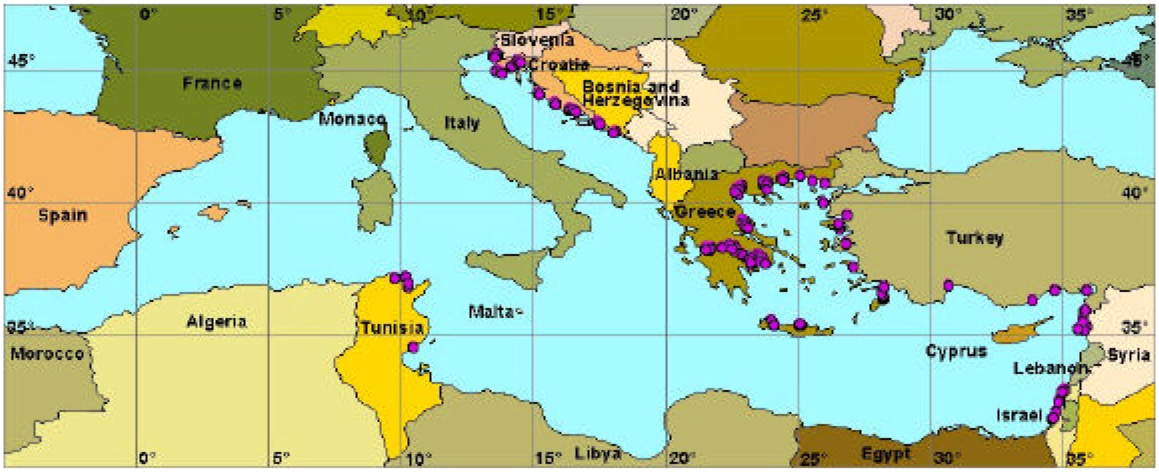
ANNEX II

Station Map for MED POL Phase III Trend (and State) Monitoring Activities

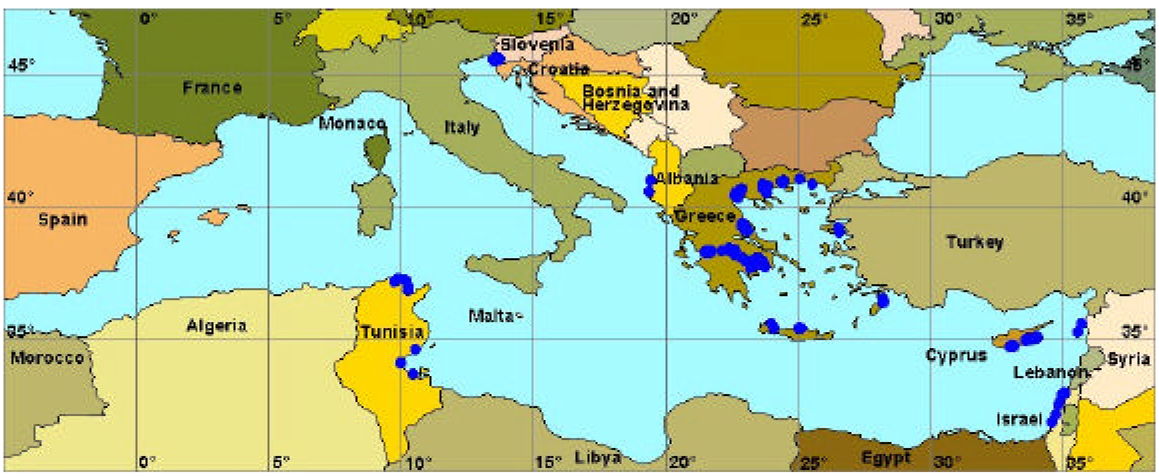


Station Map for Trend (and State) Monitoring - Biota

Station Map for Trend (and State) Monitoring – Sediment

