

Coordinated Mediterranean Pollution Monitoring and  
Research Programme

**MONITORING OF RECREATIONAL COASTAL WATER QUALITY  
AND SHELLFISH CULTURE AREAS**



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# **MONITORING OF RECREATIONAL COASTAL WATER QUALITY AND SHELLFISH CULTURE AREAS**

Report of a Seminar  
jointly convened by WHO and UNEP

Rome, 4–7 April 1978



**WORLD HEALTH ORGANIZATION**  
Regional Office for Europe  
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## PREFACE

A series of conferences was convened in 1974 and 1975 to discuss the pollution situation in the Mediterranean and ways and means of providing the pollution abatement measures required. Some of the proposed programmes were adopted by the Intergovernmental Meeting on the Protection of the Mediterranean (Barcelona, January 1975) and endorsed by UNEP.

The UNEP Coordinated Mediterranean Pollution Monitoring and Research Programme resulted from the decisions made at the above meeting. It consists mainly of seven pilot projects which are generally concerned with baseline studies and monitoring of various pollutants. Research into the effects of pollutants on marine organisms and on marine communities and ecosystems, problems of the coastal transport of pollutants and the sanitary quality of beaches and coastal waters also forms part of these projects.

One of these seven projects is the Joint WHO/UNEP Coordinated Pilot Project on Coastal Water Quality Control in the Mediterranean (MED VII). Its main objective is the assessment of the potential health hazards connected with the coastal waters of the Mediterranean needed for the rational design and efficient implementation of national programmes for the control of coastal pollution from land-based sources in the area.

The pilot project is being implemented in close collaboration with UNEP. Following the preparatory phase, an operational document was developed at the WHO/UNEP Expert Consultation on Coastal Water Quality Control Programme (EHE/76.1, Geneva, 15-19 December 1975), which document constitutes its programmatic basis and initiated the operational phase II of the pilot project.

One of the objectives of the pilot project is to design and carry out a programme for the sanitary and health surveillance of coastal recreational areas and of shellfish beds in selected areas of the Mediterranean. To this end, a network of collaborating national institutes nominated by their governments was established.

The present Seminar on Monitoring of Recreational Water Quality and Shellfish Culture Areas was organized by WHO and UNEP in collaboration with the Higher Institute of Health in Rome, which has been designated the Regional Activity Centre for MED VII. The Seminar's main objective was to bring together the principal investigators of the collaborating national institutes to discuss and review matters directly related to the monitoring exercise.

Participants at the Seminar were informed of the outcome of the Intergovernmental Review Meeting of Mediterranean Coastal States on the Mediterranean Action Plan (Monaco, 9-14 January 1978), so that they might take relevant further action.

The Seminar also discussed and made recommendations for the improvement and speeding up of the pilot project phase, on its extension and on possible follow-up action for MED VII once this phase was over.

All principal investigators of the collaborating institutes participating in the pilot project were invited to attend the Seminar. In addition, the following international organizations and agencies were invited to send representatives: FAO, IAEA, IOC, UNESCO and WMO.

#### 1. Opening of the meeting

The meeting took place at the Higher Institute of Health (Regional Activity Centre) in Rome from 4 to 7 April 1978.

The meeting was attended by 25 principal investigators or their alternates from 12 Mediterranean countries, five WHO staff members and one representative each from UNEP and FAO. A list of participants is given at Annex VI, and an agenda at Annex V.

Mr G. Ponghis, consultant at the WHO Regional Office for Europe, opened the meeting and welcomed the participants on behalf of the Organization. Referring to the work undertaken by WHO in the field of water pollution control and more specifically in marine pollution, he stressed the importance and interest that the Organization has in the development of the present project. He further emphasized WHO's eagerness to assist Member States in developing and applying practical solutions to control coastal marine pollution and promote health and development in the Mediterranean area. He thanked the Higher Institute of Health, as Regional Activity Centre, for their collaboration and assistance in arranging the present seminar. He expressed the Organization's

appreciation to the Italian authorities for hosting the meeting and for their continuing support to WHO's activities.

Dr S. Kečkeš, Director of the Regional Seas Programme Activity Centre, UNEP, speaking on behalf of the Executive Director of UNEP, expressed UNEP's appreciation of the fruitful collaboration among the participating institutions with WHO and UNEP and the hope that the present seminar would be as successful as the previous one.

Dr A.V. de Mohr, representing the Italian authorities, assured the participants of the continuing interest of his Government in the activities of the Mediterranean Action Plan.

Finally, Professor F. Pocchiari, Director-General of Rome's Higher Institute of Health, welcoming the participants, repeated the interest of his institute in the development and progress of MED VII and its intention to continue participation and assistance in the various aspects of the project.

Professor Pocchiari was elected Chairman, Professor H. Shuval and Dr S. Šobot Vice-Chairmen and Professor F.M. El-Sharkawi Rapporteur. Mr Ponghis acted as Secretary to the seminar.

## 2. Introduction

### 2.1 The Mediterranean Action Plan

In a review of the Mediterranean Action Plan, launched in early 1975, Dr Kečkeš recalled that the Convention for the Protection of the Mediterranean Sea against Pollution and the two adjoining protocols had come into force in February 1978 and provided the legal framework for the Mediterranean Action Plan. At an intergovernmental meeting of the Mediterranean coastal states in Monaco (9-14 January 1978), progress in implementing the Action Plan had been reviewed in detail and agreement had been reached on future activities. The planned activities in the pollution monitoring and research (MED POL) component of the Action Plan, including those activities relevant to MED VII, were presented by Dr Kečkeš and are contained in a circular letter (Annex I to this report).

### 2.2 The MED VII project

Mr Ponghis gave first a short account of the early start and main development of the project, its links with the UNEP Coordinated Mediterranean Pollution Monitoring and Research Programme and with the six other joint FAO/GFCM/UNEP, IOC/WMO/UNEP and IOC/UNEP pilot projects, and went on to outline the overall objective of the MED VII project, the development of the operational document (1) which forms the basis of the proposed activities and the outcome of the mid-term review meeting held at the Higher Institute of Health in Rome (30 May - 1 June 1977) (5).

The present seminar was intended to review and discuss work carried out since the above mid-term review meeting, in particular:

- (a) specific matters and problems that had arisen during the monitoring activities with particular reference to comparability and harmonization;
- (b) data collection, storage, retrieval and evaluation;
- (c) future action during and after the pilot project.

Since the mid-term review meeting, the number of collaborating institutions had reached a total of 29 and there were 12 countries involved. Final agreements with 15 laboratories had been signed.

Following the recommendations made during the mid-term review meeting, funds earmarked for the provision of equipment had been increased at the expense of other budgetary lines. Most of these funds had now been spent. Part had been used to buy in bulk basic equipment and nutrients necessary for carrying out the compulsory part of the monitoring work. The bulk purchase would permit provision of all the participating laboratories with the above basic material.

Recommendations on training made at the May 1977 review meeting were being implemented in the form of in-service training. Only four laboratories had been assisted. The interested additional laboratories had been urged to send the relevant data for the implementation of the planned training programmes.

The Guidelines for Health Related Monitoring of Coastal Water Quality (2) and the report on Health Criteria and Epidemiological Studies Related to Coastal Water Pollution (3) had been finalized.

The report of the Workshop on Coastal Water Pollution Control (4) held in June 1977 had also been circulated.

Other recommendations of the mid-term review followed up had included the preparation of a form for data collection and recording with a view to their storage, retrieval and assessment (see also section 5 below).

A document on principles and guidelines essential for the implementation of the protocol on control of pollutants from land-based sources was expected to be ready before the end of 1978, and would form part of the proposed code of practice for the disposal of liquid wastes into the Mediterranean.

### 3. Review of work carried out by each collaborating laboratory

The principal investigators were each requested to present a summary of activities under project MED VII. These summaries are attached as Annex II. In addition, the principal investigators submitted full reports with descriptions of their work and data, which were circulated to all participants.

During the discussion on the summaries, the following points were considered to be of importance.

Concern was expressed by a number of participants on the methods of analysis to be applied, especially on measuring total and faecal coliforms.

In addition to the compulsory parameters, some of the laboratories were also carrying out monitoring of pathogens such as salmonellae, vibrio cholera, viruses, etc.

Epidemiological studies were also carried out by a few of the laboratories. The inclusion of such studies in the work of laboratories not yet involved in them should be encouraged.

Shellfish studies also formed part of a number of laboratories' work. The development of criteria for sanitary control of shellfish and culture areas, in addition to the interim criteria for recreational seawater already adopted, was considered as essential.

### 4. Specific aspects of monitoring

A brief account was presented of the development of the Guidelines and their objective in bringing about a uniform approach and harmonization of procedures in order to achieve as far as possible comparable results. It was clarified that the methodology and parameters, agreed on at a previous meeting and being applied in the monitoring activity, were not intended to be strict procedures, which might not be revised in the light of the work and experience during the pilot activity. All participants in the project were expected to follow them. Only at the end of the pilot activity changes or improvements might be agreed by the collaborating laboratories, taking into account results obtained and the experience gained during the work of the pilot phase.

The controversy over the use of the membrane filtration versus the MPN method was raised in particular. Annex III gives a list of methods and nutrients used at present by the participating laboratories. All of them agreed to use the approved membrane filtration technique and specific nutrients during the pilot phase, whether or not they also used the MPN or other methods in their laboratories. It was noted that two laboratories reported unsatisfactory results with the m-FC medium at 35° used for total coliform count. Two laboratories also claimed better results from the MPN method.

It was felt by participants that parallel analysis using membrane filtration with the recommended media and alternatively using MPN would provide a useful comparison for future evaluation of both techniques.

As there were conflicting reports on the costs of the two methods and so as to have a clear picture of the finance involved, the participants suggested carrying out inter-country analysis and comparison of the costs of the various components of the different methods.

### 5. Recording and statistical analysis

A set of basic recording forms for identifying and describing collected material and for recording laboratory results is suggested in the Guidelines (2).

In addition a form for reporting data had been prepared by the Higher Institute of Health, following the recommendation of the previous mid-term review. This was intended to facilitate storage, retrieval and statistical analysis.

Several minor modifications were suggested during the discussion. In addition it was proposed to incorporate in the form a part dealing with shellfish and to expand the explanatory notes by giving examples. The form will be used as an interim one pending finalization by the International Computing Centre in Geneva, which will undertake the central storing and processing of data transmitted through these finalized reporting forms. Participants were urged to give further study and discussion to the suitability of the form prepared by the Higher Institute of Health in their respective laboratories and submit to the WHO Regional Office for Europe in Copenhagen their suggestions for modifications and additions by the end of April 1978. Following the comments sent by the collaborating laboratories, WHO will finalize the interim form and distribute it in the required quantities to the participating parties.

