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POLLUTANTS FROM LAND-BASED SOURCES IN THE MEDITERRANEAN

PREPARATION OF THIS DOCUMENT

The following document has been prepared as part of the Mediterranean Action Plan in an effort to identify the major types of land-based sources of pollution in the Mediterranean Region and to quantify, as far as possible, their contribution to the overall load of pollutants entering the Mediterranean Sea. A main objective of the document is to assist the Mediterranean States and the EEC in the negotiation and eventual implementation of the protocol dealing with the control of pollution from land-based sources.

The preparation of this document was a joint undertaking of six United Nations bodies[1/] in close co-operation with UNEP and with the active support of the responsible authorities in the States concerned. The first results of this co-operative venture were reviewed by a group of experts[2/] designated by the Governments of the Mediterranean States who discussed the technical and scientific aspects of the draft protocol for the protection of the Mediterranean Sea against pollution from land-based sources. The experts reviewed the data presented and considered them as a first estimate accurate within the range of one order of magnitude.

1/ ECE, UNIDO, FAO, UNESCO, WHO, IAEA

2/ Report on Meeting of Experts on Pollutants from Land-Based Sources; Geneva, 19-24 September 1977, UNEP/WG.13/5, 26 October 1977.

P R E F A C E

In accordance with resolution 2997 (XXVII) of the General Assembly, UNEP was established "as a focal point for environmental action and co-ordination within the United Nations system". The Governing Council of UNEP defined this environmental action as encompassing a comprehensive, transectoral approach to environmental problems which should deal not only with the consequences but also with the causes of environmental degredation.

In the area of "Oceans", which the Governing Council identified as one of UNEP's priority areas, UNEP is attempting to fulfil its catalytic role and deal with the complexity of the problem in an integrated way as demonstrated by UNEP's Regional Seas Programme.

Although the environmental problems of the oceans are of a global nature, it seemed realistic to adopt a regional approach, since in this way UNEP could focus on specific problems of the highest interest to the States of a given region and, therefore, could more readily respond to the needs of the Governments and mobilize fully their own resources. By including activities of common concern to most coastal States, in due time this regional approach should yield a mechanism that would deal effectively with the environmental problems of the oceans as a whole.

Two elements are fundamental to the regional seas programme:

(a) co-operation with the Governments of the regions. Since any specific regional programme is aimed at benefiting the States of that region, UNEP tries to involve the Governments in the programme from the very beginning through their participation in the programme's formulation and approval. The actual implementation of an adopted programme is carried out through national institutions selected by their Governments. UNEP's financial support always rests on the assumption that the Governments of the region will themselves progressively cover the operating costs of the programme as UNEP's initial catalytic role is fulfilled;

(b) co-ordination of the technical work provided through the United Nations system. Although the regional programmes are implemented predominantly by the national institutions designated by the Governments of the region with UNEP acting as an overall co-ordinator (in some cases UNEP's role is limited to the initial phase of the activities), a large number of the United Nations specialized organizations provide assistance to the national institutions, thus contributing to the programme the support and experience of the whole United Nations system.

The substantive aspect of any regional programme is outlined in an "action plan" which is formally adopted by the Governments before the programme enters an operational phase. All action plans are structured in a similar way, although the specific programme for any region will be dependent upon the needs and priorities of that region. Each action plan includes the following components:

(a) legal component. In most cases a legally binding regional convention, elaborated by specific technical protocols, provides the legal framework for co-operative action. The legal commitment of Governments clearly expresses their political will to deal individually and jointly with their common environmental problems;

(b) assessment component. All programmes include a large number of activities aimed at assessing and evaluating the causes, magnitude and consequences of the environmental problems. This assessment is not restricted solely to marine pollution but also covers the assessment of the coastal and marine activities and socio-economic that may influence, or may be influenced by, environmental degradation;

(c) management component. The assessment of the environmental situation is undertaken merely as a tool to assist national policy-makers to manage their resources in a more effective and sustainable manner. Therefore, each regional programme includes a wide range of activities in the field of environmental management. Such activities may include co-operative regional projects on rational exploitation of marine living resources, utilization of renewable sources of energy, management of fresh-water resources, protection of soil from erosion and desertification, development of tourism without ecological harm, mitigation of environmental damage associated with human settlements, etc;

(d) institutional component. The programme is implemented primarily through designated national institutions. Assistance and training are provided where necessary to allow national institutions to participate fully in the programme. Existing global or regional mechanisms are normally used for the effective co-ordination of the programme. However, specific regional mechanisms may be created if Governments feel it is necessary.

(e) financial component. As a programme develops, the Governments of the region assume a progressively increasing financial responsibility. Government financing may be channelled through a special regional trust fund or provided directly to the national institutions participating in the programme.

At present there are eight regions where regional action plans are operative or are under development.

The Mediterranean was the first region in which UNEP attempted to fulfil its catalytic role by assisting the coastal States to adopt and apply measures for the protection and development of the marine and coastal environment.

In collaboration with a number of United Nations bodies and specialized agencies, UNEP convened the Intergovernmental Meeting on the Protection of the Mediterranean in Barcelona from 28 January to 4 February 1975. During that meeting, which was attended by 16 of the 18 coastal States, an Action Plan[1/] was approved containing all the components described in general terms above.

One year later at the Conference of the Plenipotentiaries of the Coastal States of the Mediterranean Region for the Protection of the Mediterranean Sea[1/] convened by UNEP in Barcelona from 2 to 16 February 1976, the Mediterranean Governments and the EEC approved the texts of three legal instruments, namely:

- Convention for the Protection of the Mediterranean Sea against Pollution;

- Protocol for the Prevention of Pollution of the Mediterranean Sea by Dumping from Ships and Aircraft; and

- Protocol Concerning Co-operation in Combating Pollution of the Mediterranean Sea by Oil and other Harmful Substances in Cases of Emergency.

The Convention and the two protocols came into force on 12 February 1978 and have been ratified as from the end of April 1979 by 13 Mediterranean States[2/] and the EEC.

Efforts are under way to develop additional protocols for specific sources of pollution and, to date, negotiations have been focused on a draft protocol for the protection of the Mediterranean Sea against pollution from land-based sources.

1/ 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/ Egypyt, France, Greece, Israel, Italy, Lebanon, Libyan Arab Jamahiriya, Malta, Monaco, Spain, Syria, Tunisia, Yugoslavia

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I. INTRODUCTION

1. Awareness of the steadily growing pollution of the Mediterranean sea has become more and more apparent during the past decade. National authorities, research institutions and also international organizations have made their concern known and initiated various activities to safeguard marine and human resources in their region.

2. As early as 1969 the General Fisheries Council for the Mediterranean of FAO formed a Working Party on Marine Pollution in the Mediterranean which, in cooperation with the International Commission for the Scientific Exploration of the Mediterranean, produced the first comprehensive review of the state of marine pollution in the Mediterranean in 1972.[1]

3. This first report as well as various monitoring and research activities undertaken in the meantime emphasized the important role land-based pollution sources are playing in the aggravation of present pollution problems particularly as regards the coastal waters of the Mediterranean. Domestic sewage and industrial wastewaters are well known contributors of such pollution but the amount of pollutants carried by rivers or introduced through atmospheric fall-out still remained undetermined components of the total waste burden which the Mediterranean has to absorb.

4. Assessment of the total pollution input to the Mediterranean sea from land-based sources became the major objective of project MED X which was launched by UNEP as a complementary part of the Mediterranean Action Plan. Through the collaboration of several UN agencies a wide coverage of various types of pollution sources was assured and a comprehensive estimate of the total pollution load made possible.

5. The present report summarizes the results of this project and provides the data collected and evaluations made in a condensed form. The description of project aims and approaches is followed by a presentation of the established pollution source inventory which allows for an assessment of individual and total pollution loads. Detailed results are annexed in the form of tables and maps. Also, a review of waste management practices in Mediterranean countries was undertaken and its findings are provided. Conclusions and recommendations of the joint group of international agencies complete this report.

II. BACKGROUND

6. As the presently described project MED X forms an integral part of UNEP's Mediterranean Action Plan, a brief account of its general structure seems appropriate. The Mediterranean States adopted this Action Plan at Barcelona in 1975[2] which consists of three substantive components: (i) legal (framework convention and related protocols); (ii) scientific (research and monitoring); and (iii) integrated planning. All components of the Action Plan are interdependent and provide a framework for comprehensive action to promote both the protection and the continued development of the Mediterranean region.

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[1] The State of Marine Pollution in the Mediterranean and Legislative Controls. GFCM Studies and Reviews No.51; FAO, 1972.

[2] Intergovernmental Meeting on the Protection of the Mediterranean (Barcelona, 28 January - 4 February 1975). Document UNEP/WG.2/5, Annex; UNEP, 1975.

7. The project MED X on pollutants from land-based sources provides a concrete example of linkage between the different components of the Mediterranean Action Plan. It is intended to produce data which will assist Governments in the formulation of national pollution control programmes as well as in the negotiation of international agreements in this field.

8. The present set of legal instruments includes a framework convention and two protocols. An additional draft Protocol for the Protection of the Mediterranean sea against Pollution from Land-Based Sources is presently under negotiation among the countries concerned. The pollution source inventory and the pollution load assessment undertaken through project MED X will assist the governments in the discussion of its legal as well as technical aspects, particularly as regards the need for future pollution control measures.

9. The Coordinated Mediterranean Pollution Monitoring and Research Programme is accompanied by a number of related projects which will provide for complementary information assisting in the assessment of the present state of pollution of the Mediterranean sea[3]. Project MED X is one such activity. In addition, project MED IX on the Role of Sedimentation in the Pollution of the Mediterranean Sea provides for data on the pollution carried by river sediments.

10. Also, project MED X provides information on pollution loads from municipal, touristic and industrial centres which will be of immediate relevance to the integrated planning efforts undertaken as part of the environmental management component of the Mediterranean Action Plan.

III. SCOPE AND PURPOSE

11. The objective of project MED X was to provide the Governments of the States bordering the Mediterranean sea with appropriate information on the type and quantity of pollution loads arising from major land-based sources and carried by rivers, and on the present status of waste disposal and management practices.

12. In order to achieve a comprehensive picture of all major pollution entering the Mediterranean sea from land-based sources, the following tasks were to be undertaken:

(i) preparation of an inventory of all major sources of pollutants in the coastal area;

(ii) assessment of the nature and quantity of selected pollutants entering the Mediterranean from such sources;

(iii) assessment of the nature and quantity of selected pollutants entering into the Mediterranean by major rivers;

(iv) review of present waste disposal and management practices.

13. When carrying out these tasks, the coastal area of all States bordering the Mediterranean proper were taken into consideration. The term 'coastal area' describes those coastal zones which directly influence the quality of the Mediterranean sea. Usually, this zone covered a strip of land which extends not more than about 20 km inland. Other pollution sources within the Mediterranean drainage basin are covered through the inclusion of major rivers discharging into the sea.

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[3] Draft Preliminary Report on the State of Pollution of the Mediterranean Sea. Document UNEP/WG.11/4 (Prov.); UNEP, 15 July 1977.

14. An inventory of major sources was to be established which covers all relevant activities resulting in the discharge of chemical and microbiological pollutants or substances which may create physical hazards in the marine environment. A sectorial approach was used which includes the following broad categories of pollution sources: (i) domestic sewage; (ii) industrial wastes; (iii) agricultural run-off; (iv) river discharges; and (v) radioactive discharges. Air-borne pollutions which may reach the sea through short- or long-distance atmospheric transport were not taken into consideration and will be subject to a separate study.

15. Based upon this inventory an assessment of waste loads for each source category was to be made which allows for an evaluation of its contribution to the total pollution load of the Mediterranean sea. Thus, a comprehensive account of pollution by quality, quantity and geographical distribution would be possible.

16. In addition, waste disposal and management practices in the Mediterranean countries were to be reviewed and common approaches and regulatory mechanisms to be identified. This comparative study was intended to give guidance for future programmes on the improvement of waste management and the reduction of total waste loads from different sources through appropriate control measures.

17. The time-schedule for project MED X was closely linked to the preparation and negotiation of the draft protocol on land-based pollution sources which enters its critical phase in autumn 1977. Consequently, the time available for project MED X was limited to 1½ years which only allowed for an overall assessment of relevant pollution sources. More detailed pollution source inventories are expected to be established as a follow-up of this project and as a means to implement the protocol.

IV. PROJECT IMPLEMENTATION

18. During the preparatory phase of project MED X, a cooperative mechanism among the secretariats of the six UN agencies executing the project was established which ensured adequate coverage of all pollution source categories. Responsibilities were assumed as follows:

(i)	inventory and assessment of municipal sources	WHO
(ii)	inventory and assessment of industrial sources	ECE/UNIDO
(iii)	inventory and assessment of agricultural run-off	FAO
(iv)	inventory and assessment of river discharges	UNESCO
(v)	inventory and assessment of radioactive discharges	IAEA
(vi)	review of municipal waste disposal and management	WHO
(vii)	review of industrial waste disposal and management	ECE/UNIDO
(viii)	project coordination	WHO

19. During the early stages of the project, technical guidelines and a number of questionnaires were prepared by all participating agencies. These data reporting forms were to ensure a harmonized approach to the establishment of source inventories and also to allow for a comparative assessment of pollutants stemming from different waste source categories.

20. Concurrence of the countries' participation was secured by UNEP and the majority of Mediterranean Governments (11 of 18) designated a specific contact point for this project in 1976. In other countries the UNEP focal point and the agencies' regular contacts were approached. Data were largely collected by the national authorities themselves, in some cases assisted by international consultants. In addition, national and international statistics and other reports were used to complete the information. Based upon sectorial reports on each waste source category, the present summary report was then compiled.

V. BASIC APPROACHES

21. The unprecedented task of compiling a waste souce inventory over a large geographical area involving the collaboration of 18 individual countries required the development of new approaches. In addition, the different nature of pollution sources considered made harmonization of methods a prerequisite to any data collection efforts at the country level.

22. In view of the complex nature of the problem, a two-step approach was chosen which allowed for an intermediate adjustment of implementation methods. In a first phase, sectorial inventories were established which were intended to register all activities in the coastal area of the Mediterranean which may involve the discharge of wastewaters. In a second phase, this inventory, together with other information, was used to assess and quantify the pollution input from the various sources. In the following, the applied methods are elaborated in greater detail.

23. Harmonization of approaches to the different waste source categories was achieved primarily through the establishment of a common list of selected pollutants. On the basis of this list, a set of questionnaires (see table 1) was prepared by the responsible organizations which provided for a comparable data collection format. The questionnaires in draft form were circulted to the interested countries for comments. Following this exercise the questionnaires were finalized and distributed.

24. These questionnaires were completed by national authorities, frequently in collaboration with consultants, indicating the location and magnitude of pollution sources or groups of sources. Wherever the information obtained was incomplete, additional data were utilized from statistics and other reports. The results of these inventories are described in chapter VII of this report.

Table 1: Questionnaires prepared for data collection on land-based pollution sources

1. Municipal wastes disposal from coastal metropolitan or urban areas with a population of 10 000 and above (WHO)
2. Wastes disposal from coastal tourist development in rural areas (WHO)
3. Wastes disposal management at country level (WHO)
4. Industrial wastes, waste disposal and management (ECE/UNIDO/WHO)
5. Measurements of nutrients removed from agricultural lands and calculation of soil loss (FAO)
6. Land use, farm animals and fertilizer use (FAO)
7. Use of pesticides in agriculture (FAO)
8. Inventory of major rivers (UNESCO)
9. Particulate pollutants sampling and analysis form (UNESCO)
10. Radioactive discharges to the Mediterranean sea from land-based sources (IAEA).

25. The assessment of pollution loads was made for each pollutant individually. To this end, the major contributing sources had to be identified by category. Table 2 lists the pollutants considered at each source category and those for which a total input budget was computed. Insignificant contributions or uncertainty of estimate reduced the range of sources considered in most cases.

26. The geographical distribution of pollution loads was evaluated on the basis of 10 regional entities into which the Mediterranean sea was subdivided according to UNEP's pollution monitoring and research programme. In the present project only these 10 parts of the Mediterranean proper were considered while the 3 adjacent areas were excluded. Table 3 provides for a list of these areas and the countries bordering on them. The map in figure 1 shows their extent and boundaries.

27. The assessment of the pollution loads discharging into the Mediterranean from different waste sources was undertaken largely on the basis of an indirect estimate which took into account original country survey data as well as statistical information and other data sources. The estimated annual loads as presented in chapter VIII of this report may be considered accurate within an error range of about one order of magnitude.

28. A review of waste disposal and management practices was undertaken on the basis of questionnaires nos. 3 and 4 (see table 1) for domestic sewage and industrial wastewaters. Additional information was available from international reviews[4], project reports, national statistics and data collected during consultant visits. A summary of findings is contained in chapter IX of this report.

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[4] Protection of the Mediterranean sea against pollution from land-based sources: a survey of national legislation; WHO and UNEP, Geneva 1976.

Table 2: Pollutants and waste sources considered in the estimate of annual pollution loads of the Mediterranean from land-based sources

	Pollution loads originating in the coastal zone:			Loads carried by river discharges	Total load
	Domestic sewage	Industrial wastewater	Agricultural run-off		
1. Volume:					
Total discharge	+	+	+	+	+
2. Organic matter:					
BOD	+	+	+	+	+
COD	+	+	+	+	+
TOC	-	-	+	-	-
3. Nutrients:					
Phosphorus	+	+	+	+	+
Nitrogen	+	+	+	+	+
4. Specific organics:					
Detergents	+	-	-	+	+
Phenols	-	+	-	+	+
Mineral oil	-	+	-	-	+
5. Metals:					
Mercury	+	+	-	+	+
Lead	+	+	-	+	+
Chromium	+	+	-	+	+
Zinc	+	+	-	+	+
6. Suspended matter:					
TSS	+	+	+	+	+
VSS	+	-	-	-	-
7. Pesticides:					
Organochlorine compounds	-	-	+	+	+
8. Radioactivity:					
Tritium	-	+	-	+	+
Other radionuclides	-	+	-	+	+

Legend: "+" pollutant contributions from this source category are included in the pollution load assessment

"-" pollutant contributions from this source are disregarded due to insignificance or uncertainty of estimate.

Table 3: Regional entities of the Mediterranean sea and countries bordering on them

A. Mediterranean proper

	Regional sea	Bordering countries
I	Alboran	Spain, Morocco, Algeria
II	North-Western	Spain, France, Monaco, Italy
III	South-Western	Spain, Italy, Algeria, Tunisia
IV	Tyrrhenian	Italy, France, Tunisia
V	Adriatic	Italy, Yugoslavia, Albania
VI	Ionian	Italy, Albania, Greece
VII	Central	Italy, Tunisia, Libya, Malta
VIII	Aegean	Greece, Turkey
IX	North-Levantin	Turkey, Cyprus, Syria, Lebanon
X	South-Levantin	Lebanon, Israel, Egypt, Libya

B. Adjacent areas

	Regional sea	Bordering countries
XI	Atlantic	Spain, Morocco
XII	Sea of Marmara	Turkey
XIII	Black Sea	Turkey, USSR, Rumania, Bulgaria

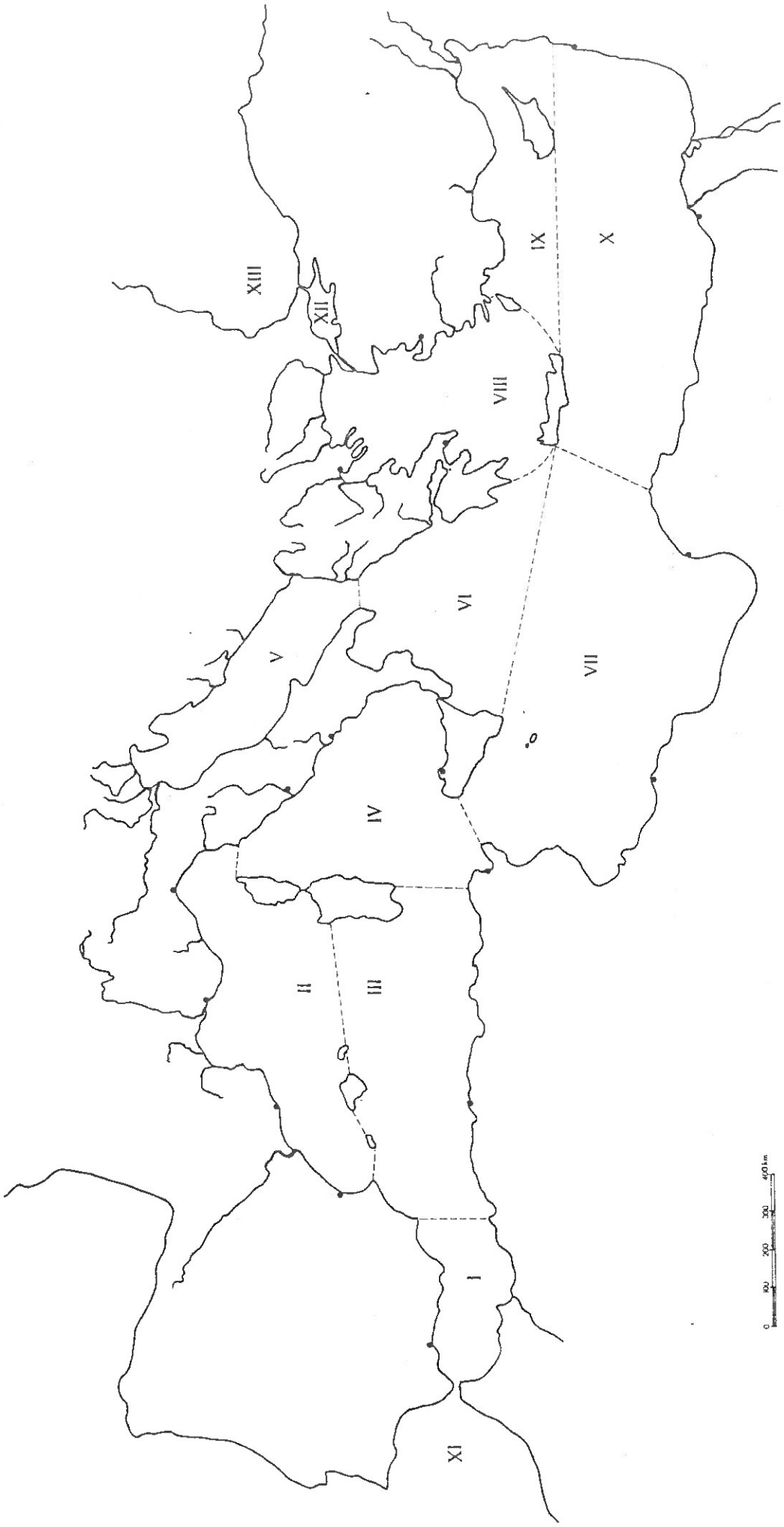

FIGURE 1: REGIONAL ENTITIES OF THE MEDITERRANEAN PROPER AND ADJACENT SEA AREAS

VI. SECTORIAL STUDY METHODS

1. Domestic sewage

29. Information on municipal waste sources was collected by means of questionnaires nos. 1, 2 and 4 providing data on resident population, tourists and industry discharging in municipal sewers. Population centres of 10 000 inhabitants and above were considered in this study. Smaller settlements are usually not fully sewered and would contribute only marginal amounts of domestic sewage. Lists of municipalities and their population were received from most countries. In addition, maps and demographic yearbooks as well as tourist organization reports were consulted. These information sources together provided an adequate basis for the establishment of a domestic waste source inventory.

30. Direct data on domestic wastewater discharges and related pollution loads were provided only in some cases. Additional information was, therefore, required on unit human waste production and other domestic sources which were taken from research studies, country project reports and other statistical sources. On this basis, annual sewage loads per capita were estimated for each country. The range of values for each pollutant is indicated in table 4.

31. Industrial sources within the municipal sewerage system which were initially included in the country surveys were subsequently transferred to the industrial waste load assessment section. The data given in table 4 account, therefore, for the domestic sewage component only. Tourist augmentation of the resident population during the holiday season was, however, taken into consideration when calculating the total annual production of domestic sewage.

