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### EVALUATION OF THE MONITORING COMPONENT OF MED POL - PHASE II

(Position Document by the Secretariat)

In co-operation with:



FAO



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## 1. INTRODUCTION

The present document was prepared by UNEP and the Cooperating Agencies involved in the coordination and the technical implementation of the monitoring component of MED POL.

The purpose of the document is to review the present structure of the MED POL monitoring programme considering on the one hand its objectives and the scientific requirements and, on the other hand, what has been proposed and accomplished by the Contracting Parties through the implementation of their national monitoring programmes since 1981, i.e. the launching of MED POL - PHASE II.

Therefore, the document will not analyse the validity of the data obtained until now (which is done in documents UNEP(OCA)/MED WG.5/INF.3,4,5 and 6), but will try to identify the gaps and the weaknesses of the monitoring programme of MED POL, intended as a regional programme, by showing where the national monitoring programmes are lacking and where and how they failed in satisfying the general objectives of the approved MED POL programme. The document will also try to suggest some remedial actions in order to bring the programme in line with the short- and long-term objectives approved by the Contracting Parties.

The document reviews the MED POL monitoring programme by analysing one by one the four types of monitoring activities, i.e. monitoring of sources, monitoring of coastal areas, monitoring of reference areas and monitoring of the transport of airborne pollution. Under the monitoring of coastal and reference areas, the main mandatory parameters are taken into consideration individually by reviewing their temporal and geographical coverage, the analytical methodology, the data quality assurance programme and the data processing activities.

## 2. GENERAL CONCEPT

The implementation of the marine pollution monitoring activities is a legal obligation of the Contracting Parties to the Barcelona Convention, according to art.10 of the Convention, art.4 of the Emergency protocol and art.8 of the Land-based sources protocol. Marine pollution monitoring programmes are implemented in the framework of MED POL.

The general long-term objective of MED POL - PHASE II is to further the goals of the Barcelona Convention by assisting the Parties to prevent, abate and combat pollution of the Mediterranean Sea Area and to protect and enhance the marine environment of the Area. The specific objectives are designed to provide, on a continuous basis, the Parties to the Barcelona Convention and its related protocols with :

- information required for the implementation of the Convention and the protocols;

- indicators and evaluation of the effectiveness of the pollution prevention measures taken under the Convention and the protocols;
- scientific information which may lead to eventual revisions and amendments of the relevant provisions of the Convention and the protocols and for the formulation of additional protocols;
- information which could be used in formulating environmentally sound national, bilateral and multilateral management decisions essential for the continuous socio-economic development of the Mediterranean region on a sustainable basis;
- periodic assessment of the state of pollution of the Mediterranean Sea.

These objectives are to be achieved through the evaluation of the information on the sources, amounts, levels, trends, pathways and effects of pollutants in the Mediterranean which are collected, analyzed and reported on a systematic basis using commonly agreed methods, and taking into account data available from other sources.

Monitoring is therefore organized on four levels, each one for a specific purpose.

A. Monitoring of sources of pollution.

Purpose: To obtain information on the type and amount of pollutants released directly into the environment.

B. Monitoring of coastal areas, including estuaries, under the direct influence of pollutants from identifiable primary or secondary sources.

Purpose: To assess the effectiveness of measures for the reduction of pollution taken under the convention and the protocols.

C. Monitoring of offshore or reference areas, which are not under direct influence of pollutants from identifiable primary or secondary sources.

Purpose: To obtain information on the general trends in the level of pollution in the Mediterranean.

D. Monitoring of the transport of pollutants to the Mediterranean through the atmosphere.

Purpose: To obtain additional information on the pollution load reaching the Mediterranean Sea.

In order to meet the above purposes, as agreed in Cannes, 2-7 March 1981, at the Second Meeting of the Contracting Parties to the Barcelona Convention (UNEP/IG.23/11), each State is required to prepare a national monitoring programme using an agreed format and to extend and review it, as appropriate, each year.

### 3. OVERVIEW

After the approval by the Contracting Parties of the scientific and technical details of the MED POL - PHASE II programme, i.e. parameters, matrices, data quality assurance, reporting formats, etc., at the meeting held in Cannes, 2-7 March 1981 (UNEP/IG.23/11), negotiations started between each State and the Coordinating Unit for MAP for the formulation of national monitoring programmes. The yearly national programmes which have been finalized since then are either signed by the national authorities and the Coordinating Unit or simply agreed upon and submitted to the Unit. The former case is normally occurring when an assistance component is foreseen, according to which the Unit commits a certain amount of funds (a maximum of US\$ 60,000 yearly) which is intended to be spent for the purchasing of equipment or chemicals related to the implementation of the approved programme. A training component may also be included. The latter case is occurring when a State proposes a monitoring programme without requiring for its implementation any assistance from the Unit. In both cases, however, the State who submits a programme commits itself to send the data obtained through the implementation of the programme on a yearly basis. Generally, a programme is not renewed if data are not submitted.

Following the above procedure, not without difficulties, the MAP Unit has either signed, or received the description of, programmes from fourteen States. A complete description of the status of National monitoring programmes as at March 1989 is contained in Table I, and Fig.1 shows the monitoring stations as they were proposed through MED POL National Programmes as at March 1989.

### 4. MONITORING OF SOURCES

#### 4.1 Geographical coverage

In terms of signed MED POL monitoring agreements, the geographical coverage of pollution source monitoring extends to nine Mediterranean countries (Algeria, Cyprus, Egypt, Greece, Libya, Malta, Morocco, Syria and Yugoslavia). This totals 50% of all countries in the region, but the percentage coverage is much lower if one takes into account the comparative size of these countries in relation to the whole region, and the fact that information from countries with the largest number of major pollution sources are not covered.

Furthermore, pollution source monitoring represents a relatively new exercise in a number of countries, and the sources designated for monitoring by national authorities within the framework of MED POL are only a variable percentage of the actual total of polluting sources.

Up to the present time, data have been received from only five (Algeria, Cyprus, Malta, Morocco and Yugoslavia) of the nine countries whose national MED POL monitoring agreements include the pollution source aspect. This lowers the present actual coverage even more.

Table I

Status of MED POL Monitoring Programmes as at March 1989

Country	Year of submission of first programme	Programme coverage by year			Data submitted by year <sup>1/</sup>		
		Sources of pollution	Coastal and estuarine	Reference areas	Sources of pollution	Coastal and estuarine	Reference areas
Algeria	1985	1985	1985	-	-	1985	-
		1986	1986	-	-	1986	-
		1987	1987	-	1987	1987	-
		1988	1988	-	-	-	-
Cyprus	1983	1983	1983	-	1983	1983	-
		1984	1984	-	1984	1984	-
		1985	1985	-	1985	1985	-
		1986	1986	-	1986	1986	-
		1987	1987	-	1987	1987	-
		1988	1988	-	-	-	-
Egypt	1986	1986	1986	1986	-	-	-
France	1986	-	-	-	-	1982	-
		-	-	-	-	1983	-
		-	-	-	-	-	-
		-	-	-	-	-	-
		-	1986	-	-	-	-
Greece	1988	1988	1988	-	-	-	-
Israel	1983	-	-	-	-	1982	-
		-	1983	-	-	1983	-
		-	1984	-	-	1984	-
		-	1985	-	-	1985	-
		-	1986	-	-	1986	-
		-	1987	-	-	1987	-
		-	1988	-	-	-	-
Italy	-	-	-	-	-	1987	-
Lebanon	1983	-	1983	-	-	-	-
		-	-	-	-	1984	-
		-	1985	-	-	-	-
		-	1986	-	-	1986	-
		-	1987	-	-	1987	-
-	1988	-	-	-	-		
Libya	1986	1986	1986	-	-	1987	-