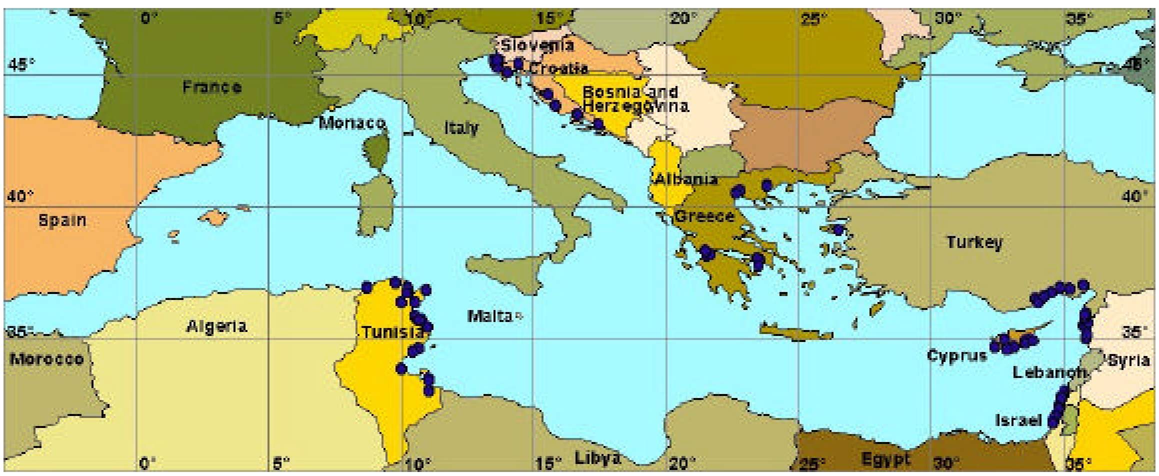


Station Map for State Monitoring – Sea Water



Station Map for Biological Effects Monitoring

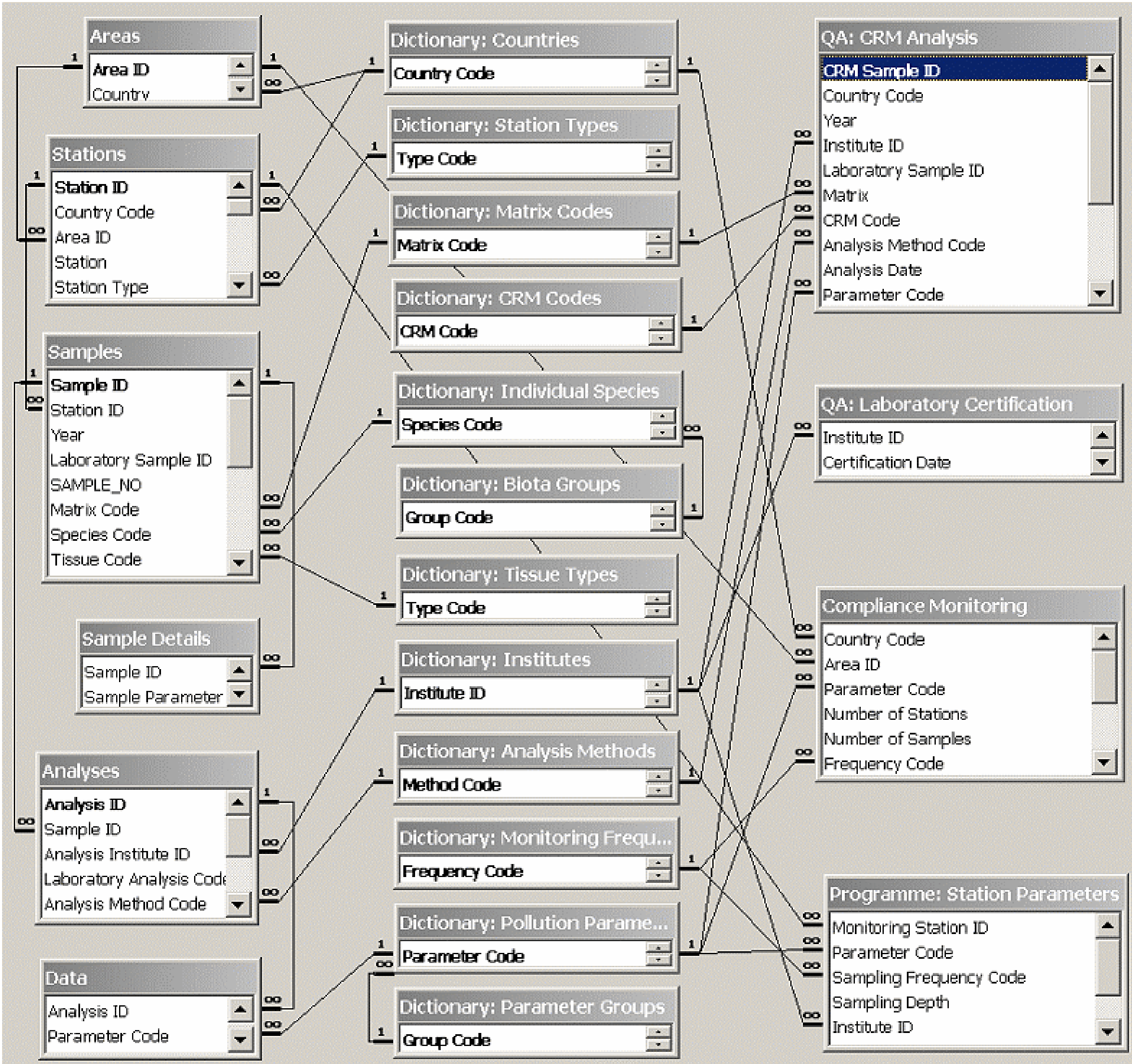
Station Map for Monitoring of Loads



ANNEX III

A List of Database Tables and the established links between them
List of Parameters