32. The gross domestic waste load was then subject to three reductions for the assessment of actual waste discharges into the sea. As a first step, the percentage of population connected to public sewerage systems was determined. It varies between 10 and 100% but remains in most cases at 50% and above. The assumption was made that the non-sewered population uses individual sewage disposal methods not resulting in direct discharges to the sea. The second reduction provides for the exclusion of sewered portions which are not discharged to the sea but rather disposed elsewhere. The percentages reaching the sea vary between 50 and 100% in most cases. The third step allowed for the reduction of waste loads due to sewage treatment. According to the type of treatment applied, percentages of reduction within the ranges given in table 4 were used. The resulting amounts of domestic wastewater and its constituents were then entered into the overall assessment procedure.

2. Industrial wastewater

33. An inventory of major industrial areas around the Mediterranean coastline was prepared which identifies their general location as well as the type and magnitude of industrial activities. Less industrialized and small countries permitted a rather detailed consideration of individual industries or complexes of factories. In some cases, even consultant visits to factories were possible. The large number of individual enterprises along the coastline of the highly or partly industrialized countries prevented a factory-by-factory approach.

34. Information on industrial waste sources was collected by means of questionnaire no.4 which provided for data on waste water flows and constituents as well as on industrial production figures, raw materials used or number of employees. A certain amount of direct information was obtained. Since the data collected were not always complete, and in general not comparable at a basin level, it was necessary in addition to use other sources of information.

Table 4: Domestic sewage: estimated annual per capita loads and reduction due to treatment

Variable	Annual per capita sewage loads		Cumulative percentage reduction due to sewage treatment[a]		
	Units per capita and year	Min - Max	Screening/ grit chamber	Primary sedimentation	Biological treatment
1. Volume:					
Total discharge	m^3	30 - 200	0	0	0
2. Organic matter:					
BOD	Kg	10 - 25	0-10	10-30	50-80
COD	Kg	20 - 55	0-10	10-20	30-60
3. Nutrients:					
Phosphorus	Kg	0.5 - 1.1	0-10	10-20	10-30
Nitrogen	Kg	4	0-10	20-40	20-50
4. Specific organics:					
Detergents	Kg	0.4 - 1.0	0-10	0-10	30-70
5. Metals:					
Mercury	g	0.02 - 0.04	0-10	0-10	40-60
Lead	g	10 - 20	0-10	20-40	60-90
Chromium	g	10 - 30	0-10	20-40	50-90
Zinc	g	50 - 100	0-10	20-50	50-80
6. Suspended matter:					
TSS	Kg	20 - 30	0-10	50-70	70-95
VSS	Kg	15 - 20	0-10	40-60	70-95

a) all figures are percentage values based upon raw sewage concentrations

35. The assessment study required a rather flexible approach ranging from direct analytical results to pure desk studies. Largely, an indirect method was applied which made use of the best information available from each country even though the basic data varied from country to country. Subsequently, these data were subjected to a computation process which made use of specific waste coefficients obtained from experience. As basic data, the following variations were considered: (i) wastewater flow data and accompanying analytical results; (ii) daily or yearly production figures;, (iii) water consumption figures; and (iv) number of employees working within a given plant or an industrial sector.

36. Wherever an indirect estimation of industrial waste loads was necessary, production figures or numbers of employees were mainly used. For this purpose, an elaborate scheme of specific coefficients of industrial waste generation was developed which provided the necessary basis for computation. Their preparation was largely based on published investigations, various national guidelines, local reports, country project reports, on-site consultant findings during the present project as well as other expert experiences. Table 5 indicates which pollutants were covered for the various industrial sectors studied. In spite of the limitations of information available at present, a remarkable number of industries were covered accounting for the majority of industrial wastes discharged into the Mediterranean.

37. Problems with the indirect method, as described above, frequently encountered were: (i) lack of information on the location of industrial plants relative to the coastline; (ii) inconsistent classification of industries; (iii) insufficient differentiation of production and employee figures; (iv) sparse experiences on trace contaminants in industrial waste waters; and (v) non-comparable reporting systems from country to country. Despite the limitations of such an indirect method of evaluation, the results obtained are quite homogeneous and complete. Under present conditions, this indirect method together with the basic data available, provide for an adequate coverage of the industrial waste component of the total pollution load assessment.

3. Agricultural run-off

38. Estimation of pollutant amounts stemming from land run-off in the coastal zone was undertaken in two groups separately: (i) sediments as total suspended solids together with phosphorus and nitrogen as well as organic matter determined as total organic carbon; and (ii) various types of pesticides. Questionnaires nos. 5, 6 and 7 provided information for this study which was carried out by a number of scientists from Mediterranean research institutes.

39. As far as the estimation of nutrient wash-out rates was concerned, only scanty analytical data on the chemical composition and sediment content of run-off waters were available. An indirect scientific assessment procedure was therefore developed which should allow for relevant estimates to within at least one order of magnitude. Various studies support the assumption made that nutrients in run-off are largely attached to sediments as carriers. As a first step, this sediment yield was computed and subsequently used for nutrient load calculations.

40. Four basic factors effecting run-off and erosion were taken into consideration: climate, soil, topography and vegetation cover. These factors were quantified when applying a sediment yield formula developed by Gavrilovic[5]. By comparison of test drainage areas with monitored

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[5] Gavrilovic, S; Proracun srednje kolicine nanosd prema potencijalu erozije; Glasnik Sum. Fakulte za Beograd, No.26 (1962).

Table 5: Industrial sectors and related pollutants considered for the pollution load assessment

	Food manufacturing	Beverage industry	Tobacco manufacturing	Rubber	Pulp and paper	Textile industries	Cement production	Leather tanning	Iron and steel basic industries	Motor vehicle production	Petroleum refineries	Crude oil terminals	Chemical industries total	Organic chemicals	Inorganic chemicals (fertilizer, chloralkali, etc)
1. Volume:															
total discharge	+	+	+	+	+	+	+	+	+	+	+	-	+	(+)	(+)
2. Organic matter:															
BOD	+	+	+	+	+	+	-	+	-	+	+	-	+	(+)	-
COD	+	+	+	+	+	+	-	+	-	+	+	-	-	(+)	-
3. Nutrients:															
Phsophorus	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrogen	+	+	-	-	-	-	-	+	+	-	-	-	-	-	(+)
4. Specific organics:															
Phenols	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-
Mineral oil	-	-	-	-	-	-	-	-	+	+	+	+	-	-	-
5. Metals:															
Mercury	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(+)
Chromium	-	-	-	-	-	(+)	-	+	-	+	-	-	-	-	(+)
Zinc	-	-	-	-	-	(+)	-	-	-	+	-	-	-	-	-
6. Suspended matter:															
TSS	+	+	-	-	+	+	+	+	+	+	+	-	-	(+)	(+)
7. Additional pollutants:															
Cyanides	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
Sulphides	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-
Fluorides	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(+)
Iron	-	-	-	-	-	-	-	-	+	-	-	-	-	-	(+)
Copper	-	-	-	-	-	(+)	-	-	-	-	-	-	-	-	-

Legend: "+" waste contributions of this pollutant evaluated and included in the assessment

"(+)" waste contributions of this pollutant only considered when directly reported from source

"-" waste contributions of this pollutant disregarded due to insignificance or absence of applicable estimates.

river discharges the formula was calibrated and adjusted to the conditions prevailing in the different parts of the Mediterranean basin.

41. For the application of this method to the Mediterranean basin, this was subdivided into 144 individual drainage areas employing available land use maps and national statistics. Subsequently, run-off and sediment yield were computed for each area. An empirical classification of five different degrees of erosion was established into which the above 144 entities were subdivided (see also Annex I/4).

42. The amounts of phosphorus, nitrogen and organic matter were then calculated by using the sediment yield as the basis and applying an estimated enrichment ratio for each of them. Increases of nutrient loads (P and N) due to fertilizer application were taken into consideration. Other factors included natural soil fertility, land use, topography and erosion intensity.

43. As far as the estimate of pesticide loads from agricultural run-off is concerned, insufficient measurements on the level of pesticide residues in soils were carried out in the Mediterranean drainage basin. A scientific assessment approach was needed, therefore, largely relying on experiences gained elsewhere. These led to a first assumption that, apart from improper practices and accidental releases, removal in run-off water and associated suspended material probably constitutes the major pathway of agricultural pesticides into the aquatic environment. Air-borne sources of pesticide pollutants were not considered and the study concentrated on the surface run-off component.

44. The establishment of an inventory on pesticide usage in the countries bordering the Mediterranean was attempted by means of a guideline and questionnaire. Sparse response required the additional utilization of information sources from FAO and the European and Mediterranean Plant Protection Organization (EPPO). Pesticide applications as insecticide, fungicide, herbicide and for other purposes were verified in each case. Data on the size of the area treated were seldomly reported and relevant estimates had to be made.

45. In the absence of field measurements, the assessment of possible pollution loads had to be made by analogy with research studies which carefully followed the fate of known amounts of pesticide applied under practical field conditions. As an approximation, a run-off portion of 1 percent of the pesticides applied was chosen and the most likely pollution load for the organochlorine compounds calculated. The other pesticides were considered of lesser importance in this respect.

4. River discharges

46. Methodology for the estimate of pollution loads carried by rivers into the Mediterranean was developed through expert meetings in Paris[6] and Rome[7]. The latter afforded also a close linkage with project MED IX on the role of sedimentation in the pollution of the Mediterranean sea. Data on river discharges and water quality as well as particulate pollutants were collected by means of questionnaires nos. 8 and 9 (see table 1).

47. Among the 68 rivers included in the inventory, only about 30 were adequately covered by monitoring data. Sampling frequencies are very variable ranging from less than 1 sample to 12 samples per year. Three countries initiated intensive surveys particularly for project MED X. In the other cases, past and current data were utilized as made available.

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[6] Pollutants entering the Mediterranean through rivers: Meeting of experts of Mediterranean countries, UNESCO House, Paris, 17-21 May 1976.

[7] Pollutants entering the Mediterranean through rivers: Meeting of experts of Mediterranean countries, Rome, 20-23 December 1976.

48. Various problems were encountered when collecting data. Metals, specific organics and organochlorine compounds were rarely monitored and, if sought for, were not detected. In addition, sample pretreatment and analytical methods vary widely from country to country. Sample filtration influences considerably metal and pesticide determination which are strongly bound to suspended particles. In view of all the limitations encountered, the results must be considered as a rough estimate for which the reliability is no more than an order of magnitude.

49. For the assessment of pollution carried by adequately monitored rivers, loads were computed on the basis of the average pollutant concentrations and the mean water discharge. Presently results are available for 30 rivers representing a total flow of 5 800 m^3/s or 43% of all freshwater discharges into the Mediterranean.

50. For selected rivers without data available which represent 3 500 m^3/s or 26% of the total freshwater inflow and for the rest of rivers not included in the inventory covering about one-third of the total discharge, the assessment has been achieved by extrapolation. Concentrations ranging from a typical unpolluted river to a typical polluted river draining an industrialized region were used for this purpose.

51. Annual loads were estimated for each of the ten regional sea areas including all rivers with available data as well as those computed indirectly. Also, natural background levels of substances were taken into account providing for an estimate of the man-made pollution loads carried by rivers.

5. Radioactive discharges

52. An inventory of nuclear installations was undertaken by means of questionnaire no.10 and national and international reports on nuclear power production as well as information on radioactive wastes from nuclear power stations. For each country, the relevant installations were listed in chronological order including those in operation and under construction.

53. The inventory specifies reactors of different type (gas cooled, fast breeder, light water reactors), research centres, reprocessing plants and one planned enrichment plant. Each source is quantified by its nominal size in electrical megawatts (MWe) for reactors and in uranium handled per year (tU/a) for reprocessing plants. Other radioactivity sources, such as medical applications, are considered to be insignificant for the purpose of this survey.

54. Much information was available on the release of radioactivity from nuclear installations already in operation. Based upon such data, a set of standard discharge values was developed which allows for an estimate of releases from installations under construction. Table 6 provides these values for tritium and other radionuclides separately according to the type of power reactor. Plant availability and allowance for variations in the operational behaviour were taken into consideration.

55. Very few nuclear installations are located on or near the Mediterranean coast. However, many are located on major rivers which flow into the Mediterranean sea. The magnitude of each radioactive release was computed at the source and at the point of discharge into the sea. Reduction factors according to length of river transport to the sea were applied for the radionuclides other than tritium. The full tritium values were taken into account. Based upon the inventory of individual sources, the current radioactivity discharged to the Mediterranean sea was estimated.

Table 6: Estimated standard discharge values from nuclear power plants in the Mediterranean [a]

Reactor type	Tritium Ci/a	other radionuclides [b] Ci/a
Boiling water reactor	50	5
Pressurized water reactor	250	3
Gas cooled reactor	500	20

[a] All figures indicate curies per year for a 1000 MWe plant operating 70% of the time.

[b] Significant isotopes include ^{54}Mn, ^{58}Co, ^{60}Co, ^{131}I, ^{134}Cs and ^{137}Cs which account for 60 to 80 percent of the radioactivity (other than tritium) reaching the Mediterranean sea.

VII. RESULTS OF POLLUTION SOURCE INVENTORY

56. The primary purpose of the inventory section of the project was to identify all major waste sources either individually or in groups by geographical location and to determine the nature and magnitude of each as far as possible. The mode of identification and quantification varies according to the different types of pollution sources. The basic units range from number of inhabitants or production figures to land area and other ways of measurement. In the present chapter, each waste source category is described by its specific characteristics while an assessment based upon common determinants is given in chapter VIII of this report.

57. The source inventory covers the coastal area as described in paragraph 13. In this area a certain overlap of waste source categories is inevitable. For example, industry discharges either directly or through municipal sewerage systems to the sea and a distinction is not always possible. Similarly, some coastal municipalities discharge their sewage into nearshore rivers which are also included in the river component of the project. The sectorial inventories list all of them while in the subsequent pollution load assessment, a careful delineation has been observed in each individual case.

58. In the following, individual sources contributing to the different waste source categories are listed in tabular form as well as located on maps. All relevant data are compiled in Annex I/1-9 of this report.

1. Domestic waste sources

59. The study revealed a total resident population in the coastal area of about 44 million inhabitants. In addition, there was a considerable number of tourists encountered during the season, who were considered when assessing the total domestic waste load. Industrial activities listed within the municipalities were not further elaborated within the domestic inventory but transferred and incorporated into the industrial survey results.

60. However, in estimating the pollution stemming from municipal sewage, the industrial waste portion discharging into municipal sewers should be taken into consideration. This portion is of increasing importance as the discharge of industrial wastes through municipal sewers provides in general better and more economic solutions.

61. The cities of 10 000 inhabitants and above are listed individually and identified by regional sea area and the relevant country coastline. These data together with actual population figures are summarized in Annex I/1. Their geographical distribution according to three population size categories is given in Annex I/2 which illustrates very clearly the demographic situation around the Mediterranean.

62. The coastal areas bordering the regional sea components nos I, V, VI, VII and IX contribute relatively small population figures with Tripoli being the only major demographic concentration area. Region III with Alger, region VIII with Athens and Ismir, and region X with Alexandria and Beirut each contain about 10% of the total coastline population. The two most densely populated coasts are found in region II and IV with 8.9 and 8.1 million people respectively. Marseille, Genova, Valencia and Barcelona are the major centres in the North-Western basin, while Rome, Napoli, Palermo and Tunis are dominant in the Tyrrhenian sea. These two regional seas alone account for almost 40% of the total resident population around the Mediterranean.

2. Industrial waste sources

63. An inventory of industrial activities contributing significant pollution loads inevitably covers a large variety of production sectors. Considering the 18 countries in this study, listing of individual factories or complexes would be beyond the scope of this report. An attempt was made, therefore, to summarize within broad categories of industrial activities as well as to identify industrial concentration areas by their geographical location. Thus, data on individual units were not lost but incorporated in larger entities.

64. The geographical distribution of the more heavily polluting industrial sectors along the Mediterranean coastline is mapped in Annex I/3. Four major categories were included: (i) leather tanning and finishing, (ii) iron and steel basic industries, (iii) petroleum refineries and oil terminals, and (iv) chemicals production (organic and inorganic).

65. Leather tanning and finishing was mainly encountered along the Spanish and Italian coastline and in the area of Athens and Alexandria with smaller centres distributed among other countries. Iron and steel basic industries are chiefly located in the Marseilles, Genova and Athens areas with less important plants in other countries. The oil industry, petroleum refineries as well as oil terminals, is established in several centres along the southern and eastern shorelines. Additional refineries are located in the North-Western basin and in the upper Adriatic. Chemical complexes are situated in a number of industrial concentration areas around the Mediterranean including organic and inorganic production facilities.

66. Other industries of significance include textile manufacturing, food processing and canning, and pulp and paper factories. In addition, there are several other activities of importance but their size is in most cases too small to justify listing and mapping them individually.

3. Agricultural run-off

67. Erosion susceptibility within the Mediterranean watershed and its geographical variability was estimated through the delineation of 4 different classes indicating slight, weak, moderate and high degrees of soil erosion. The actual amount of sediments reaching the sea is, however, much smaller than the classification indicates. It is influenced by dams and other natural or man-made structures acting as sediment traps and thus considerably reducing the discharged amounts.

68. The 144 sub-basins into which the Mediterranean watershed was divided are summarized in the map of Annex I/4 which also indicates their erosion classification. Some large rivers e.g., the Ebro, Rhone and Po, were not subject to this procedure since their sediment discharges are already covered by the river component of the project. Because of the lack of suspended sediment determinations at many river monitoring sites, the agricultural run-off computation was also used to estimate their sediment yield.

69. Subsequently, the role of sediments as the main carrier of nutrients from land run-off was utilized to determine phosphorus, nitrogen and organic matter discharges from non-point sources. Agricultural regions appear to produce relatively high discharges of nutrients while areas under well preserved forest result in somewhat low nutrient yields. No sediment and nutrient discharges were encountered from the arid areas along the Southern coastline where neither run-off nor agricultural practices play significant roles.

70. The pesticide inventory was prepared in the form of a summary of pesticide consumption by agriculture specifying their types and quantities and their use as insecticide, fungicide or herbicide. From the entries in the list provided as Annex I/5 it became evident that the amounts of pesticides used in the respective countries ranges fairly widely. These findings are due to the varying types and intensities of agriculture around the Mediterranean.

71. The summary prepared includes data from 11 countries. No information was, however, available from the other countries. Taking into account current agricultural practices in the different countries, the amounts indicated in Annex I/5 may provide for about two-thirds of the total consumption in the Mediterranean basin. Also, the restriction or prohibition of the use of persistent chlorinated hydrocarbons in a number of countries has to be considered in this respect[8].

4. River discharges

72. All major rivers around the Mediterranean which were considered for the river input study are listed in Annex I/6. Each one is identified by country and by the regional sea area into which it discharges. Average flow and drainage area are also given. Their exact location is mapped in Annex I/7 according to three discharge categories.

73. As expected, there is a large variety of water quality ranging from very clean to heavily polluted while some may even be considered as open sewers. A clear distinction must, however, be made between flux and concentration. Large rivers may result in a considerable flux of substances due to background concentrations only while others may carry significant loads due to man-made pollution. Consequently, discharge volume and character of the drainage basin have to be equally taken into consideration. Due to their large water discharges and the industrial and agricultural character of their drainage basins, the rivers Rhône and Po are major carriers of pollution. Other significant contributions are from the Ebro, Llobregat, Nile, Adige and Tevere rivers.

74. In summary, the major pollution carriers among the rivers are situated along the Northern coastline and the major portion of the total discharge originates from the Northern part of the Mediterranean watershed. Only about 20% of the total flow is discharged along the southern and eastern shoreline.

5. Radioactive discharges

75. An inventory of nuclear installations in chronological order was established for each country. Annex I/8 provides for a comprehensive list while their location is shown on the map in Annex I/9. In this inventory, all major nuclear plants located on rivers flowing into the Mediterranean are included. Reduction factors to take account of the time of decay were applied for the discharge assessment of installations remote from the sea.

76. Until the end of the seventies, there will be major nuclear installations in only three countries: France, Italy and Spain. According to present projections there will be an important increase in the number of nuclear plants during the eighties in these three countries as well as in Egypt, Greece, Israel, Turkey, Yugoslavia and perhaps in other countries. In the present inventory only the installations already built or under construction are listed.

77. In addition, there is nuclear research work going on in a number of countries, together with a widespread use of radioisotopes in medicine. Because the radioactivity discharged from these sources to the Mediterranean is limited, they are not included in the present inventory and assessment.

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[8] EPPO Publications, Series B No.79, June 1975 (countries restricting or prohibiting the use of certain pesticides).

VIII. RESULTS OF POLLUTION LOAD ASSESSMENT

78. Following the selection of major pollutants and waste source categories as given in table 2, a comprehensive assessment of the total pollution load of the Mediterranean was undertaken. The waste discharges of each country into the different regional sea areas as delineated in figure 1 were computed individually and then assembled for each pollutant by source and by regional sea area.

79. All findings of the pollution load assessment study are presented in full detail in the Annexes to this report. Annex II provides in 10 tables the estimated annual pollutant loads of the regional Mediterranean sea areas from different waste sources. Annex III summarizes in pie diagrams for most of the pollutants the contribution of annual loads from different waste sources in the regional Mediterranean sea areas.

80. In the following the results of the estimate of annual pollutant loads are presented in summary form. When considering the figures given below it has to be borne in mind that the results are likely to have a range of error of approximately one order of magnitude.

A. Estimated pollutant loads from different sources

81. Relevant data are summarized in table 7 providing for total loads in tons per annum (or equivalent) as well as by percentages for each pollutant source. To this end the total annual load has been subdivided into pollution loads originating in the coastal zone and loads carried by rivers. The first group covers all pollution sources located in the coastal area as defined in paragraph 13, including domestic sewage, industrial wastewaters and direct surface run-off from agricultural areas. Loads carried by rivers are differentiated according to man-made pollution and background flux. Ranges have been indicated, as they are considered more reliable than average figures in view of the uncertainty inherent in making estimates for rivers.

1. Total volumes

82. The total volume shown represents the annual freshwater inflow into the Mediterranean sea. As expected, coastal sources are marginal contributors in comparison to river discharges. No distinction has been made between small streams carrying surface run-off within the coastal zone and the total river flow covering the entire Mediterranean drainage basin. Also, it has proved impossible to estimate the wastewater portion of the river flow.

2. Organic matter

83. The annual pollution loads for biochemical and chemical oxygen demand both indicate that about 60 to 65% of the total load stems from coastal sources while the remainder is carried by rivers. In addition, rivers contribute a certain background load which remains unaffected by pollution control measures.

84. Industrial waste sources account for about half of the organic load from the coastal area, while domestic sewage and agricultural organics contribute roughly a quarter each. These proportions vary between BOD and COD due to difference in the organic substances involved in each case. Whereas domestic organics are highly degradable, agricultural organics consist of relatively stable substances.

85. The distinction between domestic and industrial sources reflects the method used in drawing up the inventory and calculating the respective waste loads. In practice, however, a large percentage of the industrial wastes is discharged together with domestic sewage to form a single municipal effluent discharge. Combined municipal wastewater may therefore be considered as an equally important contributor to pollution.

