



United Nations  
Environment  
Programme



UNEP(OCA)/MED WG.5/Inf.4  
14 February 1989

Original: ENGLISH

---

**MEDITERRANEAN ACTION PLAN**

Meeting of responsible investigators  
of monitoring programmes

Athens, 20-23 March 1989

EVALUATION OF MED POL - PHASE II MONITORING DATA

Part II - Micro-organisms in coastal areas

The present document was prepared by Dr R. Mujeriego in his capacity of UNEP/WHO consultant. The views expressed in the document are those of the author and do not necessarily represent the views of either UNEP or the MED POL Co-operating Agencies. The designations employed and the material in this document do not imply the expression of any opinion whatsoever on the part of UNEP or the MED POL Co-operating Agencies concerning the legal status of any state, territory, city or area, or of its authorities, or concerning the delimitation of their frontiers or boundaries.



United Nations  
Environment  
Programme



UNEP(OCA)/MED WG.5/Inf.4  
14 February 1989

Original: ENGLISH

---

**MEDITERRANEAN ACTION PLAN**

Meeting of responsible investigators  
of monitoring programmes

Athens, 20-23 March 1989

EVALUATION OF MED POL - PHASE II MONITORING DATA

Part II - Micro-organisms in coastal areas

TABLE OF CONTENTS

	<u>Page No.</u>
1. INTRODUCTION	1
2. OBJECTIVES	2
3. DATA REPORTING	3
4. DATA INTERPRETATION AND EVALUATION	3
5. INTERIM EVALUATION OF MICROBIOLOGICAL DATA	4
6. QUALITY CONTROL	6
7. CULTURE MEDIA	8
8. WATER QUALITY CRITERIA AND STANDARDS	9
9. PROMOTION OF BATHING WATER QUALITY CERTIFICATION	10
10. SCIENTIFIC AND TECHNICAL COOPERATION	11
11. CONCLUSIONS	12
12. RECOMMENDATIONS	13
13. REFERENCES	15

## 1. INTRODUCTION

Microbiological surveillance of Mediterranean coastal waters has been a basic component of the MED POL Programme since it began in 1975. During MED POL-Phase I, Pilot Project MED VII on "Coastal Water Quality Control" was established with the main objective of obtaining statistically significant data, scientific information and technical principles required to assess the microbiological pollution of coastal waters, especially as it concerned human health (UNEP, 1983; WHO/UNEP, 1981).

The microbiological data collected from 1976 to 1981 provided the basis for a preliminary evaluation of the quality of recreational waters and shellfish-growing waters in the Mediterranean Sea. The water quality assessment made according to the WHO/UNEP interim environmental quality criteria (Mujeriego, 1983; WHO/UNEP, 1983, 1985) gave further support to the microbiological limits proposed at that time and pointed out the differences between the results of that assessment and those obtained on the basis of the microbiological limits set forth in the EEC Directive 76/160 (CEC, 1976).

MED POL-Phase II was developed on the principle that monitoring of microbiological pollution of the Mediterranean Sea should reflect primarily the immediate and long-term requirements of the Barcelona Convention and its related protocols. In this context, faecal coliforms were chosen as priority parameters for monitoring recreational waters and edible bivalves under the direct influence of pollutants from identifiable primary or secondary sources (UNEP, 1983).

Based on the experience gained during MED POL-Phase I, new microbiological data reporting forms were elaborated to ensure efficiency and harmonization of data processing during MED POL - Phase II. Furthermore, a preliminary Reference Method for the Evaluation and Interpretation of Microbiological Data was prepared by WHO and UNEP to provide a common and systematic methodology for processing the data collected.

The MED VII Pilot Project indicated the need to ensure that the microbiological results obtained by Mediterranean laboratories were reliable and comparable. As a result, a series of 6 intercalibration exercises were carried out in the Mediterranean Region between 1982 and 1985. A review of these intercalibration exercises (Mujeriego, 1986) clearly pointed out the utmost importance of implementing a quality control programme among Mediterranean laboratories to ensure the reliability and comparability of microbiological data collected during MED POL-Phase II.

Following the proposal of common measures by UNEP/WHO (1983, 1985), the Fourth Ordinary Meeting of Contracting Parties to the Barcelona Convention, held in Genoa in September 1985, approved interim environmental quality criteria for bathing waters in the Mediterranean. These criteria corresponded with the faecal coliform limits proposed by WHO/UNEP, but did not include faecal streptococci. Insofar as faecal coliforms were concerned, the criteria were the same previously used to evaluate the microbiological data obtained during MED POL-Phase I.