Table name	Category
Stations	Monitoring data
Samples	Monitoring data
Sample Details	Monitoring data
Analyses	Monitoring data
Data	Monitoring data
Compliance Monitoring	Monitoring data
Areas	Monitoring program
Programme: Station Parameters	Monitoring program
Dictionary: Analysis Methods	Dictionaries
Dictionary: Biota Groups	Dictionaries
Dictionary: Countries	Dictionaries
Dictionary: CRM Codes	Dictionaries
Dictionary: Effluent Sources	Dictionaries
Dictionary: Individual Species	Dictionaries
Dictionary: Industrial Activity Groups	Dictionaries
Dictionary: Institutes	Dictionaries
Dictionary: Matrix Codes	Dictionaries
Dictionary: Monitoring Frequencies	Dictionaries
Dictionary: Parameter Groups	Dictionaries
Dictionary: Pollution Parameters	Dictionaries
Dictionary: Quality Codes	Dictionaries
Dictionary: Sample Parameters	Dictionaries
Dictionary: Station Types	Dictionaries
Dictionary: Tissue Types	Dictionaries
Format List	Formats
Format: ATM_DRY	Formats
Format: ATM_WET	Formats
Format: BIOMONITORING	Formats
Format: BIOTA_OC	Formats
Format: BIOTA_TM	Formats
Format: CRM	Formats
Format: LOADS	Formats
Format: Sea_Water	Formats
Format: SED_OC	Formats
Format: SED_TM	Formats
QA: CRM Analysis	Quality assurance data
QA: Laboratory Certification	Quality assurance data
Parameter Aliases	System
Switchboard items	System



MEDPOL Database relationships

Table of Parameters in the Database *

Parameter Code	Parameter Group Code	Description
14C34	Petroleum Hydrocarbons	n-C14 to n-C34
1ETNA	Polyaromatic Hydrocarbons	1-ethyl naphthalene
1MNPH	Polyaromatic Hydrocarbons	1-methyl naphthalene
1MPHE	Polyaromatic Hydrocarbons	1-methyl phenanthrene
1MPYR	Polyaromatic Hydrocarbons	1-methyl pyrene
2MPHE	Polyaromatic Hydrocarbons	2-methyl phenanthrene
ACID	Others (effluents, chemicals etc…)	Acidity
AG	Trace metals	Silver
AIRT	Atmospheric Parameters	Air Temperature
AIRV	Atmospheric Parameters	Air Volume
AL	Trace metals	Aluminium
ALD	Chlorinated Pesticides	Aldrin
ALI	Hydrocarbons	Alifatics
ALIPR	Petroleum Hydrocarbons	Ressolved aliphatics
ALIPT	Petroleum Hydrocarbons	Total aliphatics
ALIPU	Petroleum Hydrocarbons	UCM aliphatics
ALKA	Others (effluents, chemicals etc…)	Alkalinity
ANTHE	Polyaromatic Hydrocarbons	Acenaphthene
ANTHR	Polyaromatic Hydrocarbons	Anthracene
ANTY	Polyaromatic Hydrocarbons	Acenaphtylene
ARO	Polyaromatic Hydrocarbons	Aromatics
AROMR	Petroleum Hydrocarbons	Ressolved aromatics
AROMU	Petroleum Hydrocarbons	UCM aromatics
AS	Trace metals	Arsenic
BANTR	Polyaromatic Hydrocarbons	Benzo(a) anthracene
BAPYR	Polyaromatic Hydrocarbons	Benzo(a) pyrene
BBFRN	Polyaromatic Hydrocarbons	Benzo(b) fluoranthene
BE	Trace metals	Beryllium
BGPER	Polyaromatic Hydrocarbons	Benzo(ghi) perylene
BKFRN	Polyaromatic Hydrocarbons	Benzo(k) fluoranthene
BOD5	Others (effluents, chemicals etc…)	Biochemical Oxygen Demand
CA	Others (effluents, chemicals etc…)	Calcium
CACO3	Others (effluents, chemicals etc…)	Calcium Carbonate
CAF2	Others (effluents, chemicals etc…)	Calcium Fluoride
CB101	Chlorinated biphenyl congeners	CB101
CB105	Chlorinated biphenyl congeners	CB105
CB118	Chlorinated biphenyl congeners	CB118
CB138	Chlorinated biphenyl congeners	CB138
CB153	Chlorinated biphenyl congeners	CB153
CB156	Chlorinated biphenyl congeners	CB156
CB180	Chlorinated biphenyl congeners	CB180

Parameter Code	Parameter Group Code	Description
CB28	Chlorinated biphenyl congeners	CB28
CB52	Chlorinated biphenyl congeners	CB52
CBS	Chlorinated biphenyl congeners	CBS
CD	Trace metals	Cadmium
CHL-A	Ecological Parameters	Chlorophyll
CHLF	Halogenated Hydrocarbons	Chloroform
CHRYS	Polyaromatic Hydrocarbons	Chrysene
CL	Others (effluents, chemicals etc…)	Chlorides/Chlorine
CLC4	Volatile organic compounds	Tetrachlorocarbon
CLET3	Volatile organic compounds	Trichloroethylene
CLET4	Volatile organic compounds	Tetrachloroethylene
CLOX	Clorophenols	Chlorophenoxy Acids
CLRDA	Chlorinated Pesticides	Alpha-Chlordane
CLRDB	Chlorinated Pesticides	Beta-Chlordane
CN	Others (effluents, chemicals etc…)	Cyanides
CO	Trace metals	Cobalt
CO1	Others (effluents, chemicals etc…)	Carbon Monoxide
CO2	Others (effluents, chemicals etc…)	Carbon Dioxide
COD	Others (effluents, chemicals etc…)	Chemical Oxygen Demand
COL	Others (effluents, chemicals etc…)	Colour
CONDU	Standard Parameters	Conductivity
CR	Trace metals	Chromium
CS	Trace metals	Caesium
CTLS	Bio-Effects parameters	Catalase, µmole/mm/mg Proteine
CU	Trace metals	Copper
DDD	Chlorinated Pesticides	opDDD + ppDDD
DDDO	Chlorinated Pesticides	Dichloro-Diphenyl Dichloroethane op (same as TDEO)
DDDP	Chlorinated Pesticides	Dichloro-Diphenyl Dichloroethane pp (same as TDEP)
DDE	Chlorinated Pesticides	opDDE + ppDDE
DDEO	Chlorinated Pesticides	Dichloro-Diphenyl Dichlorethene op
DDEP	Chlorinated Pesticides	Dichloro-Diphenyl Dichlorethene pp
DDT	Chlorinated Pesticides	opDDT + ppDDT
DDTO	Chlorinated Pesticides	Dichloro-Diphenyl Trichlorethane op
DDTP	Chlorinated Pesticides	Dichloro-Diphenyl Trichlorethane pp
DDTS	Chlorinated Pesticides	opDDT + ppDDT + opDDE +