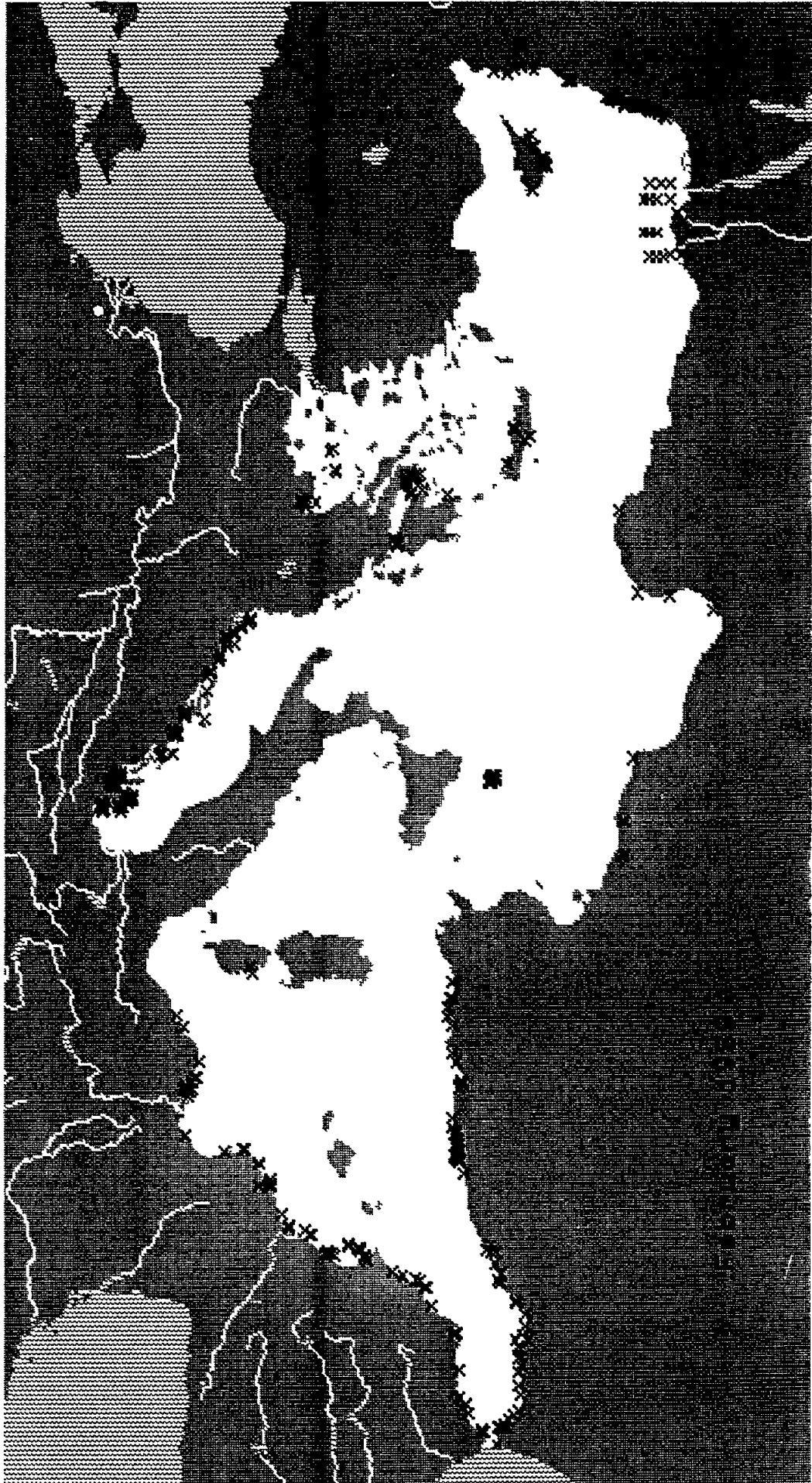
<sup>1/</sup> The indication that data have been submitted does not necessarily imply that either quality or quantity of data is acceptable.

Table I (cont'd)

Status of MED POL Monitoring Programmes as at March 1989

Country	Year of submission of first programme	Programme coverage by year			Data submitted by year <u>1</u>		
		Sources of pollution	Coastal and estuarine	Reference areas	Sources of pollution	Coastal and estuarine	Reference areas
Malta	1984	-	-	-	1982	1982	-
		-	-	-	1983	1983	-
		1984	1984	-	1984	1984	-
		1985	1985	-	1985	1985	-
		1986	1986	-	1986	1986	-
		1987	1987	-	1987	1987	-
		1988	1988	-	1988	1988	-
Monaco	1986	-	-	-	-	-	-
Morocco	1985	-	-	-	1983	1983	-
		-	-	-	1984	1984	-
		1985	1985	-	1985	1985	-
		1986	1986	-	1986	1986	-
		1987	1987	-	1987	1987	-
		1988	1988	-	-	-	-
Spain	1987	-	-	-	-	1981	-
		-	-	-	-	1982	-
		-	-	-	-	1983	-
		-	-	-	-	1984	-
		-	-	-	-	1985	-
		-	-	-	-	1986	-
		-	1987	-	-	-	-
Syria	1986	1986	1986	1986	-	1986	-
		1987	1987	1987	-	1987	-
		1988	1988	1988	-	-	-
Tunisia	-	-	-	-	-	1981	-
		-	-	-	-	1982	-
		-	-	-	-	1983	-
		-	-	-	-	1984	-
		-	-	-	-	1985	-
Turkey	-	-	-	-	-	1984	-
		-	-	-	-	1985	-
Yugoslavia	1983	1983	1983	1983	1983	1983	1983
		1984	1984	1984	1984	1984	1984
		1985	1985	1985	1985	1985	1985
		1986	1986	1986	1986	1986	1986
		1987	1987	1987	1987	1987	1987
		1988	1988	1988	-	-	-

Fig. 1 - MED POL Monitoring of Pollution in the Mediterranean  
Coastal Sampling Stations of National Monitoring Programmes





#### 4.2 Temporal coverage

Data from Cyprus, Morocco and Yugoslavia cover the period 1983-1987, from Malta 1983-1988, and Algeria only 1987. Insofar as the first four countries are concerned, the temporal coverage is satisfactory because of the general consistency of the particular sources monitored.

#### 4.3 Parameters

Except for radionuclides (RAD), the parameters monitored generally cover the lists of substances agreed on by the Working Group on Scientific and Technical Cooperation (WGSTC) for MED POL and subsequently approved by the Contracting Parties (Cannes, 2-7 March 1981; doc.UNEP/IG.23/11).

Coverage of other substances included in Annexes I and II to the Protocol for the Protection of the Mediterranean Sea against Pollution from Land-based Sources is very sparse. Out of the five countries reporting data, only three (Malta, Morocco, Yugoslavia) have sent "reasonable" amounts of data for lead and zinc, and only one (Malta) for copper, iron, nickel, manganese and cobalt.

A total of 9996 measurements were received. A break-down by parameter, as well as by country, is given in Tables I and II of document UNEP(OCA)/MED WG.5/Inf.3.

#### 4.4 Matrices

Only one matrix (effluents) applies here. In many cases, however, insufficient information is available as to exactly where the sample was taken, i.e. from the effluent itself before discharge, or from the immediate point of entry into the sea after discharge.

#### 4.5 Sampling and analytical methods

In the absence of specific MED POL reference methods for determination of the various parameters in effluents, participating institutions have been using internationally accepted methodologies, in many cases the same analytical methods as described in the MED POL reference method series for the same substances in other matrices (mainly seawater). Very little information is available on sampling methodology, which represents a major point of concern.

Guidelines for monitoring of land-based marine pollution sources were approved in outline during an expert consultation meeting in Split (1-5 December 1987) and are currently in course of preparation. The outline content of these guidelines is reproduced as an annex to document UNEP(OCA)/MED WG.5/Inf.3. Similarly, the necessary reference methods for the determination of the various parameters in effluents (keeping as close as possible to the analytical methodology described in existing methods for other matrices) are also in preparation. The two (guidelines and methods) are necessarily interlinked, and the first drafts are expected to be available by the end of 1989.

#### 4.6 Data quality assurance

In view of the fact that pollution source monitoring is a comparatively new venture in a number of countries, and also because within the MED POL programme itself, priority has necessarily been accorded (so far) to other matrices, proper data quality assurance programmes and activities in this component have still to start.

#### 4.7 Data collection, processing and presentation

Collection and presentation of data by participating national institutions has so far been either on the normal log forms or, in the case of some countries, in completely different format. This latter, in the majority of cases, does not preclude the intercomparison of the basic data but, in many instances, supplementary data which would have been useful to national authorities in the evaluation of results have not been reported.

One major failing is the absence of data on flow-rates and related information in the log forms themselves. This data is necessary to reach an estimate of the total pollution load entering the sea from any particular point-source. The matter is being corrected through incorporation of a modified log form in the guidelines under preparation.

#### 4.8 Utilisation of data

The data received by the Coordinating Unit for the Mediterranean Action Plan so far is not sufficient in itself to enable any general evaluation to be made. It will be useful in the near future, when combined with other information, in the implementation of the survey of pollutants from land-based sources (MED X bis), which is expected to be operational later in 1989.

At the present time, no information is available as to how the data collected is being utilised in the countries in question, particularly in relation to (a) sensitive areas affected by the effluents, and (b) any emission standards in force.

#### 4.9 Proposals for future work

The guidelines for monitoring of land-based marine pollution, together with the relevant reference methods, are expected to be completed in their final draft form by the end of 1989. These will be taken as a basis for reviewing the whole of the pollution source monitoring component of MED POL from the points of view of

- (a) country implementation in relation to national requirements,
- (b) consolidation and harmonisation of the programme.

It is also intended to link this monitoring component as far as possible with the MED X (bis) survey, in order to obtain a better-integrated picture of the situation.

It is important that monitoring of land-based pollutant sources be extended to all countries having signed MED POL agreements. Similarly, information will also be sought from other Mediterranean countries, in order to be able to obtain a more general picture of the situation prevailing within the region.

## 5. MONITORING OF COASTAL AND REFERENCE AREAS

### 5.1 MICROBIAL POLLUTION

Full analysis of data collector in MED POL - Phase II is presented in document "Evaluation of MED POL - Phase II Monitoring Data, Part II - Micro-organisms in coastal areas" (UNEP(OCA)/MED WG.5/Inf.4).

