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Long-Term Programme for Pollution Monitoring and Research
in the Mediterranean Sea (MED POL - PHASE II)

STATUS OF REFERENCE METHODS FOR MARINE POLLUTION STUDIES

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INTRODUCTION

While the origin and implementation of UNEP's Regional Seas Programme are generally well known, it is perhaps fitting to reiterate these in the context of the need for reference methods for marine pollution studies. This introduction provides such information to make the requirements of the reference methods and the actual ways in which they are being prepared and used within the Regional Seas Programme.

THE REGIONAL SEAS PROGRAMME OF UNEP

Following the 1972 United Nations Conference on the Human Environment, the Governing Council of UNEP endorsed a regional approach to the control of marine pollution and the management of marine and coastal resources. Consequently, in 1974 the Regional Seas Programme of UNEP was initiated with an overall strategy approved by the Governing Council. UNEP, in collaboration with a large number of UN and non-UN organizations, co-ordinates directly, or in some regions indirectly through existing regional organizations, the development and implementation of the Programme. At present the Programme involves eleven regions and has over 125 participating coastal States. It is conceived as an action-orientated global programme carried out through its regional components ("regional action plans"). It is concerned not only with the consequences (e.g. pollution) but also with the causes of environmental degradation and encompasses a comprehensive approach to combating environmental problems through the management of marine and coastal areas. Each regional action plan is formulated according to the needs of the region as perceived by the governments concerned and is formally adopted at the level of intergovernmental meetings or conferences of plenipotentiaries. Most of the action plans are supported by regional conventions which provide their legal framework.

At present, in accordance with the decisions of the Governing Council of UNEP, there are eleven regions where action plans are operative, under development or to be developed (see figure 1): the Mediterranean region (adopted in 1975); the Kuwait Action Plan region (adopted in 1978); the West and Central African region (adopted in 1981); the Wider Caribbean region (adopted in 1981); the East Asian Seas region (adopted in 1981); the South East Pacific region (adopted in 1981); the Red Sea and Gulf of Aden region (adopted in 1982); the South Pacific region (adopted in 1982); the Eastern African region (under development, adoption expected in 1985); the South Asian Seas region (to be developed, adoption expected in 1986), and the South-west Atlantic region (to be developed).

As part of the action plans mentioned above, regional conventions for the protection and management of the marine and coastal environment have been adopted in six regions (Mediterranean region, convention signed in 1976, entered into force in 1978; Kuwait Action Plan region, convention signed in 1978, entered into force in 1980; West and Central African region, convention signed in 1981, entered into force in 1984; the South-East Pacific region, convention signed in 1981; Red Sea and Gulf of Aden region, convention signed in 1982; Wider Caribbean region, convention signed in 1983). Negotiations concerning the adoption of a regional convention are at an advanced stage for the South Pacific region and for the Eastern African region. In all regions, the conventions that have been adopted may be described as "umbrella agreements". Each convention is designed to be elaborated by specific technical protocols.

UNEP is the government-designated secretariat of five action plans and of four conventions adopted in the framework of the Regional Seas Programme, and co-operates with five regional organizations acting as secretariats of the remaining regional seas action plans and conventions.

POLLUTION MONITORING IN THE FRAMEWORK OF THE REGIONAL SEAS PROGRAMME

One of the basic components of each regional action plan is the assessment of the state of marine pollution. This is achieved through regional co-ordinated research and monitoring programmes carried out in the framework of the action plans and supported with the legal authority and requirements of the regional conventions. It usually comprises four types of monitoring activities:

- (a) monitoring of sources of pollution to provide information on the type and amount of pollutants reaching the marine environment from coastal sources;
- (b) monitoring of the coastal waters, including estuaries, within the limits defined by the relevant action plan and convention, under the direct influence of pollutants from identifiable primary (e.g. outfalls, discharge or coastal dumping points) or secondary (rivers and other water courses) sources;
- (c) monitoring of reference areas which are not under direct influence of pollutants from identifiable primary or secondary sources; and
- (d) monitoring of the transport of pollutants to the marine and coastal areas defined by the action plan and convention through the atmosphere.

The monitoring programme is supported with selected research activities carried out in order to provide the scientifically sound rationale and justification for the monitoring.

The research and monitoring programmes are carried out by government-nominated national institutions of the countries participating in the regional action plans.