In 1988, the Council of the European Communities published the report on the "Quality of Bathing Water: 1983-1986". The report included an evaluation of recreational coastal waters in several member states, among them, some of the Mediterranean states participating in the Action Plan. Conformity to the bacteriological limits of the Directive 76/160 is determined on the sole basis

of the Mandatory (I) limits for faecal indicators. In this manner, the report offered a practical answer to the long discussions held between member states officials and European Commission representatives on the correct interpretation of Article 5 of the Directive 76/160.

Meanwhile, the European Blue Flag Programme, sponsored by the Commission of the European Communities since 1987, has raised increasing interest from both coastal resort towns and tourists, as they consider the European Blue Flag award an official recognition of the satisfactory quality of bathing waters.

The bathing water quality evaluation conducted at the end of MED POL-Phase I, as well as that made by the Commission of the European Communities in 1988 and that considered by the European Blue Flag Programme since 1987, all rely on the assumption that microbiological data provided by member states' laboratories are reliable and comparable. However, considering that there is no quality control programme for microbiological laboratories at either Mediterranean or European level, and taking into account the conclusions of the 6 intercalibration exercises held in the Mediterranean Region between 1982 and 1985, it is most likely that microbiological data currently available are not comparable and consequently their overall evaluation has a limited value.

In the midst of all these scientific, technical, regulatory and promotional activities, the Coordinating Unit for the Mediterranean Action Plan in Athens has been receiving microbiological data from Mediterranean states, as part of the monitoring activities they are carrying out in the framework of MED POL-Phase II. An evaluation of these data will contribute to the advance of the MED POL Programme objectives, will provide an opportunity for improving data processing methods in the Mediterranean Region, and will help to compare the evaluation conducted according to interim environmental quality criteria adopted, with evaluations made using different bathing water quality criteria and standards.

## 2. OBJECTIVES

The main objectives of this study were to review the microbiological data on coastal water quality collected within the framework of MED POL-Phase II between 1983 and 1987, and to carry out an interim evaluation of these results.

The specific objectives of this study were:

1. To evaluate the system currently employed by the Coordinating Unit in Athens for processing the above data, and to make appropriate recommendations;
2. To examine the compatibility of data, including the interpretation and evaluation of results, received from Mediterranean states, particularly Italy, France and Spain, when using processing and interpretation systems other than those used in MED POL, and to advise on methods to ensure harmonization.

### 3. DATA REPORTING

Data reporting forms developed during MED POL-Phase I for monitoring microbiological quality of coastal waters were reviewed and modified for use in MED POL-Phase II. Experience gained during the MED VII Pilot Project helped to make the new forms easier to complete and more adequate for systematic recording of chronological data. Although there were still some elements infrequently measured and others of limited interest, the new forms provided a considerably higher degree of harmonization and simplicity in microbiological data reporting.

Microbiological results received by the MED Unit in Athens since 1983 still show a considerable lack of uniformity in the reporting format. The reporting forms recommended have not been widely adopted by Mediterranean laboratories participating in MED POL-Phase II. In some cases, data is reported in a tabular format quite different from that recommended. Furthermore, relevant information is frequently included in attached reports, from which it has to be retrieved with considerable difficulty, due to incomplete description of the sampling stations or the analytical methodology adopted.

These inconsistencies in data reporting, together with the delays experienced by some Mediterranean states in sending their results, have required a considerable effort on the part of the MED Unit in Athens for sorting out and organizing the relevant information necessary for a subsequent interpretation and evaluation of microbiological data.

The MED Unit in Athens has developed a data base management programme for use in personal computers which allows a systematic recording and retrieval of all the microbiological data provided by Mediterranean states during MED POL-Phase II. The microbiological data base currently available in the Unit represents a major progress in data processing within MED POL-Phase II, and provides a sound basis for the systematic interpretation and evaluation of bathing water quality in the Mediterranean Region.

In summary, a coordinated effort will have to be made by the MED Unit in Athens, the National Coordinators for MED POL and all participating centres to further specify reporting procedures and to strongly promote their adoption by Mediterranean laboratories. In this way it will be possible to improve the efficiency of monitoring efforts and the reliability of the information obtained.

The overall evaluation of the microbiological data collected between 1983 and 1987 will provide an opportunity for defining any modification to be made on the reporting forms currently used, as well as for establishing those aspects to be further specified to participating laboratories and National Coordinators, to ensure that recommended reporting protocols are followed by all participants.