#### 5.1.1 Geographical coverage

Data on microbial pollution has so far been obtained from seven countries (Algeria, Cyprus, Israel, Lebanon, Malta, Morocco and Yugoslavia). In terms of geographical coverage, therefore, these data are restricted to the two small islands of Cyprus and Malta in the eastern and central Mediterranean respectively, the southwestern coastline, part of the eastern coastline, and the eastern Adriatic seaboard. Considering that the bulk of bathing beaches and shellfish areas (which microbial pollution mainly affects) are located elsewhere, the present coverage can in no way be considered as representative of the general Mediterranean picture.

#### 5.1.2 Temporal coverage

In five out of the seven countries submitting data, the period covered is 1983 to 1987. This period would normally be sufficient to estimate whether or not any trend is evident for the group as a whole. Analysis of the results obtained, together with their tentative interpretation, is given in section 5.1.4 below.

#### 5.1.3 Parameters

In the majority of countries, the only parameter measured was faecal coliforms. In some, faecal streptococci and/or to a lesser extent, total coliforms were also measured. In a few instances, pathogenic micro-organisms, mainly salmonellae, were also recorded.

The priority parameters approved for the MED POL monitoring programme include only one microbiological component - faecal coliforms - and monitoring has been restricted, in the main, to this. With a few exceptions, the recommendations contained in the guidelines for monitoring the quality of recreational and shellfish areas, which specify faecal coliforms, faecal streptococci and at least one pathogenic micro-organism (this last to be selected on the basis of local conditions) as the essential elements of a minimum monitoring programme, have not been followed or, perhaps, not reported.

#### 5.1.4 Matrices

##### 5.1.4.1 Coastal recreational areas

During the five-year period under review, a total of 9682 samples of seawater from 289 stations were taken and analysed. The number of "operational" stations in any one year was considerably less, varying between 50 in 1983 and 238 in 1986. An analysis of the data obtained from those stations with a minimum of 6 samples per year (UNEP(OCA)/MED WG.5/Inf.4) shows that the percentage conformity with the interim criteria adopted by the Contracting Parties in September 1985 (50% of the sample below 100 FC/100ml and 90% below 1000 FC/100ml) rose steadily from 78% in 1983 to 96% in 1987. This trend, however, is only apparent, as the number of stations varied from year to year, and it is not possible to show trends with uneven data. Furthermore, the situation cannot be compared to that shown by analysis of the results of the pilot project on coastal water quality control (1976-1980) as, in this latter case, the stations as well as their geographical distribution on an overall Mediterranean basis, were largely different.

It should therefore be stressed that the conformity percentages quoted in outline in this document and explained in more detail in document (UNEP(OCA)/MED WG.5/Inf.4) can have no bearing on the general Mediterranean situation because of the limited number of stations surveyed together with their equally limited geographical distribution. Further, compliance with the interim criteria, which represent only a partial agreement reached through compromise on minimum common acceptability, should in no way be associated with assertions of safety, since quality criteria and standards in a number of individual states (both Mediterranean and otherwise) are higher.

##### 5.1.4.2 Shellfish and shellfish waters

Results for these matrices were reported only by Yugoslavia. Between 1983 and 1987, 11 stations were operational, 245 samples of shellfish and 327 samples of seawater being taken and analysed for faecal concentrations during the period. Evaluation of the shellfish on the basis of the interim criteria proposed by UNEP/WHO but not adopted by the Contracting Parties showed that 75 of the samples (30.6%) would have been classified as unfit for consumption. Evaluation of the water samples on the basis of the interim criteria for shellfish waters adopted by the Contracting Parties in 1987 showed that 2 of the 11 stations (18.2%) would have been considered as unfit for shellfish growing during practically the whole period. It is not easy to correlate the two evaluations, but stress should be laid on the point that classification of an aquatic area as suitable for shellfish growing does not necessarily imply automatic acceptability of the consumable product itself.

##### 5.1.5 Sampling and analytical methods

According to information available, sampling and analysis were generally carried out in accordance with the appropriate UNEP/WHO reference methods. A number of institutions provided incomplete data in this respect, no mention being made of the particular methodology used.

#### 5.1.6 Data quality assurance

It was not considered feasible to carry out an intercalibration exercise on the basis of preparation and distribution of standard samples, owing to logistic problems in connection with the arrival of perishable samples at their destinations in time. As an alternative, a series of six intercalibration exercises were held in different Mediterranean centres between 1982 and 1985 (Rome, 1982; Barcelona, 1983; Athens, Tunis, 1984; Split, Marseille, 1985). Microbiologists from various Mediterranean laboratories attended these activities, in which individual determinations of bacterial parameters in standardised samples of seawater and shellfish were made. Results were generally satisfactory, but there was no assurance that the same quality of data could be obtained in the various "home" laboratories. Moreover, the series of exercises amply demonstrated the pressing need for intensive training programmes, which were commenced in 1988.

#### 5.1.7 Data collection, processing and presentation

In the majority of cases, data were collected by participating laboratories according to prescribed methodology, and submitted on the approved log forms. In many cases, the supplementary data (i.e. general oceanographical and meteorological observations) were lacking. This, however, had no major impact on the main data from the overall viewpoint, although the inclusion of such supplementary data would have been useful in the various countries for correlating actual bacterial readings in sensitive areas with pollution sources. In every case, data was submitted in raw, unprocessed form. It is not known to what extent data was processed in the various national institutions with a view to interpretation and subsequent control action.

#### 5.1.8 Utilisation of data

Data received by the Coordinating Unit for the Mediterranean Action Plan in Athens are utilised for evaluating the overall regional situation, and for detecting trends at this level. The main action-orientated utilisation of the data collected is in the various countries themselves, where results have to be evaluated in relation to their compliance with existing or planned criteria and standards, and the necessary remedial action taken in appropriate cases. It is not known with certainty to what extent MED POL monitoring data is so utilised.

#### 5.1.9 Proposals for future work

The data quality assurance component of microbiological monitoring will have to be considerably enhanced. It is proposed to achieve this by:

- (a) providing more opportunities for individual and group training
- (b) assist institutions to the extent possible in the development and maintenance of the minimum laboratory and field facilities associated with good quality work

- (c) continue updating the series of microbiological reference methods to ensure compatibility with Mediterranean conditions
- (d) possibly supplement the intercalibration component of group training activities by assisting in the organisation of national intercalibration exercises involving the preparation of standard samples by a "central" laboratory, and their analysis by peripheral laboratories.

It is also proposed to review, at individual country level, the current rationale behind microbiological monitoring of coastal recreational and shellfish areas to ensure that programmes serve as a tool for necessary national action.

The microbiological aspect of the research component of MED POL will be further re-oriented to provide data on identified gaps in knowledge required for rational action-orienting monitoring, both common and site-specific. This will include:

- (a) the determination of factors affecting the achievement of accurate results with recommended methodology
- (b) the relation between indicator organisms and pathogens
- (c) the correlation and recognised adverse health effects.

Countries who so require it will be assisted in the processing and interpretation of microbiological data necessary for decision-making relative to existing or planned criteria and standards.

Efforts will continue to be made to acquire relevant microbiological data from all Mediterranean countries, to achieve the capability of evaluating the state of pollution of the region as a whole.

## 5.2 HALOGENATED HYDROCARBONS

Full analysis of data collected in MED POL - Phase II is presented in document "Evaluation of MED POL -Phase II Monitoring Data, Part IV - Petroleum and chlorinated hydrocarbons in coastal and reference areas" (UNEP(OCA)/MED WG 5/Inf.6).

### 5.2.1 Geographical coverage

Figure 2 indicates the sampling stations from which samples (all matrices) were collected and analysed for halogenated hydrocarbons, during 1987, and results were reported to the MED UNIT prior to December 1988. It can easily be seen that the geographical coverage is quite poor. For the period 1982-87, no data have been reported from Egypt, Greece, Israel, Libya, Morocco, Syria and Tunisia (Table II). It must be noted however that many of the above countries have only signed monitoring agreements in the last biennium and that the Israeli

monitoring programme does not include halogenated hydrocarbons as one of the contaminants for monitoring. The data from Algeria, Lebanon, Italy, Turkey and Cyprus are very limited while those from France concern only seawater which is not a priority matrix.

Another point which must be noted is the fact that in many cases sampling locations change almost every year.

#### 5.2.2 Temporal coverage

Only Cyprus, Lebanon, Malta, Spain and Yugoslavia have provided data consistently. Sampling frequency is not constant; it varies from bi-monthly to semi-annually according to the signed monitoring agreements but in actual fact samples are taken at random time intervals. These inconsistencies jeopardize the drawing of conclusions and therefore certain variables must be standardised not only for the country but for the region.

#### 5.2.3 Parameters

##### 5.2.3.1 Present status

In all decisions taken, this group of substances is mentioned as high molecular weight halogenated hydrocarbons and no attempt is made to distinguish between specific compounds.