Parameter Code	Parameter Group Code	Description
		ppDDE + opDDD + ppDDD
Depth	Standard Parameters	Depth
DET	Detergents	Detergents
DIE	Chlorinated Pesticides	Dieldrin
DIN	Nutrients	NO3+NO2+NH4
DMPHE	Polyaromatic Hydrocarbons	3,6-dimethyl phenanthrene
DNAMN	Bio-Effects parameters	DNAx_MICRONUCLEI
DNERT	Bio-Effects parameters	DNAx_ELUTION RATE_TIME
DNERV	Bio-Effects parameters	DNAxELUTION RATE_VOL
DNSSF	Bio-Effects parameters	DNAx_SSF
DOXY	Standard Parameters	Dissolved Oxygen
DOXY%	Standard Parameters	Dissolved Oxygen, % of saturation
DSRI	Chlorinated Pesticides	Sum of Aldrin, Dieldrin and Endrin
DUST	Atmospheric Parameters	Dust concentration
EC	Bacterial Indicators	E. coli
EKV	Bio-Effects parameters	EKV_LEVEL
END	Chlorinated Pesticides	Endrin
ENDOA	Chlorinated Pesticides	Alpha-Endosulfan
ENDOB	Chlorinated Pesticides	Beta-Endosulfan
ENDOS	Chlorinated Pesticides	Endosulfan sulphate
ERACT	Bio-Effects parameters	EROD_ACT
EV	Bacterial Indicators	Enteroviruses
F	Others (effluents, chemicals etc…)	Fluorides/Fluorine
FC	Bacterial Indicators	Faecal Coliforms
FE	Trace metals	Iron
FLRAN	Polyaromatic Hydrocarbons	Fluoranthene
FLREN	Polyaromatic Hydrocarbons	Fluorene
FLU	Others (effluents, chemicals etc…)	Fluoride
FS	Bacterial Indicators	Faecal Streptococci
H2CO3	Others (effluents, chemicals etc…)	Dissolved carbonic acid
H2S	Others (effluents, chemicals etc…)	Hydrogen sulphide
H2SO4	Others (effluents, chemicals etc…)	Sulphuric Acid
HC	Others (effluents, chemicals etc…)	Hardness-carbonate
HCA	Others (effluents, chemicals etc…)	Hardness-calcium
HCB	Chlorinated Pesticides	Hexachlorobenzene
HCH	Chlorinated Pesticides	Hexachlorhexane (same as BHC)
HCH-A	Chlorinated Pesticides	Pesticides - alpha HCH
HCH-B	Chlorinated Pesticides	Pesticides - beta HCH
HCH-D	Chlorinated Pesticides	Pesticides - delta HCH
HEP	Chlorinated Pesticides	Heptachlor

Parameter Code	Parameter Group Code	Description
HF	Others (effluents, chemicals etc…)	Hydrofluoric Acid
HGO	Trace metals	Organic Mercury
HGT	Trace metals	Total Mercury
HH	Halogenated Hydrocarbons	Halogenated Hydrocarbons
HMG	Standard Parameters	Hardness-magnesium
HNC	Standard Parameters	Hardness-non-carbonate
HOX	Chlorinated Pesticides	Heptachlor Epoxide (same as EPOX)
INPYR	Polyaromatic Hydrocarbons	Indeno(1,2,3-cd) pyrene
K	Trace metals	Potassium
KN-O	Nutrients	N-organic (Kjeldal)
KN-T	Nutrients	N-Kjeldal
LIN	Chlorinated Pesticides	Lindane
LMSLP	Bio-Effects parameters	LMS_LP
LMSNR	Bio-Effects parameters	LMS_NRR
MG	Trace metals	magnesium
MgT	Others (effluents, chemicals etc…)	MgT
ML_SW	Bio-Effects parameters	ml_SEA WATER
MN	Trace metals	Manganese
MO	Trace metals	Molybdenum
MPNC	Bacterial Indicators	MPN coli/100 ml
MPNEC	Bacterial Indicators	MPN Ecoli/100 ml
MPNSF	Bacterial Indicators	MPN sfaecalis/100 ml
MT	Bio-Effects parameters	MT Level
NA	Trace metals	Sodium
NAPTH	Polyaromatic Hydrocarbons	Naphthalene
NH3-N	Nutrients	Ammonia reported as nitrogen
NH4	Nutrients	Ammonium
NH4-N	Nutrients	Ammonium reported as nitrogen
N-HPD	Petroleum Hydrocarbons	n-heptadecane (C17)
NI	Trace metals	Nickel
NO2	Nutrients	Nitrites
NO2-N	Nutrients	N-nitrite
NO3	Nutrients	Nitrates
NO3-2	Nutrients	Nitrates + Nitrites
NO32N	Nutrients	NO2-3-N
NO3-N	Nutrients	Nitrates reported as nitrogen
N-OCD	Petroleum Hydrocarbons	n-octadecane (C18)
NORG	Nutrients	Organic Nitrogen
O3	Atmospheric Parameters	Ozone
OIL	Oil Slick Observations	Oil content
OILT	Others (effluents, chemicals etc…)	Total oiliness