### 4. DATA INTERPRETATION AND EVALUATION

Results and reports provided by Mediterranean states generally include the basic microbiological data obtained from monitoring bathing water quality, without any attempt to interpret them according to the interim environmental quality criteria.

Reference Method for Pollution Studies No. 1 "Guidelines for Monitoring the Quality of Coastal Recreational and Shellfish-Growing Waters" includes a brief section on data evaluation and processing. However, the delays experienced in publishing both the final version of this Reference Method as well as the first version of the Reference Method on "Evaluation and Interpretation of Microbiological Data from Coastal Areas and Shellfish-Growing Waters" have not contributed to the adoption of common interpretation and evaluation methods among Mediterranean laboratories.

However, all the microbiological data reported by Mediterranean states are being processed by the MED Unit in Athens using the methodology described in the two Reference Methods previously mentioned. These interpretation and evaluation methods are the same as those adopted for processing the microbiological data obtained during MED POL-Phase I, between 1976 and 1981. The interpretation method is based on the adjustment of a log-normal probability distribution to the set of experimental results obtained in a sampling station. The evaluation method consists in comparing the relevant quality criteria with the corresponding distribution percentiles.

These methodology has been incorporated into a computer programme, entitled AQUA MARE, for use in a personal computer. Although the current version of this programme only allows data evaluation according to the interim Mediterranean environmental quality criteria, subsequent versions will also allow data evaluation according to the microbiological limits specified by EEC Directive 76/160.

##### 5. INTERIM EVALUATION OF MICROBIOLOGICAL DATA

The interim evaluation of the microbiological data collected within MED POL-Phase II has been based on the results available at the MED Unit in Athens up to December 1988.

The microbiological data available correspond to seven Mediterranean states: Algeria, Cyprus, Israel, Lebanon, Malta, Morocco, and Yugoslavia. The results include basically the faecal coliform concentrations of recreational coastal waters at selected sampling stations, as required by MED POL-Phase II monitoring agreements.

Some Mediterranean states have also reported the total coliform and faecal streptococci concentrations of some of the sampling stations surveyed. This additional information offers an opportunity for a subsequent comparison between the evaluation criteria used in MED POL and that used by the Commission of the European Communities.

The microbiological results received up to now at the MED Unit in Athens do not include any of the four Mediterranean states belonging to the European Communities: France, Greece, Italy, and Spain. As a results, it was not possible to carry out a comparative evaluation between the water quality assessments obtained with the interim Mediterranean criteria and the standards set forth in EEC Directive 76/160.

Table 1 summarizes the maximum number of sampling stations surveyed yearly in each Mediterranean state. These results illustrate the different effort made by Mediterranean states in the surveillance of coastal water quality. The total number of sampling stations surveyed is still considerably



lower than the 700 sampling stations surveyed during MED POL-Phase I (Mujeriego, 1983). However, this difference will be considerably reduced and probably exceeded when the results from Mediterranean states members of the European Communities are made available.

Table 1

Maximum number of sampling stations surveyed in one year during the 1983-1987 period of MED POL-Phase II.  
Data available by December 1988.

State	Stations surveyed
Algeria	19
Cyprus	125
Israel	43
Lebanon	8
Malta	11
Morocco	2
Yugoslavia	<u>81</u>
Total	289

The uneven geographical distribution of the sampling stations surveyed and the lack of information from Mediterranean states carrying out extensive monitoring programmes in recreational coastal waters does not at this time allow evaluation of the microbiological quality of coastal waters in the Mediterranean from a general point of view.

Table 2 summarizes the number of water samples analyzed during the 1983-1987 period by seven Mediterranean states. Those results illustrate the considerable progress made by most of these in frequency of the analyses. The number of samples taken at a given sampling station varies from 13 to 17, with an overall average of 15 samples per station and per year. This result compares very favourably with both the average value of 10 samples per station and per year, and the wide variation of frequencies registered during MED POL-Phase I.

Table 2

Water samples analyzed during the 1983-1987 period of MED POL-Phase II.  
Data available by December 1988.

State	Water samples analyzed
Algeria	60
Cyprus	3 182
Israel	2 667
Lebanon	243
Malta	241
Morocco	54
Yugoslavia	<u>3 235</u>
Total	9 682

The log-normal probability distribution method adopted for interpreting the results available appears to be adequate for the great majority of the sampling stations.

Table 3 summarizes the number and frequency of sampling stations conforming to the interim criteria. Only sampling stations with at least 6 samples per year have been included in this evaluation. However, as Table 3 indicates, practically all the stations considered have been surveyed more than 10 times per year, and thus allow a comparison of these results and those obtained at the end of MED POL-Phase I appearing in Table 4.