Table II  
Number of samples analysed for chlorinated compounds.

Year/ Country	Sea water					Sediment					Organisms					Total							
	81	82	83	84	85	86	87	81	82	83	84	85	86	87	81		82	83	84	85	86	87	
Algeria Total	0					0									1	3						4	
Cyprus Total	0			7	6	13									5	1	1	5				25	
Spain Total	0			35	64	20	1								43	17	205	297	1			683	
France Total			134	108		120																242	
Italy Total						0																0	
Lebanon Total						0																8	
Malta Total						0										5						5	
Turkey Total						0									1	17	10	9	10			47	
Yugoslavia Total						0		2	9	16	23	12			2	13	41	43	32			193	
Total	0					62																131	
Samples /Year	0	0	134	108	0	0	0	35	66	29	24	29	12	0	0	45	36	274	357	50	18	1217	
Totals																						242	780



Fig. 2 - STATIONS FROM WHICH SAMPLES (ALL MATRICES) WERE ANALYZED  
FOR HALOGENATED HYDROCARBONS  
ACCORDING TO 1987 NATIONAL MONITORING REPORTS



Data received include analyses on DDT, DDE, DDD, PCBs, dieldrin, aldrin, lindane and hexachlorobenzene. These are not the only high molecular weight halogenated hydrocarbons but they are the ones for which methodology was prepared and emphasis was given in Phase I.

#### 5.2.3.2 Other items of Annexes I and II

Annex I of the LBS protocol includes "organohalogen compounds and substances which may form such compounds in the marine environment, with the exception of those which are biologically harmless or which are rapidly converted into biologically harmless substances" as item 1. Some organohalogen compounds are also included under item 8 concerning carcinogenic, teratogenic and mutagenic substances.

Halogenated hydrocarbons are not included in Annex II since item 2 "biocides" excludes those covered in Annex I.

National monitoring programmes cannot and should not cover all organohalogen compounds mentioned in the annexes. Information on the rare ones will be gathered through pilot surveys and if necessary the research component will also be used.

#### 5.2.4 Matrices

##### 5.2.4.1 Water

At the Cannes meeting (1981) halogenated hydrocarbons were recommended for analysis in estuarine waters only.

At the 1987 Working Group for Scientific and Technical Cooperation meeting, however, halogenated hydrocarbons were recommended for analysis in organisms and sediments only.

Data in seawater have been reported from France for the years 1983 and 1984.

##### 5.2.4.2 Organisms

The analysis of halogenated hydrocarbons in organisms has been recommended by the Cannes (1981) meeting and the 1987 Working Group for Scientific and Technical Cooperation meeting. All countries which have reported data (except France) include data on organisms.

Some mandatory species were recommended by the First meeting of the Working Group for Scientific and Technical Cooperation (1981). The species were a mollusc (eg. Mytilus galloprovincialis), a commercial demersal fish (eg. Mullus barbatus), a pelagic carnivore (eg. tuna or swordfish) a pelagic plankton feeder (sardine or anchovy) and a shrimp (eg. Parapenaeus longirostris).

Eight countries provided 781 data on organisms for the period 1982-87 out of which 575 were on recommended species. Only Spain covered all the recommended species. Data on mussels were provided only by Spain, Yugoslavia and Algeria; data on Mullus sp. were provided by Spain, Cyprus, Malta, Lebanon and Turkey; data on pelagic species by Spain and Malta and data on shrimps by Spain, Malta and Lebanon.

#### 5.2.4.3 Sediments

Halogenated hydrocarbons were recommended for analysis in sediments by both the Cannes (1981) meeting and the 1987 Working Group for Scientific and Technical Cooperation meeting.

Only Spain, Yugoslavia and Cyprus provided such data.

#### 5.2.5 Sampling and analytical methods

During the period covered by MED POL - Phase II, an important transition has occurred in the methodology for the determination of halogenated hydrocarbons with the gradual replacement of packed-column gas chromatographic procedures with those employing capillary columns. The UNEP Reference Method series has reflected this change by testing and introducing a new procedure "Determination of DDT's and PCB's in selected marine organisms by capillary column chromatography (Reference Method no.40)" which complements the earlier publication entitled "Determination of DDT's and PCB's in selected marine organisms by packed column chromatography (Reference Method no.14)". Most of the data in MED POL-Phase II was obtained using the packed column technique following silica column/H<sub>2</sub>SO<sub>4</sub> clean up (Table XII in UNEP(OCA)/MED WG.5/Inf.6), and is thus readily comparable. It is clear that for future monitoring work laboratories should be encouraged to employ the capillary column technique (Reference Method no.40) with the consequent improvement in resolution and data quality that this methodology offers.

#### 5.2.6 Data quality assurance

Analysis of IAEA's worldwide intercalibration exercises over the past decade have shown that data quality for chlorinated hydrocarbon analyses is uniformly rather poor with typical coefficients of variation in the 40-70% range for most parameters. The gradual change to capillary GC techniques appears to be considerably improving this situation however. Fortunately, the exercises carried out within the MED POL programme show that all monitoring laboratories are producing acceptable data (within the consensus confidence intervals of the world-wide exercises) for chlorinated hydrocarbons in biota and 76% of the data are acceptable for sediment measurements. It should be noted, however, that the confidence intervals are rather wide and that the participation of laboratories from the region in the exercises is still insufficient (a total of 15 laboratories have participated during MED POL - Phase II). There is clearly much room for improvement of data quality for these parameters in the region. This situation was recognized in 1987 when the MED POL Quality Assurance programme was set up to provide direct support to monitoring laboratories in this matter. It is too early to evaluate the impact of this programme which encourages the adoption of sound quality control procedures but it is hoped that the on-going intercalibration exercises on Mediterranean sediments and biota will reveal a significant improvement in data quality in the region. For its part, the secretariat will continue to insist on the mandatory nature for monitoring laboratories to participate in IAEA's intercalibration exercises and encourage the use of the UNEP reference Methods (edited at the Marine Environmental Studies Laboratory, MESL of IAEA, in Monaco). Monitoring

laboratories will be able to obtain broad-based technical support from MESL for this work (including training, the provision of standards and reference materials, equipment maintenance and expert advice) and MESL will continue to organize joint sampling and analytical missions for establishing quality assurance programmes in monitoring laboratories where this service is requested.

#### 5.2.7 Data collection, processing and presentation

Only data obtained through official channels are entered into the database. Log-forms for reporting data in marine organisms have been available for a long time and are being used by all countries. Log-forms for sediments have only been adopted at the 1988 Scientific and Technical Committee meeting.

In one case data have been submitted on diskette.

Computerization of the data is based on IBM PC/AT compatible utilizing dBase III plus database software and side products. The relational file structure capability of the software has been exploited intensively to establish and link various aspects of MED POL.

Existing facilities allow :

- (a) the tabular and graphical presentation of the queried data
- (b) on-map presentation of the queried data and input to a GIS application
- (c) a statistical and specialized evaluation analysis of the data.

#### 5.2.8 Utilisation of data

Data collected have been used for the preparation of assessments and any other documents to be presented to the Contracting Parties.

#### 5.2.9 Proposals for future work

- (a) An effort should be made to include halogenated hydrocarbons in all national monitoring programmes to ensure adequate geographical coverage
- (b) A minimum program must be agreed upon to be implemented in every country incorporating the compounds to be analysed, matrices, and sampling frequency
- (c) Sampling frequency should vary according to the type of station

- hot-spot stations - bi-monthly
- general coastal - bi-annually
- trend stations - annually

Needless to stress avoidance of temporal gaps.

- (d) It should be decided which compounds to look for as a minimum requirement. PCBs and lindane should be included. Advanced laboratories could start searching for compounds other than PCBs and DDTs, especially the carcinogenic ones. Pilot surveys could be encouraged for some compounds.
- (e) Biota is a mandatory matrix and every effort should be made to analyse the recommended species. Sediment is an important matrix for trend monitoring.
- (f) Reporting forms should be used which must be completed fully and properly.

### 5.3 PETROLEUM HYDROCARBONS

Full analysis of data collected in MED POL - Phase II is presented in document "Evaluation of MED POL - Phase II Monitoring Data, Part IV- Petroleum and chlorinated hydrocarbons in coastal and reference areas" (UNEP(OCA)/MED WG.5/Inf.6).

#### 5.3.1 Geographical coverage

The geographical coverage for sampling of petroleum hydrocarbons include 6 countries, which are Cyprus, Spain, France, Malta, Turkey, and Yugoslavia. In these countries samples were analysed at various frequencies in the period 1981-87. Furthermore in most of the years only 3 or 4 countries reported data, sometimes only covering one compartment. This geographical coverage is clearly unsatisfactory and does only allow for limited interpretation regarding the overall picture of the petroleum hydrocarbons pollution in the Mediterranean.