Parameter Code	Parameter Group Code	Description
OXCON	Others (effluents, chemicals etc…)	Oxygen consumption
PA	Bacterial Indicators	Pseudomonas Aeruginusa
PAH	Polyaromatic Hydrocarbons	Polyaromatic Hydrocarbons
PB	Trace metals	Lead
PCBA	Chlorinated biphenil congeners	Poly Biphenyls (as Arochlor 1254)
PCBB	Chlorinated biphenil congeners	Poly Biphenyls (as Arochlor 1260)
PCBT	Chlorinated biphenil congeners	Total PCB
PERYL	Polyaromatic Hydrocarbons	Perylene
pH	Standard Parameters	pH
PHC	Hydrocarbons	Petroleum Hydrocarbons
PHE	Others (effluents, chemicals etc…)	Phenols
PHENA	Polyaromatic Hydrocarbons	Phenanthrene
PHYPL	Ecological Parameters	Phyto-plankton
PHYTN	Petroleum Hydrocarbons	Phytane
PO4-P	Nutrients	Orthophosphate
PORG	Nutrients	Organic Phosphorus
PRIST	Petroleum Hydrocarbons	Pristane
PYREN	Polyaromatic Hydrocarbons	Pyrene
RB	Trace metals	Rubidium
SA	Bacterial Indicators	Saphylococcus Aureus
Salin	Standard Parameters	Salinity
SB	Trace metals	Antimony
SD	Others (effluents, chemicals etc…)	Sulphides
SE	Trace metals	Selenium
SIO2	Atmospheric Parameters	SIO2 from Iraeli ATM-WET data
SIO4	Nutrients	Silicates
SM	Bacterial Indicators	Salmonella
SMBAS	Chlorinated biphenil congeners	SURFACTANS MBAS, from Croatian loads, 2001
SN	Trace metals	Tin
SO2	Others (effluents, chemicals etc…)	Sulphur Dioxide
SO3	Others (effluents, chemicals etc…)	Sulphites
SO4	Others (effluents, chemicals etc…)	Sulphate
SO4-S	Others (effluents, chemicals etc…)	Sulphates reported as sulphur
STRES	Bio-Effects parameters	STRESS/STRESS
TAR	Oil Slick Observations	Tar Ball Collection
TB	Others (effluents, chemicals etc…)	Turbidity
TC	Bacterial Indicators	Total Coliforms
TCHLP	Chlorinated Pesticides	Total chlorated pesticides
Temp	Standard Parameters	Temperature

Parameter Code	Parameter Group Code	Description
TN	Nutrients	Total Nitrogen
TOC	Others (effluents, chemicals etc…)	Total Organic Carbon
TOPP	Organo-phosphoric pesticides	Total organo-phosphoric pesticides
TP	Nutrients	Total Phosporus
TRANS	Others (effluents, chemicals etc…)	Transparency
TRIX	Others (effluents, chemicals etc…)	TRIX
TSS	Others (effluents, chemicals etc…)	Total Suspended Solids
TSSD	Others (effluents, chemicals etc…)	Total S.SD
V	Trace metals	Vanadium
ZN	Trace metals	Zinc

* Only few of these parameters are mandatory

ANNEX IV

Global NEWS (Global Nutrient Export from Watersheds)
Mediterranean Focus

UNESCO-IOC / UNEP Working Group Report (May 2003)

ANNEX V

Contributions to GOOS in the Mediterranean

MedGLOSS - The Mediterranean regional subsystem of the Global Sea Level Observing System is a real-time monitoring network for systematic measurements of the sea level in the Mediterranean and Black Sea. It is being developed on the basis of GLOSS requirements and methodology, aiming to provide high-quality standardised sea level data. MedGLOSS is a joint initiative of IOC and CIESM and will contribute to study the worldwide eustatic sea-level rise due to the "greenhouse effect" as well as to provide the ellipsoid to geoid corrections in the sea-level real time satellite elevation measurements. The MedGLOSS network has already installations in Israel, Malta, Croatia, Cyprus, Bulgaria and Romania; other prospective installations will be established in Morocco and Egypt.