The results in Table 3 indicate that the proportion of sampling stations conforming to the FC50 limit of the interim criteria is slightly larger than that conforming to the FC90 limit of these criteria. In general, this second limit determines whether a sampling station conforms or not to the interim criteria.

The proportion of sampling stations conforming to the interim criteria varies annually from 78 to 96%. However, this latter value corresponds to a limited number of sampling stations, most of which belong to a single Mediterranean state and conform to the interim criteria. The inclusion of these results brings to 85% the overall proportion of sampling stations conforming to the interim criteria over the 1983-1987 period. A similar analysis, but only considering the results of the 1983-1986 period, brings that proportion to 82% of the sampling stations.

A comparison between the results shown in Tables 3 and 4 indicate that the proportion of sampling stations conforming to the interim criteria during the MED POL-Phase II (1983-1987) is slightly higher than the corresponding value for the MED POL-Phase I (1976-1981).

However, the uneven distribution of the sampling stations considered in this interim evaluation of the MED POL-Phase II and, particularly, the lack of information from several Mediterranean states with large monitoring programmes on coastal water quality, do not allow the reaching of definite conclusions on the possible trends observed in coastal water quality over the two phases of MED POL.

## 6. QUALITY CONTROL

Quality control of the microbiological data obtained in the framework of MED POL-Phase II was initiated with a series of 6 intercalibration exercises on microbiological methods for coastal water quality monitoring, that took place in the Mediterranean Region between 1982 and 1985. These exercises were organized by Mediterranean research centres in Rome, Barcelona, Athens, Tunis, Split and Marseille, under the joint coordination of WHO and UNEP.

A review of the experimental results obtained and the conclusions reached at these intercalibration exercises (Mujeriego, 1986) pointed out that:

1. The membrane filtration (MF) method gives more precise results than the multiple-tube (MPN) technique.
2. The MF method and the MPN method give comparable results when analyzing for total coliforms and faecal coliforms, using the culture media adopted in these exercises.

3. The MF method and the MPN method give comparable faecal streptococci results when using the M-Enterococcus agar and the Rothe and Litsky broths, respectively.
4. There is considerable evidence, both in the Mediterranean Region and elsewhere, that the MF method using KF-Streptococcus agar gives significantly higher concentrations than the MPN method using the Rothe and Litsky broths.
5. The analytical determination of microbial indicators for coastal water quality monitoring needs to be further standardized among Mediterranean laboratories and be submitted to a continuous quality control programme to ensure that results obtained by different laboratories are reliable and comparable.

Table 3

Preliminary evaluation of the microbiological quality of recreational waters in the Mediterranean according to the interim Mediterranean environmental quality criteria. Sampling stations with at least 6 samples per year. MED POL Phase II: 1983-1987.

Year	Samples analyzed	Stations surveyed	Average sampling frequency	Sampling stations conforming to		
				FC50	FC90	FC50 & FC90
1983	524	50	10	43 (86%)	39 (78%)	39 (78%)
1984	1 755	133	13	120 (90%)	111 (83%)	108 (81%)
1985	2 178	128	17	115 (90%)	104 (81%)	102 (80%)
1986	3 048	238	13	216 (92%)	200 (84%)	200 (84%)
1987	1 908	150	13	145 (97%)	145 (97%)	144 (96%)
Total	9 413	699	15	639 (91%)	599 (86%)	593 (85%)

Table 4

Summary assessment of the microbiological quality of recreational waters in the Mediterranean according to the interim Mediterranean environmental quality criteria. MED POL Project VII sampling stations with at least 10 samples per year. (WHO/UNEP, 1983,1985)

Year	Stations surveyed	Sampling stations conforming to		
		FC50	FC90	FC50 & FC90
1976	21	16 (76%)	14 (67%)	14 (67%)
1977	40	38 (95%)	34 (85%)	34 (85%)
1978	33	30 (91%)	30 (91%)	28 (85%)
1979	133	124 (93%)	104 (78%)	104 (78%)
1980	86	79 (92%)	72 (84%)	69 (80%)
Total	313	287 (92%)	254 (81%)	249 (80%)

Considering the practical implications of these results on the assessment of coastal water quality, it was recommended that intercalibration of analytical methods for microbial indicators should be further continued in the Mediterranean Region to ensure the reliability and comparability of the results obtained within MED POL-Phase II. The review study also recommended that additional training of Mediterranean microbiologists should be pursued to ensure that analytical methods are fully understood and strictly applied.