#### 5.3.2 Temporal coverage

The temporal coverage for the period 1981-87 is very poor. No countries have analysed samples throughout the whole period for any of the compartments. The most reasonably covered period is 1983-85. Four countries (Cyprus, Malta, Turkey, and Yugoslavia) have provided data with a reasonable frequency. The best temporal coverage has been obtained on analysis of seawater, whereas the temporal coverage for sediments and especially organisms are extremely poor.

#### 5.3.3 Parameters

##### 5.3.3.1 Present status

At the Cannes (1981) meeting it was decided that petroleum hydrocarbons should be monitored in water and sediments; also oil residues (tar-balls) on sea-shores.

It was envisaged that after 3 years polynuclear aromatic hydrocarbons should be monitored in organisms. For estuaries it was envisaged that after 3 years polynuclear aromatic hydrocarbons and oil residues should be measured in water and suspended matter.

The 1987 Working Group for Scientific and Technical Cooperation meeting did not include petroleum hydrocarbons in the category I parameters. It was recommended that floating tar and tar-balls should be monitored as category II parameters; also polynuclear aromatic hydrocarbons in organisms.

Six countries submitted data, all of them covering dissolved/dispersed hydrocarbons in seawater, four of them also monitored sediments and one of them provided in addition 5 analyses on organisms.

#### 5.3.3.2 Other items of annexes I and II of the LBS Protocol

Crude oils and hydrocarbons of any origin appear as item 4 in Annex II of the LBS protocol.

Items 10 and 13 could also include petroleum hydrocarbons.

#### 5.3.4 Matrices

##### 5.3.4.1 Water

The analysis of petroleum hydrocarbons in water has been recommended by the Cannes (1981) meeting. During the monitoring period, data on analysis of seawater have been provided by all the countries which have monitored hydrocarbons, and this compartment has the best temporal and geographical coverage. The 1987 Working Group for Scientific and Technical Cooperation meeting suggested that this type of analysis should be discontinued; instead they recommended the monitoring of floating tar.

##### 5.3.4.2 Organisms

The analysis of polynuclear aromatic hydrocarbons in marine organisms has been recommended by the Cannes (1981) meeting and the 1987 Working Group for Scientific and Technical Cooperation meeting but not as a priority parameter. This type of analysis requires GC techniques.

Only one country reported a few data on this.

##### 5.3.4.3 Sediments

The analysis of petroleum hydrocarbons in sediments has been recommended by the Cannes (1981) meeting and four countries (Cyprus, Spain, Turkey and Yugoslavia) have provided relevant data.

The 1987 Working Group for Scientific and Technical Cooperation meeting considered that monitoring of tar-balls on beaches is more important.

#### 5.3.5 Sampling and analytical methods

Reference Methods for petroleum hydrocarbons in seawater and sediments have been available throughout MED POL - Phase II (IOC Methods and Guides Nos. 11 and 13). These methods are currently being updated to be incorporated in the UNEP Reference Methods series but the modifications

will be relatively minor ones. The simplest detection method employs UV-fluorescence on the sample extracts. Unfortunately laboratories have chosen either chrysene or crude oil for standardizing the method and the results obtained using each of these standards are not readily comparable (chrysene is a much better standard). Sampling strategies may be another significant source of error as the sampling of seawater has to be carefully organized in order to avoid bias from hot-spots or contamination from the sampling vessel. Poor sample handling may also introduce significant errors for sediments. Very few laboratories are using gas chromatographic procedures for the analysis of petroleum hydrocarbons. This is disappointing as information on the more toxic oil components cannot be obtained with the UVF procedure. Much more effort is required on these analyses in the region for future monitoring programmes. By the end of 1989 a full suite of UNEP Reference Methods for petroleum hydrocarbons in seawater, sediments and biota will become available and monitoring laboratories will be encouraged to employ capillary GC techniques where possible.

#### 5.3.6 Data quality assurance

Until 1986 no intercalibration exercises had been carried out in the region for petroleum hydrocarbons. During that year an intercalibration exercise was organized by IOC/IAEA and a training/intercalibration workshop was held in Barcelona. This latter activity made a significant contribution to the monitoring programme as it encouraged participants to intercompare their techniques and analytical results. Results of the petroleum hydrocarbon exercise (in sediments and biota) showed rather large data spread (typically 80% coefficient of variation for the simplest UVF technique). However, it is worth noting that, even in ICES exercises (which have been on-going for almost a decade) 50% of coefficient of variation are common. The critical step in the analysis of PHs is the extraction procedure and more effort is required to improve the analyst's performances in this work. Unfortunately, no standard reference materials (or intercalibration samples) are yet available for dissolved/dispersed petroleum hydrocarbons in seawater and it is difficult to assess data quality for this matrix.

Petroleum hydrocarbons will also be considered in the new Quality Assurance programme (see 5.2.6) and training has already been given on UVF and chromatography techniques to personnel from 3 monitoring laboratories. New intercalibration exercises (biota/sediments) will begin in mid 1989 for this parameter on a regional and inter-regional basis.

#### 5.3.7 Data collection, processing and presentation

The following logforms for reporting data are now available :

petroleum hydrocarbons in seawater, pelagic tar, oil slicks and tar on beaches.

#### 5.3.8 Utilisation of data

The monitoring data are to be used for assessment of oil pollution on a national and regional level in the Mediterranean Region.

### 5.3.9 Proposals for future work

Following proposals for the future monitoring of petroleum hydrocarbons are suggested :

- (a) Precise instructions for reporting of results, including logforms, should be circulated among participating countries in order to harmonize the information and facilitate data evaluation.
- (b) Effort should be made to expand the network of countries providing data on petroleum hydrocarbons, especially regarding sediment and biota.
- (c) Special attention should be given to data quality assurance, including harmonization of sampling and analytical methods and species selection for analysis in biota.
- (d) Efforts should be made to design monitoring programmes to reflect hot-spots, coastal contaminant levels and baselines.

## 5.4 HEAVY METALS

Full analysis of data collected in MED POL - Phase II is presented in document "Evaluation of MED POL - Phase II Monitoring Data, Part III- Heavy metals in coastal and reference areas" (UNEP(OCA)/MED WG.5/Inf.5).

### 5.4.1 Geographical coverage

Fig. 3 indicates the stations from which samples (all matrices) were collected and analysed for heavy metals during 1987. This is based on data reported to the MED UNIT prior to December 1988. For the period 1982-87 only Egypt, Greece, Libya and Tunisia did not provide any data (Table III). Israel, Malta, Spain and Yugoslavia submitted the biggest number of data. From some countries (eg. Italy) the number of data received is very limited. In many cases, sampling locations do not remain constant.

### 5.4.2 Temporal coverage

As in the case of halogenated hydrocarbons there is a big discrepancy between what is promised in the monitoring agreements and what is actually delivered. Sampling frequency in agreements varies from bi-monthly to bi-annually but the reported data show a random sampling for many countries. There are cases where there is intensive sampling in a season and no sampling for the remaining 9-10 months of the year. In most of the cases though there is no gap for any year and most of the data were reported for the years 1984 and 1985.



FIG. 3 - STATIONS FROM WHICH SAMPLES (ALL MATRICES) WERE ANALYZED FOR  
HEAVY METALS ACCORDING TO 1987 NATIONAL MONITORING REPORTS



### 5.4.3 Parameters

#### 5.4.3.1 Present status

The Cannes (1981) meeting agreed that the following heavy metals should be included as priority parameters in the monitoring of coastal (excluding hot-spots) and reference areas (organic mercury is included here for convenience).

- total Hg in organisms
- total Hg in sediments
- cadmium in organisms

It was envisaged that 3 years after, the following should be added:

- cadmium in sediments
- total arsenic in organisms
- selenium in organisms
- lead in organisms
- organic Hg in organisms
- organic Hg in sediments

For estuaries, the heavy metals initially included were:

- total Hg in water
- total Hg in suspended matter
- cadmium in water
- cadmium in suspended matter

Table III

The number of monitoring results submitted to the MED UNIT of heavy metal measurements carried out by national institutions within the framework of the MEDPOL Phase II monitoring programme (Sept. 1988).

