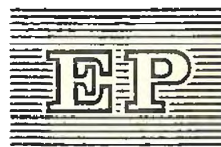




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DRAFT

LONG-TERM PROGRAMME

FOR

POLLUTION MONITORING AND RESEARCH IN THE MEDITERRANEAN

(MED POL - PHASE II)

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BACKGROUND

1. The pilot phase of the Co-ordinated Mediterranean Pollution Monitoring and Research Programme (MED POL - PHASE I) was initiated in 1974 and formally approved by the Intergovernmental Meeting on the Protection of the Mediterranean (Barcelona, 28 January - 4 February 1975) as the scientific/technical component of the Mediterranean Action Plan (Annex I).
2. Initially it consisted of seven pilot projects (MED POL I - VII), which were later expanded by an additional six pilot projects (MED POL VIII - XIII), some of which remain in a conceptual stage only. It was based on the work of 84 national research centres designated by 15 Mediterranean States as participants in co-operative networks and on the input of 8 United Nations organizations, IUCN and ICSEM. The overall co-ordination and guidance for MED POL - PHASE I was provided by UNEP, acting as the Secretariat of the Mediterranean Action Plan.
3. The general objectives of the MED POL - PHASE I, as evolved through a series of expert and intergovernmental meetings, were
 - to formulate and carry out a co-ordinated pollution monitoring and research programme taking into account the goals of the Mediterranean Action Plan and the capabilities of the Mediterranean research centres to participate in it,
 - to assist national research centres in developing their capabilities to participate in the programme,
 - to analyse the sources, amounts, levels, pathways, trends and effects of pollutants relevant to the Mediterranean Sea,
 - to provide the scientific/technical information needed by the Governments of the Mediterranean States and the EEC for the negotiation and implementation of the Convention for the Protection of the Mediterranean Sea against Pollution and its related protocols.
4. The results of MED POL - PHASE I are reflected in the documents listed in Annex II.
5. The Intergovernmental Review Meeting of Mediterranean Coastal States and First Meeting of the Contracting Parties to the Convention for the Protection of the Mediterranean Sea against

Pollution and its related protocols (Geneva, 5-10 February 1979), having examined the status of MED POL PHASE I, recommended that during the 1979 biennium a long-term pollution monitoring and research programme should be formulated (Annex III) and the present document is a response to this project,

6. The legal obligations of the Contracting Parties to the:

- Convention for the Protection of the Mediterranean Sea Against Pollution (adopted in Barcelona, 16 February 1976; entered into force on 12 February 1978);
- Protocol for the Prevention of Pollution of the Mediterranean Sea by Dumping from Ships and Aircraft (adopted in Barcelona, 16 February 1975; entered into force on 12 February 1978);

Protocol Concerning Co-operation in Combating Pollution of the Mediterranean Sea by Oil and Other Harmful Substances in Cases of Emergency (adopted in Barcelona, 16 February 1976; entered into force on 12 February 1978);

- Protocol for the Protection of the Mediterranean Sea Against Pollution from Land-Based Sources (adopted in Athens, 17 May 1980)

related to the proposed MED POL - PHASE II are contained in Annex IV.

7. Based on the recommendations made at various expert and intergovernmental meetings, this draft long-term programme for pollution monitoring and research (MED POL - PHASE II) was formulated by the Secretariat of the Convention (UNEP) in co-operation with the organizations which have supported the MED POL - PHASE I (ECE, UNIDO, FAO, UNESCO, IOC of UNESCO, WHO, WMO, IAEA) and is submitted to the Contracting Parties to the Barcelona Convention for their consideration and approval.

OBJECTIVES

8. The long-term objectives of MED POL - PHASE II are designed to provide, on a continuous basis, the Parties to the Barcelona Convention and its related protocols with:
- indicators of the effectiveness of the measures taken under the Convention¹ and the protocols,
 - information which may lead to eventual revisions of the relevant provisions of the Convention and the protocols and for the formulation of additional protocols,

- information which could be used in formulating environmentally sound national, bilateral and multilateral management decisions essential for the continuous socio-economic development of the Mediterranean region on a sustainable basis.
9. These objectives will be achieved through the evaluation of the information on the sources, amounts, levels, trends, pathways and effects of pollutants in the Mediterranean which will be collected, analysed and reported on a systematic basis using commonly agreed methods.

PRINCIPLES

10. The basic principles used in the development of MED POL - PHASE II are listed below:

- (a) Mechanisms which will be used for MED POL - PHASE II related policy making:

- periodic meetings of Contracting Parties to decide on the programme, evaluate its results, review its progress and approve its budget;
- periodic meetings of the Working Group for Scientific and Technical Co-operation consisting of national MED POL co-ordinators designated by the relevant national authorities to evaluate the results of the programme, review its progress and prepare relevant recommendations for the meetings of Contracting Parties.

- (b) The monitoring of and research on pollutants affecting the Mediterranean marine environment will reflect primarily the immediate and long-term requirements of the Barcelona Convention and its protocols (including those protocols which are in their formation stage) but will also take into account factors needed for the understanding of the relationship between the socio-economic development of the region and the pollution of the Mediterranean Sea.

- (c) The strategy of the programme will be such as to provide information on pollution trends within the Mediterranean Sea recognizing that the dynamics of the system are such that pollution in one area can cause detrimental effects in other areas.

- (d) For this purpose monitoring will be organized at several levels:

- monitoring of sources of pollution providing information on the type and amount of pollutants released directly into the environment;

- monitoring of nearshore areas under the direct influence of pollutants from identifiable primary (outfalls, discharge and coastal dumping points) or secondary (rivers) sources;
 - monitoring of offshore areas (reference areas) providing information on the general trends in the level of pollution in the Mediterranean;
 - monitoring of media (atmosphere, rivers) which play a role in the long-range transport of pollutants to the Mediterranean providing additional information on the pollution load reaching the Mediterranean Sea.
- (e) Studies and research undertaken in the framework of the programme will be directly relevant to the achievement of the objectives of the programme.
- (f) PHASE II will be based primarily on the experience and results obtained during PHASE I, but will also take into account the experience gained through other large-scale national, bilateral or multilateral research and monitoring programmes carried out in the Mediterranean and in other regions of the world.
- (g) The work will be carried out by national centres, in particular those which actively participated in PHASE I, taking into account the need for adequate geographic coverage. These centres will have to be designated by the relevant national authorities and will be named "collaborating UNEP MED POL centres" after demonstrating their competence.
- (h) The results of PHASE II will be collated, processed and disseminated by the unit co-ordinating the Mediterranean Action Plan in co-operation with the relevant specialized organizations of the UN system. The Geneva-based International Computing Centre (ICC) will be used for data processing according to agreed standard practices, making full use of existing mechanisms for data exchange.
- (i) Data generated in PHASE II will be comparable with those obtained during PHASE I and with those generated through UNEP-sponsored regional seas programmes in other regions, thus contributing to the Global Environment Monitoring System (GEMS).
- (j) The overall co-ordination of PHASE II will be vested in the unit co-ordinating the Mediterranean Action Plan, acting on behalf of UNEP as the Secretariat of the Barcelona Convention.
- (k) The day-to-day co-ordination of the work carried out by national institutions participating in PHASE II will be achieved through:

- the unit co-ordinating the Mediterranean Action Plan supplemented by staff assigned to it by the specialized organizations prepared to participate in the work, or
 - an "interagency team", consisting of staff assigned to it by the specialized organizations prepared to participate in the work, and acting under the general guidance of the unit co-ordinating the Mediterranean Action Plan.
- (l) Mechanisms which will be used, as appropriate, for the analysis of data and their initial evaluation:
- the unit co-ordinating the Mediterranean Action Plan;
 - the "interagency team";
 - the meeting of representatives of centres participating in the programme;
 - the Working Group for Scientific and Technical Co-operation;
 - experts selected by the unit co-ordinating the Mediterranean Action Plan and the "interagency team", acting in their personal capacity.
- (m) Financial resources for the implementation of PHASE II:
- (i) cash from:
- Mediterranean Trust Fund;
 - UNEP's Fund;
 - voluntary contributions.
- (ii) contributions in kind and services from:
- collaborating national centres;
 - Governments of the Mediterranean States and the EEC;
 - specialized organizations participating in the programme.