Since the inception of the Regional Seas Programme a set of reference methods for marine pollution studies is being developed by UNEP in close co-operation with the relevant organizations of the UN system, in order to ensure that the results of the regional research and monitoring programmes can be comparable on a regional and interregional level, and thus contribute to UNEP's Global Environment Monitoring System (GEMS). The reference methods are for use by participants in Regional Seas Programmes, and are frequently incorporated in relevant national legislation as mandatory standard methods. The reference methods officially adopted by governments participating in the Regional Seas Programme serve also in clarifying inter-governmental disputes arising from transfrontier pollution incidents or accidents.

The reference methods being developed cover a wide range of pollutants, e.g. trace metals, chlorinated hydrocarbons, petroleum hydrocarbons, tar, bacteria, etc., as well as providing guidelines for sampling strategies, preparation of samples, toxicity tests, data handling and evaluation. In addition, they include information on how basic oceanographic parameters are to be assessed and used to supplement the data on marine pollution.

REQUIREMENTS TO BE MET BY REFERENCE METHODS

It is apparent then that the reference methods must be formulated in such a way so as to meet some substantial requirements. These requirements include:

- (a) Analytical methods must be applicable throughout the world, including many developing countries. Thus, they must make use of easily available and serviceable equipment, reagents and facilities.
- (b) They must be reliable and produce data which are both reasonably accurate, precise and reproducible. When stating "reasonably" this means of sufficient accuracy and precision to allow meaningful interpretation for the purposes and objectives of regional marine pollution studies. They should be adequate for intra-regional and inter-regional comparisons for the GEMS of UNEP.
- (c) The methods must be used in conjunction with appropriate mandatory quality control which is achieved through reference materials (standards) available on an international basis.
- (d) The reference methods are not to be regarded as "once only" or "best" methods. Rather, as analytical techniques and instrumentation improve and become more generally available, the reference methods are revised and re-tested (meeting the constraints of (a) above). Also they must change and/or increase in scope to satisfy the temporal changes in requirements for regional and global marine pollution projects.

METHODOLOGY USED TO DEVELOP REFERENCE METHODS

The UNEP Reference Methods are developed and tested through inter-agency co-operation (e.g. UNEP, WHO, FAO, WMO, IOC, UNESCO, IAEA, ICES), with the assistance of consultant experts, marine research institutes and individual scientists.

The first draft of the method is usually prepared by an expert in the relevant field. The draft is widely distributed to selected experts, usually though not exclusively to those participating in the Regional Seas Programme, with an invitation to test the method. The results of the tests are then reviewed by expert group meetings and the draft is afterwards turned into a regular issue which is recommended to be used by all participants in the Programme. After further experience is gained with the application of the method, it may be revised again as the result of recommendation from an expert group meeting. Reference methods which were thoroughly tested and found satisfying the legal requirements of the countries participating in the Regional Seas Programme are submitted to the governments (at intergovernmental meetings) for formal adoption as mandatory methods in the context of specific regional seas action plans and conventions.

The technical co-ordination of the development and testing of reference methods is carried out by the International Laboratory for Marine Radioactivity of the IAEA in Monaco on behalf of UNEP.

This multilateral and comprehensive approach to the development, drafting, revision and testing of the reference methods is conceived as an indispensable approach to satisfy the requirements of the marine pollution studies in the framework of the Regional Seas Programme and of their use for GEMS. This procedure ensures that, inter alia, methodologies are effectively optimised and updated with respect to the specific requirements of the Programme. Furthermore, it provides a viable mechanism for continued and wide-ranging co-operation on the improvement of reference methods in the light of the development and availability of analytical technology on a global basis.

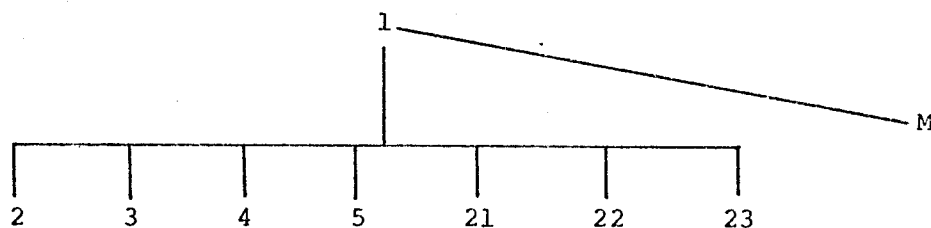
STATUS OF REFERENCE METHOD DEVELOPMENT

The table attached to this paper provides a summary of the present status of the development of the reference methods for UNEP's Regional Seas Programme.