Dr A. Weber of the Regional Office spoke on statistical evaluation and interpretation of results. He pointed out that the design of recording and reporting forms had to be given great attention. It was also important to coordinate the requirements at the different levels, e.g., local for day-to-day and medium-term management, regional and national for longer term planning and monitoring, and central for research and overall management. Such coordination should allow the recording and reporting of information needed for different purposes only once, thus saving staff time and eliminating errors in transcription. The first step in data analysis was editing and validation. Although not all measurement and reporting errors could be eliminated, such validation procedures would usually "clean" the data and eliminate a substantial number of errors.

Before starting to apply statistical tests to new data, it was essential to study their general pattern, for instance to draw a frequency histogram to see whether their distribution was bimodal, markedly skewed or followed one of the common distributions (Poisson, binomial, normal). Similarly by plotting on a coordinate diagram pairs of values, e.g., water temperature and number of coliforms, any connexion between the pairs could be detected and a first impression obtained as to the type of relation between the two variables (logarithmic, exponential, linear, etc.).

Such data inspections may suggest both useful data transformation that would simplify interpretation and statistical analysis.

Most common statistical analyses are designed:

- (1) to fit a known distribution to a series of data and to estimate the confidence limits of the parameters of this distribution;
- (2) to test the hypothesis that two or more samples come from the same universe;
- (3) to test whether two or more variates are related and to estimate the kind and/or closeness of the relationship between them.

One of the main problems to be faced by each investigator before he can undertake such statistical analysis is to decide how he should arrange his sampling: in other words, which parts of the beaches or the coast to sample, how frequently, how many determinations to examine at each sampling point, etc.

Solutions depend both on the cost and the variance function as well as on the use to be made of the data. The solution reached is usually a compromise and takes into account different data uses, and the different cost and variance functions found for the different monitoring variables.

The group recommended the preparation of a small booklet with a case study based on the above presentation and that approaches to statistical evaluation be discussed.

#### 6. Communication within the project

The participants appreciated the quarterly newsletter issued by the Regional Activity Centre. It was felt to be useful and important in bringing the participating laboratories closer together and providing a channel for the exchange of views and information. Several suggestions were made by the participants on its content and material of general interest. Each laboratory should participate actively in sending in data information and reports of local events relevant to coastal water pollution and its control. The newsletter should also include cartoons and other journalistic material. Each participating laboratory should play an active part in the preparation and improvement of this undertaking and should consider itself part of the editorial board.

#### 7. Assistance to collaborating laboratories: equipment and training

It was pointed out that the allocation of funds for equipment had been increased at the expense of other budget lines and that almost the total amount had already been spent. However, a bulk

purchase of basic equipment for the membrane filtration method had been made and the equipment and material was being distributed to those participating laboratories which had signed the agreement and would be supplied to all the others as soon as they had signed. The purchase was intended to provide all laboratories with the same basic equipment and material required for the microbiological analyses related to the compulsory part of the project and thus to promote uniformity and comparability.

Many participants from countries where there are no UNDP resident representatives experienced difficulties in receiving the equipment and material provided by WHO/UNEP free of customs duty. The group suggested that at a meeting with government representatives, the above matter could be brought to their attention with the aim of securing an agreement to exempt the material from this charge.

As regards training, the participants were urged to submit candidates so that the agreed in-service training could be carried out in time.

The participants considered that specific group training courses would be very beneficial, especially on the compulsory aspects of monitoring, which includes microbiological analysis as well as physico-chemical parameters. This would greatly contribute to harmonization of approach and methodology. Several laboratories offered their services for such training courses. A period of one week with a course-size of about 15, was considered as an adequate arrangement. In view of the shortage of available funds for training, it was suggested that a reduction of in-service training may be worth considering in order to secure the required funds for short courses.

It was also advocated that during seminars to review and discuss microbiological analysis, practical training be given in measuring physico-chemical parameters.

## 8. Future action

### 8.1 Monitoring of shellfish and culture areas

There is now extensive epidemiological evidence that the consumption of raw or insufficiently processed shellfish may cause a variety of enteric bacterial and viral infections.

For project MED VII, it was considered that the first two phases in assessing shellfish quality (the culture area and the shellfish in its natural surroundings), must comply with appropriate microbiological limits. It was understood that for a full assessment of shellfish quality as a food product, shellfish should also be examined at subsequent phases of handling (transport, processing and marketing).

The laboratory should be adequately equipped and staffed to deal with the samples, not only for the microbiological aspects, but also for other related analyses. Samples of seawater and shellfish directly from the culture area should be collected. Laboratory examination should be undertaken within six hours from the collection. Five to 10 shellfish are chosen by weight, providing approximately 25 grams dry weight. When gathering them from the culture area, loose shellfish should be avoided.

#### Laboratory examination of shellfish:

According to the operational document (WHO document EHE/76.1, samples include flesh and liquor, but in the Guidelines for Health Related Monitoring of Coastal Water Quality (2), it was recommended that the flesh alone be used. Following the recommendations of a small working group, the present meeting endorsed the Guidelines' recommendation. It was considered that the inclusion of the liquid in the sample would introduce a factor of variability which would reduce the comparability of results.

#### Microbiological methods for shellfish:

In the laboratory the shellfish are washed, brushed and separated from the shells. The flesh is transferred to a sterile flask and uniformly macerated and then diluted with four times its weight with 1% peptone water. The MPN method is recommended for the analysis.

#### Microbiological limits:

The meeting took into account the limits adopted by several countries and recommended the following interim standards:

(a) for shellfish:

- as faecal coliforms per gram of shellfish flesh

0 - 2        sale permitted  
3 - 10      temporary prohibition of sale  
above 10    sale prohibited

(b) for water of shellfish culture areas:

- less than 10 faecal coliforms/100 ml in 80% of samples  
- less than 100 faecal coliforms/100 ml in 20% of samples

Each participating laboratory is expected to provide further data on their results. Further it was proposed to solicit the opinion of FAO and other interested bodies. Thus a review of these standards would be possible by the end of the pilot phase.

### 8.2 Quality control

The meeting unanimously felt the need for quality control of microbiological examinations, but also recognized the difficulties and limitations involved. Based upon the deliberations of a small working party, the meeting agreed in principle on a pilot programme on quality control, consisting of the following elements:

Objectives: (a) to assess laboratory performance and efficiency;

(b) to harmonize practices and then achieve comparability.

Programme: Two consecutive stages are suggested. The first stage corresponds to the internal quality control (intra-laboratory), which is well described in the Guidelines, pp. 162 and 163. The second stage consists of inter-laboratory tests and comprises two phases. During phase I, known standard strains are mixed, either each strain separately, or in various percentages, with seawater and the recovery measured by the standard techniques in the various laboratories. Details of these procedures are given in Annex IV. During phase II, seawater samples are mixed with unknown strains according to the previous experiences by the EEC, ISO, the Public Health Laboratory Service of England and Wales and the Pasteur Institute in Lyons.

Implementation: The Rome Higher Institute of Health, as the Regional Activity Centre, offered its advisory services and assistance in the matter and this was gratefully accepted by the meeting. Support would cover the start-up of the programme, the selection of standard strains, preparation of water samples, selection and testing of filters and media, training of laboratory personnel and on-site inspection visits.

### 8.3 Extension of the pilot phase and subsequent development

The present stage of project implementation varies widely due to the steady growth in the network of collaborating laboratories. It was therefore felt that more time was needed to harmonize monitoring operations and to collect a required minimum of data.

Thus, participants recommended a one-year extension of the pilot phase of the project, presently scheduled to end in March 1979. It was understood, however, that the Mediterranean governments would decide on the future development of all MED POL pilot projects at the first meeting of the contracting parties of the Barcelona Convention in spring 1979. Continued financial support was considered essential for project operations, particularly as regards the centralized purchase of filtration supplies and specialized training of laboratory personnel.

The extended pilot phase would also provide the necessary time gap to develop a conceptual design and outline the framework of a medium-term or permanent monitoring system for coastal waters used for recreational purposes and for shellfish cultivation. Such a system would succeed the present pilot network arrangements.

Within the above concept, a proposal for a certification procedure concerning the survey of a beach through the existence of an adequate network of monitoring, permitting enforcement of the adopted interim quality standard for recreational seawater (3) was presented to the group for further study and future consideration.

## 9. Other recommendations

The participants made several recommendations during the various discussions. These are summarized here below. To these recommendations were added those that were already made during the previous mid-term review meeting and which were again emphasized.

- (1) Coordination at national level between the MED POL pilot project collaborating institutions should be promoted and fully utilized. Such coordination should also be organized between national laboratories involved in similar work.
- (2) The participating public health laboratories are urged to make use of already collected data on meteorological, hydrographic and dynamic conditions by other national laboratories participating in parallel MED POL projects.
- (3) Basic and applied research programmes should be promoted as part of MED VII. These should especially include isolation of pathogenic bacteria and human enteroviruses and survival of pathogenic bacteria in seawater, and the use of bacteriophages as pollution indicators.
- (4) Collaborating laboratories having the facilities to undertake virus studies should look into the possibility of using human enteroviruses in water and shellfish as a valuable parameter.
- (5) In addition to shellfish, fish should also be monitored for the presence of pathogenic bacteria.
- (6) Epidemiological studies should be strengthened and increased in number. They should follow the uniform methodology suggested in the report of the Expert Consultation on Health Criteria and Epidemiology of Health Risks related to Beach and Coastal Pollution (3).
- (7) The membrane filtration method with the agreed media should be applied by all participating laboratories. Alternative methods and media may be applied in parallel to permit comparison and evaluation.
- (8) The interim data form should be revised according to the suggestions made during the meeting and distributed to all participating laboratories. This form will be utilized until the final one, prepared by ICC, is available.
- (9) WHO should prepare a small booklet concerning the statistical handling and evaluation of collected data, including a case study as an example.
- (10) All collaborating laboratories should actively participate in the preparation of the newsletter.
- (11) Small group training for a short period should be organized to deal with the compulsory part of the project.
- (12) Monitoring of shellfish and culture areas should be intensified and increased in number.
- (13) A pilot programme for quality control of microbiological examination should be initiated.
- (14) Extension for one year of the pilot project, considering its late development, including adequate support, should be granted.
- (15) The establishment of a permanent monitoring network for coastal water quality should be elaborated.

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## Circular letter\* concerning MED POL Pilot Projects

from

S. Kečkeš  
Programme Coordinator  
Regional Seas Programme  
Activity Centre  
UNEP

13 March 1978

Dear Colleague,

We are pleased to attach herewith, for your information as a MED POL principal investigator, a copy of the Report of the Intergovernmental Review Meeting of Mediterranean Coastal States on the Mediterranean Action Plan, Monaco, 9 - 14 January 1978 (UNEP/IG.11/4). A full set of relevant documents presented to the Monaco meeting was sent to you earlier. We would appreciate it if the contents of this letter and the documents mentioned above could be brought to the attention of your collaborators.