MONITORING

11. Several types of monitoring will be undertaken, all contributing to the fulfillment of the principle contained in paragraph 10(a).
- A. Monitoring of sources of pollution providing information on the type and amount of pollutants reaching directly the marine environment
12. The purpose of this monitoring is to establish the pollution load reaching the Mediterranean Sea and to enable the

construction of a mass-balance model of pollutants relevant to the Mediterranean Sea. It will cover the:

- (a) Survey of the type and amount of pollutants discharged directly into the coastal waters from land-based (coastal) sources;
- (b) Survey of the type and amount of pollutants dumped directly into the sea;
- (c) Survey of the type and amount of pollutants dumped in emergency or released accidentally into the sea;
- (d) Assessment of the type and amount of selected substances (compounds) reaching through natural (weathering, hydrothermal, etc.) processes the sea directly from land-based (coastal) or maritime sources.

13. Pollutants (substances, compounds) to be monitored include:

- (a) Pollutants listed in Annex II of the Land-Based Sources Protocol (paragraph 12 (a)).
- (b) Pollutants listed in Annex II of the Dumping Protocol (paragraph 12(b)).
- (c) Pollutants referred to in Article 8 and Article 9 of the Dumping Protocol (paragraph 12(c)).
- (d) Pollutants referred to in Article 8 of the Emergency Protocol (paragraph 12(c)).
- (e) Substances (compounds) which may contribute substantially to the overall level (concentration) of pollutants in the sea (paragraph 12(d)).

14. The monitoring will be based on data from

- (a) Reports due to be submitted by the Contracting Parties according to Article 7, Article 8 and Article 9 of the Dumping Protocol.
- (b) Reports due to be submitted by the Contracting Parties according to Article 8 and Article 9 of the Emergency Protocol.
- (c) Reports due to be submitted by the Contracting Parties according to Article 6 and Article 13 of the Land-Based Sources Protocol.
- (d) Data from monitoring stations for substances (compounds), both to be agreed by the Contracting Parties, which may contribute substantially to the overall level (concentration) of pollutants

in the sea (paragraphs 12(d) and 13(c)). Data will be generated by national research centres designated by their governments to participate in the programme.

- B. Monitoring of the internal waters, as defined by Article 3(b) and (c) of the Land-Based Sources Protocol, under the direct influence of pollutants from identifiable primary (outfalls, discharge or coastal dumping points) or secondary (rivers) sources
15. The purpose of this monitoring is to establish the effects of measures taken by Contracting Parties under Land-Based Sources Protocol (Article 8(b)).
16. The monitoring will be ^{carried out by the} ~~based on the work of~~ national research centres designated by their governments to monitor areas selected by their governments within their national jurisdiction for the following mandatory parameters (indicators): *taking into account Annex # 1.*
- (a) in water
- soluble petroleum hydrocarbons,
 - nutrients (in special regions) combined with temperature,
 - salinity and oxygen,
 - microorganisms (total coliforms, fecal coliforms and fecal ~~steptococs~~ stteptococs), combined with temperature salinity, oxygen.
- (b) in sediments
- microorganisms
 - Hg (total)
 - Cd)
 - Zn)
 - Cu) combined with ignition loss and
 - DDT) redox potential
 - PCBs)
 - PHC)
- (c) in biota (mussels, fish and crustacea in coastal and nearshore areas; plankton, tuna and sardines in open waters)
- Hg (total)
 - Cd
 - Zn
 - Cu
 - microorganisms (total coliforms, fecal coliforms, fecal steptococs)
 - DDT
 - PCBs
- (d) in suspended matter
- Hg (total)

- Cd
- Zn
- Cu
- DDT
- PCBs

(e) on the coast

- tarballs

17. Additional parameters to become mandatory within 3 years of MED POL - PHASE II.

(a) in water

- particulate petroleum hydrocarbon
- Hg (total)
- Cd
- DDT
- PCBs
- radionuclides
- pathogens (viruses, salmonella)

(b) in sediments

- Pb
- Hg (organic)
- pathogens (viruses, salmonella)

(c) in biota

- Hg (organic)
- Se
- Pb
- As
- radionuclides
- benzpyrene
- phenols (in coastal waters)

C. Monitoring of reference areas, as defined by Article I of the Convention, which are not under direct influence of pollutants from identifiable primary or secondary sources.

18. The purpose of this monitoring is to provide information on the general trends in the level (concentration) of pollutants in the Mediterranean Sea.

19. The monitoring will be based on the work of national research centres designated by their governments to monitor areas selected by their governments if they fall within their national jurisdiction. Monitoring of areas outside of national jurisdiction will be agreed jointly by governments concerned.

20. Taking into account the present knowledge about the prevailing conditions in the Mediterranean Sea the areas indicated in Figure 1 are proposed to be monitored.
21. Parameters (indicators) to be monitored in the reference areas are those listed in paragraphs 16(a), 16(b) and 16(c), with the exception of microorganisms and nutrients. *✓ ref. Annex I*
- D. Monitoring of media (atmosphere, rivers) which play a role in the long-range transport of pollutants to the Mediterranean Sea
22. The purpose of this monitoring is to provide additional information on the pollution load reaching the Mediterranean Sea.
23. The monitoring will be based on the work of national research centres designated by their governments.
24. The monitoring areas will include:
 - (a) in the case of watercourses areas at the freshwater limit;
 - (b) in the case of saltwater marshes the areas where they communicate with the sea;
 - (c) in the case of atmosphere areas (a) directly influenced by identifiable source of air pollution and (b) reference areas not directly influenced by identifiable source of air pollution.
25. Monitoring of areas outside of national jurisdiction, or under shared jurisdiction by two states, will be agreed jointly by the governments concerned.
26. Parameters (indicators) to be monitored:
 - (a) in atmosphere
 - Hg
 - Cd
 - DDT
 - PCBs
 - Pb
 - radionuclides
 - pathogens (viruses, salmonella)
 - (b) in rivers

(Parameters to be defined using the experience of MED POL IX).
- E. Sampling and analytical techniques
27. Sampling and analytical techniques used in the monitoring