Table 1. Reference Methods for marine pollution studies

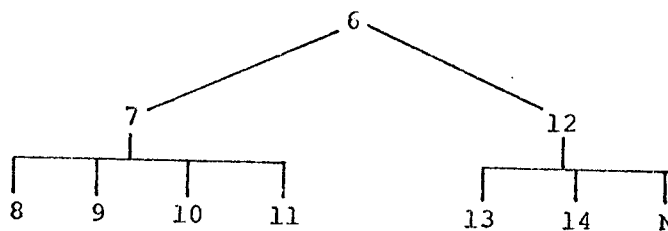
A. Sanitary quality of coastal recreational and shellfish-growing waters

No.	1	UNEP/WHO: Guidelines for monitoring the quality of coastal recreational and shellfish-growing waters.	draft(E) 09.05.84
No.	2	UNEP/WHO: Determination of total coliforms in sea-water by the membrane filtration culture method.	Rev.1(E) 31.08.84 Rev.1(F) 31.10.84
No.	3	UNEP/WHO: Determination of faecal coliforms in sea-water by the membrane filtration culture method.	Rev.1(E) 31.08.84 Rev.1(F) 31.10.84
No.	4	UNEP/WHO: Determination of faecal streptococci in sea-water by the membrane filtration culture method.	Rev.1(E) 31.08.84 Rev.1(F) 31.10.84
No.	5	UNEP/WHO: Determination of faecal coliforms in bivalves by multiple test tube method.	Rev.1(E) 31.08.84 Rev.1(F) 31.10.84
No.	21	UNEP/WHO: Determination of total coliforms in sea-water by multiple test tube method.	in print
No.	22	UNEP/WHO: Determination of faecal coliforms in sea-water by multiple test tube method.	in print
No.	23	UNEP/WHO: Determination of faecal streptococci in sea-water by multiple test tube method.	in print
	D	UNEP/WHO: Determination of faecal coliforms in estuarine waters, suspended matter and sediments.	in preparation
	M	UNEP/WHO: Statistical methods for the evaluation of results from monitoring the quality of coastal recreational and shellfish-growing waters.	in preparation



B. Chemical contaminants in marine organisms

- | | | |
|--------|---|-------------------|
| No. 6 | UNEP/FAO/IAEA: Guidelines for monitoring chemical contaminants in marine organisms. | in preparation |
| No. 7 | UNEP/FAO/IAEA/IOC: Sampling of selected marine organisms and sample preparation for trace metals analysis. | Rev.2(E) 12.11.84 |
| No. 8 | UNEP/FAO/IAEA/IOC: Determination of total mercury in selected marine organisms by cold vapour atomic absorption spectrophotometry. | Rev.1(E) 12.11.84 |
| No. 9 | UNEP/FAO/IAEA: Determination of total arsenic in selected marine organisms by hydride generation atomic absorption spectrophotometry. | in print |
| No. 10 | UNEP/FAO/IAEA: Determination of total selenium in selected marine organisms by hydride generation atomic absorption spectrophotometry. | (E) 12.11.84 |
| No. 11 | UNEP/FAO/IOC/IAEA: Determination of total cadmium, zinc, lead and copper in selected marine organisms by flameless atomic absorption spectrophotometry. | Rev.1(E) 12.11.84 |
| No. 12 | UNEP/FAO/IAEA: Sampling of selected marine organisms and sample preparation for the analysis of chlorinated hydrocarbons. | Rev.1(E) 12.11.84 |
| No. 13 | UNEP/FAO/IAEA: Determination of methylmercury in selected marine organisms by gas chromatography. | (E) 12.11.84 |
| No. 14 | UNEP/FAO/IAEA: Determination of DDTs and PCBs in selected marine organisms by packed column chromatography. | Rev.1(E) in print |
| N | UNEP/FAO/IAEA: Determination of DDTs and PCBs in selected marine organisms by capillary column gas chromatography | in preparation |



C. Chemical contaminants in sea-water

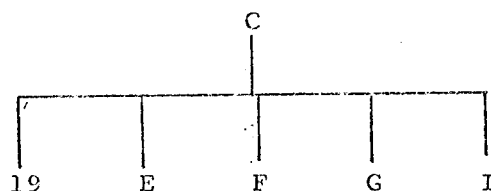
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| No. 16 | UNEP/IAEA: Determination of DDTs, PCBs, PCCs and other hydrocarbons in sea-water by gas chromatography. | draft(E) 27.09.82 |
| No. 18 | UNEP/IOC: Determination of total dissolved cadmium in sea-water by differential pulse anodic stripping voltammetry. | draft(E) 16.09.83 |
| B | UNEP/IOC/IAEA: Monitoring of petroleum hydrocarbons in sea-water. | in preparation |