From a review of the recommendations adopted at the Monaco meeting it is clear that the Governments concerned gave full credit to the work accomplished within the framework of the environmental assessment component of the Mediterranean Action Plan. This is reflected in the general recommendation No. 2 which reads:

"The pilot phase of the various activities undertaken as part of the assessment of the sources, amounts, pathways, levels and effects of pollutants should be continued. Using the experience and results obtained during the pilot phase, as well as the established network of collaborating national institutions, a long-term monitoring programme should be prepared in consultation with Governmental experts and adopted by Governments and the EEC. By analysing the trends in levels and effects of pollutants in the Mediterranean region, this programme should serve as the basis on which to take environmentally-sound management decisions essential for the future socio-economic development of the region; these trends constitute the most objective indicator of the effectiveness of the measures taken by Governments under the Convention and protocols."

Specific recommendations concerning the implementation of this general goal are contained in Annex IV to the Report of the Monaco meeting. The successful follow-up of these recommendations will depend primarily on the results of the cooperative efforts of the national institutions officially designated by the Governments of the Mediterranean States as participants in MED POL. Therefore, we are addressing this letter to you as a renewed request for your continuing collaboration. As has been past practice, the follow-up activities to the recommendations adopted at the Monaco meeting will be directed, under UNEP's overall coordination, by the organizations of the UN system (ECE, GFCM of FAO, UNESCO, IOC of UNESCO, WHO, WMO, IAEA) and by some non-governmental organizations (IUCN). One of the main objectives of this lengthy letter is to inform the almost 200 principal investigators of MED POL of the plans for the development of future activities as formulated at a recent interagency consultation (Geneva, 27 February - 1 March 1978) and to solicit directly the investigators' reactions to the activities which will be coordinated by UNEP itself.

1. The pilot phase of the original seven MED POL pilot projects and of the project on open water monitoring (MED VIII) will be extended until March 1979. GFCM, IOC, WHO, WMO and IAEA will continue to direct these pilot projects without changing the earlier agreed "operational documents" and administrative procedures.
2. Further efforts will be made by UNEP, and in particular by GFCM, IOC, WHO and IAEA, for the efficient coordination and integration of the various MED POL activities. This might require additional research and monitoring in areas not covered at present or slight readjustments in your present work.

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\* Addressed to all principal investigators of MED POL pilot projects and to the heads of national institutions designated as participants in the MED POL activities

3. The participation of additional research centres in the pilot projects, particularly in research fields and monitoring areas not adequately covered, will be solicited by UNEP. It must be kept in mind that only officially designated national institutions may be considered as participants in MED POL. At present there are 79 participating research centres in the pilot projects from 16 countries.
4. The role of the seven Regional Activity Centres for the MED POL pilot projects in evaluating the results obtained through these pilot projects and in preparing plans and background documentation needed for future activities will be increased.
5. Early steps will be taken to reinforce the intercalibration exercise organized and supervised by IAEA Monaco Laboratory. If you have not yet answered their letters asking for your participation in the intercalibration exercise, you are requested to do so before you receive a reminder letter.
6. You will be requested to submit by the end of September 1978 a comprehensive report on the results obtained since the beginning of your participation in MED POL. The relevant specialized agencies reports will serve as the basis for an integrated report on MED POL and MED POL-related activities which will be submitted to the first meeting of Contracting Parties to the Barcelona Convention (February 1979).
7. You are requested to submit to us, as soon as possible, your views on the possible scope of the medium-term monitoring programme, which will follow the present pilot phase of MED POL, as well as on the mechanisms for its implementation. Your views, together with those we are soliciting from our official contact points in the Mediterranean Governments and the relevant organizations of the UN system, will be used in the preparation of an outline for the medium-term monitoring programme to be submitted to the Governments for their consideration.
8. The preparation of the hazard profiles of substances listed or likely to be listed in the Barcelona Convention and in the annexes to the protocols of this Convention will be coordinated by UNEP's Programme Activity Centre for the International Registry of Potentially Toxic Chemicals (IRPTC). In due course you will be invited to comment on the document presently under preparation.
9. Under the coordination of WHO, and as part of the MED VII pilot project, work will continue on the collection and development of proposals for uniform Mediterranean criteria applicable to the quality of recreational waters and seafood. These proposals will be submitted to the Mediterranean Governments for their consideration and eventual adoption in connexion with the protocol to control land-based sources of pollution.
10. The International Union for the Conservation of Nature (IUCN) will formulate the scientific principles and technical guidelines for the selection, establishment and management of Mediterranean aquatic and terrestrial areas which require a special degree of protection. Your views, if any, should be addressed to Dr D. Munro, Director, IUCN, Morges, Switzerland. The principles and guidelines, once formulated, will be considered by the Mediterranean Governments and may serve as the basis for another protocol under the Barcelona Convention which would further promote the protection of the Mediterranean basin.
11. Input from participants in MED POL to documents serving as background for the environmental management and environmental legislation component of the Mediterranean Action Plan will be increasingly important and significant. Examples of this have been given in the two preceding paragraphs. The development of a model code of practice for the disposal of liquid wastes into the Mediterranean and of methodological guidelines for the scientific assessment of the waste-absorptive capacity of the marine environment are other examples. These are WHO coordinated activities into which your input is most welcome. For more information contact Mr J.I. Waddington, WHO Regional Office, Copenhagen.
12. Work will continue on the preparation of the Report on the State of Pollution of the Mediterranean Sea. The preliminary Report, which was submitted to the Monaco meeting as UNEP/IG.11/INF.4 (and was recently sent to you), will serve as the model and basis for the final Report. A small editorial board will be responsible for completing the work, but your contributions are essential. Many of you have already assisted in preparing the preliminary report, and now we would like to renew our invitation for your views and for additional data which may be included in the report. We would also appreciate receiving any of your publications relevant to the Report, if they have not already been sent to us, since

the editorial board has decided to cite only those publications which can be checked through reprints or their copies. Naturally, other sources of information will be used too, primarily those provided by the Mediterranean Governments.

13. As the results of the monitoring and research activities carried out within the framework of the MED POL pilot projects may have legislative implications for the Contracting Parties to the Barcelona Convention, a set of reference methods for Mediterranean marine pollution studies will be assembled (and developed, if necessary) and submitted for approval to the Contracting Parties. The methods presently agreed and used as well as those which are now in preparation as reference methods in the various pilot projects, will serve as the basis for our proposal to the Contracting Parties. Any comments you may have on this subject should be transmitted to GFCM, IOC and WHO respectively.
14. On MED CRUISE we have already had an exchange of useful correspondence, and we would like to thank all those who assisted us in the development of the programme. At present, we are awaiting the views of the Governments on the next steps that might be taken.
15. The inputs of riverborne and airborne pollutants into the Mediterranean were recognized as an important subject to be studied within the framework of MED POL. In cooperation with UNESCO the assessment of the riverborne pollution load will be continued while a proposal for a long-term programme to study the problems of airborne pollutants will be formulated by WMO in cooperation with other interested organizations (ECE, UNIDO, WHO, IAEA).
16. The Monaco meeting recommended that the Geneva-based UN International Computing Centre (ICC) should be used on a trial basis as the central data repository and processing facility for the Mediterranean Action Plan, including data generated by MED POL. In consultation with relevant organizations (GFCM, IOC and WHO in particular) the type of data handled by ICC and the data reporting format will be agreed upon, taking into account the existing standard practices and making full use of the existing mechanisms for data exchange. You will soon be informed of the results of our consultation, and we hope that you will have no difficulties in following our recommendation on data reporting.
17. The activities of UNESCO in developing the modelling capabilities of the Mediterranean scientists along the lines recommended by the previous UNESCO sponsored meetings on the same subject will receive our full support. For further information you may wish to contact Dr S. Marcos, UNESCO, Paris.

In this letter we have indicated only the activities planned within the framework of the environmental assessment component of the Mediterranean Action Plan. By reading the report of the Monaco meeting you will realize their importance for and contribution to the success of the whole Mediterranean Action Plan. Should you need any additional information or clarification on subjects reviewed in this letter or on any other subject covered in the Report, please do not hesitate to contact us.

From our side we expect to receive, as soon as possible, your reactions to items mentioned in paragraphs marked 6, 11 and 14 in this letter.

We would like to use this opportunity to invite all principal investigators to fill in and return to us the attached personal history form which will, whenever necessary, allow us to quickly process their recruitment as experts and advisers.

We look forward to your continued cooperation in, and invaluable contribution to, our future work.

Yours sincerely,

S. Kečkeš  
Programme Co-ordinator

Regional Seas Programme Activity Centre



Activities of Collaborating Laboratories  
under Project MED VII,  
Joint WHO/UNEP Coordinated Pilot Project on  
Coastal Water Quality Control  
- Summary Reports -

Annex II

1. Egypt

1.1 Centre for Postgraduate Studies and Research  
University of Alexandria

Alexandria is the main summer resort of Egypt. Its population is about 2.5 million and in addition it received about half a million tourists in summer, mainly to use its beaches for recreation.

Part of the city sewage is discharged into the sea through outfalls along the coast. One major outfall 735 metres long and 16 metres in depth, discharging on the average about 20,000 cubic metres/day is located at Kait Bay.

Along the coast there are also 18 minor outfalls as emergency relief for the sewerage system, designed primarily for rainwater disposal during the winter rainy season. Although it is forbidden to discharge sewage into the sea through any but the main outfall at Kait Bay, the overloading of the sewerage system results in these minor outfalls discharging sewage in summer to prevent flooding of sewers.

The High Institute of Public Health, Alexandria University is carrying out a monitoring programme sponsored by the Egyptian Academy of Science to study the pollution of Alexandria beaches resulting from sewage disposal into the sea.

Weekly samples from 20 beaches along Alexandria's coast have been taken for the last two years.

The following parameters have been measured:

Temperature, D.O., salinity, conductivity and pH.

Total coliforms, faecal coliforms (E.coli), faecal streptococci (enterococci).

Hydrographic studies: currents (speed and direction), wind (speed and direction).

Sewage discharge quantity and characteristics.

Most of the beaches showed high coliform and streptococci counts which indicate that they are heavily polluted.

A retrospective epidemiological study to find the relationship between the state of pollution of the beaches and the occurrence of typhoid among bathers and also skin diseases, showed that there is a significant risk of contracting typhoid from bathing in the polluted water; those mostly affected were the younger age-groups. This happens because the minor outfalls discharge directly into inshore waters, resulting in close contact between the bathers and the faecal matter. As a result of this real health hazard it was recommended that the outfalls should be closed immediately.

Professor F.M. El-Sharkawi  
Principal Investigator

(Environmental Health Department,  
High Institute of Public Health,  
Alexandria)

2. France

2.1 Research Centre for Biology and Medical Oceanography, Nice

The Centre has carried out numerous chemical and bacteriological studies as part of coastal zone health control measures.