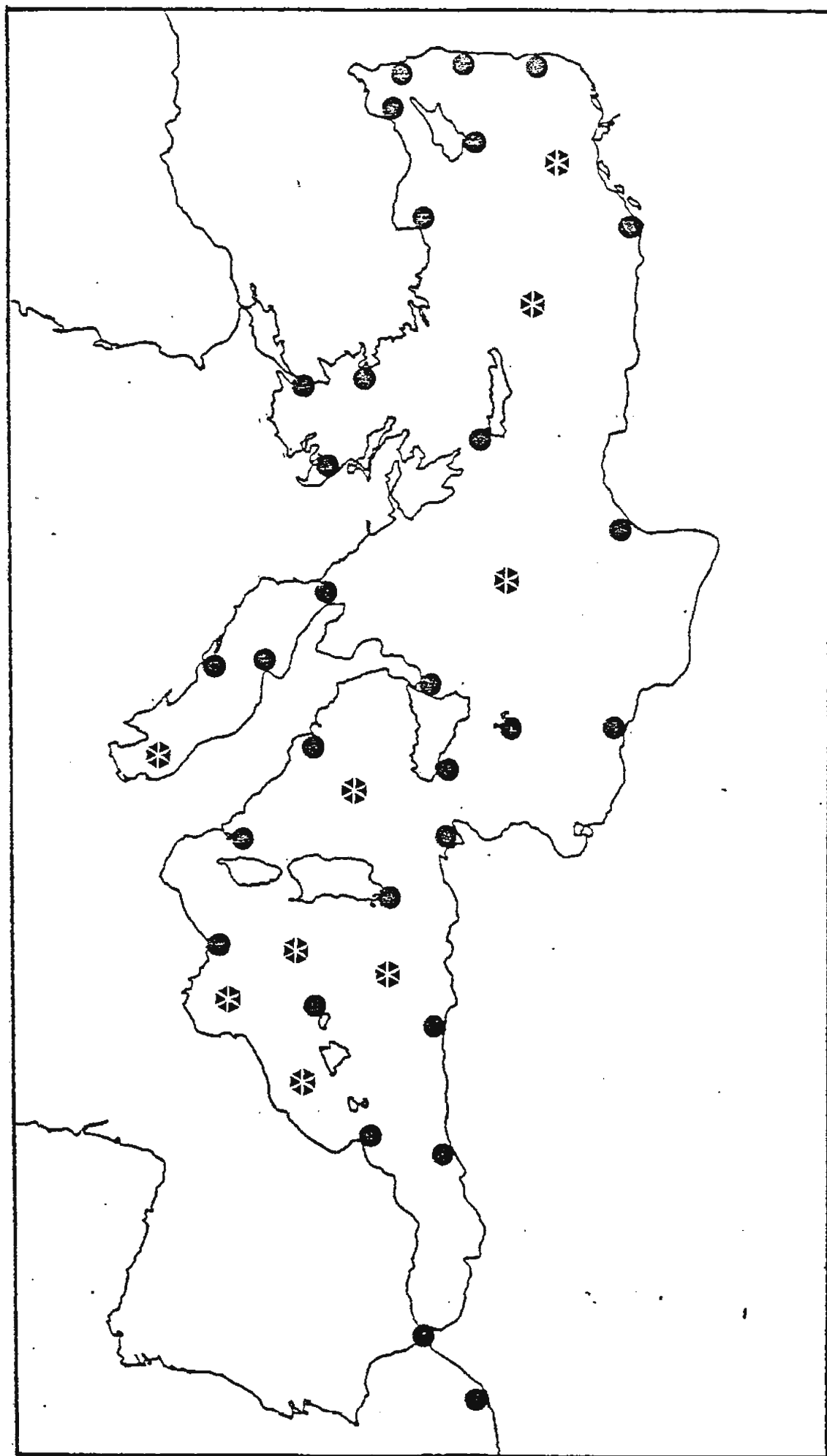


Fig. 1 - Proposed monitoring zones

- Zones in internal waters
- ⊗ Zones in reference areas

programme will be based on mandatory reference methods. Other methods could be used also, subject to a satisfactory intercalibration exercise.

28. Reference methods developed and tested during MED POL - PHASE I include (Annex V):

- (a) Mercury in marine organisms
- (b) Chlorinated hydrocarbons in marine organisms
- (c) Fecal coliforms in bathing waters and shellfish-growing waters
- (d) Fecal streptococci in bathing waters and shellfish-growing waters
- (e) Microbiological contamination of shellfish

29. Additional reference methods will be developed and tested during MED POL - PHASE II (see paragraph 39(a)).

30. Sampling frequency will depend on the purpose of monitoring. It The sampling will be:

- (a) permanent (preferably daily whenever possible) for surveys indicated in paragraphs 12(a) and 12(b);
- (b) ad hoc, i.e. whenever necessary for surveys indicated in paragraph 12(c) or whenever feasible for assessment indicated in paragraph 12(d);
- (c) seasonal (at least) for monitoring indicated in paragraphs 15-17 and 22-26;
- (d) once a year (at least) for monitoring indicated in paragraphs 18-21.

31. All national research centres will permanently participate in the intercalibration of sampling and analytical techniques. This exercise will provide the basis for the quality control programme of MED POL - PHASE II.

F. Data analysis and dissemination

32. Data will be first analyzed by the designated national research centres, organizations or authorities collecting them.

33. Depending on the nature of the data they will be reported, in an agreed format, to the Mediterranean Action Plan Co-ordinating Unit directly or indirectly through the Regional Oil Combating Centre and the Interagency Team. On this level, using the

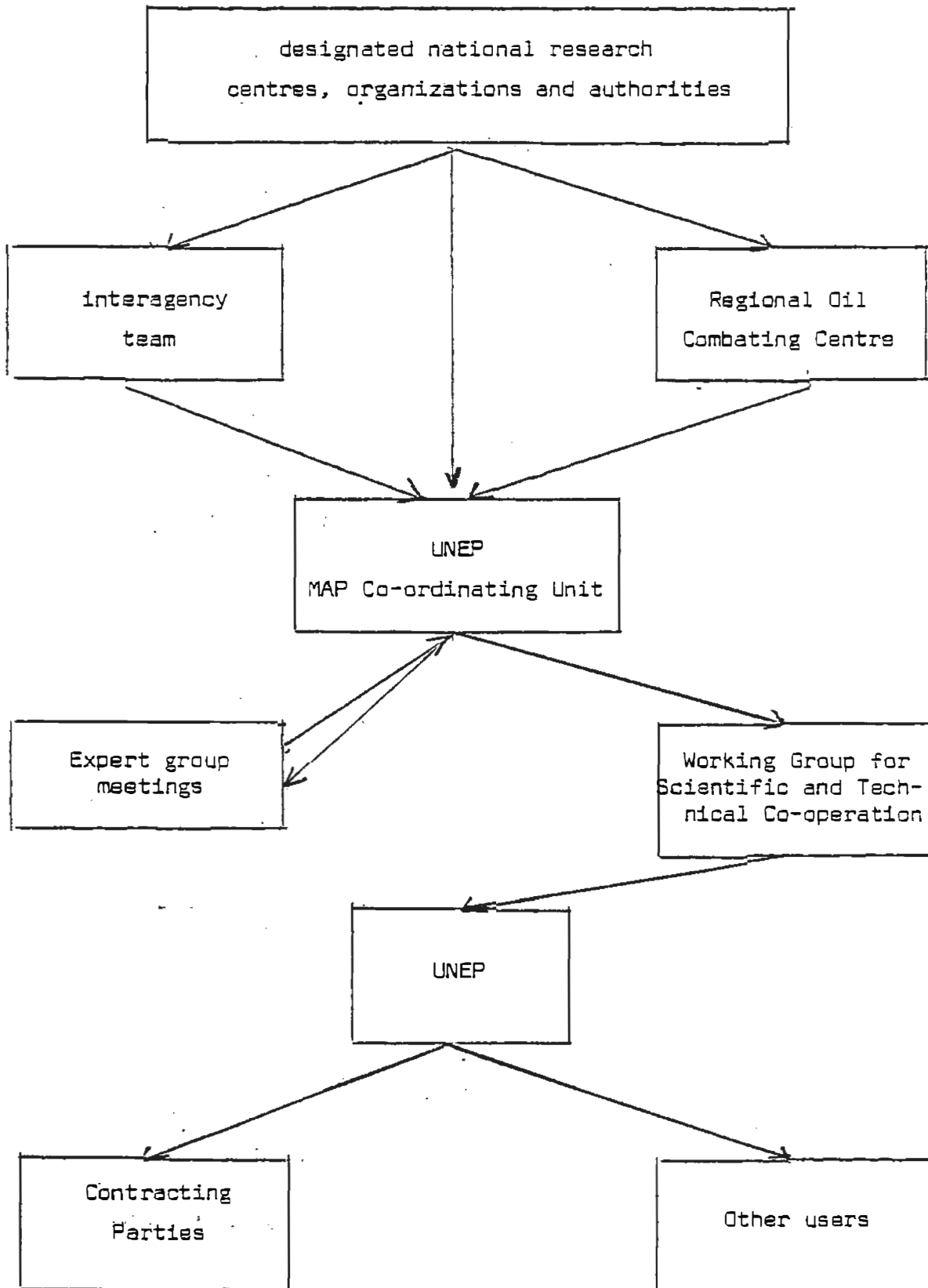
computer facilities of the Geneva based International Computing Center, the second analysis of data will be carried out, including the control of their quality, and the first integration of data will be achieved.