Country	Year	Matrix	No. of Samples Analysed		No. of Data	Elements Analysed
Algeria	1979	BI	8		31	Mu, Cu, Zn, Cd, Hg, Pb
	1980	"	9		54	"
	1985	"	27		125	"
	1986	"	33		195	Mn, Cu, Zn, As, Se, Cd Hg, Pb
	Total	BI	77		405	
Cyprus	1983	BI	5		10	Cu, Zn
	1986	"	5		10	"
	1987	"	5		10	"
	Total	BI	15		30	
France	1983	SW	145		357	Cd, Hg
	1984	"	93		186	"
	Total	SW	238		543	
Israel	1982	BI	53		58	Cd, Hg
	1983	"	56		146	Cu, Zn, Cd, Hg, Pb
	1984	SD	22		44	Cd, Hg
		BI	169	191	292	336
	1985	SD	24		46	Cd, Hg
		BI	221	245	714	760
	1986	"	48		218	Fe, Cu, Zn, Cd, Hg, Pb

Table III (continued)

Country	Year	Matrix	No. of Samples Analysed		No. of Data		Elements Analysed	
Israel (cont'd)	1987	SD	26	246	52	1276	Cd,Hg	
		BI	220		1224		Fe,Cu,Zn,Cd,Hg,Pb	
	Total	SD	72	839	142	2794		
		BI	767		2652			
Italy	1987	BI	4		8		Zn, Cd	
Lebanon	1984	BI	24		48		Cd,Hg	
	1986	SD	1	13	1	25	Hg	
		BI	12		24		Cd,Hg	
	1987	SD	14	38	14	62	Hg	
		BI	24		48		Cd,Hg	
	Total	SD	15	75	15	135		
		BI	60		120			
Malta	1984	SW	59	94	373	608	Cu,Mn,Fe,Co,Ni,Cu, Zn,Cd,Hg,Pb	
		SD	12		120			
		BI	23		115		Cu,Zn,Cd,Hg,Pb	
	1985	SW	72	84	720	780	Cr,Mn,Fe,Co,Ni,Cu, Zn,Cd,Hg,Pb	
		BI	12		60		Cu,Zn,Cd,Hg,Pb	
	1986	SW	22	51		220	Cr,Mn,Fe,Co,Ni,Cu, Zn,Cd,Hg,Pb	
		SD	13		130		417	
		BI	16		67		Cu,Zn,Cd,Hg,Pb	
	1987	SW	10	28	100	222	Cr,Mn,Fe,Co,Ni,Cu, Zn,Cd,Hg,Pb	
		SD	8		72			
BI		10	50		Cu,Zn,Cd,Hg,Pb			

Table III (continued)

Country	Year	Matrix	No. of Samples Analysed		No. of Data		Elements Analysed
Malta (cont'd)	Total	SW	163		1413		
		SD	33	257	322	2027	
		BI	61		292		
Morocco	1984	BI		11	11		Cu
	1985	"		20	20		Hg
	Total	BI		31	31		
Spain	1981	SD		40		320	Cr, Mn, Ni, Cu, Zn, Cd, Hg, Pb
		SW	42		126		Cd, Hg, Pb
		SD	110	222	571	977	Cr, Mn, Ni, Cu, Zn, Cd, Hg, Pb
		BI	70		280		Cr, Ni, Cd, Hg, Pb
	1983	SD	62		318		Cr, Mn, Ni, Cu, Zn, Cd, Hg, Pb
		BI	123	185	428	746	Cr, Ni, Cd, Hg, Pb
	1984	SD	70		385		Cr, Mn, Ni, Cu, Zn, Cd, Hg, Pb
		BI	200	270	739	1124	Cr, Ni, Cd, Hg, Pb
	1985	BI		188		704	"
	Total	SW	42		126		
SD		282	905	1594	3871		
BI		581		2151			
Syria	1986	SW		12		48	Cu, Zn, Cd, Pb
Turkey	1983	SW	47		95		Cd, Hg
		SD	17	64	23	118	

Table III (continued)

Country	Year	Matrix	No. of Samples Analysed		No. of Data		Elements Analysed
Turkey (cont'd)	1984	SW	92		196		"
		SD	52	158	86	310	"
		BI	14		28		"
	1985	SW	91		183		"
		SD	57	151	108	297	"
		BI	3		6		"
	1986	SW		23		23	Hg
	Total	SW	253		497		
		SD	126	396	217	748	
		BI	17		34		
Yugoslavia	1983	SW	91		684		Cu, Zn, Cd, Hg, Pb
		SD	54	170	203	960	"
		BI	25		73		"
	1984	SW	94		537		"
		SD	63	251	232	1123	"
		BI	94		354		"
	1985	SW	162		680		Cu, Zn, Cd, Hg, Pb
		SD	56	308	170	1140	"
		BI	90		290		"
	1986	SW	115		357		"
		SD	38	250	72	696	"
		BI	97		267		"
	Total	SW	462		2258		
		SD	211	979	677	3819	
		BI	306		984		

Matrices: SW = sea water; SD = sediments; BI = biota.

After 3 years the following should have been added:

- total arsenic in water
- total arsenic in suspended matter
- organic mercury in water
- organic mercury in suspended matter
- selenium in water
- selenium in suspended matter
- lead in water
- lead in suspended matter

The 1987 Working Group for Scientific and Technical Cooperation meeting reviewed all the monitoring parameters and decided that they should be grouped into two categories according to their priority.

For coastal and reference areas the heavy metals recommended for category I were:

- total Hg in organisms and sediments
- cadmium in organisms and sediments
- organic mercury in organisms

The second category includes only total arsenic in organisms.

The category I heavy metals for estuaries were the following:

- total Hg in organisms and sediments
- total cadmium in organisms and sediments
- organic Hg in organisms

i.e. the same as for coastal areas.

No category II metals were recommended.

As it can be seen from the above, emphasis is given on Hg and Cd but not in seawater.

The data received at the Mediterranean Coordinating Unit include, in addition to Cd and Hg, many other metals such as Cu, Zn, Pb, Mn, As, Se, Fe, Co, Ni and Cr. Countries analysing additional metals include Algeria, Israel, Malta, Spain and Yugoslavia. No mercury data were reported by Cyprus, Italy, and Syria while Cyprus and Morocco did not report any cadmium data. In addition France and Syria reported only data for seawater.

#### 5.4.3.2 Other items of Annexes I and II

Mercury and cadmium with their compounds appear in Annex I of the LBS protocol.

Item 1 of Annex II includes 20 elements which, for our purposes, we are treating as heavy metals. The elements are zinc, copper, nickel, chromium, lead, selenium, arsenic, antimony, molybdenum, titanium, tin, barium, beryllium, boron, uranium, vanadium, cobalt, thallium, tellurium and silver.

As mentioned before, some data have been reported for some of these metals (Zn, Cu, Ni, Cr, Pb, Se, As and Co). Some data have been reported for Mn and Fe which do not appear in neither the black nor the grey lists.

Some data on tin have been obtained through the pilot monitoring exercise on organotin compounds.

Information on the "uncommon" metals will be collected through pilot surveys and if necessary through the research component.

#### 5.4.4 Matrices

##### 5.4.4.1 Water

One third (33%) of the data reported and evaluated refer to seawater even though this matrix is not one of the recommended ones. France and Syria reported only data in seawater.

##### 5.4.4.2 Organisms

The recommended species appear under 5.2.4.2

Almost half of the data (46%) reported and evaluated concern biota but the fact remains as with other contaminants that laboratories analyse many different species, thus making comparability difficult. Algeria, Cyprus, Italy and Morocco reported data only in biota while France and Syria did not report any at all.

##### 5.4.4.3 Sediments

About 20% of the data refer to sediments. Countries which reported data on sediments are Israel, Lebanon, Malta, Spain, Turkey and Yugoslavia.

#### 5.4.5 Sampling and analytical methods

Sampling and analysis for heavy metals has been well covered by the UNEP Reference Method series, and techniques are described for sample preparation (Reference Method no.7), determining trace metals in organisms (Reference Method nos. 8, 9, 10, 11) and in sediments (Reference Method nos.26, 27 and 31-39). The analysis of trace metals in seawater has not been considered in the monitoring of programme owing to the technical difficulty of obtaining good quality and comparable data (ease of contamination, lack of quality control standards). A number of workshops have been held to refine and thoroughly test the techniques.

Despite the availability of these methodologies, a number of problems still prevail. One is to provide technical guidelines for employing sediments for monitoring trace metal contamination. The major problem is that total trace metal concentrations in sediments are highly variable depending upon the mineralogy of the sediments and natural variation can easily be mis-interpreted as contamination. Simple screening techniques (such as partial dissolution with 1M HCl) are presently being tested by MESL, Monaco and by the IOC/UNEP Group of Experts on Methods, Standards and Intercalibration (GEMSI).



A further methodological problem arises in the measurement of organometal contaminants, notably the highly toxic compounds methylmercury and tributyltin (TBT). The analysis of these compounds requires a different approach from total elemental (Atomic absorption spectrophotometric) analyses and hybrid of organic and inorganic analytical techniques are usually employed - organic extraction and detection by gas chromatography or AAS. A Reference Method for Methylmercury in biota has been available for over 5 years (Reference Method no.13) and is presently being updated (a workshop on the technique will be held in October in 1989). In the case of TBT, a Reference Method will shortly become available and has been tested in conjunction with the MED POL pilot monitoring survey for this compound. It is hoped to introduce quality control standards for these substances in 1989 and it is proposed that they should be regularly monitored in future studies.