The studies relate to shellfish and fish-cultivation, harbour, industrial and tourist areas along the French coast.

As a whole our work concerns the most frequently encountered pollutants for those which constitute a danger, such as heavy metals, pesticides, and pathogenic germs.

The goal of these efforts is to study trends and attempt to remedy them.

At the request of public bodies (Ministry of Health, the French National Centre for the Exploitation of the Oceans, Ministry of the Environment), the Centre has been called in on different contracts whose common aim is the safeguarding of human health and the human environment.

The present report summarizes work carried out since 1975, including:

- a health investigation into off-shore coastal areas (a National Enquiry into the Health Status of Off-Shore Zones: INSERM contract) relating to stations selected according to human activities;

- a technical control study of pollution rates for seaside resort areas (bacteriological studies in zones around bathing beaches: Ministry of the Environment);

- health monitoring of a Mediterranean shellfish and fish farming centre (Palavas-les-Flots) (contractors: CNEXO/INSERM) consisting in bacteriological and chemical surveillance of fish and shellfish-breeding facilities and the environments they are located in;

- a study of open water dispersion of pollutants from land based sources (CNEXO contract).

The work consists in water sampling along an arc between Nice and Corsica, on the basis of which chemical, bacteriological and plankton analyses were conducted.

- a histopathological and bacteriological study of marine species presenting lesions on their fins and bronchial arcs.

Dr D. Puel  
(for Principal Investigator)

### 3. Greece

#### 3.1 Environmental Pollution Control Project, Athens, Ministry of Social Services

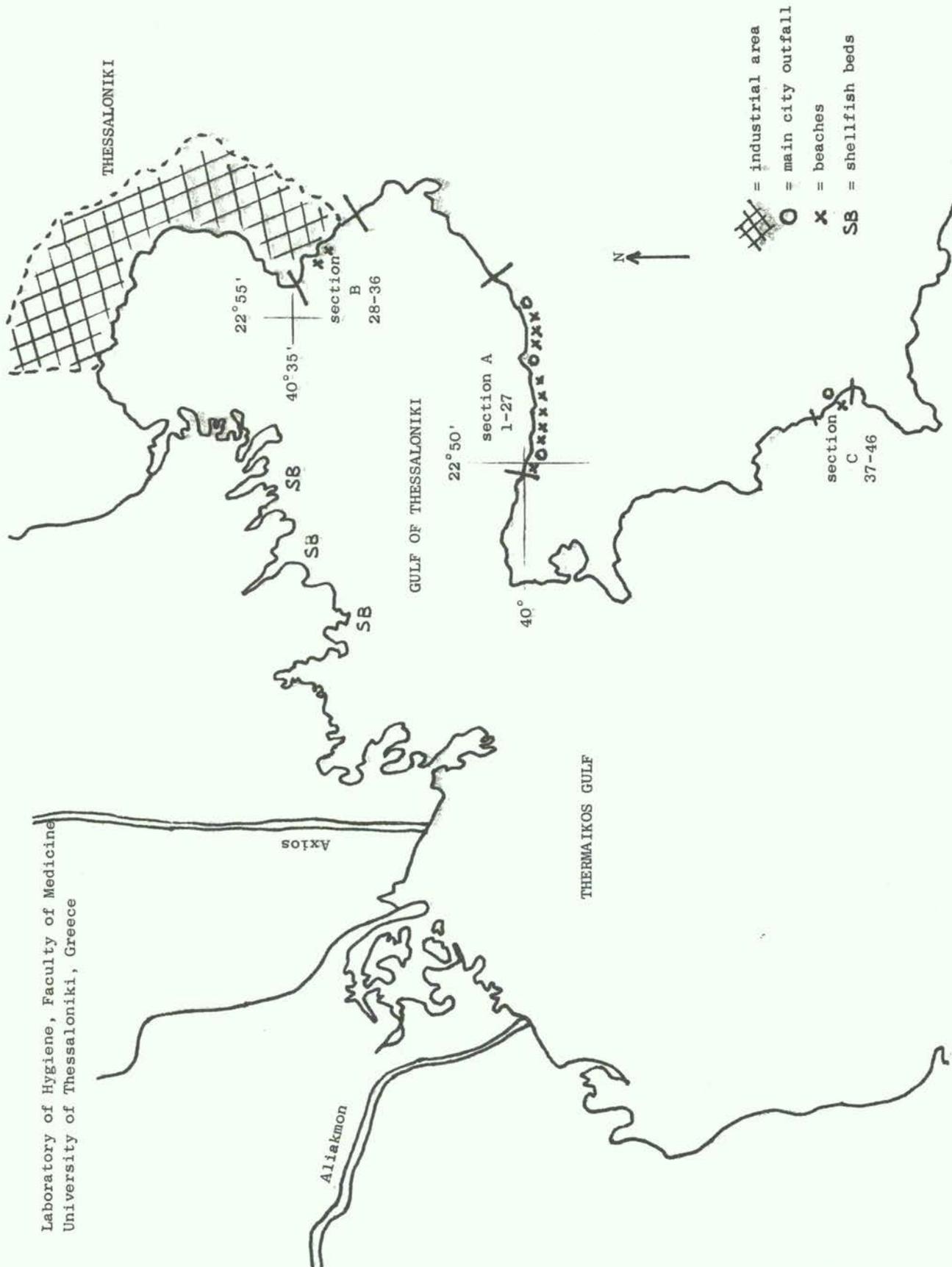
The Ministry of Social Services participates in project MED VII, through its three laboratories:

- (1) Environmental Pollution Control Project-Athens (S. Sotiracopoulos)
- (2) Athens School of Hygiene (Professor J. Papadakis)
- (3) Central Public Health Laboratory (Dr M. Thalassinou)

Because the above three laboratories are monitoring the coastal water quality in the same geographical area (Saronikos Gulf), the monitoring work (executed in accordance with operational document EHE/76.1) has been allocated among them based on their data collection and analysis capabilities.

Sampling and analytic procedures of the compulsory monitoring of MED VII are being conducted in line with those specified in the Guidelines for Health Related Monitoring of Coastal Water Quality (Rovinj, Yugoslavia - 1977), with few exceptions.

Professor J.A. Papadakis  
(School of Hygiene)  
and  
Miss S. Sotiracopoulos  
(Environmental Pollution  
Control Project)  
Principal Investigators



Laboratory of Hygiene, Faculty of Medicine  
University of Thessaloniki, Greece

### 3.2 Laboratory of Hygiene, Medical Faculty, University of Thessaloniki, Thessaloniki

Water quality in the Thessaloniki area has been determined by this laboratory since the beginning of 1976. The laboratory analyses samples of sea-water, bottom deposits and material found along the shoreline for pH, chlorine and salinity, BOD<sub>5</sub>, DO, coliforms, E.coli, enterococci, vibrios, and Salmonellae, and tests plankton for salmonellae. Analysis data include water, air temperature and humidity on the sampling days.

Sampling is done at nearly 50 points in three sections selected along the east coast of the Gulfs of Thessaloniki and Kolpos (see map). Section A covers a distance of 9 km, section B 3.8 km and section C 1.9 km. Though regularity of sampling has not always been maintained, due to adverse weather conditions and other circumstances, nevertheless certain of the analyses particularly those in the section closest to the city of Thessaloniki (section B), have produced data that can be considered new. Sampling in this section, used as a public beach, has been more intensive than elsewhere on the littoral.

For financial reasons the method of analysis chosen was the MPN method for coliforms and E.coli. Enterococci were identified using the membrane method. The membrane method will be the sole technique used as soon as the WHO/UNEP procured filters arrive.

Results so far obtained show periodic microbiological pollution. The sampling programme is to establish whether the pollution caused stems from the untreated sewage from Thessaloniki, when and under which weather conditions it occurs.

Professor T.A. Edipides  
Principal Investigator

and

Dr G.A. Stathopoulos

### 3.3 Laboratory of Food Hygiene, Veterinary Faculty, University of Thessaloniki, Thessaloniki

The laboratory performs microbiological monitoring of shellfish on the north west shore of Thermaikos Gulf (40° 30' N - 21° 50' E). For this purpose four sampling points have been established, covering the main shellfish cultivation beds. Sampling point No 1 is the nearest to the harbour and falls within the polluted area, and was included as a control.

The parameters measured are:

1. Molluscs: Total heterotrophic bacteria, total coliforms, E.coli, faecal streptococci, salmonellae and Vibrio parahaemolyticus.
2. Water in the cultivation beds: Total coliforms, E.coli, faecal streptococci, salmonellae.

Sampling was first carried out on an irregular basis, from the beginning of 1977, until October of that year. Since then, the sampling has been carried out twice per month. So far 48 samples have been analysed (20 samples of water and 28 samples of molluscs). It is planned to include shellfish from markets in the sampling.

Assistant Professor Dr A.J. Mantis  
Principal Investigator

#### 4. Israel

##### 4.1 Environmental Engineering Laboratories, Israel Institute of Technology, Haifa

Preliminary comparative studies on the fate of enteric bacteria, E.coli, bacteriophages and human enteric viruses in the marine environment

The comprehensive MED VII programme, if carried out as outlined, will provide the necessary information on the present level of coastal pollution. It seems though that more knowledge and understanding is needed in a number of subjects closely related to the present phase of the MED VII programme. Among them are: (1) behaviour of bacteriophages as compared to bacteria and enteric viruses in the marine environment; (2) survival of pathogenic agents (bacteria and viruses) in the sediment, in the area studied and/or monitored; and (3) the public health aspect of fish grown in polluted sea waters.

These subjects will be studied in three locations along the north coast of Israel, in the Haifa region: (i) in the vicinity of an industrial wastewater outfall; (ii) in the vicinity of an industrial wastewater outfall; and (iii) in a clean zone.

Preliminary investigations have been carried out, the purpose of which was to gather information and establish the methodology to be applied during the study. The tests were aimed at the recovery of bacteria (with special emphasis on salmonellae and other enteropathogens) from seawater, sediments and various organs of fish grown in polluted water. A number of enrichment selective media have been tested, compared and evaluated.

During the study, tests will be performed on samples to identify the presence of the following organisms:

1. coliform bacteria
2. faecal coliform bacteria
3. salmonellae
4. E.coli bacteriophages
5. human enteric viruses.

Dr Netty Buras  
Principal Investigator

##### 4.2 Public Health Laboratory, Ministry of Health, Haifa

This laboratory serves the Haifa and northern districts in Israel; some 20 approved beaches are located in the area covered. In 1967, monthly water quality control visits during the summer months (June - September) were initiated. Sampling procedures required two samples from each beach, at the southern and the northern ends of each site. Total and faecal coliforms were determined by the multiple tube method.