34. If necessary, specialized expert groups will be convened to assist in the analysis and integration of data.
35. Before submitting the data to the Contracting Parties and other users they will be reviewed by the Working Group for Scientific and Technical Co-operation.
36. A chart indicating the steps outlined in paragraphs 32-35 is shown in Figure 2.

RESEARCH AND STUDY TOPICS

37. Only research and studies directly relevant to the achievement of the objectives of MED POL - PHASE II are envisaged.
38. Research and studies will be carried out primarily by Mediterranean research centres and organizations on a direct contractual basis or as a voluntary contribution from these centres and organizations offered by the Contracting Parties.
39. Research and study topics included initially in the MED POL - PHASE II (sequence does not imply order of priority):
- a) Development of sampling and analytical techniques for monitoring the levels of pollutants at their source and in the marine environment. Harmonization of these methods at Mediterranean level.
 - b) Development of reporting formats required according to the Dumping, Emergency and Land-Based Sources Protocols.
 - c) Formulation of proposals for effluent quality criteria to be used as common emission standards for substances listed in Annex I of the Land-Based Sources Protocol.
 - d) Development of the scientific rationale for the formulation of environmental quality criteria to be used as common standards of use for substances listed in Annex II of the Land-Based Sources Protocol.
 - e) Epidemiological studies related to the confirmation (and eventual revision) of the proposed environmental quality criteria (standards of use) for bathing waters and edible marine organisms.
 - f) Development of proposals for guidelines and criteria governing the application of the Land-Based Sources Protocol, as requested in Article 7 of this Protocol.

Figure 2. Flow chart for data collection, analysis and reporting



- g) Hydrodynamic model of the Mediterranean. Refinement of existing models with particular emphasis on surface circulation and vertical transport. Needed as support to the understanding of the distribution of pollutants through the Mediterranean and to the development of contingency plans for cases of emergency.
- n) Research on the toxicity, persistence, bioaccumulation and carcinogenicity of substances listed in annexes of the LBS Protocol.
- i) Research on the implications of eutrophication and concomittant plankton blooms.
- j) Study of ecosystem modifications in areas influenced by pollutants, including studies of areas where ecosystem modifications are caused by large-scale coastal or inland engineering activity.
- k) Effects of thermal discharges on marine and coastal ecosystems including the study of potentially beneficial use of these discharges (aquaculture).
- l) Development of reference methods for marine pollution determination. Substances listed in LBS and dumping Protocols priorities.
- m) Climatic changes linked with marine pollution.
- n) Biogeoecycle of specific pollutants of particular relevance to human health (mercury, survival of pathogens in the Mediterranean Sea, etc.).
- o) Study of pollutants' transfer processes at river/sea and air/sea interface as well as by sedimentation.

ASSISTANCE PROGRAMME

- 40. In addition to the assistance envisaged through the activities of the Regional Oil Combating Centre direct assistance in the fields of science, education and technology will be provided through MED POI II as described in the following paragraphs.
- 41. Individual and collective training will be provided for scientists and technicians in techniques (methods) required for their effective participation in monitoring and research envisaged in the framework of MED POI - PHASE II. This assistance will be in the form of fellowships, experts, workshops, seminars, study tours, grants for attendance to meetings, etc., and will cover training in analytical

techniques, sampling, data processing, interpretation of results and various research topics.

42. Training for technicians and administrators will be organized in the application of the provisions of Annex III to the Land-Based Sources Protocol. The forms of training will be identical with those mentioned in the preceding paragraph.
43. A quality control programme will be an integral part of MED POL - PHASE II to ensure the highest degree of quality and of comparability of data. The national research centres participating in monitoring will receive standards and reference substances enabling them to participate in the permanent Mediterranean intercalibration exercise. Weaknesses detected through the quality control programme will be corrected through additional training, whenever necessary.
44. The common maintenance services for the sophisticated analytical equipment (atomic absorption spectrophotometers, gas chromatographs, etc.), developed during MED POL - PHASE I, will remain at the disposal of participants in PHASE II enabling the proper functioning of the equipment used by national research centres.
45. Standardized material and equipment will be put at the disposal of national centres participating in MED POL - PHASE II to enable their full participation in the monitoring and research programme.

CO-ORDINATION

46. The periodic meetings of the Contracting Parties will decide about the general lines of the MED POL - PHASE II, review its progress and approve its budget.
47. A standing Working Group for Scientific and Technical Co-operation will be established by the Contracting Parties to evaluate the results of the programme, review its progress, advise UNEP on technical and policy matters related to the programme and prepare recommendations for the meetings of contracting parties. The Group will consist of national MED POL co-ordinators designated by the relevant national authorities and will meet once a year.
48. The overall co-ordination of MED POL - PHASE II will be exercised by UNEP, as the Secretariat of the Mediterranean Action Plan, through the Mediterranean Action Plan Co-ordinating Unit (MAP CU).
49. The day-to-day technical co-ordination of the work carried out by national institutions will be achieved through MAP CU supplemented by ~~staff assigned to it by the specialized~~

~~Organizations prepared to participate in the work~~ or through an "interagency team" consisting of staff assigned to it by the Specialized organizations.

50. The highly specific quality control programme (paragraph 43) and maintenance services (paragraph 44) will be organized and carried out under the overall guidance of MAP CU either by competent specialized organizations or selected national institutions.