D. Chemical contaminants in marine sediments and suspended matter

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| No. 17 | UNEP/IAEA: Determination of DDTs, PCBs and other hydrocarbons in marine sediments by gas-liquid chromatography. | draft(E) 22.09.82 |
| No. 20 | UNEP/IOC: Monitoring of petroleum hydrocarbons in sediments. | in preparation |
| No. 26 | UNEP/IAEA: Determination of total mercury in marine sediments and suspended solids by cold vapour atomic absorption spectrophotometry. | in print |
| No. 27 | UNEP/IAEA: Determination of total cadmium in marine sediments by flameless atomic absorption spectrophotometry. | in print |
| E | UNEP/WHO/IAEA: Determination of phosphorus in suspended matter and sediments. | in preparation |
| F | UNEP/WHO/IAEA: Determination of nitrogen in suspended matter and sediments. | in preparation |

E. Chemical contaminants in estuarine water and suspended matter

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| No. 19 | UNEP/IOC/IAEA: Determination of total mercury in estuarine waters and suspended matter by cold vapour atomic absorption spectrophotometry. | in print |
| C | UNEP/IAEA: Guidelines for monitoring of estuarine waters and suspended matter. | in preparation |
| E | UNEP/WHO/IAEA: Determination of phosphorus in suspended matter and sediments. | in preparation |
| F | UNEP/WHO/IAEA: Determination of nitrogen in suspended matter and sediments. | in preparation |
| G | UNEP/WHO/IAEA: Determination of BOD ₅ and COD in estuarine waters. | in preparation |
| I | UNEP/UNESCO: Determination of total cadmium in estuarine waters and suspended matter | in preparation |

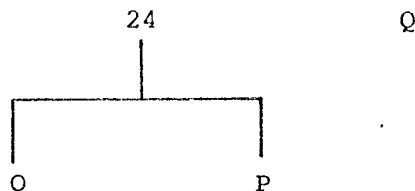


F. Chemical contaminants on beaches

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| No. 15 | UNEP/IOC/IAEA: Monitoring of tar on marine beaches. | in print |
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G. Atmospheric chemical contaminants

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| No. 24 | UNEP/WMO/IAEA: Sampling of aerosols and wet precipitation for analysis of chemical pollutants. | in print |
| O | UNEP/IAEA: Determination of selected trace metals in aerosols and in wet precipitation. | in preparation |
| P | UNEP/IAEA: Determination of halogenated hydrocarbons in aerosols and in wet precipitation. | in preparation |
| Q | UNEP/WMO/IAEA: Sampling of dry deposition. | in preparation |