The **Mediterranean Forecasting System Pilot Project (MFSPP)** closed in 2002, has started to develop the science base for the implementation of a Mediterranean ocean forecasting system. The aim was the prediction of the marine ecosystem variability in the coastal areas up to the primary producers, and from the time scales of days to months.

The project has two components: observing system and numerical modelling/data assimilation able to use the past observational information to optimally initialise the forecast. The basic assumption was that both hydrodynamics and ecosystem fluctuations in the coastal/shelf areas of the Mediterranean are intimately connected to the large scale general circulation. The second assumption was that, for the physical components of the ecosystem, monitoring and numerical modelling can work almost pre-operationally.

The project has shown that NRT forecasts of the large scale basin currents are possible. Components developed and implemented:

- automatic temperature monitoring system for the overall Mediterranean Sea (Voluntary Observing Ship-VOS system) with NRT data delivery; a pilot Mediterranean Multisensor Moored Array buoy system (M3A) to monitor temperature, salinity and currents, together with biogeochemical and optical measurements to establish the feasibility of multiparametric monitoring of the upper thermocline in the whole basin;

- NRT satellite data (sea surface height, sea surface temperature and colour) analysis and mapping on the numerical model grid; different data assimilation schemes in order to assimilate multivariate parameters, e.g., XBT from the VOS and satellite sea surface height and sea surface temperature;

- 3, 5 and 10 days forecast experiments at basin scale for three months;
- techniques to downscale the hydrodynamics to different shelf areas of the Mediterranean Sea with nested models of different resolution;

- ecosystem models in shelf areas of the basin and a strategy for validation/calibration with M3A data sets;

- methods for assimilating nutrient, chlorophyll and PAR into predictive ecosystem models;

- an overall NRT data collection and dissemination network which allows the timely release of data for the forecasting exercise.

The ***Mediterranean ocean Forecasting System: Toward Environmental Predictions*** **(MFSTEP)** Starting in 2003 is a continuation of *MFSPP*. The aim is to improve monitoring technology to achieve maximum reliability, to demonstrate the feasibility of regional scale forecasting in several Mediterranean areas, to develop biochemical modelling and data assimilation towards environmental predictions and to start the development of end-user interfaces for the exploitation of the project products. The problems addressed are: technological developments for real time monitoring, the provision of protocols for data dissemination, including telecommunication and quality control; scientific development to improve numerical models, the design and implementation of data assimilation schemes at different spatial scales, the ecosystem modeling validation/calibration at the coastal and basin scales and the development of data assimilation techniques for biochemical data; exploitation developments, consisting of software interfaces between forecast products and oil spill modeling, general contaminant dispersion models, relocatable emergency systems, search and rescue models and fish stock observing systems.

One of the goals of MFSTEP is to advance the monitoring technology to achieve maximum reliability of the observing system. In MFSTEP the observing system component will build upon the experience of the initial Observing System for the World Ocean. It consists of: a Voluntary Observing Ship (VOS) system with innovative technology to be real time, cost-effective, multidisciplinary and environmentally safe; a moored buoy system designed to serve real time validation of the basin scale models and the calibration of the ecosystem modelling components; a satellite real time data analysis system using several available and soon to be available satellite observations of the sea surface topography, temperature and colour; a high space-time resolution network of autonomous subsurface profiling floats (Array for Real-Time Geostrophic Oceanography-ARGO); a basin scale glider autonomous vehicle experiment; an Observing System Simulation Experiment (OSSE) activity; and a real time data management and delayed mode archiving system.

A pilot **Mediterranean M ultisensor Moored Array buoy system (M3A)** for the automatised monitoring of a complete set of physical parameters, including temperature, salinity and currents, together with relevant biogeochemical and optical measurements has been also designed and sucessfully deployed in the Cretan Sea during MFSPP. The system has proved the feasibility of multiparametric monitoring of the upper thermocline using multi-sensor moored systems. The overall M3A design has fulfilled the requirements of the MFS multidisciplinary observations. The modular system structure used with acoustic links has proved to be a promising one. The experience has shown that 2-3 months maintenance can guarantee high quality data with the exception of turbidity measurements (plus surface optical measurements). Improvements are however necessary for what concerns (1) data transmission technology, both surface and subsurface; (2) use of a smaller surface buoy without an umbilical cord; (3) subsurface transmission from ADCP mooring; (4) addition of optical sensors. The buoy system is currently operated by NCMR (Greece). Two more buoys in the western Mediterranean and Adriatic Sea will be deployed during MFSTEP.

MFSPP-VOS (Voluntary Observing Ship) system – Within the Mediterranean Forecasting System Pilot Project a pilot automatic upper ocean temperature monitoring system covering the whole Mediterranean has been implemented in the period September 1999 - June 2000 with NRT XBT data delivery from 7 ship tracks. The system has shown the adequacy of XBT sampling at 12 nm and with a repeat time of two weeks for assimilation in forecasting models.

A quality control and data management system handling data in NRT has been established by the centralized data collection center located in ENEA, La Spezia.