BUDGETARY CONSIDERATIONS

51. The financial resources needed for the work envisaged in the framework of MED POL - PHASE II will come from:
- (a) Governments participating in the Mediterranean Action Plan (cash contributions through the Mediterranean Trust Fund and contributions in kind through participation of their national institutions).
 - (b) UNEP (cash contributions on a project funding basis and contributions in kind through certain services).
 - (c) National institutions participating in the programme (contributions in kind through services, staff time, etc.).
 - (d) Specialized UN organizations participating in and supporting the programme (contributions in kind through services, staff time, etc.).
 - (e) Voluntary contributions (in cash and kind) from sources not mentioned previously.
52. The timetable/workplan of MED POL - PHASE II activities and their budgetary implications are shown in Table I.

TABLE 1 : MED POL - PHASE II timetable/workplan and its budgetary implications

activity	timetable	financial resources
(i) Approval for initiation of MED POL - PHASE II by second meeting of the Contracting Parties	March 1980	

(to be completed)

Extract^{1/} from the
Mediterranean Action Plan
adopted by the
Intergovernmental Meeting on the Protection of the Mediterranean
(Barcelona, 28 January - 4 February 1975)

Co-ordinated Pollution Monitoring and Research Programme in the
Mediterranean

The Intergovernmental Meeting on the Protection of the Mediterranean,

1. Having considered the research and monitoring projects, as set forth in document UNEP/WG.2/3, entitled "Co-ordinated programme for research, monitoring, and exchange of information and assessment of the state of pollution and of protection measures".
2. Agrees that, due to limitations in facilities and scarcity of trained scientists the seven proposed programmes, not listed in order of priority:

Baseline studies and monitoring of oil and petroleum hydrocarbons in marine waters

Baseline studies and monitoring of metals, particularly mercury, in marine organisms

Baseline studies and monitoring of DDT, PCB's and other chlorinated hydrocarbons in marine organisms

Effects of pollutants on marine organisms and their populations

Effects of pollutants on marine communities and eco-systems

Coastal transport problems of pollutants

Coastal water quality control programmes

should be, in the first stage, pilot projects.

3. Calls upon the Executive Director of UNEP, in consultation with Governments, and with the co-operation of appropriate organizations of the United Nations system as well as of competent intergovernmental regional organizations, to convene a limited number of meetings of

^{1/} UNEP/WG.2/5, Annex, pages 2-3.

experts selected from institutions expressing their desire to participate in the various programmes, to draw up documents describing in detail the operations for each pilot project. The pilot projects should have an operational phase of at least two years.

4. Invites the Executive Director of UNEP, in order to increase the number of participants in the various programmes, to organize, as a first priority, an intensive in-service training of scientists and technicians and to provide additional equipment, this being the best basis for the development of the abilities of national laboratories and institutions. The in-service training should be organized and confined within the Mediterranean countries to the largest possible extent.

5. Requests the Executive Director of UNEP to keep Mediterranean Governments informed of these programmes as they are formulated and developed.

6. Calls upon Governments and appropriate international bodies to help the national institutions concerned to participate in the preparation and implementation of these monitoring and research activities.

List of selected documents relevant to the development and results
of the Co-ordinated Mediterranean Pollution Monitoring and Research Programme
(MED POL - PHASE I)

Report of the IOC/GFCM/ICSEM International Workshop on Marine Pollution in the Mediterranean (Monte-Carlo, 9-14 September 1974), UNESCO 1974.

Project on Pollution in the Mediterranean (Msida, 8 - 13 September 1975), IOC/MPPP/3, UNESCO 1975.

Report of the FAO(GFCM)/UNEP Expert Consultation on the Joint Co-ordinated Project on Pollution in the Mediterranean (Rome, 23 June - 4 July 1975), FAO 1975.

Report of the WHO/UNEP Expert Consultation on Coastal Water Quality Control Programme in the Mediterranean (Geneva, 15 - 19 December 1975), EHE/76.1, WHO 1976.

Directory of Mediterranean Marine Research Centres. First Edition UNEP 1976.

Manual of Methods in Aquatic Environment Research. Part 2 : Guidelines for the Use of Biological Accumulators in Marine Pollution Monitoring. FAO Fisheries Technical Paper No. 150. FAO 1976.

Manual of Methods in Aquatic Environment Research. Part 3 : Sampling and Analysis of Biological Material. FAO Fisheries Technical Paper No. 158. FAO 1976.

Guidelines for Health Related Monitoring of Coastal Water Quality. Report of a meeting of WHO/UNEP Joint Group of Experts (Rovinj, Yugoslavia, 23 - 25 February 1977). WHO 1977.

Health Criteria and Epidemiological Studies Related to Coastal Water Pollution. Report of a meeting of WHO/UNEP Joint Group of Experts (Athens, 1 - 4 March 1977). WHO 1977.

Co-ordinated Mediterranean Pollution Monitoring and Research Programme (MED POL). Summary Report of the Mid-term Review Meeting on IOC/WMO/UNEP and IOC/UNEP Pilot Projects, (Barcelona, 23 - 27 May 1977). IOC-WMO-UNEP/MED-MRM/3. UNESCO 1977.

Guidelines for the Implementation of Pilot Projects MED I and MED VI. Supplements 1 and 3 to IOC-WMO-UNEP/MED-MRM/3. UNESCO 1977.

Manual for Monitoring Oil and Petroleum Hydrocarbons in Marine Waters and on Beaches. Supplement to manuals and guides No.7. UNESCO 1977.

Mid-term Review of the Joint WHO/UNEP Co-ordinated Pilot Project on Coastal Water Quality Control in the Mediterranean. Report of the meeting of principal investigators of collaborating laboratories (Rome, 30 May - 1 June 1977). WHO 1977.

Coastal Water Pollution Control. Report of a joint WHO/UNEP Workshop (Athens, 27 June - 1 July 1977). WHO 1977.

Manual of Methods in Aquatic Environment Research. Part 4 : Bases for Selecting Biological Tests to Evaluate Marine Pollution. FAO Fisheries Technical Paper No. 164. FAO 1977.

Selected Bibliography on Studies and Research Relevant to Pollution in the Mediterranean. FAO Fisheries Technical Paper No. 165. FAO 1977.

Directory of Mediterranean Marine Research Centres. Second Edition. UNEP 1977.

Preliminary Report on the State of Pollution of the Mediterranean Sea. UNEP/IG.11/INF.4. UNEP 1978.

Monitoring of Recreational Coastal Water Quality and Shellfish Culture Areas. Report of a joint WHO/UNEP Seminar (Rome, 4 - 7 April 1978). WHO 1978.

Coastal Quality Monitoring of Recreational and Shellfish Areas (MED VII). Report of a Workshop jointly convened by WHO and UNEP. (Rome, 17 - 19 January 1979). WHO 1979.

Pollutants from Land-Based Sources in the Mediterranean. (Report prepared in collaboration with ECE, UNIDO, FAO, UNESCO, WHO, IAEA). UNEP/WG.18/INF.4. UNEP 1979.

Manual of Methods in Aquatic Environment Research. Part 5 : Statistical Tests. FAO Fisheries Technical Paper No. 182. FAO 1979.

Principles and Guidelines for Discharge of Wastes into the Marine Environment. WHO 1979.

Data Profiles for Chemicals for the Evaluation of their Hazards to the Environment of the Mediterranean Sea. Vols. I and II. IRPTC/UNEP 1979.

Co-ordinated Mediterranean Pollution Monitoring and Research Programme (MED POL). Programme description. UNEP/IG.14/INF.3. UNEP 1979.