Table 7: Estimated annual pollution loads of the Mediterranean from land-based sources

(detailed explanations are provided in the report § 81 to § 91)

Pollutant	Pollution loads originating in the coastal zone				Loads carried by rivers into the Mediterranean				Total Mediterranean Loads		
	Domestic t/a	Industrial t/a	Agricultural t/a	Sub-total t/a	Pollution t/a	Background t/a	Sub-total t/a	(range)	Pollution	Total (including background) t/a	(range)
1. Volume:											
Total discharge x10^9	2	6	-*	(8)	(-)	420	420	(400-500)	(-)	430	(400-500)
2. Organic matter:											
BOD x10^3	500	900	100	1 500	1 000	(800)	1 800	(1200-2300)	2 500	3 300	(2700-3800)
COD x10^3	1 100	2 400	1 600	5 100	2 700	800	3 500	(2300-4700)	7 800	8 600	(7400-9800)
3. Nutrients:											
Phosphorus x10^3	22	5	30	57	260	40	300	(200-400)	320	360	(260-460)
Nitrogen x10^3	110	25	65	200	600	200	800	(600-1000)	800	1 000	(800-1200)
4. Specific organics:											
Detergents x10^3	18	-	-	18	42	0	42	(9-75)	60	60	(30-90)
Phenols x10^3	-	11	-	11	1	0	1	(0.5-1.8)	12	12	(6-18)
Mineral oil x10^3	-	120	-	120	(-)	0	(-)		(120)	(-)	
5. Metals:											
Mercury	0.8	(7)	-	(8)	90	30	120	(40-200)	100	130	(50-200)
Lead	200	1 400	-	1 600	2 200	1 000	3 200	(2700-3800)	3 800	4 800	(4300-5400)
Chromium	250	950	-	1 200	1 200	400	1 600	(500-2700)	2 400	2 800	(1700-3900)
Zinc	1 900	5 000	-	6 900	14 000	4 000	18 000	(14000-22000)	21 000	25 000	(21000-29000)
6. Suspended matter:											
TSS x10^6	0.6	2.8	50	53	-	300	300	(100-500)	-	350	(100-600)
7. Pesticides:											
Organochlorines	-	-	-*	-	90	0	90	(50-200)	90	90	(50-200)
8. Radioactivity:											
Tritium Ci/a	-	400	-	400	2 100	(-)	2 100	(1600-3100)	2 500	(-)	
Other radio-nuclides Ci/a	-	25	(-)	25	15	(-)	15	(10-25)	40	(-)	

Legend: - contributions from this source negligible

(-) insufficient data base for estimate

-* included in river assessment

3. Nutrients

86. Phosphorus and nitrogen loads largely derive from river inputs (75 to 80%), not including the amounts carried as natural background flux. The major contributors in the coastal area are domestic sewage and agricultural run-off, with only marginal amounts from industrial sources. This extremely biased distribution makes any sensible nutrient control dependent upon measures taken within the catchment areas of the major rivers.

4. Specific organics

87. Detergent discharges are largely due to household uses. One-third of the total load stems from coastal municipalities while the other two-thirds are contributed by the population living within the river catchment areas. Phenols as well as mineral oil discharges are largely due to industrial activities with contributions from coastal refineries and oil terminals predominating. No estimate of mineral oil pollution of rivers was possible due to a lack of reliable data.

5. Metals

88. The discharges of mercury are largely due to river inputs with only 8% from coastal sources. The data base for estimating industrial mercury discharges was limited and the actual figure may be rather higher. As regards the other three metals, between half (chromium) and two-thirds (zinc) of the pollution load is carried by rivers. In addition, considerable amounts of metals are transported naturally into the Mediterranean as background contributions. Most of the metal loads originating in the coastal zone derive from industrial sources and lesser amounts from domestic sewage. Unfortunately, estimates proved impossible in the case of cadmium loads, owing to an almost complete lack of data for all source categories.

6. Suspended matter

89. Large amounts of suspended solids are carried naturally from the watershed into the Mediterranean sea. About 15% stem from surface run-off within the coastal area, while the rest is carried by major rivers. Comparatively minor contributions originate from domestic and industrial sources. The different origin and characteristics of domestic and industrial solids should, however, be taken into consideration.

7. Pesticides

90. Only persistent organochlorine compounds were included in this estimate which indicates a total load of about 90 t/a carried by surface run-off, directly or through rivers, into the Mediterranean sea. Breakdown into specific organochlorine groups shows that about one-third stems from DDT compounds, BHC compounds and from other organochlorines. Cyclodienes account for only about 5% of the total.

8. Radioactive discharges

91. Estimates of the current loads include tritium and other radionuclides from nuclear power plants located at the coast as well as on major rivers discharging into the Mediterranean. About 85% of the tritium and 40% of the other radionuclides stem from power plants on major rivers and only the remainder from coastal sources. The river data do not, however, include discharges into the Rhône from nuclear power plants in operation prior to 1977.

9. Microbial pollution

92. No data were available to permit a direct assessment of microbial pollution of the Mediterranean from domestic sources, which represent by far the largest source of such pollution. However, it is estimated that, since human faeces contain about 1×10^{12} coliforms per capita per day, the total discharge is about 6.5×10^{12} coliforms per m^3 of sewage taking into account the reduction attributable to such treatment facilities as existing. These indicator organisms provide presumptive evidence of the presence of bacterial and viral pathogens.

B. Regional contributions to pollution loads

93. A summary of annual loads for each pollutant according to the 10 regional sea areas delineated in figure 1 is provided in table 8 of this report. As could be expected, it shows marked differences up to one order of magnitude between the regions. The particular waste source category largely responsible for dominant contributions varies, however, from region to region.

94. Heaviest pollution loads are discharged into the North-Western basin (region II) which is not only bordered by three industrialized countries but also receives major river pollution loads. This regional sea area has to absorb almost one-third of the total pollution load of the Mediterranean. The Adriatic sea (region V) is also severely affected and receives about one-quarter of the total load, likewise due to large rivers and major coastal sources.

95. Moderate pollution loads are encountered in the Tyrrhenian and Aegean sea (regions IV and VIII). They receive each about 10% of the total Mediterranean pollution load.

96. The other six regional sea areas (nos. I, III, VI, VII, IX and X) each account for no more than 5% of the total load. Mineral oil pollution is, however, an exception to this general rule. Due to large oil terminals and some refineries, more than half of the total mineral oil discharges are located in the Central and North-Levantin basin (regions VII and IX). Additional mineral oil contributions are located in three other regions (see table 10).

97. Taking the geographic distribution of the waste loads into consideration, Mediterranean pollution problems can largely be attributed to a limited number of significant point sources along coastlines. Industrial centres, municipalities and several rivers are the major sources in this respect. In the case of rivers, a distinction has to be made, however, between man-made pollution and background loads carried naturally into the sea. Agricultural pollution loads are, in addition, contributed by direct surface run-off from the coastal area.

Table 8: Estimated annual pollution loads of the regional Mediterranean sea areas

(all figures in tons per annum or percentages)

Pollutant \ Sea area	I		II		III		IV		V		VI		VII		VIII		IX		X		TOTAL
	t/a	%	t/a	%	t/a	%	t/a	%	t/a	%	t/a	%	t/a	%	t/a	%	t/a	%	t/a	%	t/a
1. Volume:																					
Total discharge x10^9	7	2	99	23	9	2	33	8	151	35	33	8	6	1	47	11	25	6	18	4	428
2. Organic matter:																					
BOD x10^3	90	3	950	29	120	4	370	11	800	25	230	7	70	2	330	10	140	4	150	5	3 250
COD x10^3	300	3	2400	28	400	5	1100	13	1700	20	600	7	300	3	950	11	550	6	300	3	8 600
3. Nutrients:																					
Phosphorus x10^3	7	2	126	35	9	3	29	8	85	24	23	6	7	2	33	9	19	5	20	6	358
Nitrogen x10^3	25	2	387	37	27	3	62	6	273	26	61	6	20	2	90	9	51	5	46	4	1 042
4. Specific organics:																					
Detergents x10^3	1.5	3	14.8	25	1.8	3	8.2	14	16.2	27	3.8	6	1.2	2	6.0	10	2.7	5	3.5	6	59.7
Phenols x10^3	1.2	10	3.9	31	0.6	5	1.0	8	1.6	13	1.5	12	1.1	9	0.9	7	0.2	2	0.4	3	12.4
Mineral oil x10^3	2	2	10	7	1	1	3	3	4	4	10	9	41	36	4	4	27	23	13	11	115
5. Metals:																					
Mercury	2	2	33	25	3	2	11	8	41	32	10	8	2	2	14	11	7	5	7	5	130
Lead	90	2	1360	28	120	2	630	13	1440	30	230	5	100	2	440	9	180	4	230	5	4 820
Chromium	100	4	1000	36	120	4	380	14	200	7	210	8	50	2	290	11	150	5	260	9	2 760
Zinc	300	1	5200	21	700	3	3000	12	8600	35	1600	6	500	2	2500	10	1100	4	1200	5	24 700
6. Suspended matter:																					
TSS x10^6	(-)	-	(-)	-	(-)	-	(-)	-	(-)	-	(-)	-	(-)	-	(-)	-	(-)	-	(-)	-	(-)
7. Pesticides:																					
Organochlorines	6.4	7	14.9	17	10.4	12	12.1	13	14.0	16	6.1	7	2.9	3	7.4	8	6.7	7	9.1	10	90
8. Radioactivity:																					
Tritium Ci/a	-	0	1100	44	-	0	120	5	1260	51	1	0	-	0	-	0	-	0	-	0	2 480
Other radio-nuclides Ci/a	-	0	16	42	-	0	14	37	7	18	1	3	-	0	-	0	-	0	-	0	38

Legend: (-) insufficient data base for estimate

IX. WASTE DISPOSAL AND MANAGEMENT PRACTICES

98. As part of the present project's activities, current practices in the Mediterranean countries concerning the disposal of waste and relevant management procedures were studied. This review largely concentrated on the legislation basis of waste management but also attempted to consider the situation with regard to particularly hazardous pollutants. A summary of findings is presented hereunder while a country by country review is provided in Annex IV to this report.

1. Introduction

99. Among the Mediterranean countries there exists a wide range of levels of legislation and control concerning coastal pollution. These differences are to be expected for they reflect the varying stages of industrial, social and economic development of the countries and their consequent local circumstances and needs.

100. In most countries the control of land-based discharges to the sea is motivated by the need to protect the local environment. Action is taken, as necessary, to ensure the health of sea bathers, preserve amenities of the beaches and to safeguard local inshore fisheries. In recent years however there has been a growing awareness of the need also to protect the Mediterranean sea as a whole entity. This protection will be essentially a long-term measure as distinct from the more locally orientated actions where the results are more quickly and readily observable. The legislation and management practices for controlling land-based discharges to the sea need to be directed towards both coastal and total sea pollution.

101. The uses of sea water are more limited than those of freshwater which is essential for drinking and domestic use, for agriculture and for most industrial purposes. This indispensability of freshwater has meant that priority has been given to control measures and expenditure to protect water meeting these needs.

102. Sea water does not play a major role in the overall management and planning of national water resources. When means are limited they are employed where the need is most urgent and where the return for expenditure is most significant and immediate. In consequence the measures for the control of the pollution of sea water have, in the past, tended to be subsidiary to those adopted to safeguard the quality of inland freshwater.

2. Legislation and responsibility

103. Legal enactments controlling various aspects of sea pollution tend to be dispersed among laws and regulations intended primarily for other purposes. They are often incorporated into legislation concerned with fisheries, with navigation and with port authorities. Sometimes the only effective and enforceable control is that available under the planning laws.

104. Where there is comprehensive water legislation as in some of the countries, provision for protection of coastal waters is usually included. The method of control varies largely according to the degree of decentralisation which is practised. In some countries the central government lays down fairly detailed standards which are applicable nationally. Alternatively there may be detailed classification of receiving waters with corresponding effluent standards permitting a restricted measure of local decision. Among the countries with a long history of the management of water resources there has been a movement away from national standards and a delegation of authority to local agencies. Their recent legislation has been of an enabling character leaving the detailed execution as a local responsibility.

105. The growing practice is for control to be exercised by issuing individual licences, sometimes also termed consents or permits, for each discharge. Limitations as to quantity and quality are laid down in the licence, which is subject to review, usually at minimum intervals. The requirements for each discharge are determined by the local people according to the uses and importance of the receiving water and to its capacity to absorb pollution loads. This system provides a valuable degree of flexibility in both space and time and enables a progressive policy to be pursued. (In one, non-Mediterranean, country where this system is employed, there is a built-in safeguard for the discharger. If he considers the conditions of the license to be unreasonably restrictive he can appeal to the central government which will, after investigation, make a decision binding on both parties).

106. It seems likely that the general adoption of a licensing system will be necessary to enable the participating countries to carry out the terms of the Protocol[9] For some countries their existing system will not require serious modification if any, but for others a licensing system will be an innovation and may need to be introduced in stages. Although there will be local and national variations the basic principles of the system will be similar.

107. There is clearly scope for general agreement to be reached on the basic outline of the system and a need for experiences in its operation to be made generally available. This could be met by the preparation of a set of model laws and regulations. These would not be mandatory but serve as guidelines for the formulation of national legislation with modifications appropriate to individual national circumstances.

3. Organization

108. At central government level there is in all of the countries a diversity of interests and different ministries cover a variety of subjects all concerned with some aspect of the control of water pollution e.g., health, water supply, industry, transport, navigation, agriculture, fisheries, energy, tourism and recreation. The interests of these ministries are often conflicting and some of the countries provide for adequate consultation and discussion by the establishment of a form of coordinating agency. In several instances it is the task of an environmental ministry, under various names; in another country interdepartmental committees with their own secretariat have been set up. Such agencies ensure that there is full prior consultation on any proposed legislation affecting, inter alia, water resources and that in all major decisions affecting water all interested parties are informed. There is a clear and obvious need for some form of high level central coordinating agency in all countries.

109. At the local, sub-national, level there is a wide range of executive bodies. The most highly developed are the specialized river basin agencies which are responsible for most of the aspects of water resource management including water quality. In other countries existing local authorities are charged with the task of implementing pollution legislation with varying degrees of supervision by central government. Where local authorities are not suitably equipped for this work central government exercises full responsibility,despite geographical problems.

110. Difficulties arise in some countries when central government attempts to delegate responsibility to the districts due to their shortage of staff with the necessary knowledge and training. The system of licensing practised in some of the countries requires for its proper functioning staff adequate in numbers, skill and facilities according to the number, size and character of the local discharges. Without such staff and resources a decentralized system is not feasible.

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[9] Protocol for the Protection of the Mediterranean sea against Pollution from Land-Based Sources.

4. Enforcement

111. The diligence with which enforcement is carried out varies not only between countries but also within countries. There are various reasons for this. Frequently the law is vaguely worded and definitions are ambiguous, because national legislation has to cater for a wide range of situations and eventualities. The licensing system can be much more precise in its requirements and evasion is then more difficult.

112. Enforcement may be hampered by lack of trained staff and sampling and analytical facilities. Penalties may be inadequate, and it may be cheaper to pay the fines than to install treatment. There is little doubt that "available powers are not fully utilized" and their exercise may conflict with other local interests; as for example the desirability of encouraging new industry to an area or the undesirability of undue or exaggerated publicity likely to discourage tourists.

5. Finance

113. In most of the Mediterranean countries the expenditure on pollution prevention measures is met by government loans or grants. In one or two of the more heavily industrialized countries systems have been developed for raising money locally as a charge for services for sewerage and treatment levied on both the domestic and the industrial producers of waste waters. For the domestic households the charge may be a flat rate and included in local taxes while the industrialist may pay according to the polluting load discharged. In one country the system has been developed further and payment is required for the discharge of polluting water on a load basis irrespective of whether or not any sewerage is provided or treatment is given.

114. There are clear advantages in developing financially self-sufficient systems. It provides the executing agency with its own funds, independent of government subsidy which usually covers capital expenditure but often ignores essential running costs. It provides industry with an incentive to reduce its polluting load by conservation and recycling, and it also stimulates local interest. The arrangement conforms with the widely accepted basic principle that the cost of industrial waste treatment should be regarded as a manufacturing cost. In practice of course the charge is passed on to the consumer.

115. It is obvious that to meet the obligations of the Protocol many of the Mediterranean countries will need to raise additional funds and it would be timely to consider the extent to which the local charging systems of the more industrialized countries might usefully be adopted, in some form, by all the countries.

6. Environmental impact statements

116. The practice of preparing environmental impact statements has been developed in recent years and has been adopted by a few of the Mediterranean countries. When any major development is proposed a comprehensive study is carried out of all the possible effects it may have, both directly or indirectly, upon the entire environment including any possible consequences for any part of the water cycle. Such a statement is of considerable assistance to those responsible for exercising judgement and making decisions on the proposal.

117. It has been demonstrated by the present study that the greater part of some persistent polluting substances enter the Mediterranean through the rivers and they originate largely from industrial discharges to inland waters. When consideration is being given to proposals for an inland factory and to the formulation of suitable license conditions for the effluent, full regard should be had to its possible effect upon the Mediterranean,a matter likely to be overlooked in inland situations. If an environmental impact statement were to be prepared this aspect of the proposal would be included and properly considered. This is an isolated example of the benefit to be derived from the preparation of an environmental impact statement but the adoption of the practice by other Mediterranean countries would be of material assistance in protecting the sea and coastal waters against the consequences of future developments within the Mediterranean basin.

7. Specific groups of pollutants

Agricultural chemicals

118. Most countries have legislation intended to prevent the pollution of water by the more harmful of the biocides used in agriculture. In the main this is effected by restrictions upon the use or the mode of application of specified substances, amounting sometimes to a national prohibition, particularly when less harmful substitutes are available. In some countries there is a screening and authorization process for all new agricultural chemicals.

119. In general there is a widespread awareness of the potential danger of the indiscriminate use of these substances, in particular of certain of the chlorinated hydrocarbons, and the need to exercise strict control.

Detergents

120. Control of detergents is exercised not by restriction on aqueous discharges but on the sale and use of those surface active agents which are not readily decomposed. This affords a relatively easy means of control because of the commercial availability of the "softer" detergents which have a much smaller content of persistent material and may cost only slightly more than the "hard" material.

121. Whereas the "hard" material will normally leave a residue of about 35-40% of the original the current "soft" materials meet legal requirements for a residual of about half that amount i.e. 20% and in practice most of the surface active agents now employed leave residues of less than 10% and even down to 5%. A number of Mediterranean countries have enforced an 80% biodegradability requirement for some years and it is now required under recent directives of the European Economic Community[10,11]. There should be no difficulty in obtaining general acceptance of such a limitation in the Mediterranean countries.

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[10] Council Directive No.73/404/EEC of 22 November 1973 on the approximation of the laws of the Member States relating to detergents.

[11] Council Directive No. 73/405/EEC of 22 November 1973 on the approximation of the laws of the Member States relating to methods of testing the biodegradability of anionic surfactants.

Heavy metals

122. There appears to be little if any direct control of heavy metals discharged into the Mediterranean. Rivers have been found to be the major source of heavy metals entering the Mediterranean and while some heavy metals e.g. mercury may originate from natural as well as artificial sources the majority are of industrial origin. Limitations on discharges into inland waters will therefore influence the fluvial load of these substances entering the sea.

123. A complicating factor is that a substantial proportion of the heavy metal load may be transported in river sediment which renders monitoring and load assessment more difficult than for substances carried largely or exclusively in solution. Existing information on the quantity and characteristics of the heavy metal loads entering the Mediterranean is very scanty and will clearly need to be augmented substantially in order to meet the responsibilities accepted under the Protocol.

Oil

124. Although much of the marine oil pollution results from discharges from ships there are also shore-based sources such as terminals and refineries. The prevention of pollution measures and their enforcement vary considerably between different Mediterranean countries. The need is for legal powers not merely for prohibition or restriction but also for requiring precautionary measures to be taken e.g. the provision of bunds around storage tanks and for immediate remedial facilities to be kept available to cope with accidents.

125. Oil contamination of beaches can be most unpleasant and may occur in places remote from the source of the oil.

Plastics

126. The accumulation of plastic containers of all types can be seriously detrimental to the amenities. They may also interfere with navigation and fishing. The presence of plastics and oil, referred to in the preceding section, may not offer any serious health hazards but could have serious implications for tourism.

X. CONCLUSIONS AND RECOMMENDATIONS

127. The relatively short time period of 1½ years provided for project development and implementation did not allow for an in-depth study of each individual pollution source along the Mediterranean coastline. It was possible, however, to achieve a comprehensive overview as well as a comparative evaluation of major point and non-point sources. Such information was requested by mid-1977 in order to assist in the critical stages of the preparation of the draft protocol on land-based sources.

128. All the various sectorial studies revealed without exception the limited availability of relevant data in all Mediterranean countries. Particular data deficiences were encountered for hazardous pollutants such as heavy metals, specific organics and pesticides. Furthermore, the available statistical documents frequently did not provide for a more detailed analysis of data according to industrial activities or geographical locations.

129. Collection of the required data in the countries faced various difficulties: data collection and reporting formats vary from one country to another; a large number of different data sources had to be included in each study; certain sectorial data were not readily available; in some cases the required data were not obtained due to confidentiality restrictions which could not be overcome in the short time provided for the project.

130. In view of the limitations and difficulties encountered, the pollution load assessment for all waste source categories has been, to a great extent, estimated indirectly. It has been worked out taking into consideration demographic statistics, industrial production and employee figures, and agricultural consumption data in addition to the data provided by the questionnaires Similarly, extrapolations from known sources were made in the case of rivers and of nuclear power stations. Despite the short-comings of such an indirect method of evaluation, the results obtained are homogeneous and fairly complete and cover the entire Mediterranean region. The quality of estimates calculated may be considered accurate within an error range of about one order of magnitude.

A. Conclusions

131. Compilation and comparison of the sectorial results achieved revealed a number of interesting facts which could assist in the improvement of present pollution control efforts of the countries bordering the Mediterranean sea.

132. Domestic sources largely contribute organic matter (BOD or COD), microbial pollution and nutrients as well as detergents from household uses. Some of the metals are also derived from municipal sewage discharges.

133. Industrial waste discharges are responsible for considerable amounts of organic matter and suspended solids. Various industrial processes result also in phenol and metal releases while mineral oils are largely introduced from refineries and crude oil terminals.

134. Agricultural run-off is responsible for a considerable portion of the nutrient input to the sea. Suspended solids and pesticide discharges are largely due to soil erosion in the Mediterranean watershed. However, the contributions from agricultural run-off within the coastal area is but a fraction of the pollution loads carried by rivers into the sea. The airborne load of pesticides could, however, not be included in the study.

135. Major rivers and drains transport an integrated load of domestic, industrial and agricultural pollutants from the entire drainage basin into the sea. Their contribution is therefore very high in suspended solids, nutrients, metals and organic matter. They also carry most of the pesticide residues from agricultural areas in the Mediterranean watershed.

136. The total discharge of radioactivity into the Mediterranean from nuclear installations is rather low in comparison to the radioactive contaminants in other materials discharged (particularly phosphates) and due to fall-out from earlier weapon tests.

B. Recommendations

137. The present project which is to terminate in 1977 should be considered only as a first step towards the required efforts for pollution control in the Mediterranean. Further studies and activities are indispensable. The momentum so far acquired, although significant, will need further stimulus if progress is to be maintained and increased.

138. A number of specific proposals are therefore included here which would strongly help in this task. They are listed according to the type of activity required and include source inventories, monitoring, research, control and management as well as suggestions for international efforts.

1. Source inventories

139. Further analysis of the results of the present project should be undertaken by each interested country. This, complemented by local ad hoc investigations, would assist in planning action required in leading to more efficient control of land-based pollution sources.

140. Based upon detailed country investigations, comprehensive pollution load inventories should be prepared for each regional sea area and the total Mediterranean basin on a regular basis. The protocol on land-based sources of pollution may provide the necessary legal basis for this task.

2. Monitoring

141. Routine monitoring of major municipal sewage discharges should be organized in each country. A minimum number of parameters should be agreed upon and their regular sampling and analysis initiated. Similarly, effluents from major industrial complexes should be periodically monitored. Detailed analysis of particularly hazardous substances at critical industrial sources should be carried out. Pollutants listed in Annex I, even if they are present only as trace contaminants, and in Annex II of the Protocol are of priority importance in this respect.

142. River water quality montitoring programmes should be established in the developing countries and strengthened in the others. In particular, large and small but heavily polluted rivers should be included in such national programmes which should include monitoring at the tidal limits. Special efforts should be undertaken to initiate the sampling and analysis of suspended sediments for metal and pesticide contents.

143. Individual radionuclides should be monitored in the effluents from nuclear installations as well as in the affected rivers. Also, their distribution from the point of discharge into the Mediterranean sea should be measured and mapped.