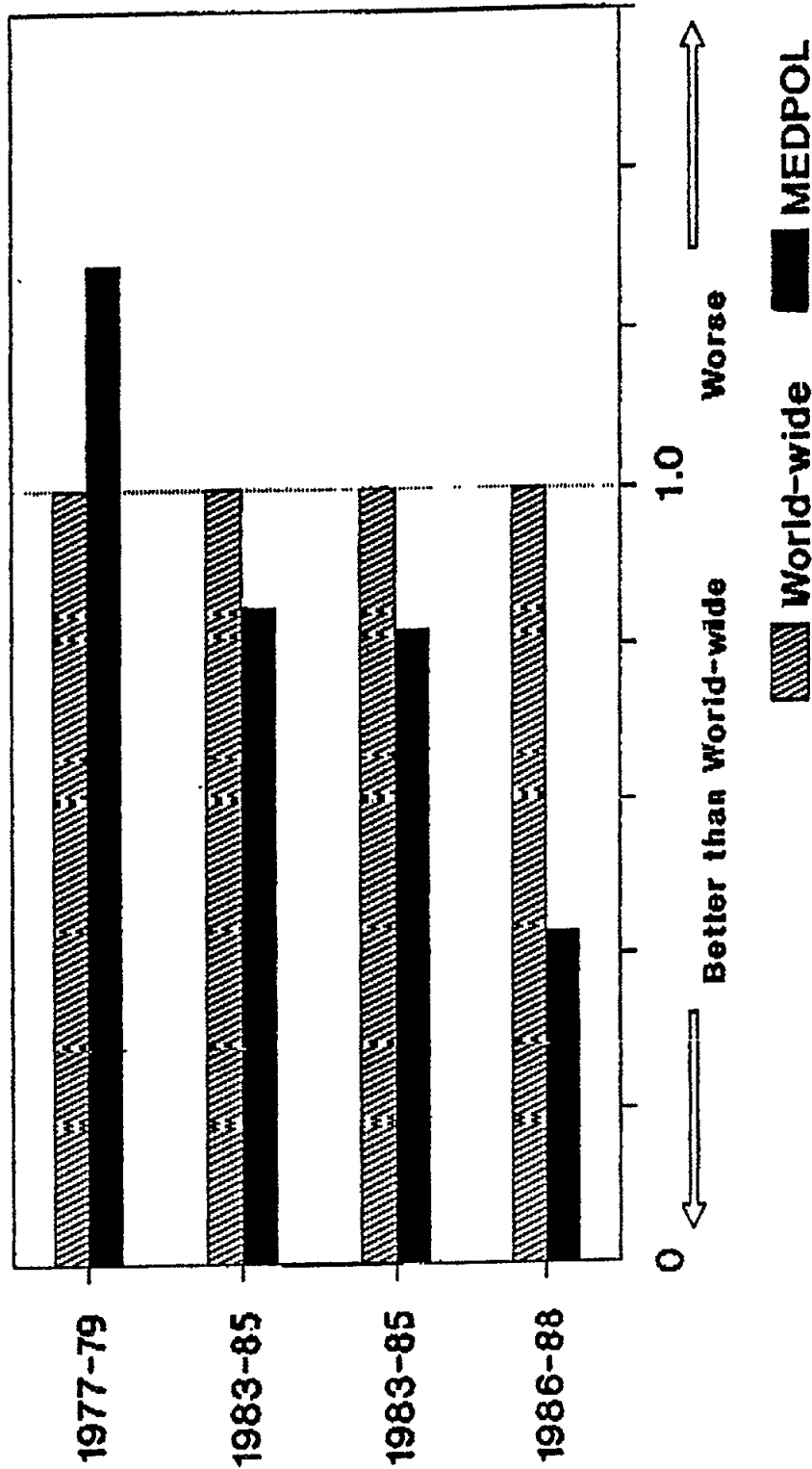
#### 5.4.6 Data quality assurance

As a result of sustained efforts by most MED POL laboratories to improve the quality of their trace metal data during MED POL - Phase II, enormous improvements were achieved. This can be clearly seen from Fig. 4 which illustrates statistically pooled coefficients of variation (a measure of precision) for four intercalibration exercises on homogenized lyophilised biota distributed both worldwide and to MED POL laboratories. The first exercise (before the MED POL programme began) showed that Mediterranean laboratories lagged behind the world average. As the MED POL programme advanced, the data quality improved dramatically. This encouraging result should be considered with caution however. The analytical precision for some critical elements (such as cadmium and lead) is still in need of considerable improvement. More worrying, the participation of monitoring laboratories in intercalibration exercises is inadequate and almost half of the MED POL - Phase II data was unsupported by quality control practices including participation in intercalibration exercises. In the most recent exercises (end of 1988) participation has still not improved. The secretariat (in particular the Marine Environmental Studies Laboratory of IAEA) has made a considerable effort to contact each non-participating laboratory individually in order to encourage them and, in some cases, to offer technical support. Notwithstanding this effort, the obligation to adopt quality control procedures remains a responsibility of monitoring report submitted, described how intra-laboratory analytical data quality control had been applied, if at all.

Endeavours to promote quality control and good laboratory practice will continue in 1989 and beyond. A Reference Method (Reference Method "QA") is currently in revision which will supply monitoring laboratories with detailed instructions on quality control procedures and it is hoped to see further improvements in data quality and participation in intercalibration exercises in future years.

# Trace Metal Data Quality (Marine Biota) MEDPOL and Global Inter-calibration

Fig. 4 -



Pooled coefficient of variation (for Cd, Cu, Hg, Mn, Pb). Normalised to 1 for the world-wide exercise.

#### 5.4.7 Data collection, processing and presentation

Only data obtained through official channels are entered into the database. Log-forms for reporting data in marine organisms have been available for a long time and are being used by all countries. Log-forms for sediments have only been adopted at the 1988 Scientific and Technical Committee meeting.

In one case data have been submitted on diskette.

Computerization of the data is based on IBM PC/AT compatible utilizing dBase III plus database software and side products. The relational file structure capability of the software has been exploited intensively to establish and link various aspects of MED POL.

Existing facilities allow :

- (a) the tabular and graphical presentation of the queried data
- (b) on-map presentation of the queried data and input to a GIS application
- (c) a statistical and specialized evaluation analysis of the data.

#### 5.4.8 Utilisation of data

#### 5.4.9 Proposals for future work

- (a) A minimum programme must be agreed upon to be implemented by every country without deviations. The programme will include the agreed metals to be analysed, matrices and sampling frequency.
- (b) Biota is a mandatory matrix and every effort should be made to analyse the recommended species. Sediments are important for trend monitoring.
- (c) Sampling frequency should vary according to the type of station
- (d) A standard method to be agreed upon for sediment sampling and analysis in order that data reflect better the pollution situation.

### 5.5 NUTRIENTS

#### 5.5.1 Geographical coverage

The geographical coverage for sampling and analysis of nutrients is limited. Only 5 countries (Cyprus, Malta, Yugoslavia, Morocco, and Algeria) are currently submitting data on nutrients, which includes nitrogen and phosphorus. The amount of data submitted do not so far allow for an extended view on the loading of nutrients to the Mediterranean as a whole.

#### 5.5.2 Temporal coverage

The temporal coverage for nutrients is very poor. No countries have submitted data for the entire period. One country has submitted data for the three subsequent years 1985-87 (Yugoslavia). The temporal coverage obtained during the monitoring period does not give sufficient information for any estimation on the development on nutrient enrichment in this region.

#### 5.5.3 Parameters

##### 5.5.3.1 Present status

The submitted data includes two different parameters, N and P content in urban and industrial effluent water and N and P content in coastal water. These two parameters obviously cannot be compared although both parameters give valuable information concerning the nutrient loading of the coastal waters.

##### 5.5.3.2 Other items of annexes I and II of LBS Protocol

#### 5.5.4 Matrices

##### 5.5.4.1 Water

Data on nutrients exist only from water samples. Some countries have only submitted data on nutrient content in effluent water while other have submitted data on nutrient content measured in coastal water samples.

#### 5.5.5 Sampling and analytical methods

Measurement of nitrogen in wastewater was in some cases determined by the phenolate method after workup of the samples by Kjeldahl. Determination of phosphorus in waste waters was in most cases determined by ammonia molybdate after digestion after Kjeldahl. However, other methods have been employed and it must be concluded that no standardized methods has been employed.

Determination of nutrients in sea water was normally carried out by using spectrophotometric methods after sampling with Nansen or Niskin bottles in various depths.

#### 5.5.6 Data quality assurance

No data quality assurance exist on the data provided on nutrients in effluent water and seawater.

#### 5.5.7 Data collection, processing and presentation

#### 5.5.8 Utilisation of data

The data on nutrient levels in effluent water and seawater can be used on a national basis for the determination of legal measures towards discharge of effluent water and to assess potential risks for eutrophication of coastal waters.

The existing data do not provide sufficient information to carry out regional assessments or mass balances.

#### 5.5.9 Proposals for future work

Following proposals for the future monitoring of nutrients are suggested:

- (a) Efforts should be made to harmonise sampling and analytical techniques on the determination of nutrients in effluent water and sea water.
- (b) Special attention should be given to expansion of the existing network of countries and institutions currently measuring nutrients.

### 5.6 PERSISTENT SYNTHETIC MATERIAL

#### 5.6.1 Geographical coverage

The geographical coverage in the currently running pilot monitoring study includes Cyprus, Turkey, Spain, Italy (two stations), and Israel.