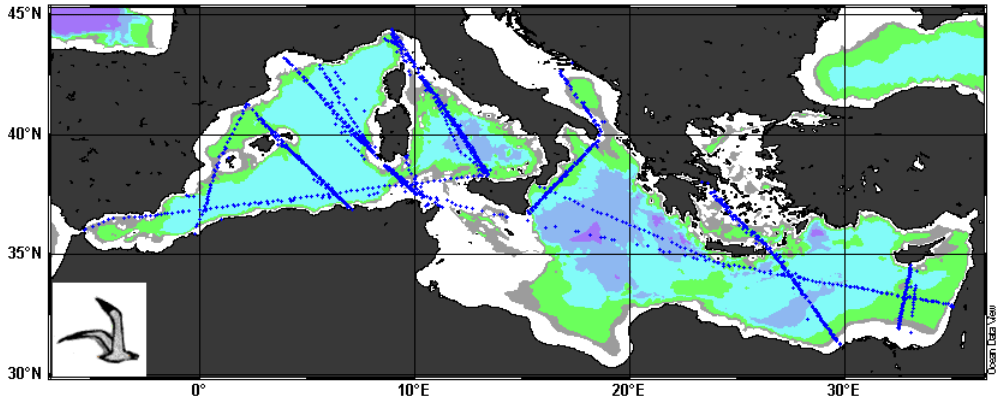


Fig.1 The MFS-VOS tracks working from September 1999 to June 2000

NRT satellite data sets are used by INGV (Italy) for the initialization of weekly forecasts. This is a continuation of the activity initiated within MFSPP. 1) Sea Level Anomalies (SLA) and 2) Sea Surface Temperature (SST) are operationally analysed and mapped on to the numerical model grid and assimilated an Optimal Interpolation scheme (System for Ocean Forecast and Analysis, SOFA) which is multivariate in input and output.

A contribution to the ARGO project – The MFSTEP EC project to start in 2003 will deploy a high space-time resolution network of autonomous subsurface floats for a fully operational test of the ocean forecasting system. Technical developments envisaged in the project: the profilers will be customised to the MFSTEP needs and to the future telemetry systems, a selected sampling design will be adopted and specific software written to take advantage of the future 2-way telemetry for data transmission and for interactive modifications of the profiler mission characteristics. The MedARGO profilers will be launched from ships-of-opportunity along the VOS-XBT line. The profiler data will be processed and disseminated by the centralised Archiving and Dissemination Data Centre (ADDC) in Brest, France. The data will also be collected and archived at the MedARGO Thematic Expert Data Center (MedARGO/TEDC) in Trieste, Italy. Data summaries will be visualized and distributed in NRT using web servers and ftp sites at the ADDC. Some products will be posted on the MedARGO/TEDC web server. Dissemination via GTS, emails, etc. is also planned. The ADDC will assure data exchange, and general relationships with the international ARGO program. The final quality control and processing of the profiler data will be done at the ADDC.

POSEIDON is a Greek marine operational monitoring system which covers the need for timely and reliable information with delivery of ocean forecasts in the Greek territorial waters. The system consists of a network of observing buoys to record the physical, biological and chemical parameters of the Greek seas, and of a specialised operational centre for the processing of the data and forecast assembly. The observation buoys are equipped with sensors that monitor: air-pressure, air-temperature, wind speed and direction, wave height, period and direction, sea surface salinity and temperature, surface current speed and direction, sea surface dissolved oxygen, light attenuation with fluorescence, salinity and temperature in depths 0-50m, chlorophyll-A, nutrients and radioactivity. The data is first transferred to the operational centre by means of three telecommunication systems: INMARSAT-C satellite, Radio UHF, Cellular GSM.

The POSEIDON operational centre is equipped with a high performance computer system (SGI-ORIGIN 2000) with 8 CPUs on board providing adequate power for the forecasting model's integration, UNIX and MS Windows based workstations for data analysis and presentation, ORACLE data base for storing and managing the field data. The numerical models are designed to forecast: Atmospheric conditions, Offshore wave height and direction, 3-D general circulation, Shallow water wave characteristics, and Buoyant pollutant transport. The POSEIDON system produces a series of data and outputs that targets key users with services and information in the form of: primary data in real time (on-line) transmitted from the observation buoys; historical data and time-series, statistical analyses and data produced by hindcasting; forecasts for the condition of the Greek seas for the next 1-3 days, and long-term operational forecast.

The **Rayo (Red de Alerta Y Observación - Alert and Observation Network)** project consists of a series of buoy networks deployed to measure and monitor the marine environment in Spanish waters. The main part of the system is the so called "deep water network", consisting of 9 Seawatch (provided by Oceanor) and 3 wavescan buoys measuring waves (Waverider sensors, three of them are directional), currents (UCM-60 sensor), wind (Aanderaa 2740 for speed and Aanderaa 3590 for direction), atmospheric pressure (Vaisala PTB200A(D)) and temperature (Aanderaa 3455), sea surface temperature and salinity (Aanderaa 2994S). Information from the Seawatch buoys is transmitted every hour via Inmarsat to both the harbour authorities and to the main building at Puertos del Estado, Madrid. Additionally, directional wave information is propagated in real time to the mouths of the harbours by means of a wave model. The propagation method is based on the so called "spectral point to point propagation", developed at Puertos del Estado. The deep water network is complemented with three current meter chains, 3 directional Smart buoys for shallow water directional wave measurements and 3 coastal radars. Apart from the ‘deep water network’, there is also the Coastal Network providing real time data in some specific points located at shallow waters. The main objective of the measurements is to complement those of the Deep Sea Network at those locations of special interest for the port operations or wave modelling validation. The buoys employed are scalar Waverider (REMRO network), and directional.