3. Research

144. Investigations and pilot studies on existing wastewater treatment and sea outfall systems should be undertaken at several places around the Mediterranean coastline. Such studies should cover municipal sewage as well as hazardous industrial pollutants. Also, these investigations should be extended to the coastal receiving waters in order to assess potentially harmful effects on human health and the marine ecosystem.

145. Further research on the physico-chemical interactions at the solid-liquid interface should be undertaken, particularly in estuaries, in order to allow for a better assessment of pollutants carried by river sediments into the Mediterranean. Such investigations are indispensable for the determination of metal and pesticide loads from river discharges and their subsequent transformation and dispersion in the marine environment.

146. Pilot zone studies in agricultural areas should be conducted in order to obtain improved estimates of sediment yields from erosion and of nutrient and pesticide wash-out rates under different physiographical conditions. Such studies should be combined with river investigations to gain a better insight into the relationship between sediment yield and river transport mechanisms.

147. Training activities and technical assistance should be promoted in order to intensify present research efforts and to support the initiation of new efforts wherever needed.

4. Prevention and control

148. Local and national activities should be stimulated which will assist in the study and application of methods of control of coastal water pollution due to municipal sewage. In this respect, due consideration should be given to alternative treatment and disposal methods such as the reuse on-land for agriculture and low-cost methods of treatment such as waste stabilization ponds exploiting local geographical and climatic advantages. Also, present deficiencies in the operation and maintenance of sewage handling facilities and the training of operators should receive more attention.

149. The application of economically sound treatment methods and processes for various industrial wastewaters should be promoted and the best practicable technology applied. Such methods should aim to reduce pollution at the source and provide for the conservation and possible reuse of substances which are particularly hazardous and consist of valuable material resources.

150. As regards agricultural pollutants, the economic impact of control methods such as fertilizer limitation and soil loss reduction procedures should be estimated. Also, the restriction and prohibition of persistent organochlorine pesticides should be promoted as an effective instrument for pollution control at the source. The rational use of fertilizer and pesticides should allow for full efficiency with a minimum of polluting impact on the marine environment.

5. Management

151. In order to ensure efficient management, an appropriate combination of regulatory, technical and economic instruments should be applied so as to provide continuing incentive to control both pollution and marine water quality.

152. The development of appropriate administrative procedures which will succeed in bringing about the necessary coordination of efforts for seawater pollution control should be thoroughly studied by the interested countries and an efficient sollution applied wherever there are multiple responsibilities resting with a diversity of national, provincial and local services. This should be the minimum step towards the building of the necessary managerial and administrative institutions. Relevant manpower needs and structures require equal attention in this process.

153. Administrative practices such as the issuing of individual licences should be further developed and introduced wherever appropriate. General adoption of a licensing system should be in accordance with the requirements set forth in the protocol on land-based pollution sources. Adequate staffing of the necessary administrative institutions at all levels is essential. Also, the introduction of local charging systems in order to ensure a proper

financial basis for effective waste management should be considered. Thus, adequate funds would be provided which can be allocated to water resources development and pollution control measures.

154. The potential environmental impact of new installations around the Mediterranean sea should be taken into consideration as early as possible in the planning process. Direct and indirect impacts should be assessed as to their short- and long-term consequences in relation to different available alternatives.

C. International cooperation

155. In support of the tasks outlined in the above list of recommendations which should lead to an improved control of coastal water quality, a number of activities are suggested. Such action proposals include programmes and projects which are to be undertaken jointly by the countries concerned and in collaboration with the relevant UN Agencies. Assistance to developing countries should specially be considered.

156. The establishment of detailed pollution source inventories and the assessment of waste loads reaching the Mediterranean should be initiated as an important task for all countries involved. The use of common methodology should ensure the comparability of results. To this end, the application of a simplified version of the guidelines and questionnaires used under project MED X is proposed.

157. Common sampling schemes and analytical procedures for the monitoring of municipal and industrial effluents should be prepared and their application promoted. Also, the relevant data handling should be based on uniform methods. Thus, a comparable data base for the assessment of waste loads discharged from major point-sources in the coastal zone of the Mediterranean would be ensured.

158. River monitoring programmes should be initiated and intensified providing for adequate coverage of hazardous substances particularly in the more polluted rivers. Standardized measurement methodology and data handling as well as analytical quality control could be brought about with a minimum of effort by the incorporation of relevant river monitoring stations into the global water quality monitoring network which is presently being established under the UNEP/WHO/UNESCO/WMO Project on Global Water Quality Monitoring (GEMS/WATER).

159. In support of the above suggestions, a network of national services responsible for the monitoring and control of land-based sources should be established which would provide for the necessary mechanism for the routine collection and compilation of country information. Co-ordination should be brought about through strengthening of the cooperation of national focal points.

160. The proportionate contribution of pollutants from air-borne sources and imported due to atmospheric transport phenomena is at present an unknown factor in the pollution of the Mediterranean and should be subject to an evaluation study. Experiences gained elsewhere, e.g. in the Baltic sea, should be consulted during the formulation of the study.

161. The development of a model code of practice for the discharge of liquid wastes into the Mediterranean coastal waters should be considered as a priority task. Such a guideline on the treatment and disposal of municipal and industrial wastewaters according to technically sound principles and methods was recommended by a recent workshop of Mediterranean experts[12].

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[12] Workshop on Coastal Water Pollution Control, Athens, 27 June - 1 July 1977.

162. As a complementary activity to this practical guideline which will also assist in the implementation of the protocol on land-based pollution sources, internationally comparative studies at existing sea outfall and wastewater treatment systems should be initiated. Development as well as demonstration of recommended practical solutions should result from such studies.

163. National experts of the Mediterranean countries - scientists, engineers and administrators - should be brought together periodically to exchange views, discuss their common problems and develop appropriate approaches and methods for the control of pollution in the Mediterranean. Such exchange of information and international cooperation in the field of applied research, monitoring, and technical assistance is considered essential and should be supported by adequate training programmes. Relevant activities may be part of the arrangements among the contracting parties of the protocol on land-based sources of pollution.

164. Training activities and technical assistance in connection with research and also in support of control measures are proposed as crucial for the implementation of pollution reduction programmes. Training of sewage treatment plant operators should receives particular attention in this respect. A study on manpower needs in that direction would be appropriate.

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List of cities with a population of 10 000 inhabitants and above

Per country and per zone

Zone	Country	Cities[1]			
I	Algeria	Oran	465	Beni Saf	31
		Mers El Kebir	27	Monaine	11
		Arzow	22	Ghazaouet	27
		Dethioua	17	Bab El Assa	17
		Odyel	11	Marsa Ben Il'llidi	13
		Bir El Djir	16		
	Total 657				
I	Morocco	Ceuta (Spain)	136	Melilla (Spain)	134
		Al-Hoceima	257	Nador	501
	Total 1 032				
I	Spain	La Linea	70	Almunecar	14
		San Roque	20	Salobrena (tourist place)	9
		Estepona	20	Motril	35
		Marbella	20	Adra	12
		Fuengirola	27	Roquetas de Mar	15
		Torremolinos	20	Almeria	127
		Malaga	400	Aguilas	19
		Velez-Malaga	35	Cartagena	158
	Total 1 001				
I	TOTAL ZONE 2 690				
II	France	Argeles sur Mer	24	Six-Fours la Plage	27
		Perpiqnan	49	La Seyne-Sur-Mer	54
		Narborne	41	Toulon	184
		Agde	35	La Valette-du-Var	13
		Marseillan	10	La Garde	14
		Sete	43	La Pradet	11
		Frontignan	15	Hyeres	50
		Palavas-Les-Flots	11	Le Lavandou	11
		La Grande Motte	10	Saint-Tropez	16
		Le Grau du Roi	18	Grimaud	11

[1] inhabitants x 10^3

Zone	Country	Cities[1]			
II	France (Cont'd)	Port-Saint-Louis du-Rhone	10	Sainte Maxime	10
		Port-de-Bouc.	22	Frejus	49
		Istres	15	Saint-Raphael	34
		Miramas	14	Mandelieu	16
		Berre L'etang	11	Le Cannet	38
		Vitrolles	14	Cannes	95
		Marignane	26	Vallauris	21
		Martigues	37	Antibes	65
		Les Pennes Mirabeau	13	Cagnes-sur-Mer	28
		Septemes-Les-Vallons	11	St Laurent du Var	12
		Marseille	916	Nice	359
		Cassis	11	Beausoleil	12
		Aubagne	28	Roquebrune-Cap-Martin	14
		La Ciotat	48	Menton	34
		Bandol	11	Ajaccio (Corsica)	52
		Sanary-sur-Mer	13		
	Total 2 686				
II	Italy	Ventimiglia	27	Lavagna	14
		Bordighera	12	Sestri Levante	22
		San Remo	65	La Spezia	122
		Taggia	15	Lerici	14
		Imperia	42	Carrara	70
		Alassio	14	Massa	65
		Albenga	21	Seravezza	20
		Loano	13	Pietrasanta	26
		Finale Ligure	14	Forte dei Marmi	10
		Vado Ligure	10	Camaiore	31
		Savona	80	Viareggio	58
		Varazze	15	Massarosa	20
		Arenzano	11	Pisa	104
		Genova	804	Livorno	178
		Recco	11	Rosignano Marittimo	29
		Santa Margherita Ligure	13	Cecina	23
		Rapallo	29	Sorso (Sardegna)	12
		Chiavari	32	Sassari (Sardegna)	112
				Porto (Sardegna)	19
	Total 2 177				
II	Monaco	Monaco	44		
	Total 44				
II	Spain	Denia	24	Mataro	100
		Oliva	17	Malgrat del Mar	11
		Gandia	41	Arenys de Mar	11
		Tabernes de Valldigma	16	Gava	10
		Cullera	19	Calella	10
		Sueca	23	Blanes	10

[1] inhabitants x 10^3

Zone	Country	Cities[1]			
II	Spain (Cont'd)	Valencia	714	Lloret del Mar	10
		Oropesa del Mar	2	San Feliu de Guixols	14
		Sagunto	54	Figueras	29
		Nules	10	San Agaro	10
		Burriana	24	Playa de Aro	10
		Villarreal de los infantes	33	Palamos	11
		Almazora	15	Blanes	20
		Castellon de la Plana	110	Palafrugell	10
		Benacasim	4	Torroella de Montgri	10
		Peniscola	3	La Escala	10
		Benicarlo	17	Cadaques	10
		Vinaroz	18	Rosas	10
		S.Carlos de la Rapita	10	Port-Bou	10
		Amposta	14	San Antonio Abad (Ibiza)	10
		Tarragona	78	San Juan Bautista (Ibiza)	10
		Vendrell	11	Soller (Mallorca)	9
		Villanueva y Geltru	45	Pollensa (Mallorca)	11
		Sitges	11	Alcudia (Mallorca)	10
		Prat de Llobregat	53	La Puebla (Mallorca)	10
		Hospitalet	242	Ciudadela (Menorca)	10
		Barcelona	1 745	Mahon (Menorca)	22
		Badalona	202		
	Total 3 963				
II	TOTAL ZONE 8 870				
III	Algeria	Annaba	226	Azzefoum	13
		Barrahal	15	Tigzirt	12
		El Kala	13	Dellys	31
		Ben Aman	14	Iflisson	11
		El Farf	14	Baghias	12
		Ben Hallidi	14	Bordj Manaiel	42
		El Wadjar	192	Tonia	29
		Skikja	123	Boudouaou	29
		Stora	13	Reghaia	30
		El Arroueh	40	Zemmouri	18
		Ramdane Djamal	17	Alger	1 269
		Salah Bouchaour	18	Rauiba	48
		Azzaba	26	Ain Taya	29
		Es Sebt	15	Bordj El Kiffan	32
		Ain Cherchar	15	Cheraga	25
		Ben Azzoun	13	Ain Benian	23
		Zirout Youcef	32	Staoueli	14

[1] inhabitants x 10^3

Zone	Country	Cities[1]			
III	Algeria (Cont'd)	Beni Ouelbane	11	Zaralua	11
		Collo	41	Hadjout	21
		Zitouna	20	Tipazo	16
		Tamalous	22	Kolea	28
		Ain Kechera	18	Fouka	12
		Oum Toub	15	Dou Ismail	38
		Jijel	50	Cherchell	35
		El Aouane	13	Gouraya	18
		Kokkada Motletine	31	Damous	20
		Biotatlassouriah	15	Tanes	29
		Taher	31	Deni Haoua	18
		Sidi Abdelaziz	17	Zeboudja	18
		Chehfa	17	Bouzghaia	28
		Djamila	22	Taougit	27
		Settara	12	Sidi Ali	21
		Bejaia	87	Sidi Lakhdar	35
		Tichi	17	Hadjadj	23
		Aokas	14	Achaacha	24
		Tasknout	10	Mostagonem	100
		Timizart	12		
	Total 3 464				
III	Italy	Alghero (Sardegna)	36	Sant'Antioco (Sardegna)	12
		Oristano (Sardegna)	20	Cagliari (Sardegna)	238
		Iglesias (Sardegna)	29	Quartu Sant'Elena (Sardegna)	35
	Total 370				
III	Spain	La Union	13	Benidorm	60
		Santa Pola	10	Altea	10
		Alicante	218	Ibiza (Ibiza)	22
		Villajoyosa	10	Palma de Mallorca (Mallorca)	262
	Total 605				
III	TOTAL ZONE 4 439				
IV	France	Bastia (Corsica)	46		
	Total 46				

[1] inhabitants x 10^3

Zone	Country	Cities[1]			
IV	Italy	Plombino	40	Eboli	27
		Portoferraio (Elba)	11	Agropoli	12
		Follonica	19	Capaccio	14
		Grosseto	68	Pontecagnano Faiano	18
		Orbetello	14	Vietri sul Mare	10
		Monte Argentario	14	Cetraro	11
		Tarquinia	13	Paola	16
		Civitavecchia	47	Amantea	11
		Rome	2 874	Vibo Valentia	32
		Anzio	26	Rosarno	18
		Nettuno	27	Gioia Tauro	16
		Latina	89	Palmi	18
		Terracina	36	Bagnara Calabra	12
		Fondi	26	Villa St. Giovanni	12
		Gaeta	24	Messina (Sicilia)	263
		Formia	27	Milazzo (Sicilia)	29
		Minturno	17	Barcellona Pozzo di Gotto (Sicilia)	36
		Sessa Aurunca	25	Lipari (Lipari)	10
		Mondragone	22	Patti (Sicilia)	13
		Pozzuoli	66	Capo, D'Orlando (Sicilia)	10
		Ischia (Ischia)	16	Sant Agata di Militello (Sicilia)	12
		Ercolano	54	Cefalu (Sicilia)	13
		Napoli	1 221	Termini Imerese (Sicilia)	26
		Bacoli	22	Bagheria (Sicilia)	38
		Guiliano in Campania	39	Palermo (Sicilia)	666
		Portici	83	Villabate (Sicilia)	11
		Massa Lubrense	10	Carini (Sicilia)	17
		Torre del Greco	97	Alcarno (Sicilia)	43
		Vico Equense	16	Castellammare del Golfo (Sicilia)	14
		Torre Annunziata	57	Erice (Sicilia)	24
		Castellammare di Stabia	72	Trapani (Sicilia)	70
		Monte di Procida	12	Paceco (Sicilia)	13
		Sorrento	16	Marsala (Sicilia)	83
		Procida	10	Olbia (Sardegna)	28
		Salerno	160	La Maddalena (Sardegna)	11
		Battipaglia	37		
	Total 7 064				
IV	Tunisia	Bizente	63	Ras Jebel	13
		Menzel Bourguiba	42	Grand Tunis	874
		Metline	16	Soliman	13
	Total 1 021				
IV	TOTAL ZONE 8 131				

[1] inhabitants x 10^3

Zone	Country		Cities[1]			
V	Albania		Durres	57	Vlore	51
			Kavaja	17		
		Total 125				
V	Italy		Brindisi	86	Sant'Elpidio a Mare	15
			Ostuni	32	Porto Sant'Elpidio	19
			San Pietro Vernotico	15	Civitanova Marche	35
			Carovigno	13	Potenza Picena	12
			Fasano	35	Ancona	107
			Monopoli	42	Falconara Marittima	26
			Polignano a Mare	14	Senigallia	40
			Mola di Bari	25	Fano	51
			Bari	380	Pesaro	89
			Giovinazzo	19	Riccione	31
			Molfetta	65	Cattolica	16
			Bisceglie	46	Rimini	125
			Trani	41	Bellaria-igea Marina	12
			Barletta	78	Savignano sul Rubicone	12
			Margherita di Savoia	12	Cesenatico	20
			Manfredonia	52	Cervia	25
			Vieste	12	Ravenna	138
			Sannicandro Garganico	19	Comacchio	21
			Termoli	19	Porto Tolle	10
			Vasto	27	Chioggia	53
			Ortona	22	Venezia	365
			Francavilla al Mare	14	San Michele al Taglia-	
			Pescara	134	mento	12
			Montesilvano	22	Iesola	22
			Roseto degli Abruzzi	20	Eraclea	11
			Giulianova	22	Caorle	11
			San Benedetto del		Latisana	10
			Tronto	45	Grado	10
			Grottammare	10	Monfalcone	31
			Fermo	35	Muggia	14
			Porto san Giorgio	15	Trieste	270
		Total 2 984				
V	Yugoslavia		Pula	70	Split	184
			Rijeka	132	Dubrovnik	20
			Zadar	70	Hercegnovi	20
			Sibenik	20		
		Total 516				
V	TOTAL ZONE	3 625				

[1] inhabitants x 10^3

Zone	Country	Cities[1]			
VI	Greece	Kerkyra (Corfu)	29	Amalias	14
		Preveza	11	Pyrgos	21
		Mesolongion	12	Kalamata	39
		Patras, Patrai	121		
	Total 247				
VI	Italy	Pachino (Sicilia)	21	Crotone	55
		Noto (Sicilia)	25	Ciro Marina	11
		Avola (Sicilia)	30	Rossano	28
		Siracusa (Sicilia)	119	Corigliana Calabro	33
		Augusta (Sicilia)	37	Cassano allo Jonio	18
		Catania (Sicilia)	399	Bernalda	11
		Acireale (Sicilia)	49	Policaro	10
		Aci Castello (Sicilia)	12	Castellaneta	16
		Riposto (Sicilia)	13	Massafra	25
		Taormina (Sicilia)	10	Taranto	241
		Reggio di Calabria	177	Palagiano	12
		Locri	12	Sava	20
		Siderno	16	Manduria	29
		Caulonia	10	Nardo	32
		Catanzaro	91	Galatone	15
		Cutro	15	Gallipoli	19
		Isola di Capo Rizzuto	11	Tricase	14
	Total 1 636				
VI	TOTAL ZONE 1 883				
VII	Italy	Valderice (Sicilia)	10	Licata (Sicilia)	42
		Mazara del Vallo (Sicilia)	41	Gela (Sicilia)	72
		Campobello di Mazara (Sicilia)	12	Vittoria (Sicilia)	48
		Castelvetrano (Sicilia)	31	Comiso (Sicilia)	20
		Menfi (Sicilia)	14	Ragusa (Sicilia)	64
		Sciacca (Sicilia)	34	Modica (Sicilia)	46
		Ribera (Sicilia)	19	Scicli (Sicilia)	24
		Porto Empedocle (Sicilia)	17	Pozzallo (Sicilia)	14
		Agrigento (Sicilia)	50	Ispica (Sicilia)	14
		Palma di Montechiaro (Sicilia)	25		
	Total 597				

[1] inhabitants x 10^3

Zone	Country		Cities[1]			
VII	Libyan Arab Jamahiriya		Zwara, Zuwara, Zuara	25	Garabulli, Garaet el Garabulli	20
			Sabratha	40	Al Khums, Homs	30
			Sorman	30	Zlitan	40
			Az-Zawijah, Zawia	83	Misratah, Misurata	139
			Janzour, Zanzur	30	Surt, Sirte	14
			Tripoli, Tarabulus el-Gharb	670	Ajedabia, Ajdabiyah	55
			Tajurah, Tajoora	20	Benghazi	400
		Total 1 596				
VII	Malta		Valletta	14	Birkirkara	17
			Sliema	20	Qormi	14
			Msida	12	Zejtun	10
			Hamrun	14	Rabat	11
			Paola	11		
		Total 123				
VII	Tunisia		Kelibia	19	Teboulba	14
			Menzel Temime	19	Sayda, Lamta, Bouhjar	12
			Korba	13	Ksar Hellal	19
			Dar Chaabane	16	Mahdia	22
			Nabeul	30	Chebba	11
			Hammamet	17	Ksour Essef	15
			Hammam Soussa	16	Sfax	171
			Sousse	70	Gabes	41
			Monastir	27	Houmt Souk	16
			Moknine	26	Zarzis	14
		Total 588				
VII	TOTAL ZONE	2 904				
VIII	Greece		Argos	19	Thessalonike	557
			Korinthos	21	Kavala	46
			Megara	17	Alexandroupolis	23
			Elefsis	19	Mytilene (Lesvos)	23
			Salamis	18	Chios (Chios)	24
			Athens (and Piraeus)	2540	Hermoupolis (Kykladhes)	14
			Chalkis	36	Rodos, Rhodes (Rodos)	32
			Lamia	38	Herakleion (Krete)	78
			Volos	51	Rethymnon (Krete)	15
			Katerine	31	Chania (Krete)	41
		Total 3 643				

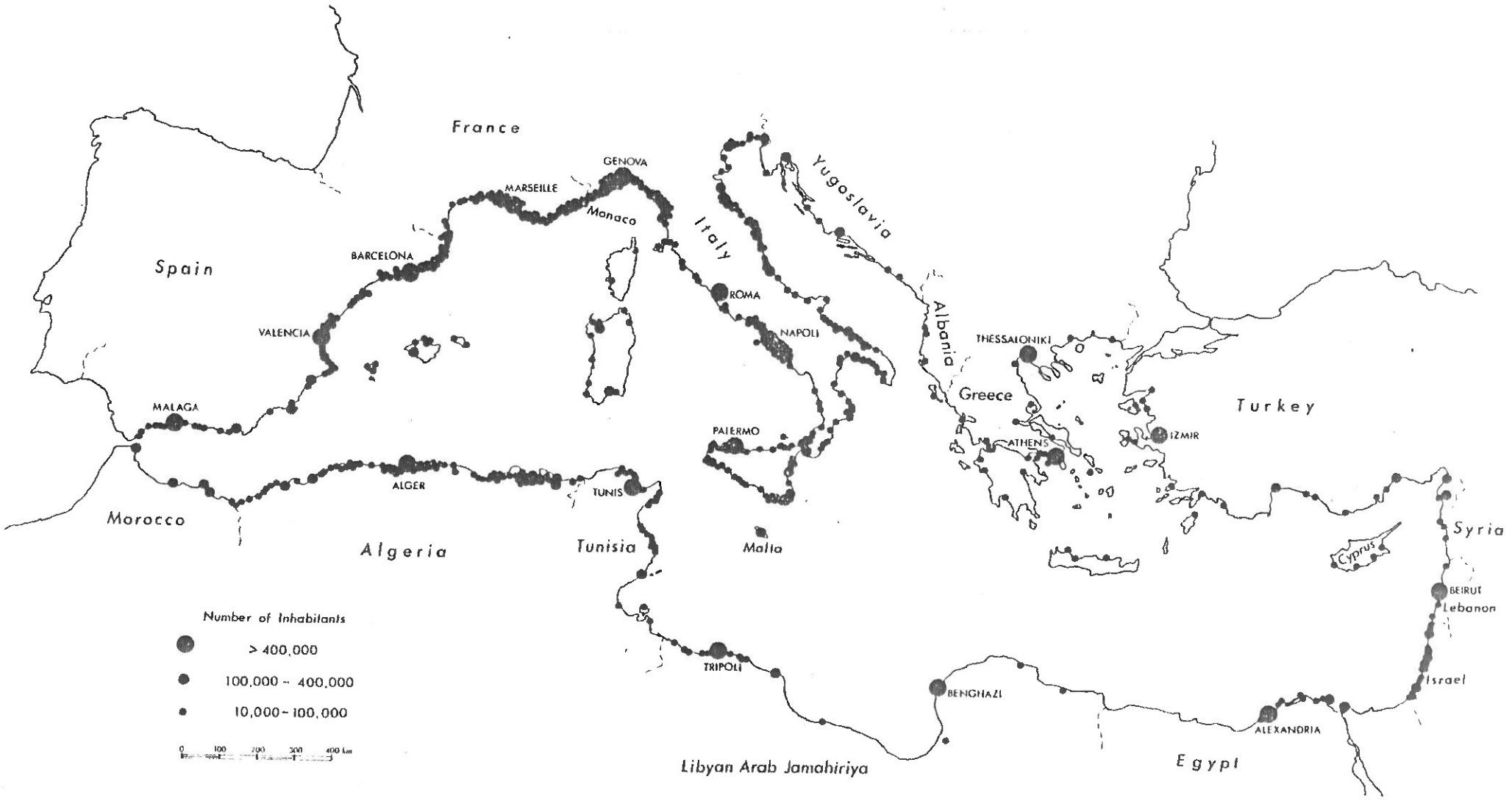
[1] inhabitants x 10^3

Zone	Country		Cities[1]			
VIII	Turkey		Marmaris	6	Dikili	7
			Bodrum	8	Ayvalik	18
			Cesme	5	Burhaniye	13
			Ismir	858	Edremit	26
		Total 941				
VIII	TOTAL ZONE	4 584				
IX	Cyprus		Famagusta	65	Limassol	65
			Larnaca	35	Paphos	20
		Total 185				
IX	Lebanon		Tripoli Tarabulus esh-Sham	175		
		Total 175				
IX	Syria		El Ladhiqiya (Lattakia)	200	Baniyas	30
			Djableh (Jeble)	40	Tartus	48
		Total 318				
IX	Turkey		Iskenderun	103	Anamur	20
			Samandagi	23	Alanya	18
			Hatay, Dörtyol-Payas	124	Manavgat	11
			Mersin	152	Antalya	140
			Erdemli	19	Fethiye	13
			Dilifke	19		
		Total 642				
IX	TOTAL ZONE	1 320				