Summary Reports on the Scientific Results of MED POL. Parts I, II and III. UNEP/IG.18/INF.3. UNEP 1980.

Selected Bibliography on the Pollution of the Mediterranean Sea (prepared in collaboration with FAO, WHO, IOC, WMO, IAEA and UNEP). (in preparation).

Reference Methods for Marine Pollution Studies in the Mediterranean (prepared in collaboration with FAO, WHO, IOC, IAEA and UNEP). (in preparation).

The State of Pollution of the Mediterranean Sea. Pergamon Press/UNEP (in preparation).

Recommendations^{1/}
relevant to the MED POL - PHASE I and PHASE II
adopted by the
Intergovernmental Review Meeting of Mediterranean Coastal States and
First Meeting of the Contracting Parties to the Convention for the Protection
of the Mediterranean Sea against Pollution and its
related protocols
(Geneva, 5 - 10 February 1979)

1. The seven pilot projects on pollution monitoring and research (MED I - MED VII) are designated to lead to the establishment of a long-term pollution monitoring and research programme. During the 1979 - 1980 biennium, such a programme should be formulated in consultation with the Governments and the EEC and with the assistance and participation of the relevant specialized organizations of the United Nations system. This programme should ensure systematic and regular information on the sources, amounts, levels, pathways and effects of pollutants in the Mediterranean basin. The methodology of the long-term programme should be based on experience gained during the 1975 - 1980 pilot phase, with modifications, as appropriate, and on the participation of research institutions to be designated by their Governments and the EEC.
2. The seven ongoing pilot projects on pollution monitoring and research projects (MED I - MED VII) should be extended until the second meeting of the Contracting Parties (1981) in order to strengthen the basis for national marine pollution monitoring and research activities geared to satisfying the needs and requirements of the individual States and of an international co-operative programme for continuous monitoring of, and research on, the state of pollution of the Mediterranean, as envisaged by the Barcelona Convention.
3. In order to ensure the smooth continuation of the work and the highest degree of data comparability over the period 1975 - 1980, no substantial changes should be introduced in the methodology used at present in MED I - MED VII projects, except when the results obtained until now indicate a need for it. The mandatory intercalibration of analytical techniques and the common maintenance services (MED XI) should also continue. In the future, the interlaboratory comparison exercises conducted through the IAEA should be reinforced and the services improved. Relevant findings should be communicated to the Governments and the EEC.

4. Based upon the methodology used during the pilot phase and taking into account already existing standard methods, a consolidated set of Reference Methods for Pollution Studies in the Mediterranean should be prepared by the end of 1979.
5. In order to assist the work of marine scientists in the Mediterranean, a Selected Bibliography on the Pollution of the Mediterranean Sea should be published by the end of 1979.
6. The Report on the State of Pollution of the Mediterranean Sea should be finalized by the end of 1979 making full use of data obtained through the MED POL pilot projects and other relevant sources. The final form of this report should be prepared and released in consultation with the Mediterranean Governments and the EEC.
7. The results obtained through MED POL should be systematically collected, analysed and published annually as:
 - (i) consolidated reports on each of the MED POL pilot projects;
 - (ii) collated reports of individual research centres participating in MED POL; and
 - (iii) a report assessing the operational capabilities of the national centres in terms of equipment and specialists, with an indication of the assistance that has been provided within the framework of MED POL.
8. Assistance should be provided to national research centres designated as participants in the MED I - MED VII projects within the budgetary framework of each pilot project, in order to strengthen those centres that do not have either sufficiently trained personnel or the equipment needed for their effective participation in the programme.
9. To prepare for the launching of the long-term pollution monitoring and research programme, currently available methods for data recording, archiving and statistical analysis should be tested and elaborated using the facilities of the Geneva-based United Nations International Computing Centre (ICC), taking account of existing standard practices and making full use of the existing mechanisms for data collection, handling, exchange and dissemination.
10. The work of the seven MED POL Regional Activity Centres in the pilot phase of the monitoring and research programme should be evaluated.
11. The pilot project MED X on the evaluation of land-based sources of pollution should be pursued in a way which allows for the collection of data from countries that could not participate in the first part of this project. During the first phase the assessment of river inputs was undertaken under MED IX and X jointly. It was decided that during the biennium 1979-1980 this assessment should be pursued under MED IX.

12. Interest was expressed, although for several delegations this interest was purely scientific, in:

- (i) monitoring of pollution levels of the open waters and the biogeochemical cycle of the most important pollutant (MED VIII);
- (ii) assessment of input of airborne pollutants in the Mediterranean (MED XII);
- (iii) development of conceptual and predictive models of biogeochemical cycles and water mass movement (MED XIII).

Taking into account, however, the present state of the art for some of the projects and the difficulties in initiating or implementing them, also in view of the limited availability of resources for the MED POL programme, the following priorities are suggested:

1st Priority MED POL I - VII, IX, X and XI

2nd Priority - MED POL VIII, XII and XIII.

The results of pilot projects within the MED POL programme should be subjected to a review by a meeting of experts on the Mediterranean long-term pollution monitoring and research programme which should be asked to make recommendations concerning project revisions or continuance.

13. Work should be continued on the development of the scientific rationale for the criteria applicable to the quality of recreational waters, shellfish-growing areas, waters used for aquaculture, and seafood. Based on this rationale and taking into account existing national provisions and international arrangements and agreements, the criteria should be formulated on a scientific basis and submitted to the Governments and the EEC for their consideration.

Articles of the
Convention for the Protection of the Mediterranean Sea Against Pollution
and its related protocols
relevant to MED POL - PHASE II

CONVENTION FOR THE PROTECTION OF THE MEDITERRANEAN SEA AGAINST POLLUTION

Article 1

Geographical Coverage

1. For the purposes of this Convention, the Mediterranean Sea Area shall mean the maritime waters of the Mediterranean Sea proper, including its gulfs and seas, bounded to the West by the meridian passing through Cape Spartel lighthouse, at the entrance of the Straits of Gibraltar, and to the East by the southern limits of the Straits of the Daruanelles between Menmetsik and Kumkale lighthouses.
2. Except as may be otherwise provided in any protocol to this Convention, the Mediterranean Sea Area shall not include internal waters of the Contracting Parties.

Article 2

Definitions

For the purposes of this Convention:

- (a) "Pollution" means the introduction by man, directly or indirectly, of substances or energy into the marine environment resulting in such deleterious effects as harm to living resources, hazards to human health, hindrance to marine activities including fishing, impairment of quality for use of sea water and reduction of amenities.

Article 3

General Provisions

1. The Contracting Parties may enter into bilateral or multilateral agreements, including regional or subregional agreements, for the protection of the marine environment of the Mediterranean Sea against pollution, provided that such agreements are consistent with this Convention and conform to international law.

Article 4

General Undertakings

1. The Contracting Parties shall individually or jointly take all appropriate measures in accordance with the provisions of this Convention and those protocols in force to which they are party, to prevent, abate and combat pollution of the Mediterranean Sea Area and to protect and enhance the marine environment in that Area.

Article 9

Co-operation in Dealing with Pollution Emergencies

2. Any Contracting Party which becomes aware of any pollution emergency in the Mediterranean Sea Area shall without delay notify the Organization 1/ and, either through the Organization or directly, any Contracting Party likely to be affected by such emergency.