In spite of the considerable interest raised by these intercalibration exercises among Mediterranean microbiologists and the MED Unit in Athens, no quality control programme has been implemented in the Mediterranean Region up to date, either on a state or on a regional basis. However, public health authorities in some Mediterranean states have initiated preliminary quality controls to evaluate comparability of results among national laboratories and to determine the adequacy of alternative methods for analyzing faecal indicators.

Without the existence of any quality control programme at a regional level in the Mediterranean, it is not possible to assess the degree of comparability and reliability of the microbiological data provided by Mediterranean states. Natural changes taking place in coastal environments can account for most of the variations observed in the microbiological quality of bathing waters, both in consecutive concentrations of a given indicator as well as in the relative proportions of two indicators.

Although continuing training of Mediterranean microbiologists should contribute to a better understanding and application of the recommended analytical methods, the only way to ensure the reliability and comparability of the data obtained would be to implement a systematic quality control programme among participating laboratories.

The experience gained in a preliminary quality control programme conducted at a small scale in the Mediterranean Region (Mujeriego, 1985) should provide useful guidance when establishing a larger scale quality control programme.

## 7. CULTURE MEDIA

The comparability of microbiological results obtained by different laboratories has a strong dependence on the culture media adopted for the analyses. Among the culture media currently available for faecal indicator determination, those commonly used for analysis of faecal streptococci, KF-Streptococcus agar and M-Enterococcus agar, seem to produce significantly different results.

Since 1986, a number of comparative studies have been conducted between culture media for analysis of faecal streptococci. The studies conducted in the coasts of Israel (Yoshpe Purer, 1988) and Spain (Feliú and co-workers, 1988), as well as those in Italy (Volterra, 1988), Malta (Gauci, 1988) and Yugoslavia (1988), all within the framework of the MED POL-Phase II Programme, clearly indicate that KF-Streptococcus agar gives a considerable number of false positives, while M-Enterococcus agar generally underestimates the number of faecal streptococci in a water sample. As an example, faecal streptococci concentrations obtained in the coastal waters of Tarragona were from 5 to 100 times higher than the corresponding enterococci concentrations.

The importance of these results cannot be overemphasized considering the growing interest among Mediterranean public health authorities in using faecal streptococci as an additional indicator to the faecal coliforms generally used. These results are also of special interest to EEC member states as Directive 76/160 specifies a Guide (G) limit for faecal streptococci which has to be satisfied in those coastal waters wishing to receive the European Blue Flag award.

Although it is considered that neither of these two culture media offers ideal precision, it is becoming increasingly evident that M-Enterococcus agar is probably the more adequate for analysis of faecal streptococci.

## 8. WATER QUALITY CRITERIA AND STANDARDS

The work carried out during MED POL-Phase I provided the basis for establishing interim environmental quality criteria to evaluate bathing waters in the Mediterranean Sea. The original proposals, based on the assessment of the data collected during MED POL-Phase I (WHO/UNEP, 1983, 1985), included quality criteria in terms of faecal coliforms and faecal streptococci. However, the interim environmental quality criteria for bathing waters approved during the Extraordinary Meeting of the Contracting Parties to the Barcelona Convention, held in Genoa in September 1985, were exclusively based on faecal coliforms, as summarized in Table 5.

Table 5

Interim quality criteria adopted by Mediterranean States for recreational coastal waters in the Mediterranean Sea, and bacteriological limits set forth in the EEC Directive 76/160, concerning the quality of bathing waters.

---

---

Interim criteria (UNEP 1985)

FC50 = 100 FC/100 ml

FC90 = 1 000 FC/100 ml

Quality standards, Directive 76/160 (CEC, 1976)

Mandatory values (I)

TC95 = 10 000 TC/100 ml

FC95 = 2 000 FC/100 ml

Guide values (G)

TC80 = 500 TC/100 ml

FC80 = 100 FC/100 ml

FS90 = 100 FS/100 ml

---

In spite of the years that have passed since the beginning of the Mediterranean Action Plan in 1975, it has not yet been possible to establish an adequate evaluation of the quality of Mediterranean recreational coastal waters. The evaluation conducted at the end of MED POL-Phase I provided a preliminary assessment of such quality. The data being received in the MED Unit in Athens, covering the period from 1983 to 1987, should allow for an updating and extension for the assessment then made.

Four Mediterranean states which are also members of the European Communities, consequently have to comply with the limitations set forth in Directive 76/160 (CEC, 1976) concerning the quality of bathing waters in all EEC member states. These bacteriological limits are summarized in Table 5.