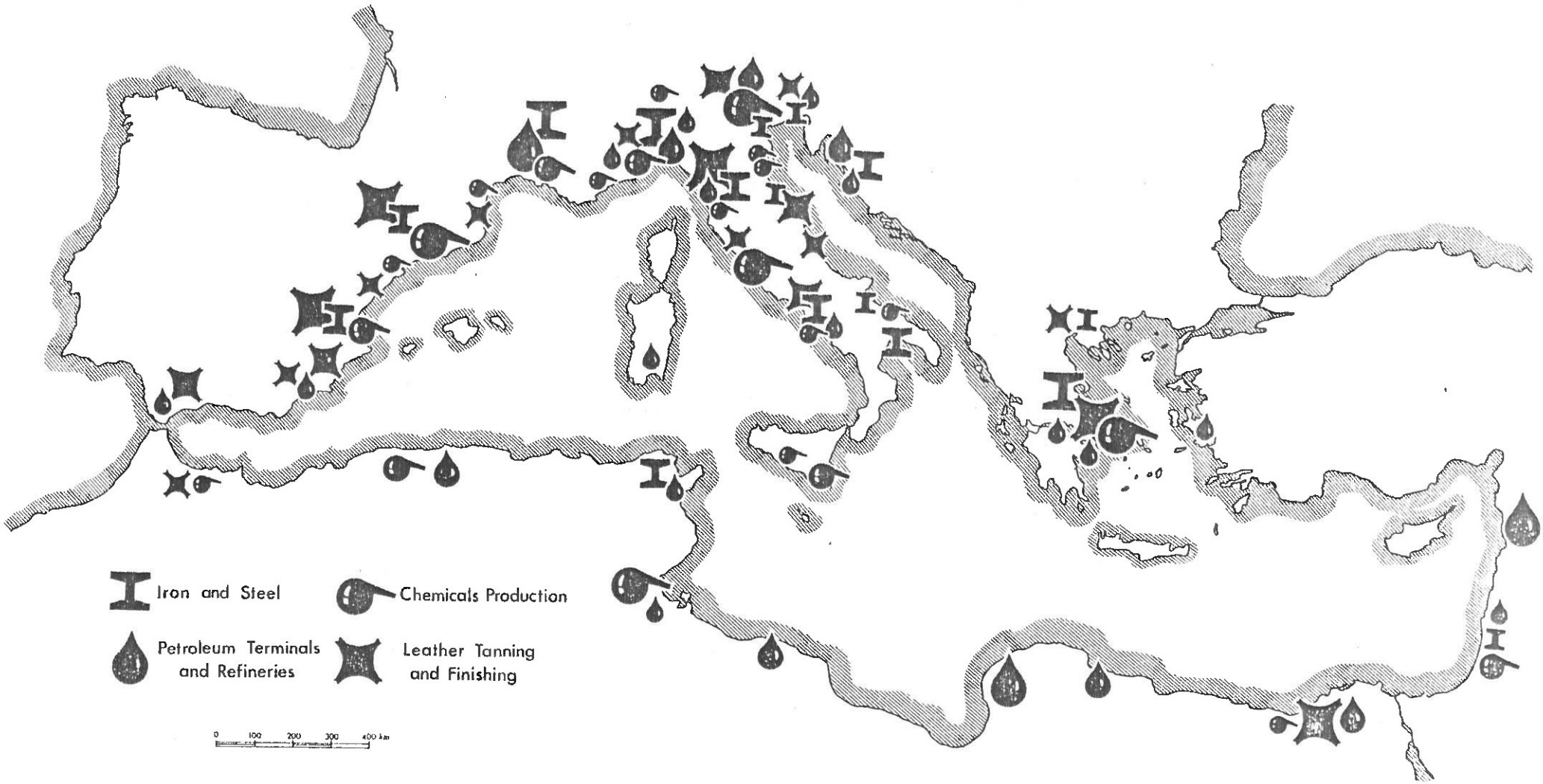
[1] inhabitants x 10^3

Zone	Country		Cities[1]			
X	Egypt		Esbat Elborg, El Burg	27	Ballim	18
			Alexandria	2 397	Ras El Bar (tourist place)	5
			Abu Qir	25	Damietta, Dumyat	103
			Rosetta, Rashid	37	Port Said, Bur Said	310
			Gamassa (tourist place)		Port Fouad	25
	Total	2 947				
X	Israel		Rafah (adm)	50	Jaffa, Yaffa	
			Khan Yunis (adm)	53	Ramat Gan	116
			Deir el-Balah (adm)	18	Herzliya	39
			Gaza (adm)	118	Netanya	80
			Ashkelon	40	Hadera	31
			Ashdod	38	Haifa	225
			Bat Yam	84	Akko, Acre	34
			Tel-Aviv	384	Nahariya	22
	Total	1 332				
X	Lebanon		Sour, Tyre	20	Beirut	939
			Saida, Sidon	25		
	Total	984				
X	Libyan Arab Jamahiriya		Derna, Darnah, Darna	55	Tobruk, Tubruq	70
	Total	125				
X	TOTAL ZONE	5 388				
	TOTAL MEDITERRANEAN	43 834				

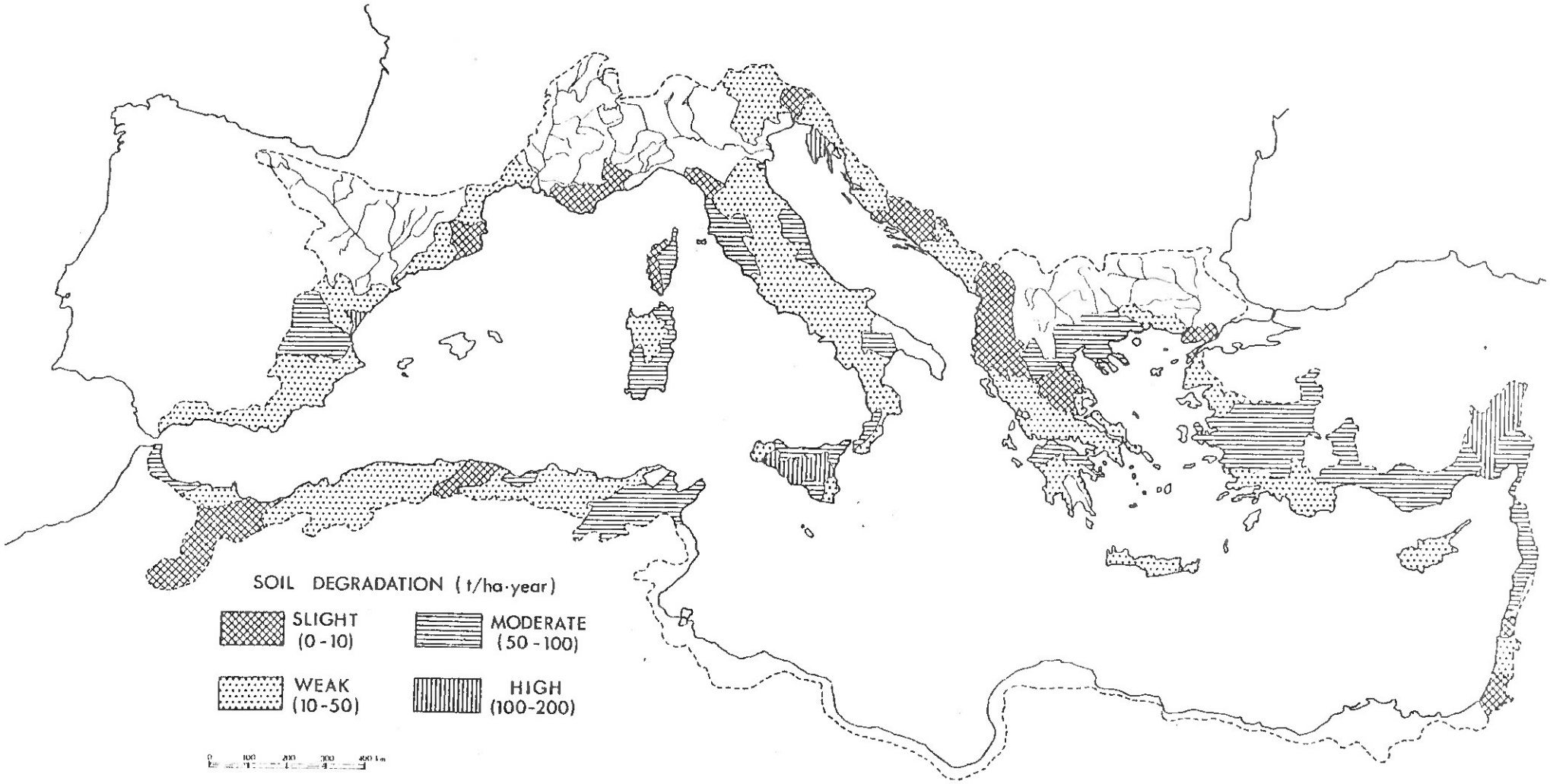
[1] inhabitants x 10^3



DISTRIBUTION OF RESIDENT POPULATIONS ALONG THE MEDITERRANEAN COASTLINE



LOCATION OF MAJOR INDUSTRIAL AREAS ALONG THE MEDITERRANEAN COASTLINE



DISTRIBUTION OF EROSION POTENTIALS WITHIN THE MEDITERRANEAN WATERSHED BASIN

ANNEX 1/4

Pesticide Consumption by Agriculture in the Mediterranean Watershed
(excluding Albania, Algeria, France, Malta, Monaco, Morocco, Yugoslavia, 5 regions of Italy)

Kind of Pesticide	Consumption (t active ingredient per year)											estimated area treated ($10^3 km^2$)
	Cyprus (1976)	Egypt (1975/76)	Greece (1973)	Israel (1974)	Italy[3] (1975)	Lebanon (1973)	Libya (1974)	Spain[4] (1976)	Syria[4] (1976)	Tunisia (1973/74)	Turkey[4] (1976)	Total	
A. INSECTICIDES	91.0	4824.6	1335.0	816.3	21205.0	709.1	257.0	6607.4	81.6	379.2	3377.5	39683.7	647.1
1. Organochlorine compounds	14.9	743.3	85.5	132.3	2972.4	35.3	5.8	323.2	65.8	39.0	1266.8	5684.1	216.8
1.1 DDT and related compounds	11.2	169.3	-	10.3	866.4	-	-	12.7	36.7	-	864.1	1970.7	29.1
1.2 BHC and lindane	0.6	21.9	-	25.0	1563.7	-	1.7	122.3	9.1	36.0	163.0	1943.1	126.6
1.3 Cyclodienes(aldrin, dieldrin,endrin,etc.)	0.1	98.7	-	0.8	-	-	2.0	99.2	6.3	3.0	81.2	291.1	15.4
1.4 Other organochlorine compounds	3.0	453.4	85.5	96.5	542.3	-	2.1	89.0	13.7	-	158.5	1444.3	44.4
1.5 Unspecified organo-chlorine compounds	-	-	-	-	-	35.3	-	-	-	-	-	35.3	1.3
2. Carbamates	10.0	303.8	493.0	-	2301.3	67.0	0.4	542.8	-	85.0	258.1	4061.4	87.6
2.1 Carbaryl	4.0	273.2	410.0	-	2110.3	-	-	495.6	-	85.0	247.5	3625.6	54.0
2.2 Other carbamates	6.0	30.6	83.0	-	191.0	-	0.4	47.2	-	-	10.6	368.8	32.2
2.3 Unspecified carbamates	-	-	-	-	-	67.0	-	-	-	-	-	67.0	1.4
3. Organophosphorus compounds	66.1	1982.1	496.0	473.0	8733.1	480.0	221.8	1227.8	15.8	99.2	1638.0	15432.9	325.6
3.1 Parathion	30.0	75.8	106.0	80.0	2594.6	-	3.1	59.2	2.3	26.0	7.8	2984.8	105.3
3.2 Malathion	25.0	181.2	109.0	60.0	997.0	-	40.3	237.6	1.6	47.5	65.3	1764.5	23.8
3.3 Diazinon	2.1	-	-	150.0	1119.4	-	-	39.5	-	-	50.9	1361.9	49.7
3.4 Other organo - phosphorus compounds	9.0	1725.1	281.0	183.0	4022.1	-	178.4	891.5	11.9	25.7	1514.0	8841.7	76.7
3.5 Unspecified organo-phosphorus compounds	-	-	-	-	-	480.0	-	-	-	-	-	480.0	10.1
4. Other insecticides	-	1795.4	260.5	211.0	7198.2	126.8	29.0	4513.6	-	156.0	214.6	14505.1	17.1
B. FUNGICIDES	958.0	7508.4	25323.5	2265.6	114593.0	1279.1	207.9	19567.1	215.1	629.3	15441.3	187988.3	457.5
1. Copper compounds	8.0	95.5	2886.9	828.0	26109.4	34.0	25.1	2149.2	-	56.2	2186.9	34379.2	135.3
2. Mercury compounds	-	-	-	0.1	-	-	0.1	5.0	-	-	4.7	9.9	27.1
3. Dithiocarbamates	100.0	469.2	1066.7	292.5	16698.4	-	38.4	1485.9	59.2	137.0	614.8	20962.1	195.0
4. Other fungicides[1]	850.0	6943.7	21369.9	1145.0	71785.2	1245.1	144.3	15927.0	155.9	436.1	12634.9	132637.1	97.1
5. Unspecified fungicides	-	-	-	-	-	-	-	-	-	-	-	-	3.0
C. HERBICIDES	43.5	146.8	489.2	1970.3	5846.9	36.6	40.9	834.1	7.2	133.6	581.2	10130.3	133.6
1. Arsenic compounds	-	-	-	140.0	-	-	-	14.9	-	-	-	154.9	0.02
2. Phenoxy compounds	10.0	23.3	169.8	72.0	862.6	-	37.5	373.6	7.2	120.0	314.2	1990.2	37.9
2.1 2,4 - D	10.0	23.3	131.4	38.8	673.2	-	37.5	373.6	7.2	120.0	314.2	1682.7	32.0
2.2 MCPA	-	-	38.4	29.2	189.4	-	-	26.5	-	-	-	283.5	5.5
2.3 2,4,5-T [2]	-	-	-	4.0	-	-	-	1.7	-	-	-	5.7	-
2.4 Other phenoxy compounds	-	-	-	-	-	-	-	18.3	-	-	-	18.3	0.4
3. Other herbicides	33.5	123.5	319.4	1758.3	4984.3	-	3.4	445.6	-	13.6	267.0	7948.6	95.2
4. Unspecified herbicides	-	-	-	-	-	36.6	-	-	-	-	-	36.6	0.5
D ALL OTHER PESTICIDES	-	801.2	-	873.0	6920.4	71.4	37.2	3367.3	2.4	-	2397.7	14470.6	5.4
TOTAL	1092.5	13281.0	27147.7	5925.2	148565.3	2096.2	543.0	30375.9	306.3	1142.1	21797.7	252272.9	1243.6

1 principally sulphur

2 applied to non-cultivated areas such as highways and railway right-of-ways

3 except Piemonte, Valle d'Aosta, Lombardia, Trentino Alto Adige and Umbrian regions

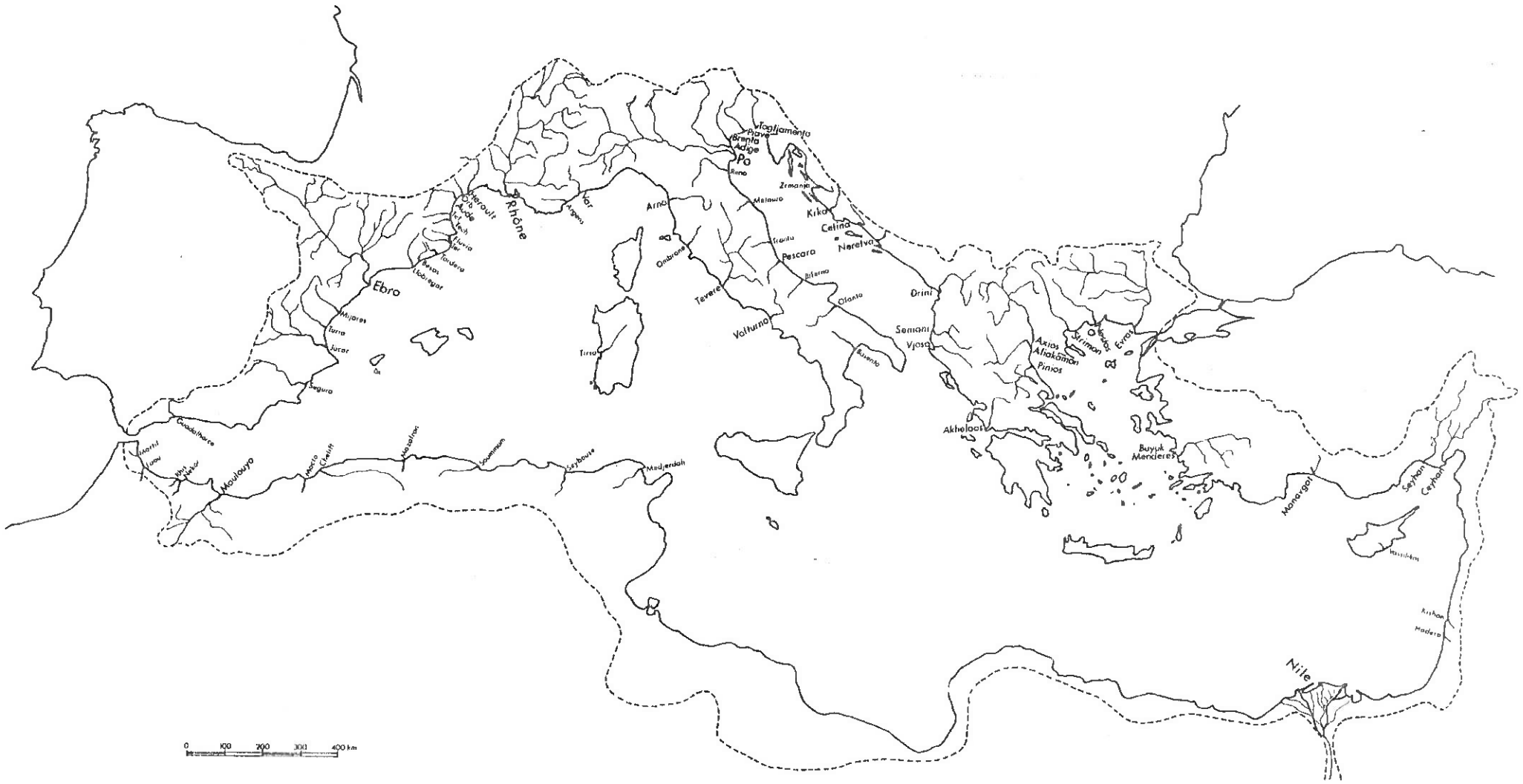
4 Mediterranean watershed only

List of rivers included in the pollution source inventory

Sea area No	Sea area Name	Country	River	Flow m^3/s	Drainage area $10^3 Km^2$	Remarks m = monitored
I	Alboran	Spain	Guadalhorce	8.5	2.85	m
		Morocco	Laou	28	0.94	
			Riss	7.5		
			Nekor	2.2	0.63	
			Moulouya	50	52	
			Martel et al.	~ 24		
		Total		~ 120		
II	North Western	Spain	Jucar	40	21.5	m
			Turia	14.6	6.3	m
			Mijares	11.3	2.5	m
			Ebro	550	84	m
			Llobregat	22	4.9	m
			Besos	1.3	1.0	m
			Todera	3.8	0.8	m
			Ter	14.5	1.8	m
			Fluvia	6.8	1.0	m
		France	Tedr			
			Tet	13.7		m
			Aude	66	1.79	m
			Orb	31.9	1.15	m
			Hérault	53.4	2.55	m
			Rhône	1712	95.6	m
			Argens	16	2.53	m
			Var	65.4	1.83	m
		Italy	Arno	103		
		Total		~ 2730		
III	South Western	Spain	Segura	7.3	14.9	m
		Algeria	Macta	2.7	4.0	
			Cheliff	40	43.7	
			Mazafran	13.8	1.9	
			Soummam	24.9	8.4	
			Seybouse	13.4	5.9	
		Italy	Tirso	4.4	0.6	
		Total		~ 107		

Sea area		Country	River	Flow	Drainage area	Remarks
No	Name			m^3/s	$10^3 Km^2$	m = monitored
IV	Tyrrhenian	Italy	Ombrone	25	2.7	
			Tevere	234	16.5	m
			Volturuo	98	5.6	
		Tunisia	Medjerdah	31	22.1	
		Total		388		
V	Adriatic	Italy	Ofauto	11.6	2.7	
			Biferuo	21	1.29	
			Pescara	54	3.12	
			Tronto	17	0.91	
			Metauro	13.6	1.04	
			Reno	45	3.41	
			Po	1550	70	m
			Adige	231	11.95	m
			Brenta	73	1.56	
			Piave	88	3.33	
			Tagliamento	89	1.88	
		Yugoslavia	Zrmanja	40	0.78	
			Krka	51	2.25	
			Cetina	89	5.8	
			Neretva	355	12.75	
		Albania	Drini	342	12.48	
			Semani	113	5.3	
			Vjöse	182	5.2	
		Total		3365		
VI	Ionian	Greece	Akhelos	167		
		Italy	Basento	13	1.4	
		Total		180		
VII	Central		no rivers			
VIII	Aegean	Greece	Pinios	102		
			Aliakmon	133	9.46	
			Axios	163	24.66	
			Strimon	111	16.55	
			Nestos	100	6.18	
			Evros	311		
		Turkey	Buyuk Menderes	100	23.8	
		Total		1020		