#### 5.6.2 Temporal coverage

The pilot study was started in 1988, and some data have been submitted for 1988.

#### 5.6.3 Parameters

The parameter to be determined are persistent synthetic material, also called litter. Persistent synthetic material are normally divided into a number of subgroups, i.e. plastics, styrofoam, fishing gear, glass, metal, rubber, wood, construction material, and clothing.

#### 5.6.4 Matrices

The current study includes only one matrix, namely litter on beaches, and persistent material floating or sinking in the pelagic zone.

#### 5.6.5 Sampling and analytical techniques

The sampling method includes sampling of persistent synthetic material from transects running perpendicular to the beach orientation from the waterline of the back of the beach with a frequency of one month. The collected material is grouped after collection into subgroups and counted.

The pelagic sampling in the pilot experiment is carried out according to an agreed method with nets on a quarterly basis.

#### 5.6.6 Data quality assurance

In the pilot study the same method is employed at all sampling sites and the sampling technique will be evaluated at a training workshop for the participants in the pilot study.

#### 5.6.7 Data collection, processing and presentation

#### 5.6.8 Utilisation of data

The data obtained in the pilot study will be used in a preliminary assessment of the levels of persistent synthetic materials in the Mediterranean and to form the basis for proposals for future work.

#### 5.6.9 Proposal for future work

### 5.7 PHYSICAL OCEANOGRAPHY

#### 5.7.1 Geographical coverage

The number of countries, which have submitted data on physical parameters is limited. So far only Cyprus, Morocco, Malta, and Yugoslavia have submitted data on physical oceanographic parameters.

#### 5.7.2 Temporal coverage

The temporal coverage of physical oceanographic data is poor. Very few time-series of data longer than two years exist. One country (Morocco) has submitted data on conductivity and temperature during the monitoring period 1984-87, and two countries (Malta and Yugoslavia) have submitted data during the period 1985-87. Besides from these examples the submitted data are very scarce.

#### 5.7.3 Parameters

Two physical oceanographic parameters (temperature and conductivity) have been measured and reported.

#### 5.7.4 Matrices

The physical oceanographic observations have entirely been recorded from coastal waters.

#### 5.7.5 Sampling and analytical methods

The measurement of temperature and conductivity have been determined employing standard methods.

#### 5.7.6 Data quality assurance

No particular data quality assurance information is provided.

#### 5.7.7 Data collection, processing and presentation

#### 5.7.8 Utilisation of data

The physical oceanographic data are to be used in facilitating the interpretation of the other monitoring data, as regards distributions and levels in relation to the conditions in the sea (stratification, temperature, water exchange, residence time of water, dispersion conditions, frontal zones, vertical exchange, upwelling).

#### 5.7.9 Proposals for future work

It is suggested that efforts be made to enhance the monitoring of the physical conditions to include at least wind, temperature, salinity and with priority also currents and water levels.

### 6. MONITORING OF AIRBORNE POLLUTION

#### 6.1 Current status

Monitoring of the transport of pollution to the Mediterranean Sea through the atmosphere has constituted a part of the monitoring component of MED POL since its endorsement in 1981 but following the recommendation of the Contracting Parties (UNEP/IG.23/11, paragraph 41), the first phase of this monitoring was implemented within the MED POL research component.

Following the recommendation of the Fourth Ordinary Meeting of the Contracting Parties (Genoa, 9 - 13 September 1985) to initiate in 1986 a pilot project on studying air pollutant deposition into the Mediterranean region and pollutant concentrations in air, the corresponding studies were implemented in several countries (Algeria, France, Italy, Spain and Yugoslavia). Six more countries expressed willingness to participate in the pilot project (Cyprus, Greece, Libya, Morocco, Tunisia and Turkey) but, due to various reasons, were unable to implement the above studies.

The purpose of this type of monitoring is to establish the input (flux) of pollutants into the Mediterranean Sea through the atmosphere and thus to provide additional information on pollution load reaching the Mediterranean Sea (UNEP/WG. 62/3 Rev. 1, 1982).

The detailed monitoring and modelling programme was prepared during the WHO/UNEP Workshop on Airborne Pollution of the Mediterranean Sea (Belgrade, November 1987) and submitted to the First Meeting of the Scientific and Technical Committee (Athens, May 1988) which agreed that "the programme should be initiated within the framework of national monitoring agreements in as many countries as possible on a voluntary basis". The Committee also agreed that an ad hoc expert group on airborne pollution of the Mediterranean Sea be established for reviewing and co-ordinating activities under the programme.

At present National Co-ordinators of four countries (Tunisia, Cyprus, France, Turkey) have confirmed that these countries would implement the monitoring programme (either within MED POL or beyond it).

## 6.2 Proposals for future work

Since this new monitoring component of MED POL is still at the very initial stage the proposals for future work in the Mediterranean countries are connected at present mainly with organizational matters and are the following:

- (a) to nominate monitoring stations for the programme;
- (b) to nominate national research institutions responsible for implementation of the programme
- (c) to include officially the proposed monitoring activities into the national monitoring programme and submit them to the MED Unit.

To assist countries in conducting the airborne pollution monitoring programme, WMO and the MED Unit should arrange the provision of sampling and analyzing equipment (upon request), to distribute guidelines on available reference methods, to prepare and distribute formats for data reporting, to provide, if necessary, technical assistance and consultant services.

## 7. RECOMMENDATIONS

### 7.1. SOURCES OF POLLUTION

- (a) All countries participating in the MED POL monitoring programme should monitor sources of pollution.
- (b) Stations in national monitoring programmes should be located in such a manner that major sources of pollution (cities above 10,000 inhabitants, big touristic complexes, rivers, major industries) are covered.
- (c) Guidelines for monitoring of land-based marine pollution, together with relevant reference methods should be completed by the end of 1989 in order to be used in 1990.

### 7.2. COASTAL AND REFERENCE AREAS

#### 7.2.1. Microbial pollution

- (a) Efforts should be made by the MED Unit and respective countries in order to improve geographical coverage of microbiological pollution, in particular in the south of the Mediterranean.
- (b) The rationale behind on-going microbial pollution monitoring programmes at country level should be reviewed in order to ensure that each programme serves as a tool for national action.



- (c) A coordinated effort should be made by the MED Unit, the National Co-ordinators for MED POL and all participating centres to follow recommended reference methods, adopted reporting formats and agreed procedure for data submission.
- (d) Participating Centres should be encouraged to utilize the methodology adopted by the MED Unit to interpret and evaluate microbiological data.
- (e) Data quality assurance programme of microbiological monitoring should be enhanced in order to ensure reliability and comparability of the data.

#### 7.2.2. Halogenated and petroleum hydrocarbons and heavy metals

- (a) Efforts should be made by the MED Unit and the Mediterranean countries to ensure adequate geographical coverage of monitoring, in particular in the south of the Mediterranean.
- (b) A coordinated effort should be made by the MED Unit, the National Co-ordinators for MED POL and all participating centres to follow adopted reporting formats and agreed procedure for data submission.
- (c) A minimum programme must be agreed upon to be implemented in every country.
- (d) Sampling frequency should vary according to the following types of stations:
  - hot-spot stations - bi-monthly
  - general coastal - bi-annually
  - trend stations - annually
- (e) Participation in the intercalibration exercise should be mandatory for all participating laboratories.
- (f) Intra-laboratory analytical data quality control against laboratory standards should be regular practice.
- (g) Only laboratories participating in an intercalibration exercise and having validated their methods should take part in MED POL Monitoring activities .
- (h) Biota should be a mandatory matrix for halogenated hydrocarbons and heavy metals and every effort should be made to analyze the recommended species. Monitoring of biota should be focused on the most common indicator species, which are Mytilus, Mullus, Parapeneaus and the pelagic tuna and/or sword fish. Sediment should be an important matrix for trend monitoring and more efforts should be devoted to sediment surveys.

### 7.3. MONITORING OF AIRBORNE POLLUTION

(a) Since this new monitoring component of MED POL is still at the very initial stage the recommendations for future work in the Mediterranean countries are connected at present mainly with organizational matters and are the following:

- to nominate monitoring stations for the programme;
- to nominate national research institutions responsible for implementation of the programme;
- to include officially the proposed monitoring activities into the national monitoring programme and submit them to the MED Unit.

### 7.4. DATA QUALITY ASSURANCE

(a) In addition to the recommendations concerning data quality assurance which appear above under points 7.1 and 7.2 the intention of the MED Unit is to prepare and implement National Data Quality Assurance programmes which will include workplan and timetable for intercalibration, training, scientific and technical visits and other details.

### 7.5. DATA COLLECTION, PROCESSING AND PRESENTATION

- (a) In order to process and present data, collected in the Mediterranean Unit, in faster and more efficient way the intention of the secretariat is to assist countries, through direct assistance for monitoring activities, that data and reports be communicated from countries to the Mediterranean Unit in agreed uniform format, initially on diskettes and later through network facilities.
- (b) In order to improve capabilities of countries for processing and presentation of data the intention of the secretariat is to supply countries with appropriate software.