The European Commission has faced considerable difficulties in obtaining the comprehensive reports that member states have to submit in accordance with Article 12 of the Directive. The delays of member states in reporting the results of their monitoring programmes, and the inclusion of incomplete results in the relevant reports, have not allowed the Commission to comply with the provisions of the Directive regarding the extension and deadlines specified in it (IPEE, 1986; EIW, 1987).

The Council of the European Commission report on "Quality of Bathing Waters: 1983-1986" (CEC, 1988) represents a considerable advance on its objective of documenting and evaluating the quality of the Communities' bathing waters. One has to stress the great progress made by some member states when preparing detailed maps of their sampling network, in which it is possible to identify their degree of conformity to the limits set forth by the Directive.

One of the most significant aspects in the Commission report is the definition of the criteria adopted for establishing conformity with the microbiological limits of the Directive: conformity with the bacteriological limits is based on the Mandatory (I) values for total coliforms and faecal coliforms appearing in Table 5. This observation provides an indirect, but definite answer to the numerous questions raised by Article 5 of the Directive among member states officials, as evidenced during the two seminars held to evaluate the implementation of the Directive (IPEE, 1986; EIW, 1987). With this point of controversy apparently settled, one can expect the implementation of the Directive to progress at an increased pace.

As has been previously mentioned, the MED Unit in Athens has experienced considerable difficulties in processing the microbiological data received from Mediterranean states due to the heterogeneous protocols used by participating laboratories for reporting the results. As has also been indicated, a coordinated effort will have to be made by the MED Unit in Athens, the National Coordinators for MED POL and Mediterranean laboratories to further specify and follow recommended reporting procedures.

Similarly, the Commission of the European Communities will have to establish more homogeneous and systematic criteria for evaluating the reports submitted by member states, and member states will have to put in more effort in preparing their annual reports, if the annual reports of the Commission are to conform not only to the letter, but also to the spirit, of the Directive.

## 9. PROMOTION OF BATHING WATER QUALITY CERTIFICATION

The proposal to establish a certification programme for Mediterranean beaches was suggested on several occasions during the MED VIII Pilot Project of MED POL-Phase I. However, the significant difficulties encountered in ensuring the reliability and comparability of the results obtained by Mediterranean laboratories prevented this proposal from becoming a reality. Although the implementation of such a programme through WHO and UNEP offered the advantage of an objective qualification process, it also raised the

difficulty of these United Nations agencies becoming involved in a decision-making process with so many implications for Mediterranean states, particularly in a field with as many economic consequences as tourism.

During 1985 and 1986, the French Ministry of Environment established the Blue Flag Programme to promote the quality of beaches among tourist resort towns. Two of the basic criteria considered in the awarding process were: (1) bathing waters had to conform to the bacteriological Guide (G) limits of Directive 76/160, and (2) the effort made by municipalities on coastal water pollution control had to be above the national average. This promotion programme received considerable interest from French coastal municipalities, news media and public opinion. The success of this experience prompted its extension to all EEC member states in 1987, when the first European Blue Flags were awarded.

The number and the characteristics of some of the Mediterranean beaches awarded with the European Blue Flag in 1987 and 1988 reveal that the microbiological quality of bathing waters did not have the determining role established in the selection criteria. The critical views expressed in the news media of several Mediterranean states clearly show the urgent need to approach this European programme on a more rigorous technical basis.

A recent presentation by the responsible officer of the French Section of the Foundation for Environmental Education in Europe (July, 1988) showed the interest in reinforcing the quality control of the bacteriological data used in the selection process of the European Blue Flag Programme.

It is in this context that a close collaboration between the Commission of the European Communities, sponsor of the European Blue Flag Programme, and the MED Unit in Athens should contribute to the implementation of a large scale quality control programme capable of ensuring the reliability and comparability of the microbiological data being produced by Mediterranean and European laboratories.

If there is no effective response to the real challenge facing Mediterranean and European laboratories to obtain comparable and reliable results, one can easily understand the difficulties in assessing the quality of bathing waters at a regional scale as well the risk of discredit, both at national and international level, in which the European Blue Flag Programme can incur when this Flag is awarded to bathing waters of inadequate aesthetic and sanitary quality.

## 10. SCIENTIFIC AND TECHNICAL COOPERATION

The adoption of common methodology for reporting, interpreting and evaluating microbiological data, the evaluation of culture media for faecal indicator analysis, the training of microbiologists in such analysis, and the implementation of a quality control programme for bacteriological analyses are four excellent subjects for a close and continuous collaboration between the MED Unit in Athens and the Commission of the European Communities.