Under the MED VII programme, surveillance was extended in 1977 to include monitoring during the three winter months (January - March). During this period, faecal streptococci were also measured. Quality control during the summer season continued as described for previous years; for administrative reasons only 138 samples were collected in 1977-78, 180 were examined during 1976. In all, 105 samples were cultured for Vibrio parahaemolyticus and Vibrio alginolyticus.

During the winter months from only one beach, in the vicinity of the estuary of the River Naaman, were 2400 or more total coliforms/100 ml isolated on several sampling days. Even on these days, faecal coliforms numbered 0 - 240/100 ml. During the summer months, results showed 0 - 240 total coliforms and 0 - 5 faecal coliforms/100 ml. Other isolates of 2400 or more total coliforms or faecal coliforms/100 ml, during the winter and summer months, were mostly from different beaches on single sampling days. It must therefore be concluded that the quality of coastal water conforms with proposed standards in Israel and by MED VII.

Methodology: The MPN and MF procedures were compared for the enumeration of faecal streptococci. Confirmatory tests according to Sherman were also performed. The series was limited to 50 samples and it is intended to continue this work.

Dr R. Seligmann

#### 4.3 Environmental Health Laboratory, Hadassah Medical School, Hebrew University, Jerusalem

Field monitoring under the mandatory and optional portions of the agreement with WHO was initiated late October 1977.

The Environmental Health Laboratory has adapted the organic flocculation method (Katzenelson et. al., 1976) for concentrating and testing viruses in sea water (Katzenelson, 1977), yielding a mean virus recovery rate of 63%, with seeded poliovirus in 35 litre samples of seawater. In field tests, samples of 65-80 litres of seawater were collected at a bathing beach 3 kilometres from the main Tel Aviv outfall. The samples were concentrated and assayed for enteric viruses, which were positive in three out of five samples. The three samples positive for viruses had total coliform counts ranging from 20-1400/100 ml. and faecal coli counts of 10-80/100 ml. This preliminary study indicates that a sensitive and efficient system for concentrating and detecting viruses in seawater is now available and provides further evidence that enteric viruses can be found, even when coliform and faecal coli counts are within the limits generally considered safe for bathing.

During the period October 1977 - February 1978, 25 samples of seawater were taken from bathing beach and other sampling stations, and bacteriological tests for total coliforms, E.coli and Streptococcus fecalis were made according to WHO recommended methods using membrane filter techniques. In addition about 100 litre samples from each station were concentrated and tested for viruses by the method developed in this laboratory.

The purpose of the virus testing is to determine the relationship between the three standard bacterial indicators of pollution currently included in the MED VII programme and the concentration of enteric viruses with the aim of evaluating the reliability of bacterial indicators for the risk of viral contamination of bathing waters.

The programme of statistical analysis of the data from 14 years of bacteriological monitoring of bathing waters off the Tel Aviv area beaches, including some 10,000 bacterial test results and data on environmental parameters, is near completion under a cooperative programme sponsored by the Ministry of Health.

The Laboratory has received three WHO fellows (two from Yugoslavia and one from Italy) for training in methods of concentrating and detecting viruses in seawater using the new methods developed at the laboratory.

Professor H.I. Shuval  
Principal Investigator

#### 4.4 A.Felix Public Health Laboratory, Ministry of Health, Tel Aviv

Monitoring of beaches is only one of many tasks; samples are brought to the laboratories by sanitary inspectors. The laboratory has been monitoring Tel Aviv beaches since 1963 and in 1968-69 conducted a thorough study of the effect on coastal pollution of the sewage outfall in the north of Tel Aviv. In that study the multiple tube (MPN) and membrane filter (MF) methods were employed for enumeration of coliforms and enterococci and faecal coliforms were determined in EC medium incubated at 44.5°C. Many serotypes of salmonellae were also isolated. The study led to the following conclusion:

- (a) There is only a 50% agreement between the results of the MPN and MF methods in seawater. In the other 50% the MPN gives considerably higher results (95% confidence limits).
- (b) The number of coliforms is 20 - 100 times higher than that of enterococci, and the faecal coliforms are 3 - 38 times higher than enterococci.

Hence if one indicator organism alone is to be chosen for routine evaluation of beaches (many of them examined four times weekly), the preference should be for coliforms tested by the MPN method, which we have been doing since then.

Three years ago, the test for faecal coliforms was added in order to accumulate enough data for re-evaluation of the standard. The recommended standard now is: "less than 1000 faecal coliforms in 90% of the samples".

Monitoring was done on 25 beaches and at 10 other points. The water of most beaches contained very few coliforms and all of them complied with the standards. Samples were mainly taken in the

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bathing season, though several were taken in the winter. Results were considerably better when the sea was calm or waves were very low.

Dr Y. Yoshpe-Purer  
Principal Investigator

5. Italy

5.1 Institute of Hydrobiology and Fish Culture, University of Messina, Messina

The microbiological investigations provided for in the mandatory part of the MED VII project have been greatly facilitated in that our laboratories were already using membrane filters in the routine work.

However, specific tests were carried out to compare methods used by the Institute in the determination of total coliforms and faecal coliforms with those set down in the programme, and also to ensure correct utilization of the large quantity of data obtained in previous research in the area being studied.

For the collection of seawater samples, boats, material and staff were organized so as not to interfere with the normal activities of the Institute and to ensure the absolute regularity of sampling.

We also collected and processed the bibliographical material on the area being monitored by us in order to utilize all available basic background information. To this end, the results of research under way in the hydrographic area in the Straits of Messina will also be used.

Prof. S. Genovese  
Principal Investigator

5.2 Higher Institute of Health, Rome

The Higher Institute of Health group has monitored a stretch of coast (Castel Porziano) with characteristics representative of the whole Italian coastline. This area is not greatly affected by concentrated discharge but receives waters from inland areas of inhabited and industrial land and parkland areas. Moreover, it is close to a large city (Rome) whose population use the area for bathing.

Mandatory parameters were obtained by the methods proposed by WHO, and those pertaining to the optional part of the programme by other methods set down under Italian law.

The data collected have been summarized and some preliminary considerations on the relationships between microbiological parameters and some meteorological and hydrographic conditions reported.

Furthermore, correlation coefficients between microbiological measures have been computed.

The statistical indications are intended as a mere suggestion for future analyses when a greater amount of data more representative of the various conditions hypothesized is available.

Mr G. Ugolini  
(for Prof. L. Villa,  
Principal Investigator)

### 5.3 Institute for Water Research - CNR, Rome

With the aim of evaluating the impact of the Tiber river on the receiving marine ecosystem, the Water Research Institute has undertaken a research programme in the coast at the mouth of the river.

As a part of this programme under MED VII, bacteriological data (total coliforms, faecal coliforms and faecal streptococci), biomass and density of phytoplankton, nutrients and parameters describing general conditions in the monitoring area were determined at about 20 sites, both on the surface and at different depths, during 1976 and 1977. Bacteriological examinations were performed in collaboration with the Institute of Hygiene - University of Rome.

In the area, the results concerning the evaluation of eutrophication conditions in the zone further away from fluvial influence show a situation which is typical of the oligotrophic feature of Mediterranean waters.

Due to the Tiber influence, the inshore coastal stations show higher values of N and P.

As far as the bacteriological data are concerned, the great part of the considered stations, show values which are under the limit established by EEC standard levels for bathing waters. Only the area closest to the river mouths has a level of bacteria which is higher than the above-mentioned standards.

Dr R. Pagnotta  
(for Principal Investigator)

### 5.4 Zoological Station of Naples and Institute of Water Supply and Wastes Disposal, University of Naples, Naples

Under the MED VII project the staff of the Zoological Station has carried out constant monitoring of the Gulf of Naples from September 1977 til today.

Sampling covers 168 points for each of which bacteriological data (total coliforms, E. coli, faecal streptococci) and chemical data (dissolved oxygen, salinity) have been collected according to the mandatory programme set out in the guidelines. The membrane filter method was used. Tests for the detection of salmonellae and BOD<sub>5</sub> were carried out on samples collected at the outfalls of sewer trunk lines.

The results obtained show the presence of heavy faecal pollution near the three main sewers of Cuma, S. Vioivanni and the Sarno River, for which E. coli values exceed 1,000,000/100 ml. At a distance of about 2 km. however, the E. coli values lie within the upper limits of 100/100 ml. Therefore the bathing area has acceptable E. coli values.

Dr E. Tosti  
(for Principal Investigator)

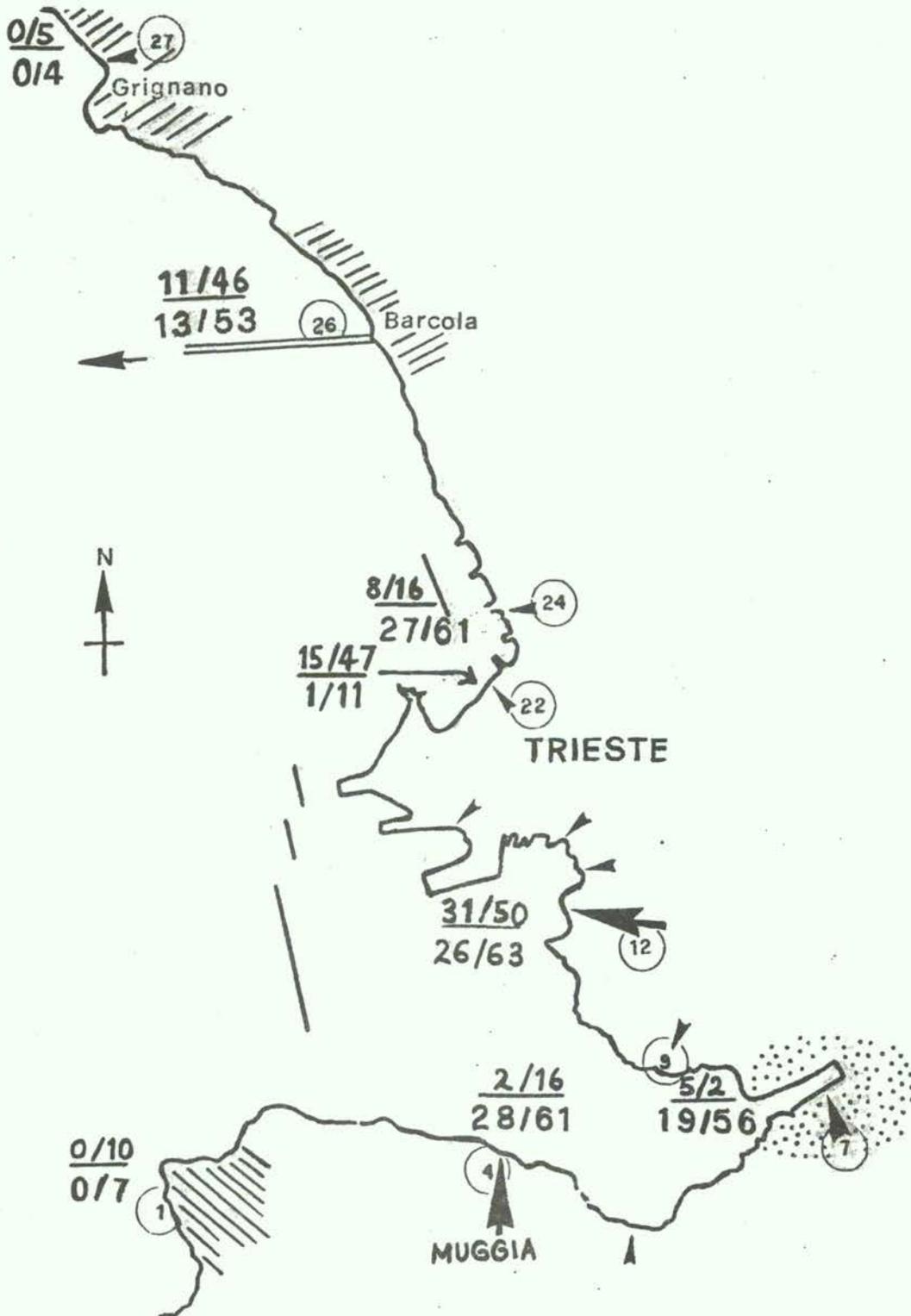
### 5.5 Institute of Hygiene, University of Trieste, Trieste

As we have not yet received the material (filters) from the WHO, the period has been spent on the development of the methodology, using our own material.