H. Effects on marine organisms and ecosystems

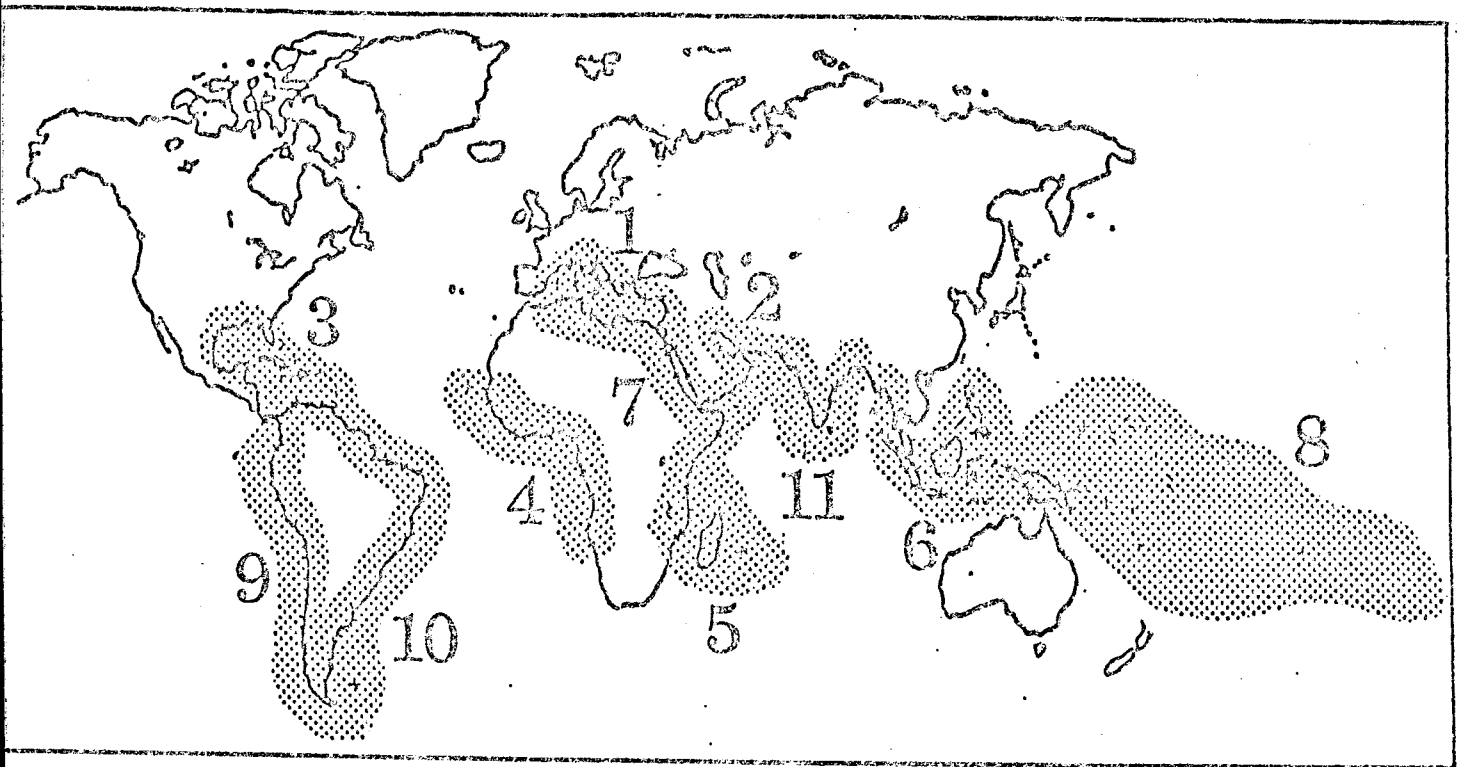
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|--------|---|----------------|
| No. 25 | SPC/UNEP: Coral reef monitoring handbook. | (E) 27.08.84 |
| A | UNEP: Sampling and identification of common Mediterranean scyphomedusae and evaluation of their occurrence. | in print |
| H | UNEP/FAO: Acute toxicity tests. | in preparation |
| J | UNEP: Biological non-acute toxicity tests. | in preparation |

I. Standard physical, chemical and meteorological observations

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|---|--|----------------|
| K | UNEP/IOC/IAEA: Determination of basic oceanographic and meteorological conditions. | in preparation |
| L | UNEP/IOC/IAEA: Determination of standard physical and chemical parameters. | in preparation |

J. Miscellaneous methods

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|---|--|----------------|
| R | UNEP/WHO/IAEA: Determination of methylmercury, total mercury and selenium in human hair. | in preparation |
| | UNEP/WHO/IAEA: Guidelines for monitoring and epidemiological studies on health effects of methylmercury. | in preparation |



1. Mediterranean Region	(Action Plan adopted: 1975; Regional Convention signed: 1976)
2. Kuwait Action Plan Region	(Action Plan adopted: 1978; Regional Convention signed: 1978)
3. Wider Caribbean Region	(Action Plan adopted: 1981; Regional Convention signed: 1983)
4. West and Central African Region	(Action Plan adopted: 1981; Regional Convention signed: 1981)
5. Eastern African Region	(Action Plan preparation initiated; Regional Convention in preparation)
6. East Asian Region	(Action Plan adopted: 1981)
7. Red Sea and Gulf of Aden Region	(Action Plan adopted: 1982; Regional Convention signed: 1982)
8. South Pacific Region	(Action Plan adopted: 1982; Regional Convention in preparation)
9. South-East Pacific Region	(Action Plan adopted: 1981; Regional Convention signed: 1981)
10. South-West Atlantic Region	(Action Plan preparation to be initiated)
11. South Asian Seas Region	(Action Plan preparation initiated)

Figure I. Geographic coverage of UNEP Regional Seas Programme