Although the role of National Coordinators established in MED POL-Phase II includes the collection, transmittal and distribution of information related to the MED POL Programme, a close and periodic discussion between scientists and technicians directly involved in the monitoring activities should play a major role in the adoption and implementation of both the MED POL Programme and the EEC Directive 76/160.

It has to be pointed out that the meetings of principal investigators of the MED VII pilot project held during the course of MED POL-Phase I, were mainly responsible for the progress made in such controversial issues as the selection of faecal indicators, the adoption of analytical methodology, the definition of interim coastal water quality criteria and the implementation of intercalibration exercises on microbiological methods.

The limited progress made during MED POL-Phase II in the development and implementation of such important aspects as (1) reporting, interpretation and evaluation of microbiological results, and (2) implementing a quality control programme among microbiological laboratories would clearly indicate the need for a renewed collaboration between those directly responsible for implementing monitoring programmes.

It is quite evident that the challenges posed by the implementation of a quality control programme, either at a Mediterranean or a European level will require, at the very least, a scientific, technical and economic effort equivalent to that made during the periodic meetings of principal investigators of the MED POL-Phase I MED VII pilot project.

## 11. CONCLUSIONS

From the review of the microbiological data on coastal water quality obtained within the framework of MED POL-Phase II between 1983 and 1987, the following conclusions can be drawn:

1. Microbiological results received at the MED Unit in Athens since 1983 still show a considerable lack of uniformity in the reporting format. The reporting forms recommended for use in the MED POL-Phase II have not been widely adopted by Mediterranean laboratories.
2. Results and reports provided by Mediterranean states generally include the basic microbiological data obtained in their monitoring programmes, without any attempt to interpret them according to the interim environmental quality criteria adopted in 1985.
3. The data base management system developed at the MED Unit in Athens represents a major progress in data processing within the MED POL-Phase II.
4. The interpretation of microbiological data by a log-normal probability distribution model is applicable to practically all the sampling stations reported.
5. The microbiological data currently available at the MED Unit in Athens correspond to seven Mediterranean states: Algeria, Cyprus, Israel, Lebanon, Malta, Morocco, and Yugoslavia. No results have been received from any of the four Mediterranean states belonging to the European Communities: France, Greece, Italy and Spain.
6. The number of water samples analyzed during the 1983-1987 period illustrate the considerable progress made by most Mediterranean states in the frequency of the analyses. The number of samples taken at a given sampling station varies from 13 to 17, with an overall average of 15 samples per station and per year.



7. The proportion of sampling stations conforming to the interim environmental quality criteria varies annually from 78 to 96%, with an overall average of 85% over the period 1983-1987. This value is slightly higher than the corresponding value for the MED POL-Phase I (1976-1981). However, the data available do not allow the reaching of definite conclusions on the possible trends observed in coastal water quality over the two phases of MED POL.
8. It is not possible to assess the comparability and reliability of the microbiological data provided by Mediterranean states, due to the lack of a quality control programme at regional level in the Mediterranean.
9. The European Blue Flag Programme has raised growing interest from European coastal municipalities, news media and public opinion. However, there is a need to approach this promotion programme with a more rigorous technical basis, specially to ensure the reliability and comparability of the microbiological data considered in the selection process.
10. The limited progress made during MED POL-Phase II in the development and implementation of data reporting and processing, as well as in implementing a quality control programme, clearly indicate the need for a renewed collaboration between those directly responsible for carrying out monitoring programmes.
11. The microbiological data currently available at the MED Unit in Athens is not sufficient for an adequate evaluation of the quality of Mediterranean coastal waters.
12. Both the MED Unit in Athens and the Commission of the European Communities have faced considerable difficulties in obtaining the microbiological results from member states and, as a result, they have experienced considerable delays in preparing their water quality assessments.

## 12. RECOMMENDATIONS

From the results and conclusions reached in this study, the following recommendations can be formulated:

1. A coordinated effort should be made by the MED Unit in Athens, the National Coordinators for MED POL and all participating centres to further specify reporting procedures and to strongly promote its adoption by Mediterranean laboratories.
2. The data base management system developed at the MED Unit in Athens should be made available to participating laboratories to increase the efficiency of the monitoring efforts and to promote data reporting harmonization.
3. The methodology adopted by the MED Unit in Athens to interpret and evaluate microbiological data should be made available to participating laboratories to develop its technical capabilities and to promote harmonization of methodology.