Sea area		Country	River	Flow	Drainage area	Remarks m = monitored
No	Name			m^3/s	$10^3 Km^2$	
IX	North Levantin	Turkey	Manavgat	129	0.93	
			Seyhan	188	20.45	
			Ceyhan	230	19.8	
		Cyprus	Vassilikos	0.12	0.15	m
		Total		547		
X	South Levantin	Israel	Kishon	0.46	0.68	m
			Hadera	0.56	0.52	m
		Egypt	Nile	~ 500	2960	
		Total		~ 500		

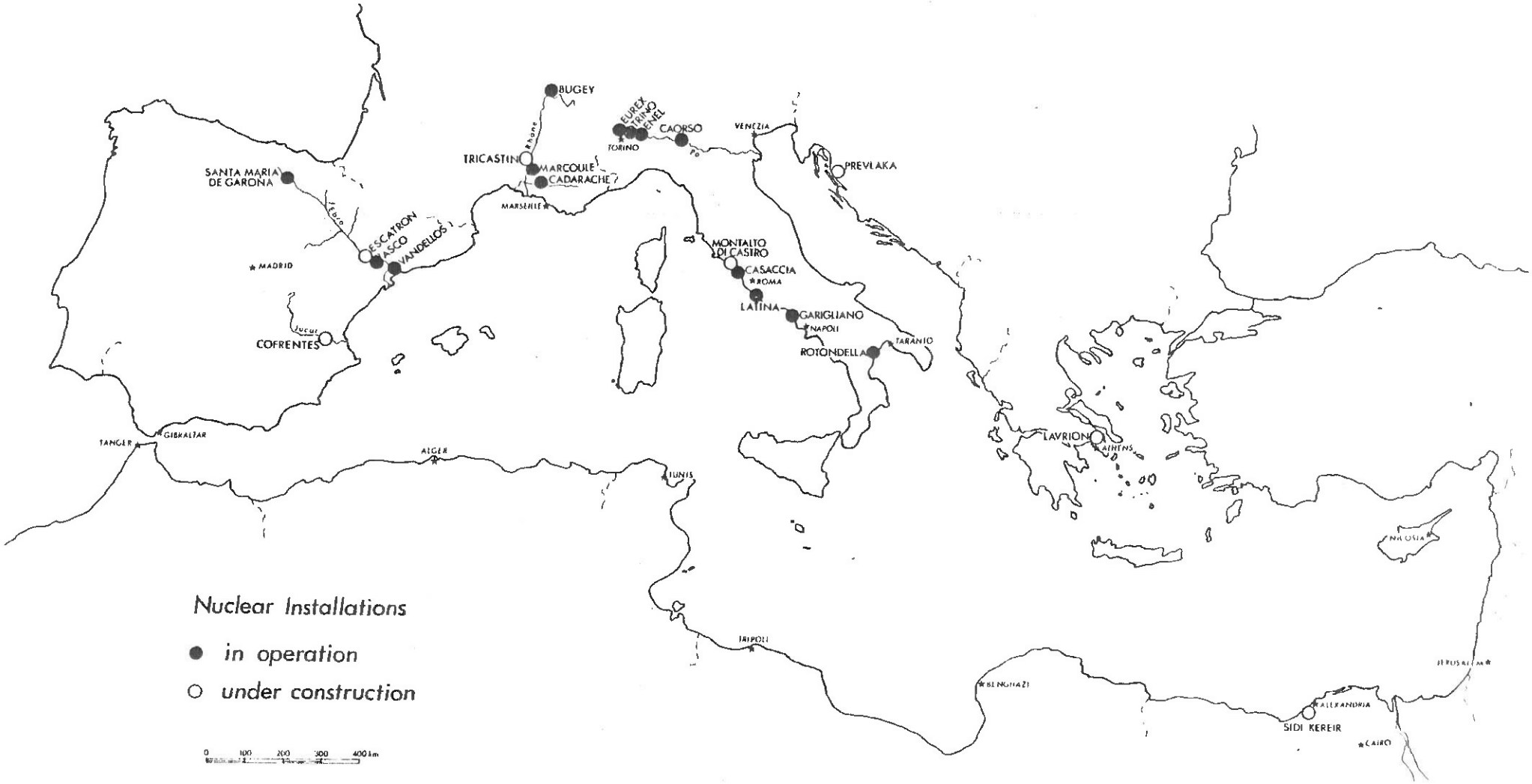


SITUATION OF RIVERS INCLUDED IN THE POLLUTION SOURCE INVENTORY

List of nuclear installations in operation or under construction by country and year of commissioning

Country	Name	Location	Distance from sea, km	Type	Nominal Size MWe	Date of Commissioning
FRANCE	Marcoule	Rhone	90	res. center	-	1958
	G 2-3	Rhone	90	GCR	80	1960
	UP-1	Rhone	90	reproc		1966
	Cadarache	Durance/Rhone	100	res. center	-	1966
	Raposodie	Durance/Rhone	100	FBR	15	1967
	Bugey 1	Rhone	350	GCR	560	1972
	Phenix	Rhone	90	FBR	250	1974
	Bugey 2	Rhone	350	PWR	925	1977
	Bugey 3	Rhone	350	PWR	925	1977
	Bugey 4	Rhone	350	PWR	905	1978
	Bugey 5	Rhone	350	PWR	905	1978
	Tricastin 1	Rhone	150	PWR	905	1979
	Tricastin 2	Rhone	150	PWR	905	1979
	Tricastin 3	Rhone	150	PWR	905	1980
	Tricastin 4	Rhone	150	PWR	905	1980
	Eurodif	Rhone	150	enrichm. plant		

Country	Name	Location	Distance from sea, km	Type	Nominal Size MWe	Date of Commissioning
ITALY	Casaccia	Arrone	20	res. center	-	1961
	Latina	coast	0	GCR	210	1964
	Garigliano	Garigliano	4	BWR	160	1964
	Trino	Po	400	PWR	250	1965
	Trisaia	coast	0	reproc. pilot	(0.1 tU/a)	1970
	Saluggia	(Dora Baltea) Po	400	reproc. pilot & res. center	(0.1 tU/a)	1971
	Caorso	Po	300	BWR	900	1977
	Cirene	Latina (coast)	0	LWR	1000	1982
	Montalto di Castro 1	coast	0	BWR	1000	1982
	Montalto di Castro II	coast	0	BWR	1000	1983
	ENEL VII	Piemonte	400	LWR	1000	1983
	ENEL VIII	Piemonte	400	LWR	1000	1984
SPAIN	Santa Maria de Garona	Ebro	700	BWR	460	1970
	Vandellos I	coast	0	GCR	480	1972
	Asco I	Ebro	70	PWR	930	1977
	Asco II	Ebro	70	PWR	930	1978
	Cofrentes	Jucar	30	BWR	975	1978
	Vandellos II	coast	0	PWR	1000	1982
	Escatron I	Ebro	150	LWR	1000	1982
	Vandellos III	coast	0	PWR	1000	1983
GREECE	Lavrion	coast	0	LWR	600	1982
EGYPT	Sidi Kereir	coast	0	PWR	600	1982
YUGO-SLAVIA	Prevlaka	coast	0	LWR	600	1983



LOCATION OF NUCLEAR POWER PLANTS IN THE MEDITERRANEAN BASIN

Estimated annual pollution loads of the regional Mediterranean sea areas:

Estimated loads of region I

Pollutant \ pollution source	originating in coastal zone						carried by Rivers		TOTAL
	Domestic		Industrial		Agricultural				
	t/a	%	t/a	%	t/a	%	t/a	%	t/a
1. Volume:									
Total discharge $10^6 m^3/a$	110	2	140	2	-*		6 000	96	6 250
2. Organic matter:									
BOD x 10^3	20	24	29	35	6.2	7	29	35	84
COD x 10^3	47	18	72	28	100	39	40	15	259
3. Nutrients:									
Phosphorous x 10^3	1.1	17	0.2	3	1.9	29	3.4	51	6.6
Nitrogen x 10^3	5.7	23	1.3	5	4.0	16	14	56	25
6. Specific organics:									
Detergents	860	58	-	-	-	-	620	42	1 480
Phenols	-	-	1 200	99	-	-	16	1	1 220
Mineral oil	(-)		1 700	100	-	-	(-)		1 700
5. Metals:									
Mercury	0.04	2	0.60	24	-	-	1.8	74	2.5
Lead	8.4	9	43	46	-	-	42	45	93
Chromium	10.6	10	60	58	-	-	33	32	104
Zinc	85	32	150	57	-	-	27	10	262
6. Suspended matter:									
TSS x 10^3	27		18		3.1		(-)		(-)
7. Pesticides:									
Organochlorines	-	-	-	-	-*		6.4	100	6.4
8. Radioactivity:									
Tritium Ci/a	-	-	-	-	-	-	(-)		-
Other radio-nuclides Ci/a	-	-	-	-	(-)		(-)		-

Legend: - contributions from this source negligible
(-) insufficient data base for estimate
-* included in river assessment

Estimated annual pollution loads of the regional Mediterranean sea areas:

Estimated loads of region II

Pollutant \ pollution source	originating in coastal zone						carried by Rivers		TOTAL
	Domestic		Industrial		Agricultural				
	t/a	%	t/a	%	t/a	%	t/a	%	t/a
1. Volume:									
Total discharge $10^6 m^3/a$	780	1	2 500	3	-*		95 000	96	98 300
2. Organic matter:									
BOD x 10^3	150	16	340	36	7.5	1	450	47	948
COD x 10^3	340	14	850	35	120	5	1 100	46	2 410
3. Nutrients:									
Phosphorous x 10^3	7.9	6	1.4	1	2.2	2	115	91	126
Nitrogen x 10^3	34	9	8.0	2	4.8	1	340	88	387
5. Specific organics:									
Detergents	6 800	46	-	-	-	-	8 000	54	14 800
Phenols	-	-	3 700	94	-	-	240	6	3 940
Mineral oil	(-)		10 000	100	-	-	(-)		10 000
6. Metals:									
Mercury	0.28	1	2.7	8	-	-	30	91	33
Lead	66	5	490	36	-	-	800	59	1 360
Chromium	95	9	370	37	-	-	540	54	1 000
Zinc	670	13	2 100	41	-	-	2 400	46	5 170
6. Suspended matter:									
TSS x 10^3	200		570		3.8		(-)		(-)
7. Pesticides:									
Organochlorines	-	-	-	-	-*		14.9	100	14.9
8. Radioactivity:									
Tritium Ci/a	-	-	200	22	-	-	720	78	920
Other radio-nuclides Ci/a	-	-	8	57	(-)		6	43	14

Legend:
- \- contributions from this source negligible
- (-) insufficient data base for estimate
- -* included in river assessment

Estimated annual pollution loads of the regional Mediterranean sea areas:

Estimated loads of region III

pollution source / Pollutant	originating in coastal zone						carried by Rivers		TOTAL
	Domestic		Industrial		Agricultural				
	t/a	%	t/a	%	t/a	%	t/a	%	t/a
1. Volume:									
Total discharge $10^6 m^3/a$	110	1	240	3	-*		8 500	96	8 850
2. Organic matter:									
BOD x 10^3	26	23	45	39	7.5	7	35	31	114
COD x 10^3	58	17	110	32	120	34	61	17	349
3. Nutrients:									
Phosphorous x 10^3	1.1	13	0.2	2	2.2	27	4.8	58	8.3
Nitrogen x 10^3	7.2	26	1.7	6	4.8	17	14	51	27.7
6. Specific organics:									
Detergents	960	53	-	-	-	-	860	47	1 820
Phenols	-	-	580	97	-	-	20	3	600
Mineral oil	(-)		600	100	-	-	(-)		600
5. Metals:									
Mercury	0.04	1	0.2	7	-	-	2.5	92	2.7
Lead	10	8	52	43	-	-	59	49	121
Chromium	12	10	63	52	-	-	47	39	122
Zinc	100	15	210	30	-	-	380	55	690
6. Suspended matter:									
TSS x 10^3	37		45		3.8		(-)		(-)
7. Pesticides:									
Organochlorines	-	-	-	-	-*		10.4	100	10.4
8. Radioactivity:									
Tritium Ci/a	-	-	-	-	-	-	(-)		-
Other radio-nuclides Ci/a	-	-	-	-	(-)		(-)		-

Legend: - contributions from this source negligible
(-) insufficient data base for estimate
-* included in river assessment

Estimated annual pollution loads of the regional Mediterranean sea areas:

Estimated loads of region IV

Pollutant \ pollution source	originating in coastal zone						carried by Rivers		TOTAL
	Domestic		Industrial		Agricultural				
	t/a	%	t/a	%	t/a	%	t/a	%	t/a
1. Volume:									
Total discharge $10^6 m^3/a$	340	1	570	2	-*		32 000	97	32 900
2. Organic matter:									
BOD x 10^3	79	21	100	27	11	3	180	49	370
COD x 10^3	180	16	260	24	180	16	480	44	1 100
3. Nutrients:									
Phosphorous x 10^3	3.6	12	1.2	4	3.3	11	21	72	29.1
Nitrogen x 10^3	17	27	3.0	5	7.3	12	35	56	62.3
6. Specific organics:									
Detergents	3 140	38	-	-	-	-	5 100	62	8 240
Phenols	-	-	940	91	-	-	95	9	1 040
Mineral oil	(-)		3 000	100	-	-	(-)		3 000
5. Metals:									
Mercury	0.12	1	1.10	10	-	-	9.5	89	10.7
Lead	29	5	370	59	-	-	230	36	629
Chromium	39	10	160	42	-	-	180	48	379
Zinc	350	12	1 200	40	-	-	1 400	47	3 000
6. Suspended matter:									
TSS x 10^3	86		150		5.6		(-)		(-)
7. Pesticides:									
Organochlorines	-	-	-	-	-*		12.1	100	12.1
8. Radioactivity:									
Tritium Ci/a	-	-	100	100	-	-	(-)		100
Other radio-nuclides Ci/a	-	-	12	100	(-)		(-)		12

Legend:
- \- contributions from this source negligible
- (-) insufficient data base for estimate
- -* included in river assessment

Estimated annual pollution loads of the regional Mediterranean sea areas:

Estimated loads of region V

pollution source / Pollutant	originating in coastal zone						carried by Rivers		TOTAL
	Domestic		Industrial		Agricultural				
	t/a	%	t/a	%	t/a	%	t/a	%	t/a
1. Volume:									
Total discharge $10^6 m^3/a$	280	~ 0	1 100	1	-*		150 000	99	151 000
2. Organic matter:									
BOD x 10^3	55	7	170	21	10	1	560	71	795
COD x 10^3	130	8	410	25	160	10	940	57	1 640
3. Nutrients:									
Phosphorous x 10^3	2.5	3	0.5	1	3.0	3	79	93	85
Nitrogen x 10^3	12	4	4.2	2	6.5	3	250	91	273
6. Specific organics:									
Detergents	2 200	14	-	-	-	-	14 000	86	16 200
Phenols	-	-	1 200	77	-	-	350	23	1 550
Mineral oil	(-)		3 900	100	-	-	(-)		3 900
5. Metals:									
Mercury	0.084	~ 0	0.50	1	-	-	40	99	41
Lead	21	1	120	8	-	-	1 300	91	1 440
Chromium	28	14	87	44	-	-	82	42	197
Zinc	210	2	500	6	-	-	7 900	92	8 600
6. Suspended matter:									
TSS x 10^3	63		170		5.0		(-)		(-)
7. Pesticides:									
Organochlorines	-	-	-	-	-*		14.0	100	14.0
8. Radioactivity:									
Tritium Ci/a	-	-	-	-	-	-	1 060	100	1 060
Other radio-nuclides Ci/a	-	-	-	-	(-)		6	100	6

Legend:
- \- contributions from this source negligible
- (-) insufficient data base for estimate
- -* included in river assessment

Estimated annual pollution loads of the regional Mediterranean sea areas:

Estimated loads of region VI

pollution source / Pollutant	originating in coastal zone						carried by Rivers		TOTAL
	Domestic		Industrial		Agricultural				
	t/a	%	t/a	%	t/a	%	t/a	%	t/a
1. Volume:									
Total discharge $10^6 m^3/a$	77	~0	240	1	-*		32 000	99	32 300
2. Organic matter:									
BOD x 10^3	16	7	66	30	11	5	130	58	223
COD x 10^3	36	6	170	28	180	30	220	36	606
3. Nutrients:									
Phosphorous x 10^3	0.71	3	0.3	1	3.3	15	18	81	22.3
Nitrogen x 10^3	3.5	6	2.8	5	7.5	12	48	78	61
6. Specific organics:									
Detergents	640	17	-	-	-	-	3 200	83	3 840
Phenols	-	-	1 400	94	-	-	90	6	1 490
Mineral oil	(-)		10 000	100	-	-	(-)		10 000
5. Metals:									
Mercury	0.026	~0	0.16	2	-	-	9.6	98	9.8
Lead	6.5	3	4.9	2	-	-	220	95	232
Chromium	8.5	4	18.0	9	-	-	180	87	207
Zinc	63.0	4	180	11	-	-	1 400	85	1 640
6. Suspended matter:									
TSS x 10^3	20.0		320		5.6		(-)		(-)
7. Pesticides:									
Organochlorines	-	-	-	-	-*		6.1	100	6.1
8. Radioactivity:									
Tritium Ci/a	-	-	1	100	-	-	(-)		1
Other radio-nuclides Ci/a	-	-	1	100	(-)		(-)		1

Legend:
- \- contributions from this source negligible
- (-) insufficient data base for estimate
- -* included in river assessment

Estimated annual pollution loads of the regional Mediterranean sea areas:

Estimated loads of region VII

Pollutant \ pollution source	originating in coastal zone						carried by Rivers		TOTAL
	Domestic		Industrial		Agricultural				
	t/a	%	t/a	%	t/a	%	t/a	%	t/a
1. Volume:									
Total discharge $10^6 m^3/a$	120	2	170	3	-*		5 000	95	5 300
2. Organic matter:									
BOD x 10^3	20	30	18	27	9.4	14	20	30	67.4
COD x 10^3	45	16	45	16	150	55	35	13	275
3. Nutrients:									
Phosphorous x 10^3	0.85	13	0.2	3	2.8	42	2.8	42	6.7
Nitrogen x 10^3	5.4	27	0.8	4	6.0	30	7.5	38	19.7
6. Specific organics:									
Detergents	710	59	-	-	-	-	500	41	1 210
Phenols	-	-	1 100	98	-	-	15	2	1 120
Mineral oil	(-)		41 000	100	-	-	(-)		41 000
5. Metals:									
Mercury	0.032	2	0.16	9	-	-	1.5	88	1.7
Lead	7.6	8	55	56	-	-	35	36	98
Chromium	9.0	17	18	33	-	-	27	50	54
Zinc	77	16	160	34	-	-	230	50	467
6. Suspended matter:									
TSS x 10^3	27		1 200		4.7		(-)		(-)
7. Pesticides:									
Organochlorines	-	-	-	-	-*		2.9	100	2.9
8. Radioactivity:									
Tritium Ci/a	-	-	-	-	-	-	(-)		-
Other radio-nuclides Ci/a	-	-	-	-	(-)		(-)		-

Legend: - contributions from this source negligible
(-) insufficient data base for estimate
-* included in river assessment

Estimated annual pollution loads of the regional Mediterranean sea areas:

Estimated loads of region VIII

pollution source / Pollutant	originating in coastal zone						carried by Rivers		TOTAL
	Domestic		Industrial		Agricultural				
	t/a	%	t/a	%	t/a	%	t/a	%	t/a
1. Volume:									
Total discharge $10^6 m^3/a$	160	~ 0	400	1	-*		46 000	99	46 600
2. Organic matter:									
BOD x 10^3	30	9	100	31	17	5	180	55	327
COD x 10^3	66	7	260	28	270	30	320	35	916
3. Nutrients:									
Phosphorous x 10^3	1.5	5	0.8	2	5.1	16	25	77	32.4
Nitrogen x 10^3	7.9	9	1.8	2	11	12	69	77	90
6. Specific organics:									
Detergents	1 400	23	-	-	-	-	4 600	77	6 000
Phenols	-	-	780	86	-	-	130	14	910
Mineral oil	(-)		4 100	100	-	-	(-)		4 100
5. Metals:									
Mercury	0.054	~ 0	0.22	2	-	-	14	98	14.3
Lead	14	3	110	25	-	-	320	72	444
Chromium	18	6	25	9	-	-	250	85	293
Zinc	140	6	250	10	-	-	2 100	84	2 490
6. Suspended matter:									
TSS x 10^3	47		210		8.5		(-)		(-)
7. Pesticides:									
Organochlorines	-	-	-	-	-*		7.4	100	7.4
8. Radioactivity:									
Tritium Ci/a	-	-	-	-	-	-	(-)		-
Other radionuclides Ci/a	-	-	-	-	(-)		(-)		-

Legend: - contributions from this source negligible
(-) insufficient data base for estimate
-* included in river assessment

Estimated annual pollution loads of the regional Mediterranean sea areas:

Estimated loads of region IX

pollution source / Pollutant	originating in coastal zone						carried by Rivers		TOTAL
	Domestic		Industrial		Agricultural				
	t/a	%	t/a	%	t/a	%	t/a	%	t/a
1. Volume:									
Total discharge $10^6 m^3/a$	19	~ 0	25	~ 0	-*		25 000	100	25 000
2. Organic matter:									
BOD x 10^3	6.2	5	7.8	6	19	14	100	75	133
COD x 10^3	13	3	20	4	300	58	180	35	513
3. Nutrients:									
Phosphorous x 10^3	0.24	1	0.05	~ 0	5.6	29	13	69	19
Nitrogen x 10^3	1.9	4	0.5	1	12.2	24	36	71	51
6. Specific organics:									
Detergents	190	7	-	-	-	-	2 500	93	2 700
Phenols	-	-	150	68	-	-	70	32	220
Mineral oil	(-)		27 000	100	-	-	(-)		27 000
5. Metals:									
Mercury	0.01	~ 0	0.05	1	-	-	7	99	7.1
Lead	2.2	1	8.0	4	-	-	170	95	180
Chromium	2.2	2	3.0	2	-	-	140	96	145
Zinc	23	2	24	2	-	-	1 100	96	1 150
6. Suspended matter:									
TSS x 10^3	9.3		2.7		9.4		(-)		(-)
7. Pesticides:									
Organochlorines	-	-	-	-	-*		6.7	100	6.7
8. Radioactivity:									
Tritium Ci/a	-	-	-	-	-	-	(-)		-
Other radio-nuclides Ci/a	-	-	-	-	(-)		(-)		-