After preliminary tests the membrane filter method, as compared with the MPN method - when water dilutions are optimum - was found to be acceptable. We intend to start work as soon as sufficient material has been received.

In the meantime, as part of the MED VII project, we have worked on the detection of salmonellae in the Gulf of Trieste. Using various methods we have isolated 163 salmonellae from a total of 408 samples of seawater and shellfish (see map).

SAMPLING POINT LOCATIONS ON COAST OF  
TRIESTE GULF AND NUMBER OF S.-POSITIVE SAMPLES IN  
1976 (ABOVE) AND 1977 (BELOW)



The salmonellae isolated were serologically typed. An attempt will be made to relate the serotypes isolated in the sea environment to those serotypes isolated in man in the district.

A method for the detection of viruses in the sea environment has been perfected. Shellfish were given preference as the sampling material. Using this method we isolated 8.3% cytopathic agents from 120 samples examined. These are now being typed.

Given the said results, we would suggest that the microbiological limits established for seawater, as regards both bathing areas and shellfish cultures, be revised as soon as possible.

In a good percentage of cases, salmonellae and viruses were isolated in an environment containing an E. coli level below 1000/100 ml.

Prof. L. Majori  
Principal Investigator

#### 5.6 Regional Activity Centre for Project MED VII, Higher Institute of Health, Rome

In 1977 the Higher Institute of Health was again the centre for the collection of data from the Provincial Health Laboratories. The results have been divided into coastline per province.

In processing the results the Italian standard was taken into consideration (100 faecal coliforms/100 ml, detected by the MPN method).

Table 1 sums up results for summer 1977 (June-September) and for 1976.

An examination of the results shows that there has been some improvement in some coastal areas such as Grosseto, Taranto, Udine, Sassari, etc. Other coasts have on the other hand deteriorated, from a microbiological point of view. There is rising generalized faecal pollution of the coastal waters off Sicily. Off Sardinia there has been an increase in the coli titre in the Province of Cagliari. This was only found in a series of samples collected in July 1977 in the Golfo degli Angeli, Saint Elia Point, where there were two concomitant factors, the emptying into the sea of untreated sewage by local hotels and the particular state of the sea which prevented offshore dispersion.

L. Volterra, L. Villa  
and M. Boeddu

Table 1

## ITALIAN COASTAL PROVINCES: FAECAL COLIFORM TRENDS

(Percentage of analyses exceeding 100 faecal coliforms/100 ml. in bathing areas)

<u>Province</u> <sup>*/</sup> <u>Mainland - West to East</u>	<u>1976</u> (summer)	<u>1977</u> (summer)
Imperia	18.11	12.19
Genoa	20.02	37.30
Savona		16.76
La Spezia	0.00	0.00
Massa Carrara	38.12	52.43
Lucca	13.61	43.52
Pisa	5.81	25.74
Leghorn	3.97	22.35
Grosseto	35.48	20.77
Viterbo	26.66	31.25
Rome	4.94	14.78
Latina	8.64	19.69
Caserta		47.64
Naples	16.46	14.92
Salerno	26.17	
Potenza		25.92
Cosenza	17.80	0.00
Catanzaro	18.19	12.23
Reggio Calabria	0.00	13.91
Matera	0.00	7.84
Taranto	5.00	0.00
Lecce	0.00	7.69
Brindisi	24.52	31.33
Bari	12.04	8.57
Foggia	10.53	9.00
Campobasso	31.11	47.88
Chieto		24.52
Pescara	10.88	12.00
Teramo	5.28	3.60
Ascoli Piceno	9.52	3.70
Macerata	49.75	44.06
Ancona	0.00	24.68
Pesaro	14.00	
Forlì	2.93	0.00
Ravenna	10.61	3.69
Ferrara		12.00
Rovigo		0.00
Venice	31.42	42.77
Udine	25.00	0.00
Gorizia		50.49
Trieste	29.41	32.00
<u>Sicily</u>		
Messina	31.71	33.65
Palermo	7.00	27.65
Trapani	0.00	23.25
Agrigento	2.85	7.35
Caltanissetta	16.60	16.00
Ragusa	28.18	29.48
Syracuse	0.00	15.44
<u>Sardinia</u>		
Catania	4.21	15.08
Cagliari	0.91	5.82
Sassari	6.00	0.00

\*/ Data from the provincial laboratories of Salerno and Pesaro did not arrive in time to be processed.

## 6. Lebanon

### 6.1 Marine Research Centre, National Council for Scientific Research, Beirut

Actual monitoring started in August 1977, and has been continuing since, usually on a bi-monthly basis. Sampling is being conducted in accordance with the Guidelines set for this project. However, as far as bacterial counts are concerned, thus far we have been unable to adhere strictly to set procedures since we do not yet have a fully equipped microbiology laboratory at the Centre and rely on private laboratories for analyses. This situation is soon to be remedied. The parameters total coliforms faecal coliforms, Strep. faecalis, Clostridium, pH, salinity, temperature, wind, wave conditions, floating garbage and wastes, and oil slicks are monitored in 41 stations (3 being offshore control stations). The sampling zone is frequented by a considerable number of bathers throughout the summer season.

Although there is a very high population density in the narrow coastal strip of Lebanon (actual statistics do not exist), particularly in the vicinity of the sampling zones, thus far we have not observed any basic trends of high bacterial counts. Sampling throughout the incoming summer season should be very interesting. If the situation permits, and if our capabilities allow we intend to increase the sampling during the summer to include V. cholera in the routine bacteriological analyses.

Dr H.H. Kouyoumjian  
Principal Investigator

## 7. Malta

### 7.1 Public Health Laboratory, Valletta

Regular monitoring of beaches and bathing waters commenced in early February 1978. The three sampling areas are Mellieha Bay (four sampling points), St Luciano (clean reference point), Rinella (main sewage outflow). Surface sea temperature, salinity, reporting according to the modified Garber classification and bacteriological data by the MF were method recorded.

Results so far show the importance of currents. In future the MPN method will be carried out parallel with MF. O<sub>2</sub> measurements and turbidity measurements will also be recorded.

During the summer season, many samples of seawater are taken by the health inspectors from no less than 20 beaches in Malta and Gozo. These samples are taken at least weekly in areas which are liable to contamination due to sewage overflow. These samples are examined for total coliforms and faecal coliforms by the MPN method only.

Bathing is prohibited when coliforms are in excess of 1800/100 ml or when faecal coliforms are in excess of 100/100 ml.

The results obtained so far show that partially all our recreational waters are within the limits of health tolerance. Areas found contaminated due to sewage overflow with faecal coliforms in excess of 1000/100 ml include beaches in Msida-Shema area, M'xlolak area, St Thomas and B'bugia areas.

Dr L.J. Spiteri  
Principal Investigator

## 8. Monaco

### 8.1 Monaco Scientific Centre, Monte Carlo

The Microbiology and Pollution Research Laboratory at the Centre was established in 1967 to monitor marine pollution. It is staffed by physicists, chemists, microbiologists and oceanographer-biologists.

Since then the laboratory has been conducting a marine water quality monitoring programme at a dozen coastal stations (the locations of the stations were picked out with the aim of supervising

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pollution sources, runoff, and the hygiene of water at bathing beaches). In 1974, the programme was extended to cover the whole of the Monaco Bay, i.e., some 20 additional stations.

In addition to meteorological observations, the programme includes analysis of the following parameters, on a systematic basis, in principle weekly: temperature, salinity, pH, dissolved oxygen, nutrient salts, detergents, heavy metals, turbidity, and phytoplankton.

In addition, hydrological conditions in the zone subject to monitoring were established between 1967 and 1972 using current meters, floats and tracers (Rhodamine).

A perusal of the results shows that in a coastal area in section, analysis of the bacteriological results obtained on certain of the coastal stations were made difficult because of the effect of the lie of the land on the force and direction of the wind on the one hand, and on the other, by shifting sea currents. It pointed to the importance of such factors as:

- weather conditions on the sampling days;
- weather conditions on days preceding the sampling;
- the quantity of rain water to have fallen during the week preceding sampling;
- the flow-rate from the outfall or outfalls on the day of sampling and its (their) average variation.

The laboratory accepts scientists or students during training in sampling and analysis techniques utilized at it.

Dr M. Boisson  
(for Mr R. Vaissière  
Principal Investigator)

9. Morocco

9.1 Sea Fisheries Institute, Casablanca

During 1977, as part of the MED VII programme, the Institute carried out both biochemical and bacteriological analysis on water and on shellfish (mussels) at the experimental cultivation beds at Cala Iris. The results obtained, particularly quantities of E. coli and of faecal streptococci show that the quality of water and shellfish in the zone, which is far from the pollution source, is excellent. Nevertheless, routine analysis during the month of January 1978 revealed the presence of a high mytilotoxin ratio in the mussels (7600). The presence of this toxic substance is due to the "red bloom" phenomenon occurring in the aftermath of certain combinations of oceanic and meteorological conditions; it therefore has no link to pollution of domestic or landward origin.

In addition, and as part of the same activities, biochemical analysis (temperature, salinity, dissolved oxygen, BOD<sub>5</sub>) and studies of current and sedimentation have been undertaken in the Marchica Lagoon close to the town of Nador. These studies will be continued during 1978 and will be amplified by bacteriological tests.