4. A coordinated effort should be made between the MED Unit in Athens and the National Coordinators for MED POL to obtain the microbiological data available at the four Mediterranean states members of the European Communities. The evaluation of these results would greatly contribute to a better assessment of the quality of Mediterranean coastal waters.
5. Following the assessment conducted on KF-Streptococcus agar and M-Enterococcus agar to establish which is the more adequate for analysis of faecal streptococci in Mediterranean coastal waters, the relative reference method should be amended accordingly.
6. A quality control programme should be implemented in the Mediterranean Region to ensure reliability and comparability of the microbiological data obtained by participating laboratories.
7. A closer collaboration should be established between the Commission of the European Communities and the MED Unit in Athens to implement a large scale quality control programme capable of ensuring the reliability and comparability of microbiological results obtained by European and Mediterranean laboratories.
8. Close and periodic discussions should take place between scientists and technicians directly involved in monitoring activities to further promote the implementation of both the MED POL Programme and the EEC Directive 76/160.

### 13. REFERENCES

- Commission of the European Communities (1988). EUR 11588 - Quality of bathing water, 1983-1986. Office for official publications of the European Communities. Luxembourg.
- Council of the European Communities (1976). Council Directive of 8 December 1975 concerning the quality of bathing water (76/160/CEE). Official Journal of the European Communities, No L 31/1-7.
- European Institute for Water, EIW (1987). Seminar on the EEC Directive 76/160 concerning the quality of bathing water, Como. EIW, 67000 Strasbourg.
- FAO/UNESCO/IOC/WHO/WMO/IAEA/UNEP (1983). Coordinating Mediterranean Pollution Monitoring and Research Programme (MED POL) - Phase I: Programme description. UNEP Regional Seas Reports and Studies no. 23. UNEP, Nairobi.
- Feliú Mendez, M.T., A. Hernández, S. Grané (1988). Estudio de métodos de análisis microbiológico de estreptococos fecales en aguas marinas. Unpublished report.
- Gauci, V. (1988). Enumeration of faecal streptococci in sea water (comparative exercise). Unpublished report.
- Institut pour une Politique Européenne de l'Environnement IPEE (1986). Séminaire Européen sur la mise en oeuvre de la Directive eaux de baignade dans les états membres de la Communauté, Montpellier. IPEE, 75341 Paris Cedex.
- Joly, T. (1988). Le Pavillon Bleu d'Europe. Jornadas técnicas sobre protección, ordenación y ecología de playas. Consorcio de la Costa Brava. Gerona.
- Krstulovic, N. (1988). Comparative study of media for the determination of faecal streptococci in seawater. Unpublished report.
- Mujeriego, R. (1983). Microbiological quality of coastal waters in the Mediterranean: scientific and technical implications. WHO Regional Office for Europe, Copenhagen.
- Mujeriego, R. (1985). Intercalibración de laboratorios dedicados a la vigilancia sanitaria de aguas naturales. Comisión Interdepartamental de Investigación e Innovación Tecnológica, y Departamento de Sanidad y Seguridad Social de la Generalidad de Catalunya. Barcelona.
- UNEP (1983). Long-term Programme for Pollution Monitoring and Research in the Mediterranean (MED POL) - Phase II. UNEP Regional Seas Reports and Studies no. 28. UNEP, Nairobi.
- UNEP (1985). Report of the fourth ordinary meeting of the Contracting Parties to the Convention for the Protection of the Mediterranean Sea against Pollution and its related protocols. UNEP, Athens.

UNEP/WHO (1983). Assessment of the present state of microbial pollution in the Mediterranean Sea and proposed control measures. Document UNEP/WG.91/6. UNEP, Athens.

UNEP/WHO (1985). Assessment of the present state of microbial pollution in the Mediterranean Sea and proposed control measures. Document UNEP/WG.118/6. UNEP, Athens.

WHO/UNEP (1986). Review of intercalibration exercises on microbiological methods for coastal water quality monitoring. Document UNEP/WG.144/Inf.6. UNEP, Athens.

Volterra, L. (1988). Determination of the most suitable medium for enumeration of faecal streptococci in seawater. Unpublished report.

WHO/UNEP (1981). Coastal water quality control in the Mediterranean. Final report of the Joint WHO/UNEP Coordinated Pilot Project MED-VII (1976-1980). WHO Regional Office for Europe, Copenhagen.

Yoshpe-Purer, Y. (1988). Determination of the most suitable medium for enumeration of faecal streptococci in sea water. Unpublished report.