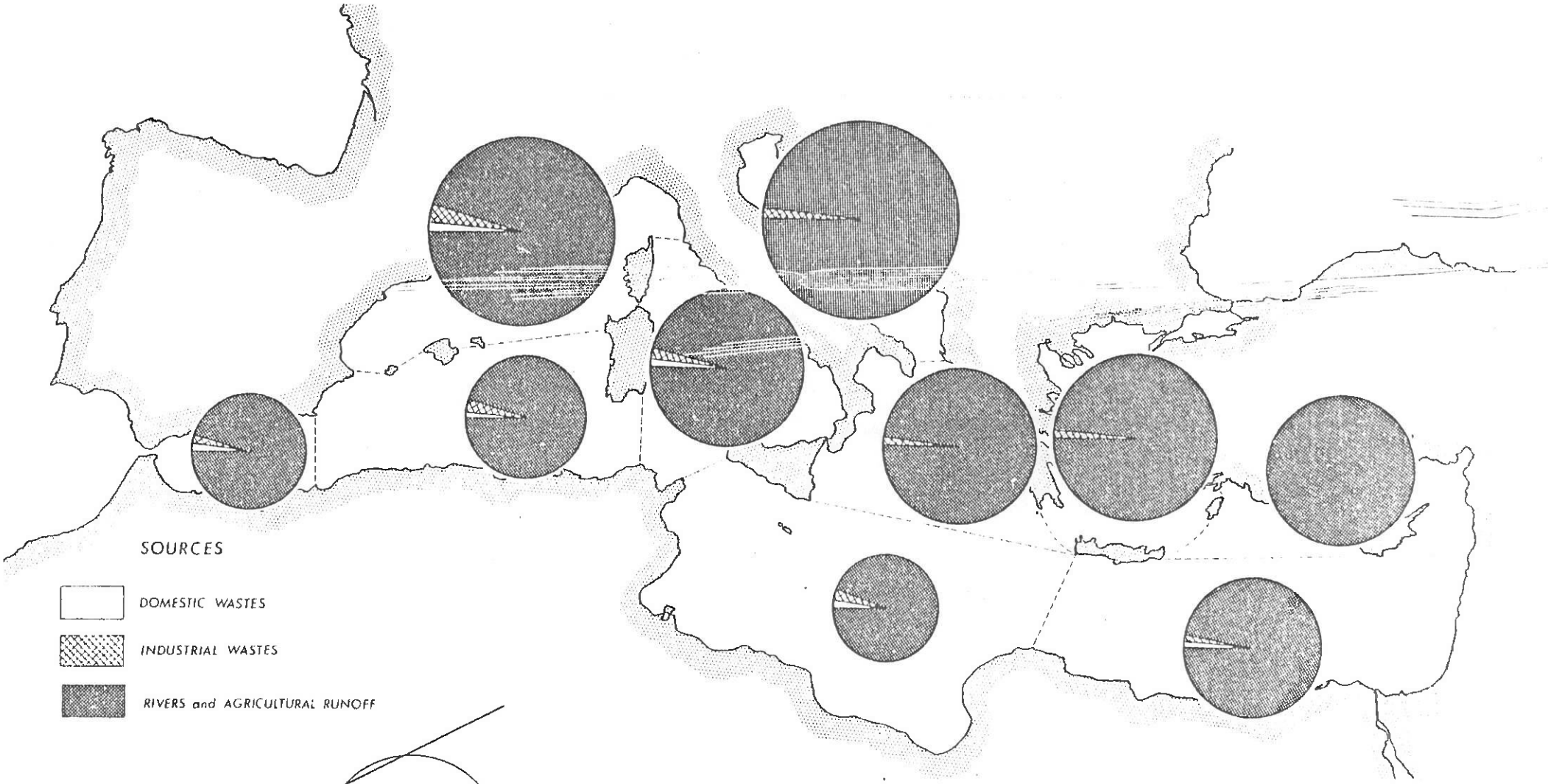
Legend:
- \- contributions from this source negligible
- (-) insufficient data base for estimate
- -* included in river assessment

Estimated annual pollution loads of the regional Mediterranean sea areas:

Estimated loads of region X

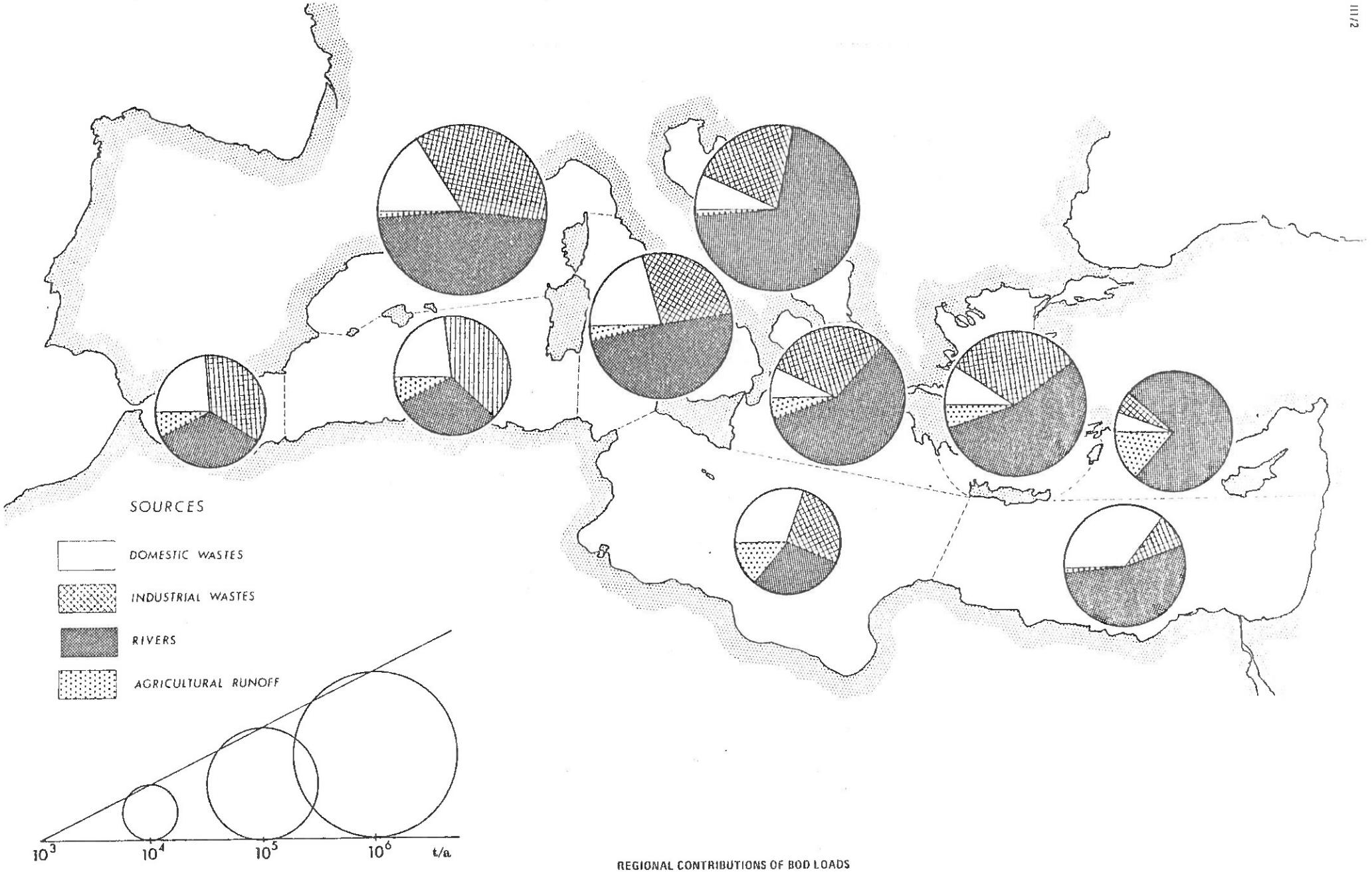
Pollutant \ pollution source	originating in coastal zone						carried by Rivers		TOTAL
	Domestic		Industrial		Agricultural				
	t/a	%	t/a	%	t/a	%	t/a	%	t/a
1. Volume:									
Total discharge $10^6 m^3/a$	190	1	130	1	-*		17 000	98	17 300
2. Organic matter:									
BOD x 10^3	51	36	13	9	0.6	1	77	54	142
COD x 10^3	110	38	32	11	10	3	140	48	292
3. Nutrients:									
Phosphorous x 10^3	2.2	11	0.1	1	0.2	1	17	88	19.3
Nitrogen x 10^3	15	33	0.6	1	0.4	1	30	65	46
6. Specific organics:									
Detergents	1 600	46	-	-	-	-	1 900	54	3 500
Phenols	-	-	320	84	-	-	58	16	380
Mineral oil	(-)		13 000	100	-	-	(-)		13 000
5. Metals:									
Mercury	0.074	1	1.2	17	-	-	5.6	82	6.9
Lead	16	7	96	41	-	-	120	52	232
Chromium	18	7	150	58	-	-	93	35	261
Zinc	170	14	240	20	-	-	790	66	1 200
6. Suspended matter:									
TSS x 10^3	78		98		0.3		(-)		(-)
7. Pesticides:									
Organochlorines	-	-	-	-	-*		9.1	100	9.1
8. Radioactivity:									
Tritium Ci/a	-	-	-	-	-	-	(-)		-
Other radio-nuclides Ci/a	-	-	-	-	(-)		(-)		-

Legend:
- \- contributions from this source negligible
- (-) insufficient data base for estimate
- -* included in river assessment

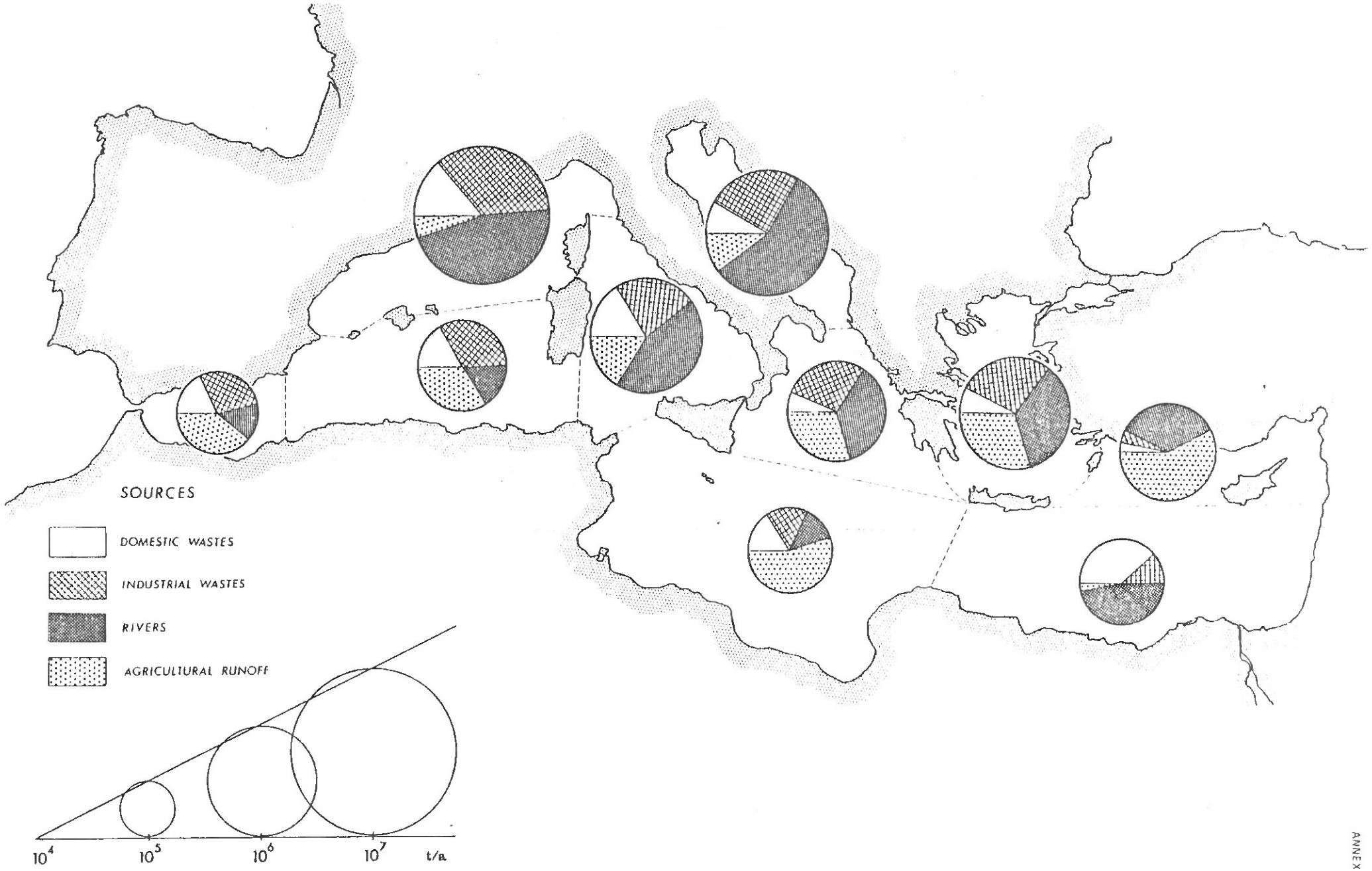


REGIONAL CONTRIBUTIONS OF DISCHARGE VOLUMES

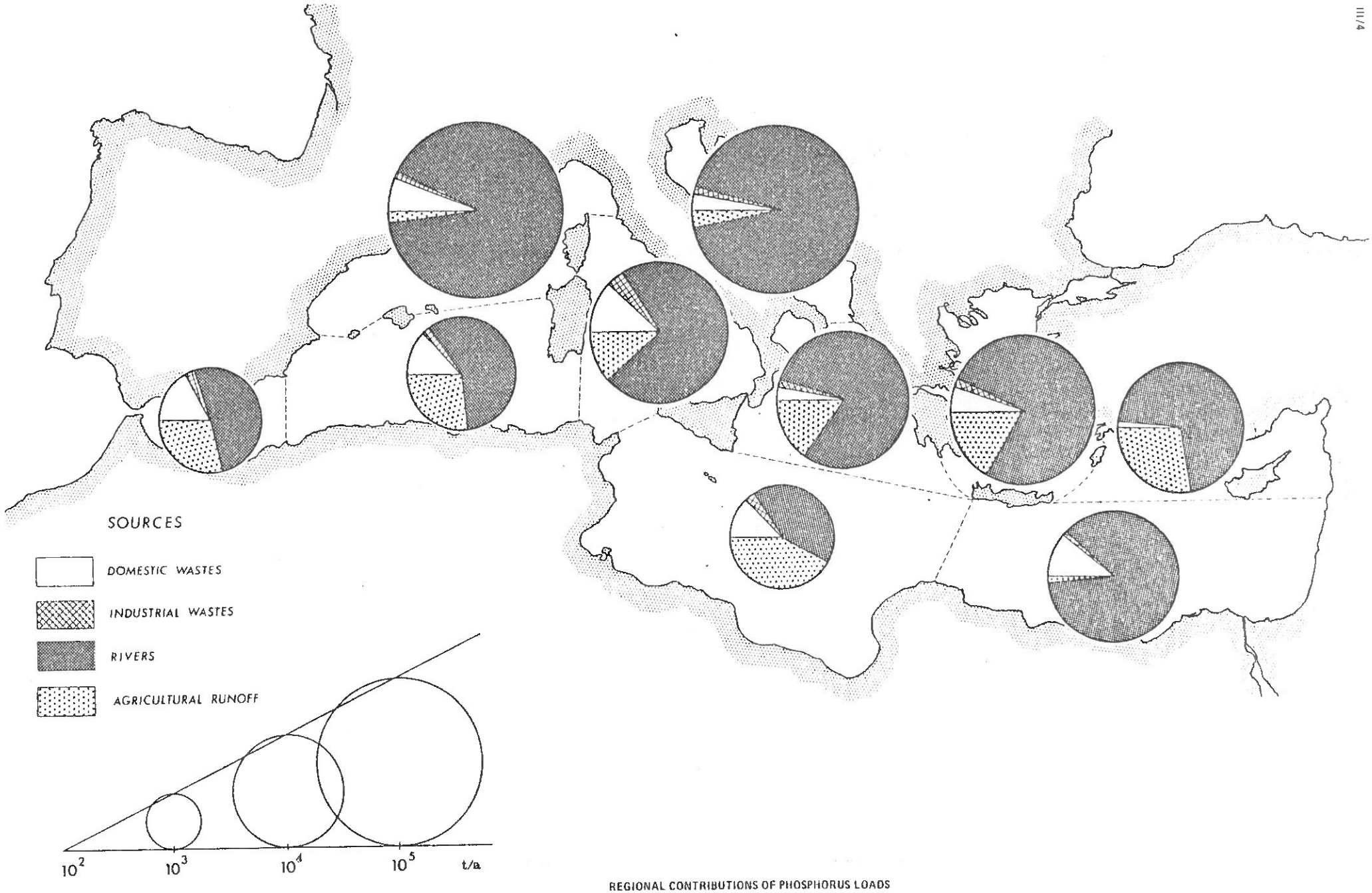
ANNEX III/1



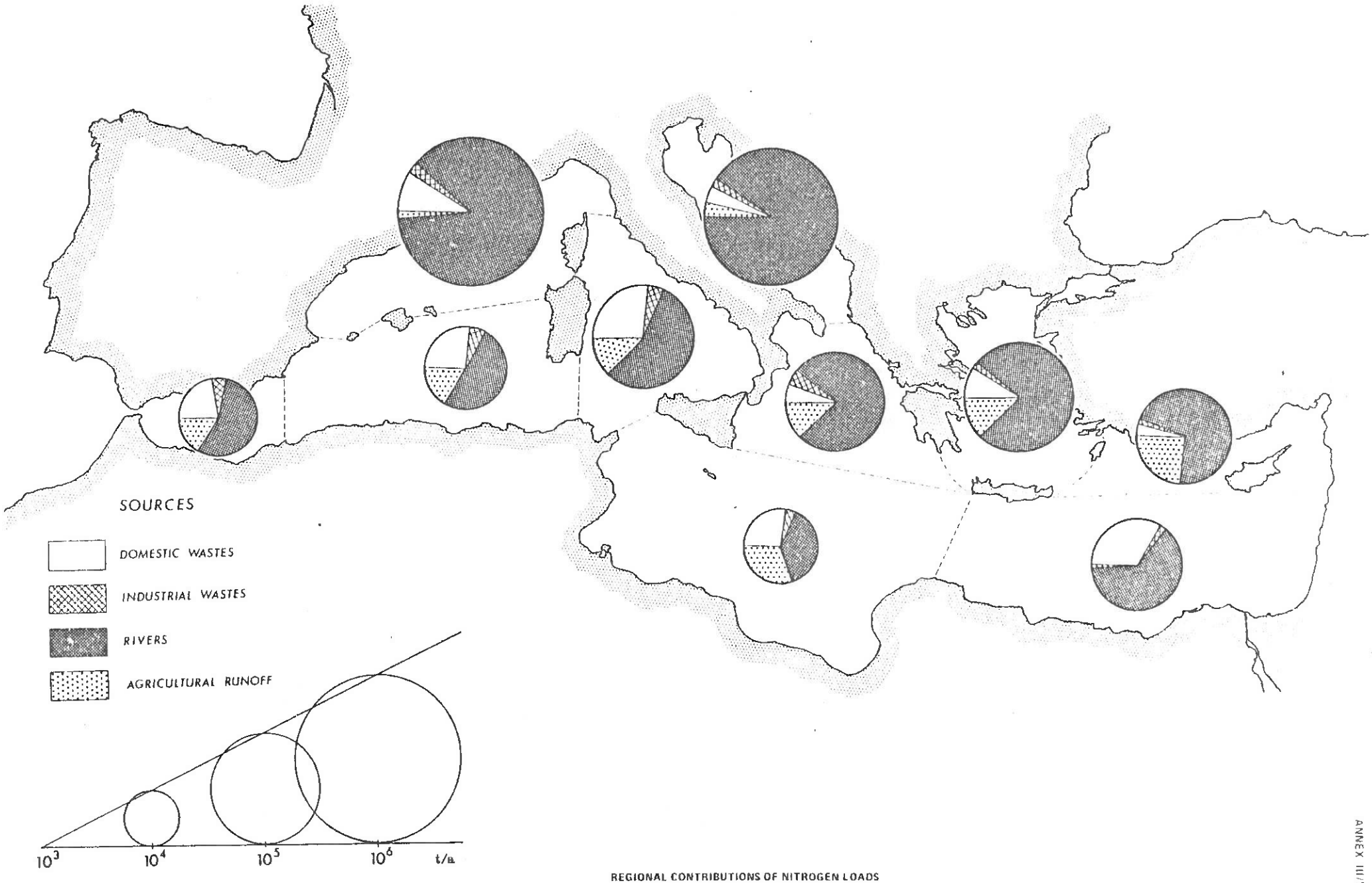
REGIONAL CONTRIBUTIONS OF BOD LOADS



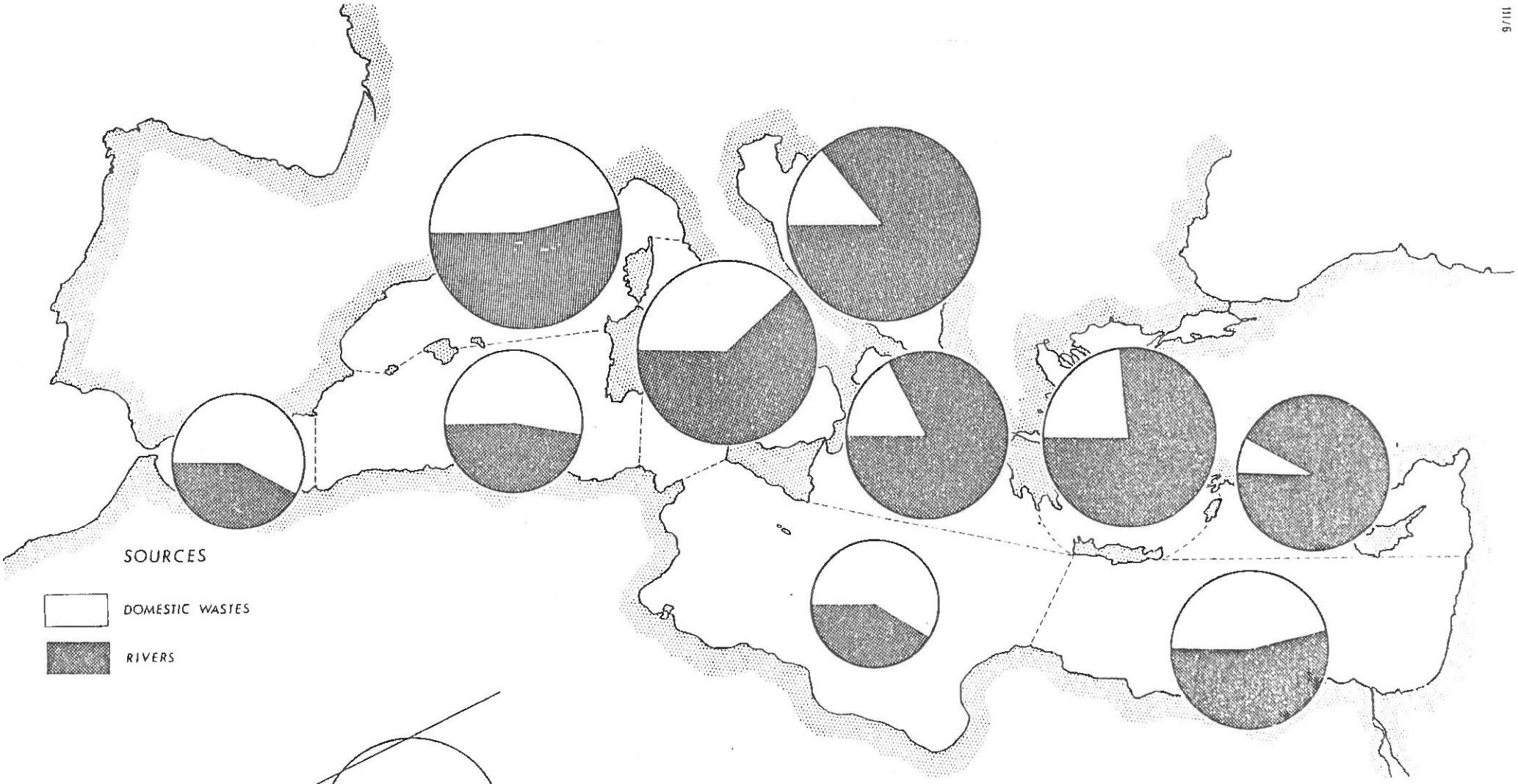
REGIONAL CONTRIBUTIONS OF COD LOADS



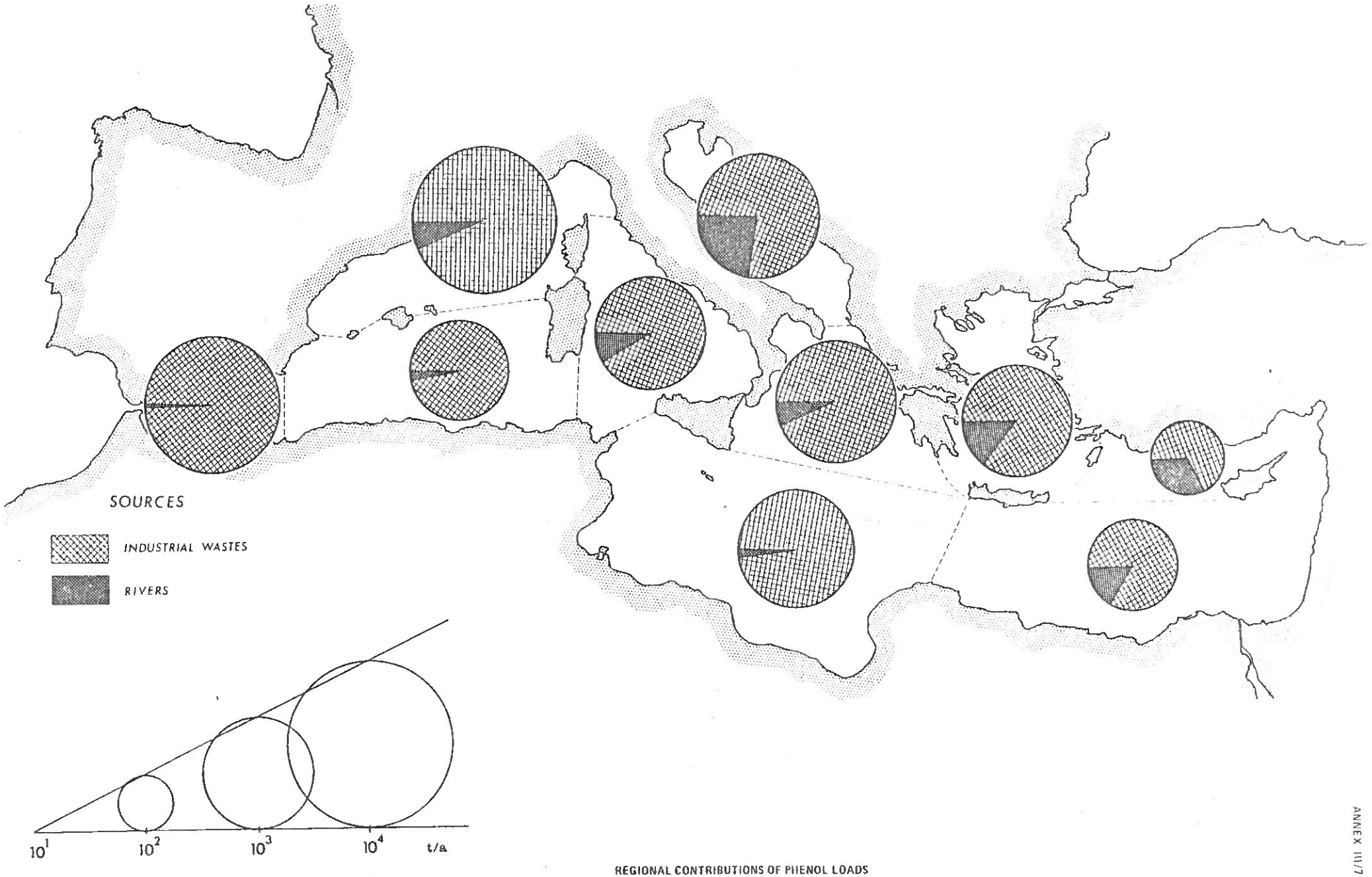
REGIONAL CONTRIBUTIONS OF PHOSPHORUS LOADS