Article 10

Monitoring

1. The Contracting Parties shall endeavour to establish, in close co-operation with the international bodies which they consider competent, complementary or joint programmes, including, as appropriate, programmes at the bilateral or multilateral levels, for pollution monitoring in the Mediterranean Sea Area and shall endeavour to establish a pollution monitoring system for that Area.

2. For this purpose, the Contracting Parties shall designate the competent authorities responsible for pollution monitoring within areas under their jurisdiction and shall participate as far as practicable in international arrangements for pollution monitoring in areas beyond national jurisdiction.

3. The Contracting Parties undertake to co-operate in the formulation, adoption and implementation of such annexes to this Convention as may be required to prescribe common procedures and standards for pollution monitoring.

1/ Article 13 of the Convention designates UNEP as the "Organization".

Article 11

Scientific and Technological Co-operation

1. The Contracting Parties undertake as far as possible to co-operate directly, or when appropriate through competent regional or other international organizations, in the fields of science and technology and to exchange data as well as other scientific information for the purpose of this Convention.
2. The Contracting Parties undertake as far as possible to develop and co-ordinate their national research programmes relating to all types of marine pollution in the Mediterranean Sea Area and to co-operate in the establishment and implementation of regional and other international research programmes for the purposes of this Convention.
3. The Contracting Parties undertake to co-operate in the provision of technical and other possible assistance in fields relating to marine pollution, with priority to be given to the special needs of developing countries in the Mediterranean region.

Article 14

Meetings of the Contracting Parties

1. The Contracting Parties shall hold ordinary meetings once every two years and extraordinary meetings at any other time deemed necessary, upon the request of the Organization or at the request of any Contracting Party, provided that such requests are supported by at least two Contracting Parties.
2. It shall be the function of the meetings of the Contracting Parties to keep under review the implementation of this Convention and the protocols and, in particular:
 - (i) To review generally the inventories carried out by Contracting Parties and competent international organizations on the state of marine pollution and its effects in the Mediterranean Sea Areas;
 - (iii) To adopt, review and amend as required the annexes to this Convention and to the protocols
 - (v) To establish working groups as required to consider any matters related to this Convention and the protocols and annexes;

Article 20

Reports

The Contracting Parties shall transmit to the Organization reports on the measures adopted in the implementation of this Convention and of Protocols

to which they are Parties, in such form and at such intervals as the meeting of Contracting Parties may determine.

Article 21

Compliance Control

The Contracting Parties undertake to co-operate in the development of procedures enabling them to control the application of this Convention and the protocols.

PROTOCOL FOR THE PREVENTION OF POLLUTION OF THE MEDITERRANEAN SEA BY DUMPING FROM SHIPS AND AIRCRAFT

Article 1

The Contracting Parties to this Protocol (hereinafter referred to as "the Parties") shall take all appropriate measures to prevent and abate pollution of the Mediterranean Sea Area caused by dumping from ships and aircraft.

Article 2

The area to which this Protocol applies shall be the Mediterranean Sea Area as defined in article 1 of the Convention for the Protection of the Mediterranean Sea against Pollution (hereinafter referred to as "the Convention").

Article 7

The permits referred to in articles 5 and 6 above shall be issued only after careful consideration of all the factors set forth in Annex III to this Protocol. The Organization shall receive records of such permits.

Article 8

The provisions of articles 4, 5 and 6 shall not apply in case of force majeure due to stress of weather or any other cause when human life or the safety of a ship or aircraft is threatened. Such dumpings shall immediately be reported to the Organization and, either through the Organization or directly, to any Party or Parties likely to be affected, together with full details of the circumstances and of the nature and quantities of the wastes or other matter dumped.

Article 9

If a Party in a critical situation of an exceptional nature considers that wastes or other matter listed in Annex I to this Protocol cannot be disposed of on land without unacceptable danger or damage, above all for the safety

of human life, the Party concerned shall forthwith consult the Organization. The Organization, after consulting the Parties to this Protocol, shall recommend methods of storage or the most satisfactory means of destruction or disposal under the prevailing circumstances. The Party shall inform the Organization of the steps adopted in pursuance of these recommendations. The Parties pledge themselves to assist one another in such situations.

Article 14

1. Ordinary meetings of the Parties to this Protocol shall be held in conjunction with ordinary meetings of the Contracting Parties to the Convention held pursuant to article 14 of the Convention. The Parties to this Protocol may also hold extraordinary meetings in conformity with article 14 of this Convention.

2. It shall be the function of the meetings of the Parties to this Protocol:

(a) To keep under review the implementation of this Protocol, and to consider the efficacy of the measures adopted and the need for any other measures, in particular in the form of annexes;

(b) To study and consider the records of the permits issued in accordance with articles 5, 6 and 7 and of the dumping which has taken place;

PROTOCOL CONCERNING CO-OPERATION IN COMBATING POLLUTION OF THE MEDITERRANEAN SEA BY OIL AND OTHER HARMFUL SUBSTANCES IN CASES OF EMERGENCY

Article 1

The Contracting Parties to this Protocol (hereinafter referred to as "the Parties") shall co-operate in taking the necessary measures in cases of grave and imminent danger to the marine environment, the coast or related interests of one or more of the Parties due to the presence of massive quantities of oil or other harmful substances resulting from accidental causes or an accumulation of small discharges which are polluting or threatening to pollute the sea within the area defined in Article 1 of the Convention for the Protection of the Mediterranean Sea against Pollution (hereinafter referred to as "the Convention").

Article 4

The Parties shall develop and apply, either individually or through bilateral or multilateral co-operation, monitoring activities covering the Mediterranean Sea Area in order to have as precise information as possible on the situation referred to in article 1 of this Protocol.

Article 6

1. Each Party undertakes to disseminate to the other Parties information concerning:

- (a) The competent national organization or authorities responsible for combating pollution of the sea by oil and other harmful substances;
- (b) The competent national authorities responsible for receiving reports of pollution of the sea by oil and other harmful substances and for dealing with matters concerning measures of assistance between Parties;
- (c) New ways in which pollution of the sea by oil and other harmful substances may be avoided, new measures of combating pollution and the development of research programmes.

2. Parties which have agreed to exchange information directly between themselves shall nevertheless communicate such information to the regional centre. 1/ The latter shall communicate this information to the other Parties and, on a basis of reciprocity, to coastal States of the Mediterranean Sea Area which are not Parties to this Protocol.

Article 8

1. Each Party shall issue instructions to the masters of ships flying its flag and to the pilots of aircraft registered in its territory requiring them to report by the most rapid and adequate channels in the circumstances, and in accordance with annex I to this Protocol, either to a Party or to the regional centre:

- (a) All accidents causing or likely to cause pollution of the sea by oil or other harmful substances;
- (b) The presence, characteristics and extent of spillages of oil or other harmful substances observed at sea which are likely to present a serious and imminent threat to the marine environment or to the coast or related interests of one or more of the Parties.

Article 9

1. Any Party faced with a situation of the kind defined in article 1 of this Protocol shall:

- (a) Make the necessary assessments of the nature and extent of the casualty or emergency or, as the case may be, of the type and approximate quantity of oil or other harmful substances and the direction and speed or drift of the spillage;
- (b) Take every practicable measure to avoid or reduce the effects of pollution;

(c) Immediately inform all other Parties, either directly or through the regional centre of these assessments and of any action which it has taken or which it intends to take to combat the pollution;

Article 12

1. Ordinary meetings of the Parties of this Protocol shall be held in conjunction with ordinary meetings of the Contracting Parties to the Convention, held pursuant to article 14 of the Convention. The Parties to this Protocol may also hold extraordinary meetings as provided in article 14 of the Convention.