Dr El Hachmi Gmira  
(for Principal Investigator)

10. Spain

10.1 Laboratories of the Malaga Provincial Health Authorities, Malaga

The Malaga Pilot Zone includes 148 km of provincial coastline. The number of sampling stations for coastal water quality monitoring is 130, with an average distance between stations of about 1 km. A group of eight natural beach formations was selected, including 45 sampling stations, for an intensive study programme during the summer months of July, August and September 1977. Among the 45 stations there were 3 reference stations, 36 stations located along 18 km east and west of the city of Malaga, and 6 additional stations on the beaches of Marbella.

The results obtained lead to the following preliminary conclusions:

1. The main reason for not being able to detect a well-defined thermocline in the immediate vicinity of the submarine outfalls can be attributed to the wind regime prevailing in the zone. Under most favourable conditions, the water temperature profile varied from 22.5°C at the surface to 18°C at the bottom depth of 20-23 m. The surface water temperature could drop to 17°C under strong westerly winds.
2. Wastewater plumes emerging from the various one-kilometre long submarine outfalls reached the sea surface throughout the summer, forming 100-150m wide slicks readily visible due to their grease and oil content. Only during the last week of August and as a result of three days of calm weather, the plumes had difficulty in steadily reaching the surface of the sea. The most apparent consequence of these stagnant conditions was a notable reduction of water transparency over an area of several square kilometres.
3. The bacteriological quality of coastal recreational water relates quite well to the proximity and characteristics of wastewater disposal sites.
4. Preliminary results available from an epidemiological survey conducted among more than 10 000 holidaymakers shows: (1) that skin, eyes, ear and throat infections are the most frequent public health ailments, (2) that there is an apparent correlation between the morbidity rates of these ailments and water quality indexes based on indicator organisms concentrations, (3) that an increasing number of people are becoming concerned with the impairment of coastal water quality. Nevertheless, there is ample evidence of the lack of unfavourable public reaction to conditions which are clearly associated with highly undesirable coastal water quality.
5. The more spectacular result of wastewater disposal into the sea is the formation of readily visible patches or bands of a yellowish scum, formed by oil and grease emulsified with detergents. These bands of scum vary from a few metres up to 500 m or more in length, by 2-3 m in width and are located within a larger oily slick about 5-10 m wide. Once they reach the beaches carried by drifting winds, they disintegrate at the breaking water line leaving the water mass with a turbid and unsightly appearance. There is evidence to suppose that this scum is mainly due to wastewater disposal from land-based sources and not from the relatively few ships calling at Malaga Harbour.
6. An analytical technique for determining initial dilution achieved by submarine outfalls was tried out experimentally, based on the silica content of wastewater and receiving seawater. Calculated values for initial silica dilution are about 100:1.
7. Field observations seem to indicate that a pretreatment stage capable of significantly reducing both oil and grease and suspended solids from wastewater effluents would greatly reduce most of the undesirable effects associated with the disposal at sea of wastewater from land-based sources.

Dr R. Mujeriego  
Principal Investigator

#### 10.2 Laboratories of the Tarragona Provincial Health Authorities, Tarragona

The Tarragona Pilot Zones covers 200 km of provincial coastline. Among the possible monitoring stations, a total number of seven natural beach formations have already been identified, and a total of 6 sampling stations distributed in each of them. The average distance between stations is about 1 km, while the coast length covered is about 40 km. The main selection criteria were the number of holidaymakers using the beaches and the proximity of an important industrial complex.

Coastal water quality monitoring activities in Tarragona started before collaboration in the MED VII project, in particular, with respect to air and water pollution control of the important industrial complex located near the city of Tarragona.

Winter water quality data have been collected and plans are under way to establish an evaluation programme for the dilution technique (MPN) and the membrane filtration technique used in testing indicator organisms. The results of this study, together with the experience gained at Malaga, will

Annex II

be of major importance in establishing the adequacy of the membrane filtration technique as the standard testing procedure for coastal water quality monitoring.

Plans are under way to carry out an intensive study programme during the 1978 summer season. The main objectives of this study are:

1. To evaluate statistically the bacteriological water quality of the coastal areas.
2. To study the functional characteristics of the submarine outfalls in the area, both for municipal as well as for industrial wastewater.
3. To determine the overall contribution of the Ebro River with respect to organic and inorganic components.
4. To evaluate the bacteriological quality of shellfish growing areas, as well as industrial installations for their treatment. The area has a significant shellfish production and several treatment facilities, some of them of considerable capacity and using technology on a large scale.
5. To carry out an epidemiological survey on the effect of coastal water quality on public health. The results obtained in Malaga will be a highly valuable contribution for the success of this task.
6. To establish a preliminary programme of sediment quality control, especially around the disposal areas of submarine outfalls carrying industrial wastewaters.

Dr R. Mujeriego  
Principal Investigator

11. Turkey

11.1 Environmental Engineering Department, Middle East Technical University (METU), Ankara

The METU Environmental Engineering Department has chosen the Antalya Konyaalti Strait as its pilot project area. The area is one of the places in the country with the highest tourism potential, and is already much frequented by local summertime visitors.

The geological formations in the area are particularly interesting, with underground galleries carrying ground water up to 40 m<sup>3</sup>/sec. to the sea from distances of up to 16 km inland.

This geological formation has made it impossible for local industrial effluents and domestic sewage to be carried down to the sea by the way of these natural disposal galleries. Unfortunately information on the pathways of these galleries is not available at present, but studies are going on.

The parameters, physical, chemical and bacteriological (biological) were under consideration as suggested in the check-list of this project. Studies in the area, to investigate sewage disposal by outfalls, and another investigation on the inactivation of E. coli is continuing, also giving consideration by bottom and deep layer waters of the bay. In general, the results obtained up to now indicate the coastal water to be relatively clean.

The coastal waters of the area under study display high bactericidal power. E. coli destruction was noticed as being 3-4 days as compared to a longer period in western Mediterranean coastal waters. The number of vibrio and predator organisms was high, giving a rather powerful self-purification capacity in the inshore coastal waters. For analysis, Millipore membrane filtration techniques are preferred because of ease of operation and because they are time-saving.

It is planned to continue the research work under the Guidelines of MED VII, but also to give consideration to other indicators of pollution to be able to make some correlations between biological parameters that are still under discussion.

Prof. S.E.Ulug  
Principal Investigator

## 12. Yugoslavia

### 12.1 Marine Biological Station, Institute of Biology, University of Ljubljana, Portoroz

Our programme on coastal water quality monitoring covered the area of the Yugoslav side of the Gulf of Trieste (North Adriatic), i.e. 17 km of Slovenian littoral, including two shallow bays: Koper Bay and Piran Bay. Koper Bay is the most polluted part of the area and Piran Bay is practically unpolluted.

To monitor the health quality of coast waters used for bathing, 27 representative coastal stations were selected in the recreational waters along this stretch of coastline. Seven additional open water stations at varying distances offshore were also monitored for reference purposes. The chief sources of pollution (Rivers Dragonja and Rižona, and main outfalls) were included in our programme and twelve stations selected.

The following parameters were measured at all stations: total and faecal coliforms, faecal streptococci, salinity and temperature. At the reference stations, the whole pelagic eco-system and its bioproductivity was investigated (nutrients, phytoplankton, eutrophication, bioassay). For bacteriological parameters the membrane filtration technique and media were used, in line with the Guidelines for Health Related Monitoring of Coastal Water Quality, WHO/UNEP (1977). The sampling and analysis was done twice, in November 1977 and in February 1978.

Our monitoring programme also included investigations into experimental shellfish culture of Mytilus galloprovincialis mussels in Strunjan Bay. Shellfish and growing water sampling was done at the same time. The frequency of sampling and analysis was monthly, from July 1977 to March 1978. Measurements were made for both total and faecal coliforms.

Miss M. Lenarčič  
Principal Investigator

### 12.2 Rudjer Boskovic Institute, Centre for Marine Research, Rovinj

Four areas on the western and eastern coast of Istria, Northern Adriatic, were selected in which the quality of recreational waters had been systematically investigated since June of 1976 (Bay of Rijeka), since August of 1976 (vicinity of Pula and Poreč) and since March of 1977 (vicinity of Umag).

The Operational document (EHE/76.1) and the Guidelines for Health Related Monitoring of Coastal Water Quality were used as a framework for planning and execution of the work.

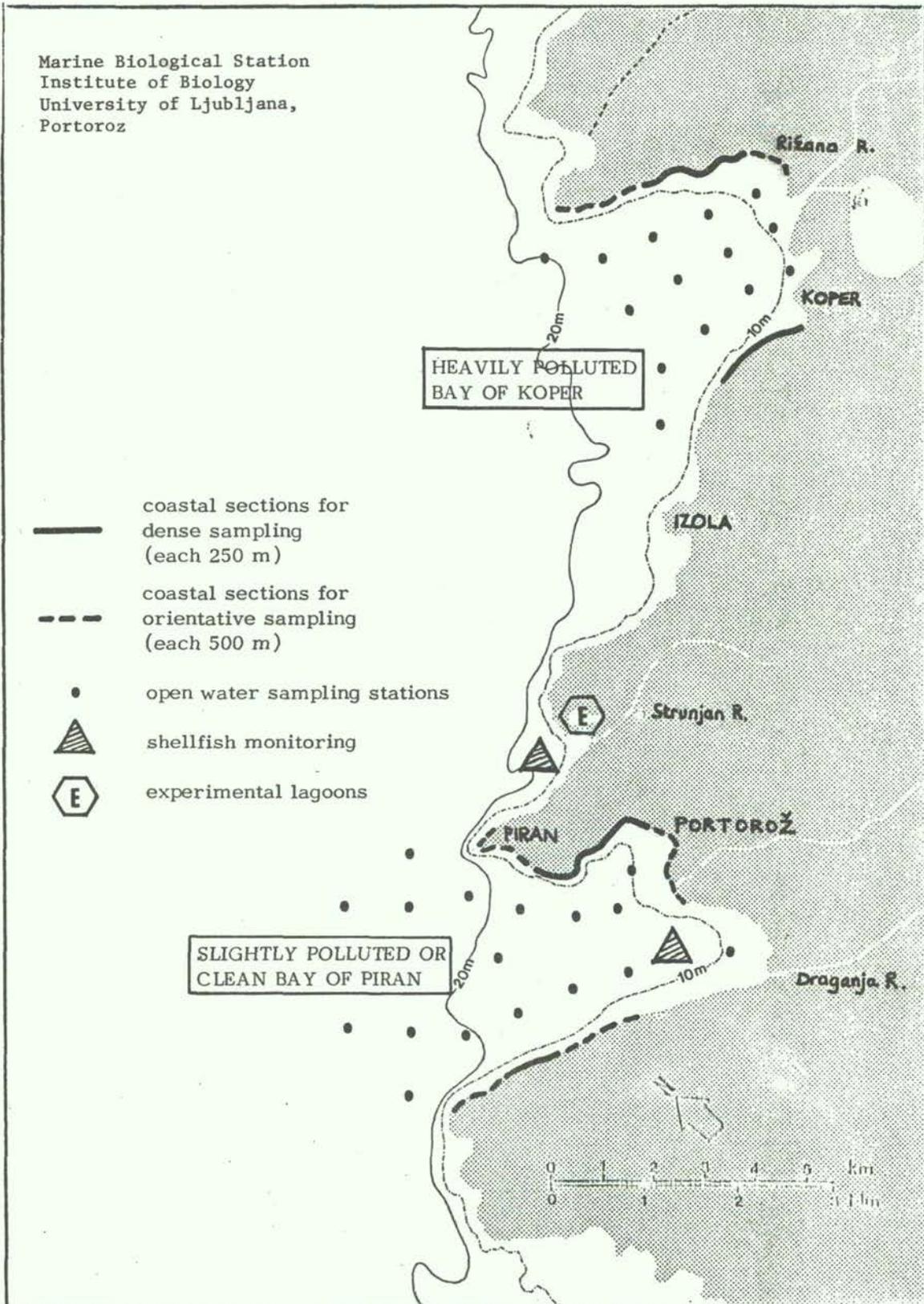
Eight coastal stations and 2 open water stations were investigated in the Bay of Rijeka, 7 coastal stations and 2 open water stations in the vicinity of Pula, 6 coastal stations and 2 open water stations around Poreč and 6 coastal stations and 2 open water stations near Umag.