ADRICOSM – (ADRIatic sea integrated COastal areaS and river basin Management system pilot project) aims to implement an integrated coastal zone management system in the Adriatic Sea consisting of a predictive circulation module and a river basin and wastewater management module. It will predict coastal currents variability in Near Real Time. This project involves institutions of Italy, Slovenia and Croatia and French Institutions. It is supported by the Italian Ministry for the Environment and Territory.

MedGOOS 1 buoy deployed in 2002 by Harris and IMC - International Marine Centre of Oristano (Italy) in the Sardinian Sea. The buoy is moored at -2000 m ca., at 42 nautical miles W off the Gulf of Oristano. The system is powered by an oil generator having with over 6months autonomy. Data transmission is via satellite Intelsat and Argos, the safety control of the buoy (positioning and operating) is performed by Inmarsat-C. Data are broadcast to the MCS-Harris office in Florida (USA), and sent back to the IMC Oristano by FTP.

MedGOOS 2 buoy deployed in 2002 and operated by IAMC-CNR, Oristano (Italy) in the Sardinian Sea at about 13 nautical miles W off the Gulf of Oristano Gulf, at -870 m. The surface buoy is connected to a floating submerged buoys at 800 m depth, anchor (2 tons). The surface buoy, solar powered, is an Oceanor Wavescan, 7 m high (3 m above the sea level), 3 m large and with a weight of about 1.2 tons. Data are transmitted every three hours to the CNR-IAMC Oristano section via a GSM mobile. The cable is about 1200 m long, and inductive in the first 500 m. The buoy is equipped with a meteorological station at +3 m, an RDI ADCP Long Ranger

75kHz with a temperature sensor at -3 m. The buoy moves around the deployment point describing a circle with a range of about 1000 m

MAMBO - (Monitoraggio AMBientale Operativo nel Golfo di Trieste) operated by OGS (Italy) is a real-time meteo-marine system in the Gulf of Trieste, North Adriatic. The system is based upon moored buoys equipped with meteo sensors, a multiparametric profiling probe (pressure, temperature, conductivity, dissolved oxygen, chlorophyll A, pH, turbidity). The data are transmitted to land in real-time and diffused on the Internet. An RT-ADCP has been recently implemented to obtain high resolution profiles of marine currents. A Directional Waverider has also been deployed to obtain the wave climate of the area and validate wave propagation models. The time series data are used to validate physical and biological models.

Annex VI

Annex VI

Abbreviations

AAS	:	Atomic Absorption Spectrometry
BAC	:	Bacteriological Parameters
BIO	:	Biota
BOD	:	5-Day Biochemical Oxygen Demand
BOP	:	Basic Oceanographic Parameters (depth, temperature, salinity, dissolved oxygen)
COD	:	Chemical Oxygen Demand
CRM	:	Certified Reference Material
DQA	:	Data Quality Assurance
EEA	:	European Environment Agency
EFF	:	Effluents
EQO	:	Enviornmental Quality Objectives
EROD	:	Ethoxyresorufin O-deethylase
EU	:	European Union
FI	:	Fillet of fish
GESAMP	:	Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection
GOOS	:	Global Ocean Observing System
HH	:	Halogenated Hydrocarbons
ICES	:	International Council for the Exploration of the Sea
ICZM	:	Integrated Coastal Zone Management
LMS	:	Lysosomal Membrane Stability
MAP	:	Mediterranean Action Plan
MC	:	Microbiological
MFS	:	Mediterranean Forecasting System
NUT	:	Nutrients
OC	:	Organic Contaminants
OSPAR	:	Oslo and Paris Commissions
PAH	:	Polyaromatic Hydrocarbons
PCB	:	Poly chlorinated biphenyls
PHC	:	Petroleum Hydrocarbons
PHE	:	Phenols
PM	:	Particulate Matter
RIV	:	River
RM	:	Reference Methods
RTD	:	Research and Technology Development
SAP	:	Strategic Action Programme
SED	:	Sediments
T	:	Temperature
TBT	:	Tributyl tin
TC	:	Total Coliform
TM	:	Trace Metals
TRIX	:	Trix index
TSS	:	Total Suspended Sediments
UNEP	:	United Nations Environment Programme
VBA	:	Visual Basics Application

WAT	:	Water (for sea water and river water)
WFD	:	Water Framework Directive
WHO	:	World Health Organization
WST	:	Whole Soft Tissue

Biological Species

BB	:	*Boops boops*
DT	:	*Donax trunculus*
MB	:	*Mullus Barbatus*
ME	:	*Mytilus edulis*
MG	:	*Mytilus galloprovincialis*
MS	:	*Mullus surmuletus*
PP	:	*Perna perna*
PS	:	*Pomatomus saltator*
SAU	:	*Sparus auratus*
TD	:	*Tapes decussatus*
UM	:	*Upeneus moluccensis*