2. It shall be the function of the meetings of the Parties to this Protocol, in particular:

(a) To keep under review the implementation of this Protocol, and to consider the efficacy of the measures adopted and the need for any other measures, in particular in the form of annexes;

PROTOCOL FOR THE PROTECTION OF THE MEDITERRANEAN SEA AGAINST POLLUTION FROM LAND-BASED SOURCES

Article 1

The Contracting Parties to this Protocol (hereinafter referred to as "the Parties") shall take all appropriate measures to prevent, abate, combat and control pollution of the Mediterranean Sea Area caused by discharges from rivers, coastal establishments or outfalls, or emanating from any other land-based sources within their territories.

Article 3

The area to which this Protocol applies (hereinafter referred to as the "Protocol Area") shall be:

(a) the Mediterranean Sea Area as defined in article 1 of the Convention;

(b) waters on the landward side of the baselines from which the breadth of the territorial sea is measured and extending, in the case of watercourses, up to the freshwater limit;

(c) saltwater marshes communicating with the sea.

Article 5

1. The Parties undertake to eliminate pollution of the Protocol Area from land-based sources by substances listed in annex I to this Protocol.

2. To this end they shall elaborate and implement, jointly or individually, as appropriate, the necessary programmes and measures.

3. These programmes and measures shall include, in particular, common emission standards and standards for use.

4. The standards and the time-tables for the implementation of the programmes and measures aimed at eliminating pollution from land-based sources shall be fixed by the Parties and periodically reviewed

Article 6

1. The Parties shall strictly limit pollution from land-based sources in the Protocol Area by substances or sources listed in annex II to this Protocol.

2. To this end they shall elaborate and implement, jointly or individually, as appropriate, suitable programmes and measures.

3. Discharges shall be strictly subject to the issue, by the competent national authorities, of an authorization taking due account of the provisions of annex III to this Protocol.

Article 7

1. The Parties shall progressively formulate and adopt, in co-operation with the competent international organizations, common guidelines and, as appropriate, standards or criteria dealing in particular with:

(a) the length, depth and position of pipelines for coastal outfalls, taking into account, in particular, the methods used for pretreatment of effluents;

(b) special requirements for effluents necessitating separate treatment;

(c) the quality of sea water used for specific purposes that is necessary for the protection of human health, living resources and ecosystems;

(d) the control and progressive replacement of products, installations and industrial and other processes causing significant pollution of the marine environment;

(e) specific requirements concerning the quantities of the substances listed in annexes I and II discharged, their concentration in effluents and methods of discharging them.

2. Without prejudice to the provisions of article 5 of this Protocol, such common guidelines, standards or criteria shall take into account local ecological, geographical and physical characteristics, the economic capacity of the Parties and their need for development, the level of existing pollution and the real absorptive capacity of the marine environment.

3. The programmes and measures referred to in articles 5 and 6 shall be adopted by taking into account, for their progressive implementation, the capacity to adapt and reconvert existing installations, the economic capacity of the Parties and their need for development.

Article 8

Within the framework of the provisions of, and the monitoring programmes provided for in, article 10 of the Convention, and if necessary in co-operation with the competent international organizations, the Parties shall carry out at the earliest possible date monitoring activities in order:

(a) systematically to assess, as far as possible, the levels of pollution along their coasts, in particular with regard to the substances or sources listed in annexes I and II, and periodically to provide information in this respect;

(b) to evaluate the effects of measures taken under this Protocol to reduce pollution of the marine environment.

Article 9

In conformity with article 11 of the Convention, the Parties shall co-operate as far as possible in scientific and technological fields related to pollution from land-based sources, particularly research on inputs, pathways and effects of pollutants and on the development of new methods for their treatment, reduction or elimination. To this end the Parties shall, in particular, endeavour to:

(a) exchange scientific and technical information;

(b) co-ordinate their research programmes.

Article 10

1. The Parties shall, directly or with the assistance of competent regional or other international organizations or bilaterally, co-operate with a view to formulating and, as far as possible, implementing programmes of assistance to developing countries, particularly in the fields of science, education and technology, with a view to preventing pollution from land-based sources and its harmful effects in the marine environment.

2. Technical assistance would include, in particular, the training of scientific and technical personnel, as well as the acquisition, utilization and production by these countries of appropriate equipment on advantageous terms to be agreed upon among the Parties concerned.

Article 13

1. The Parties shall inform one another through the Organization of measures taken, of results achieved and, if the case arises, of difficulties encountered in the application of this Protocol. Procedures for the collection and submission of such information shall be determined at the meetings of the Parties.

2. Such information shall include, inter alia:

- (a) statistical data on the authorizations granted in accordance with article 6 of this Protocol;
- (b) data resulting from monitoring as provided for in article 8 of this Protocol;
- (c) quantities of pollutants discharged from their territories;
- (d) measures taken in accordance with articles 5 and 6 of this Protocol.

Article 14

1. Ordinary meetings of the Parties shall take place in conjunction with ordinary meetings of the Contracting Parties to the Convention held pursuant to article 14 of the Convention. The Parties may also hold extraordinary meetings in accordance with article 14 of the Convention.

2. The functions of the meetings of the Parties to this Protocol shall be, inter alia;

- (a) to keep under review the implementation of this Protocol and to consider the efficacy of the measures adopted and the advisability of any other measures, in particular in the form of annexes;
- (b) to revise and amend any annex to this Protocol, as appropriate;
- (c) to formulate and adopt programmes and measures in accordance with articles 5, 6 and 15 of this Protocol;
- (d) to adopt, in accordance with article 7 of this Protocol, common guidelines, standards or criteria, in any form decided upon by the Parties;

Note: For the full text of the Convention and its related protocols consult the following documents:

- 1. UNEP: Mediterranean Action Plan and the Final Act of the Conference of Plenipotentiaries of the Coastal States of the Mediterranean Region for the Protection of the Mediterranean Sea (UNEP, 1978)

2. UNEP: Final Act of the Conference of Plenipotentiaries of the Coastal States of the Mediterranean Region for the Protection of the Mediterranean Sea Against Pollution from Land-Based Sources (UNEP, 1980).

REFERENCE METHODS DEVELOPED
AND TESTED DURING MED POL - PHASE I

Determination of Total Mercury in edible tissue of mussels by Flameless Atomic Absorption Spectrophotometry after liquid pressure decomposition of the organic material.

Determination of Total Mercury in edible tissue of fish by Flameless Atomic Absorption Spectrophotometry after liquid pressure decomposition of the organic material.

Determination of DDTs in edible tissue of shrimps and fish by gas-liquid chromatography.

Determination of DDTs in edible tissue of mussels by gas-liquid chromatography.

Determination of Faecal Coliforms in sea-water by the Membrane Filtration Culture Method

Determination of Faecal Streptococci in Sea-Water by the Membrane Filtration Culture Method.

Determination of Total Coliforms in Sea-Water by the Membrane Filtration Culture Method.

Determination of Faecal Coliforms in shellfish by the Multiple-Test tube method (MPN).