Total coliforms, faecal coliforms, faecal streptococci, dissolved oxygen, BOD<sub>5</sub>, pH, salinity, temperature and atmospheric conditions were monitored at all stations. In addition, data on currents and nutrients were collected at the open water stations.

No attempt was made to generalize the findings or to correlate the data obtained with the hydrographic conditions and existing land-based pollution sources.

Miss D. Fuks  
Principal Investigator

COAST OF SLOVENIA (Yugoslavia) IN THE  
GULF OF TRIESTE (ADRIATIC)  
LOCATIONS OF PROPOSED MONITORING AREA AND STATIONS



### 12.3 Institute for Oceanography and Fisheries, Split

Under the MED VII project our Institute undertook monitoring studies in four areas (Zadar, Split, Ston and Dubrovnik).

This programme for the quality of coastal water included areas used intensively for recreational activities, extensively by shipping and also for discharges of wastewater and shellfish breeding.

To monitor these areas, 29 stations were selected. The survey began in November 1976, and six cruises have been carried out since December 1977.

The following parameters are monitored: total coliforms, faecal coliforms, faecal streptococci, total heterotrophic bacteria, dynamic conditions, structure of sediments, nutrients, density of phytoplankton and visual observation.

Bacteriological examinations are performed in accordance with recommendations of this project. Other parameters are measured by standard oceanographic methods.

The analysis of data revealed that there are some polluted areas (mainly near the harbour of Zadar, Split and Dubrovnik). The Ston area (shellfish beds) is untouched by faecal pollution. Other parts of monitored areas are also within the limits of sanitary tolerance.

Dr S. Šobot  
Principal Investigator

## ANNEX III

## METHODS USED FOR BACTERIOLOGICAL MONITORING - PROJECT MED VII

MPN - most probable number of multiple tube method  
 MF - membrane filtration method with recommended media  
 n.i.a.- no information available

Country and designated institution	Bacteriological test:			Remarks
	Total Coliforms	Faecal Coliforms	Faecal Streptococci	
<u>EGYPT</u>				
1. Centre for Postgraduate Studies and Research, Alexandria University	MPN	MPN	MPN	Switch to MF for bathing season in 1978.
<u>FRANCE</u>				
1. Scientific & Technical Institute for Sea Fisheries (ISTPM), Sète				n.i.a.
2. Research Centre for Biology & Medical Oceanography (CERBOM), Nice	MF	MF	MF	Media not identified.
<u>GREECE</u>				
1. Laboratory of Hygiene, Medical School, University of Thessaloniki	MF	MF	MF	
2. Environmental Pollution Control Project, Ministry of Social Services, Athens	MF	MF	MF	Teepol media used for total coliforms most of the time.
	MPN/MF <sup>x/</sup>	MPN/MF <sup>x/</sup>	MF <sup>x/</sup>	x/ MPN with glutamate media, teepol, M. Endo, m-FC broth.
3. Department of Food Hygiene, Veterinary Faculty, University of Thessaloniki	MF/MPN	MF/MPN	MF	For shellfish only MPN method for coliforms and faecal coliforms and PP for faecal streptococci
<u>ISRAEL</u>				
1. Environmental Engineering Laboratories, Technion, Haifa	MF	MF	MF	Used m-FC medium for coliforms
2. Environmental Health Laboratory, Hadassah Medical School, Hebrew University, Jerusalem	MF	MF	MF	
3. A. Felix Public Health Laboratories, Ministry of Health, Tel Aviv	MPN	MPN	MF will be used	Parallel use of MF to be added.
4. Public Health Laboratories, Ministry of Health, Haifa	MPN	MPN	MF will be used	Parallel use of MF to be added.
<u>ITALY</u>				
1. Higher Institute of Health, Rome	MF	MF	MF	

x/ these data refer to the Laboratory of the Athens School of Hygiene.

continued

Country and designated institution	Bacteriological test:			Remarks
	Total Coliforms	Faecal Coliforms	Faecal Streptococci	
2. Zoological Station, Naples				
3. Centre for Study and Research in Sanitary Engineering, Institute of Water Supply and Wastes Disposal, Naples	MF	MF	MF	m-FC broth used for total coliforms
4. Institute of Water Research (CNR), Rome	MPN	MPN	MPN	Use of MF will start with WHO supplies
5. Institute of Hygiene, Genoa				n.i.a.
6. Institute of Hydrobiology and Fish Culture, Messina	MF	MF	MF	
7. Institute of Hygiene, Trieste	MPN	MPN	MPN	Change to MF planned
<u>LEBANON</u>				
1. Marine Research Centre, National Council for Scientific Research, Beirut	MPN	MPN	MF	MF for total and faecal coliforms will start with WHO supplies
<u>MALTA</u>				
1. Public Health Laboratory, Ministry of Health & Environment, Valletta	MF	MF	MF	MPN will be carried out in parallel as well as on other beaches
<u>MONACO</u>				
1. Scientific Centre of Monaco, Monte-Carlo	MF	MF	MF	
<u>MOROCCO</u>				
1. Sea-fisheries Institute, Casablanca	MPN	MPN	MF	Possibility of MF for total and faecal coliforms when WHO supplies received
2. National Institute of Health, Rabat				n.i.a.
<u>SPAIN</u>				
1. Institute for Fisheries Research, Barcelona				n.i.a.
2. Mar Menor Laboratory, San Pedro del Pinatar (Murcia) Spanish Institute of Oceanography				n.i.a.
3. Laboratories and Services of the Malaga Provincial Health Authority, Malaga	MPN	MPN	MPN	MPN/MF evaluation study planned for summer 1978

continued

Country and designated institution	Bacteriological test:			Remarks
	Total Coliforms	Faecal Coliforms	Faecal Streptococci	
4. Laboratories and Services of the Tarragona Provincial Health Authority, Tarragona	MPN	MPN	MPN	MPN/MF evaluation study planned for summer 1978
<u>TURKEY</u>				
1. Environmental Engineering Department, METU, Ankara	MF	MF	MF	
<u>YUGOSLAVIA</u>				
1. Rudjer Boskovic Institute, Centre for Marine Research, Rovinj	MF	MF	MF	MPN/MF with a different media. Evaluation study planned for 1978
2. Institute for Oceanography and Fisheries, Split	MF	MF	MF	MPN/MF for evaluation study
3. Marine Biological Station, Institute of Biology, University of Ljubljana, Portoroz	MF	MF	MF	MPN for total and faecal coliforms for shellfish

## QUALITY CONTROL SCHEME

Send to each laboratory three lyophilized standard strains, (from national type collection): Escherichia coli, Enterobacter, and Pseudomonas, and following directions:

1. Open the vials and inoculate into broths, incubate for 24h at 35°C.
2. Inoculate slants of nutrient agar from each strain.
3. Wash the cultures from the slants with phosphate buffer and dilute in the phosphate buffer to obtain a suspension of 1000 organism/ml (suspension A).
4. Spread 0.1 ml on Mac Conkey plates for the viable counts.
5. Dilute 10 ml of suspension A with 90 ml buffer (suspension B).
6. Filter three portions of 1 ml of suspension B from each strain after increasing the volume to about 50 or 100 ml.
7. Place the filter on m-FC broth and inoculate plates and filter at 35°C.
8. Count the number of colonies on the filters of every species and compare the average to the count on the plate; calculate the percentage of recovery considering the plate as 100%.
9. Prepare 3 mixed suspensions from suspension A in the following order:

MIX I	1 ml of <u>Escherichia coli</u> (A)
	5 ml of <u>Enterobacter</u> (A)
	4 ml of <u>Pseudomona</u> (A)
MIX II	4 ml of <u>Escherichia coli</u> (A)
	3 ml of <u>Enterobacter</u> (A)
	3 ml of <u>Pseudomonas</u> (A)
MIX III	8 ml of <u>Escherichia coli</u> (A)
	1 ml of <u>Enterobacter</u> (A)
	1 ml of <u>Pseudomonas</u> (A)
10. After obtaining a mixture, place 0.1 ml of each one (after shaking them well) on Mac Conkey agar.
11. Filter 3 portions of 1 ml of each mixture after diluting to 50 or 100 ml and place filter again on m-FC broth, incubate at 35°C.

Evaluation of results for mixed suspensions:

Count the number of colonies of each species on the three filters of the same suspension and compare the average number to the average of each species obtained on plates. Calculate the percentage of recovery, regarding the number of the colonies on the plates as 100%. Repeat the same for every mixture.

AGENDA

1. Opening of the Seminar
2. Election of officers of the meeting
3. Adoption of the agenda
4. Introductory statements
  - 4.1 Development of the Mediterranean Action Plan
  - 4.2 Development of the MED VII project
5. Review of work carried out by each collaborating laboratory
  - 5.1 Short report of the Principal Investigator of each laboratory on the progress of work within the MED VII objectives
  - 5.2 General discussion
6. Specific aspects of monitoring
  - 6.1 Application in the field of the "Guidelines for Health Related Monitoring of Coastal Water Quality"
  - 6.2 Monitoring procedures (parameters, methodology, harmonization) used in the implementation of MED VII
7. Data processing
  - 7.1 Collection, storage, retrieval and analysis of data
  - 7.2 Statistical evaluation and interpretation of results
8. Reporting, newsletter
9. Assistance to participating laboratories: equipment and training
10. Future action and recommendations
11. Other matters
12. Adoption of the report and closure of the meeting.

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\* unable to attend

\*\* also representing WHO Regional Office for the Eastern Mediterranean

Annex VI

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