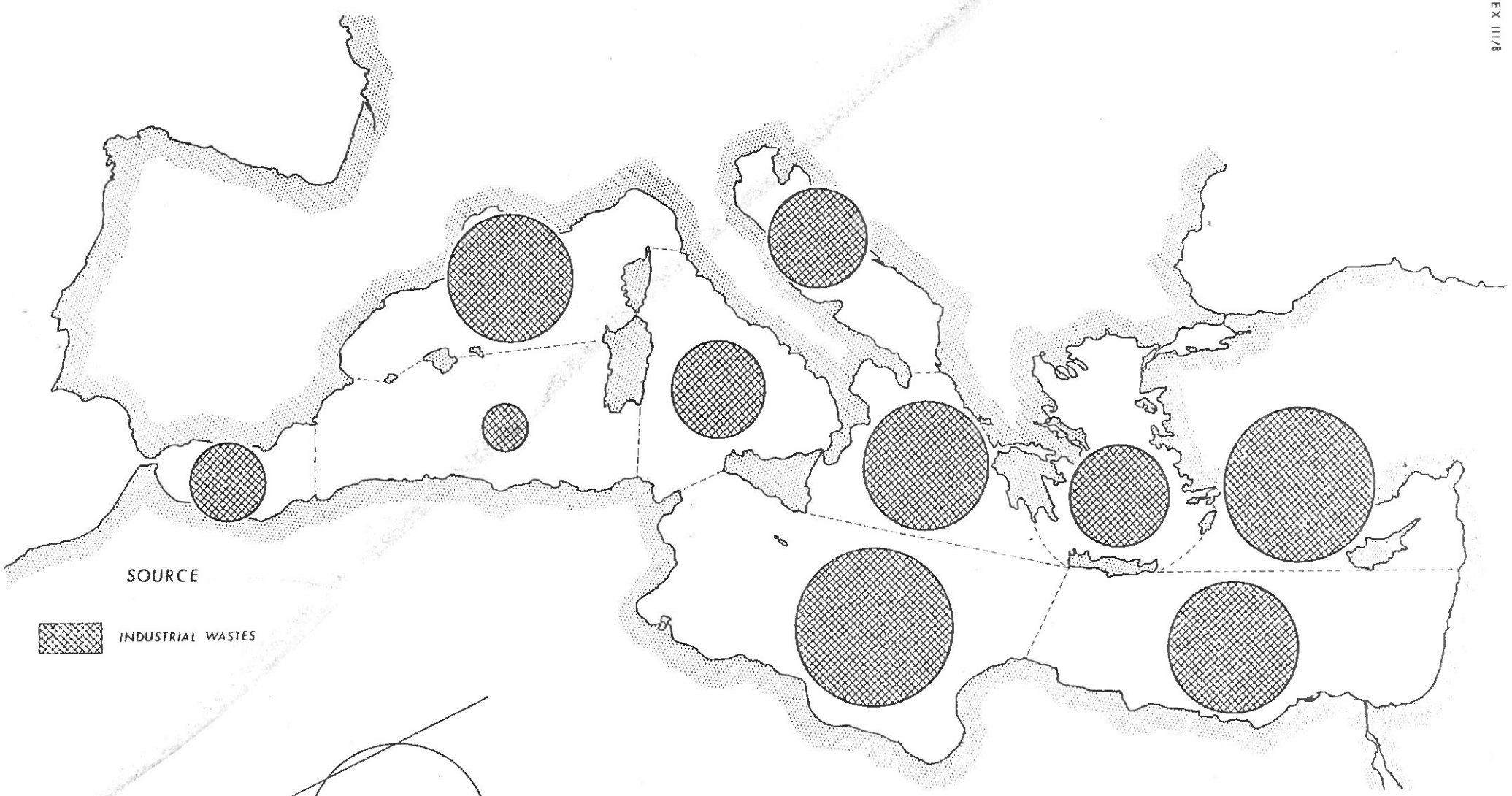
REGIONAL CONTRIBUTIONS OF NITROGEN LOADS

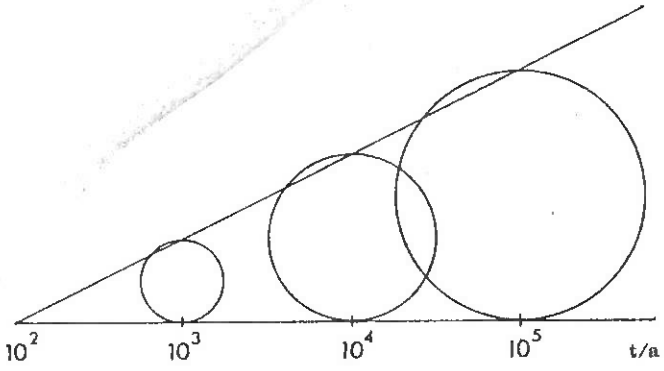


REGIONAL CONTRIBUTIONS OF DETERGENT LOADS

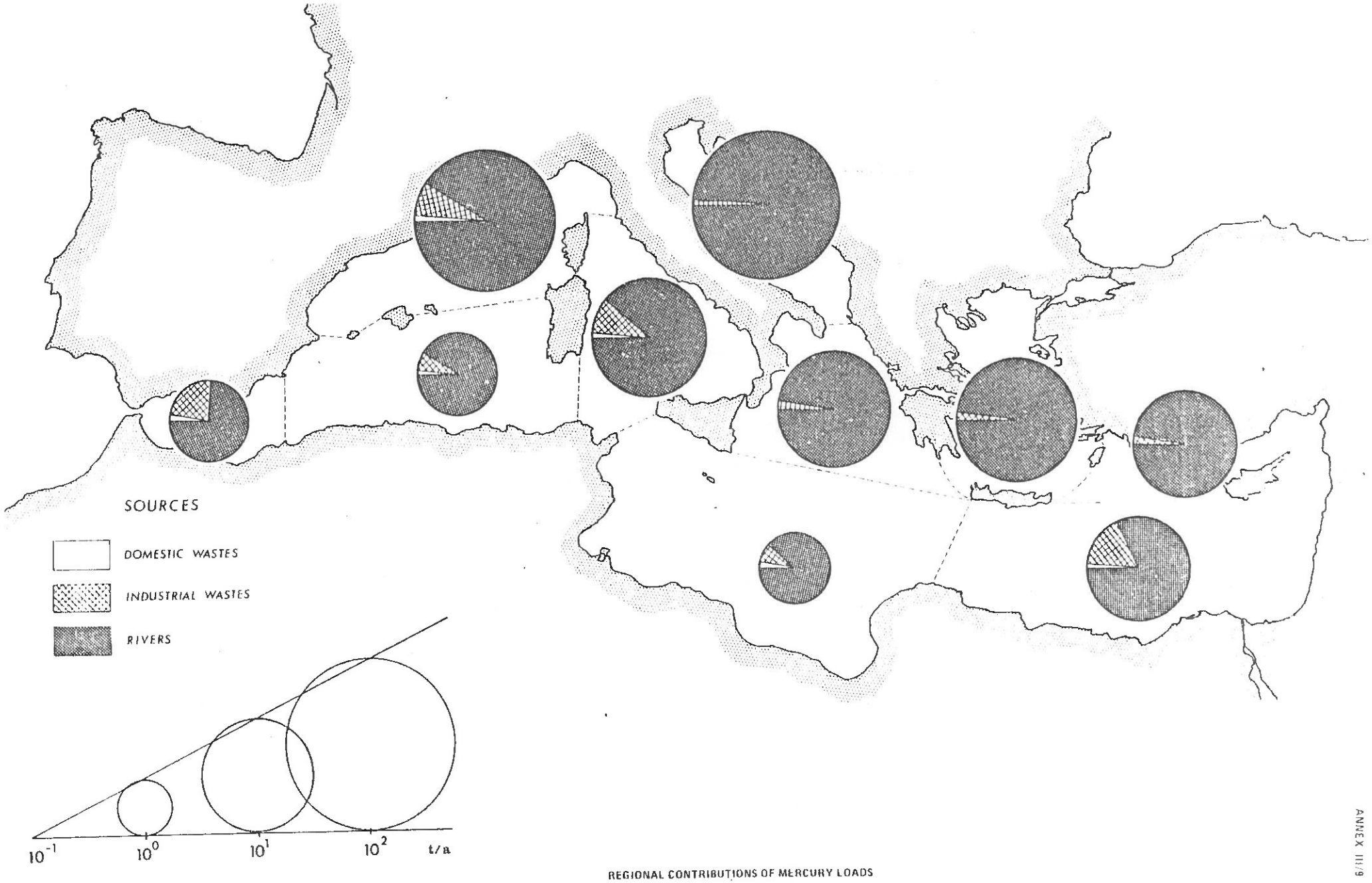


REGIONAL CONTRIBUTIONS OF PHENOL LOADS



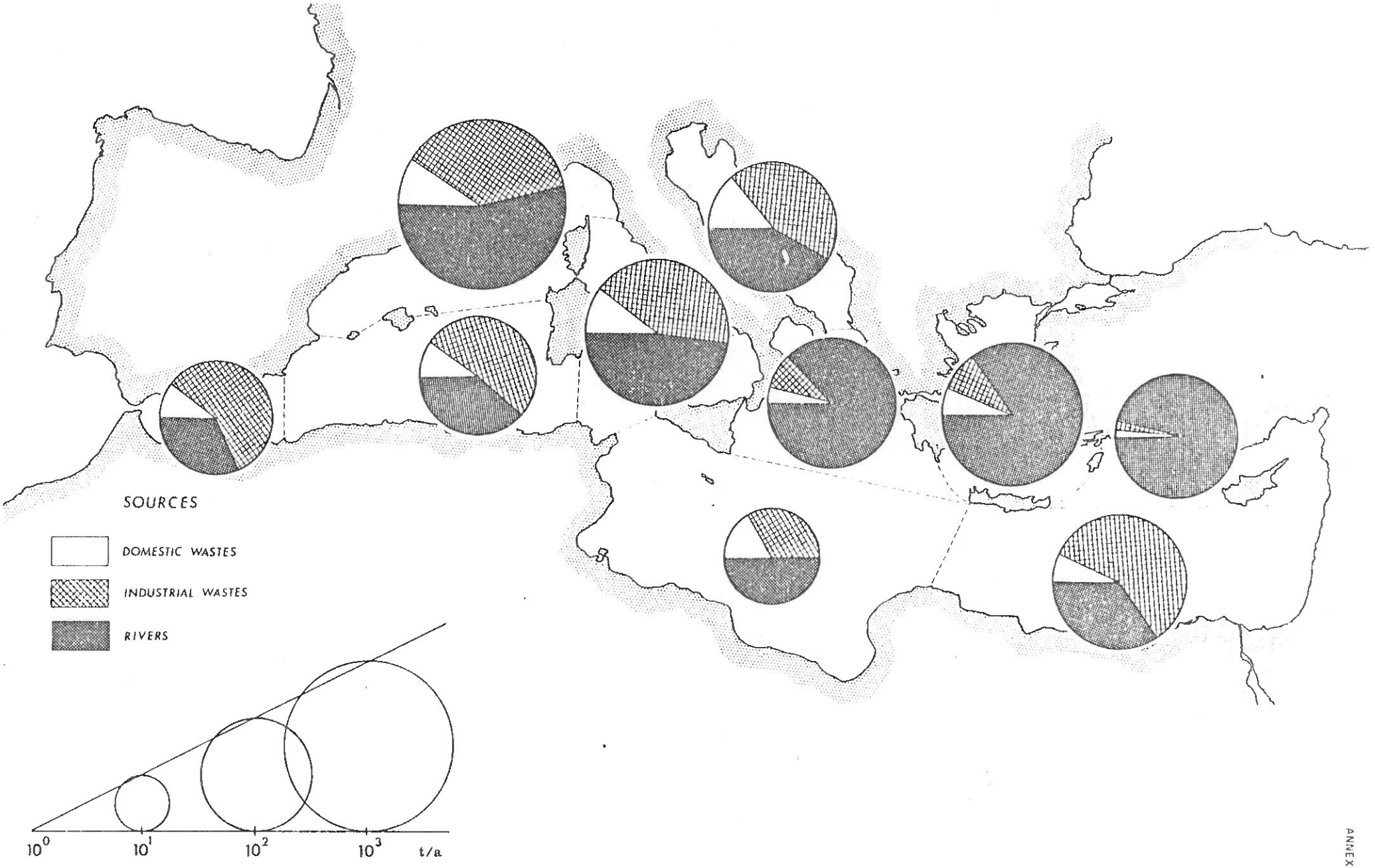


REGIONAL CONTRIBUTIONS OF MINERAL OIL LOADS



REGIONAL CONTRIBUTIONS OF MERCURY LOADS

REGIONAL CONTRIBUTIONS OF LEAD LOADS

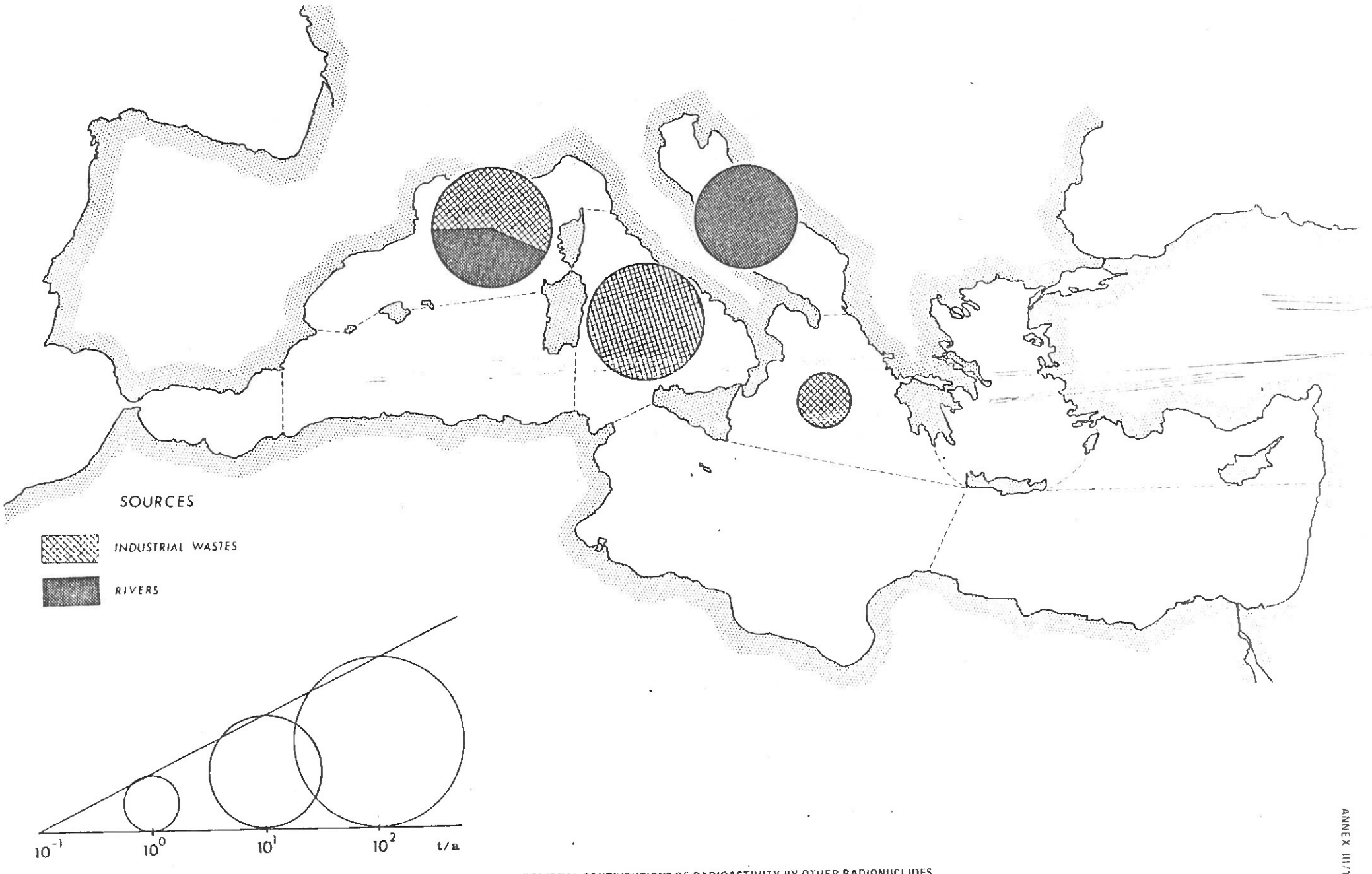


REGIONAL CONTRIBUTIONS OF CHROMIUM LOADS

REGIONAL CONTRIBUTIONS OF ZINC LOADS

REGIONAL CONTRIBUTIONS OF ORGANOCHLORINE PESTICIDES

REGIONAL CONTRIBUTIONS OF RADIOACTIVITY BY TRITIUM



REGIONAL CONTRIBUTIONS OF RADIOACTIVITY BY OTHER RADIONUCLIDES

ANNEX III/15

ANNEX IV: WASTE DISPOSAL AND MANAGEMENT PRACTICES:

Review of Country Situations

Albania

No information is available about the practices in this country.

Algeria

A draft ordinance on the management of water resources including their protection against pollution has been under consideration. It is understood that a new Ministry of Environment, Water and Soil Preservation has just been established. There is legislation for the control of pesticides.

Cyprus

There is no separate legislation concerned with the control of water pollution. There is legislative provision for the protection of the foreshore, fisheries and inland water supplies. Mine wastes are also controlled. Sewage boards have been established for certain of the larger towns and sewer construction has been planned and in one or two instances commenced.

Egypt

There is a comprehensive law of 1962 on the discharge of liquid wastes augmented by regulations decreed in 1967.

Receiving waters are classified, according to detailed criteria, into three groups the sea being included in class C. Wastes are divided into two categories. Detailed standards are laid down for permitted discharges into each class of water. The requirements for discharges into class C are of a more general character requiring that they do not adversely affect beaches, marine installation, shellfish breeding areas or fish or other aquatic organisms.

The responsibility for implementing the law rests with the local authorities, e.g. the sewage and health authorities of the Governates. There is a Higher Commission on Water within the Ministry of Health.

The regulations have been vigorously applied within the area of the Nile Delta which in consequence has remained relatively unpolluted.

France

For a long time France has had legislation to control water pollution. The legislation in force is comprehensive and takes the unity of the water cycle into account. It is based on the Law of 16 December 1964 which introduces a policy of quality objectives for the various watercourses and lays down regulations for the composition of all wastes discharged into the aquatic media. Under this Law, such discharges are subject to permits consistent with the quality objectives assigned to the receiving media. The ministry responsible for the environment implements this legislation and coordinates the work of the chief technical

ministries with responsibilities for the harnessing or use of water resources. It also supervises the six river basin financing agencies set up in France in 1968. These agencies levy fees on all discharges into and offtakes from fresh water sources and the sea by local communities and industry. The income from these fees is distrubuted by the agencies in the form of subsidies, advances and loans to communities and industries which operate installations to safeguard the quality or quantity of water resources.

Greece

There are a series of health decrees covering water pollution in which sea water quality is classified according to use and regulations are laid down for sewage discharges. The Ministry of Social Affairs is concerned with the implementation of these decrees but several other ministries have active interests in the various uses of water. Recently joint ministerial and inter-departmental committees to coordiante all environmental protection activities have been established with a separate secretariat responsible to the Minister of Coordination and Planning. A new law for the protection of the marine environment has been enacted giving authority to the Ministry of Merchant Marine to control the discharges of any kind of wastes from coastal installations. It foresees and requires the construction of adequate reception facilities at harbours and refineries. Fines may be imposed in cases of pollution from both vessels and coastal installations. A new sewerage scheme for Athens is in progress and proposals for sewerage and treatment at Thessaloniki and Volos are well advanced.

Israel

Legislation concerning sea pollution is distributed among a number of different laws and their execution is similarly the responsibility of various ministries. The Water Law assigns to the Water Commissioner within the Department of Agriculture a wide range of responsibilities regarding the management of discharges and effluents. There are other laws of relevance to marine pillution. The Oil in Navigable Water Ordinance forbids the discharge of oil from land and vessels into the territorial waters of the country. The National Parks and Nature Reserve Law sets up the legal mechanism for designating parks and nature reserves including marine reserves. Once designated, the regulations for conduct apply including the prevention of pollution. The Planning and Building Law regulates the physical planning and the licensing of construction. A territorial Waters Committee has been established for this purpose. This committee is responsible for issuing permits for all installations which discharge effluents into coastal waters. In addition, there were relevant advisory bodies established such as the Panel of Ministerial Representatives on Enviromental Quality, the National Committee for the Prevention of Pollution of the Sea and the High Committee for Sewage. Present projections foresee the almost total reuse of effluents for irrigation resulting in zero discharge to the sea.

Italy

Legislation for the control of water pollution has been fragmentary and there has in recent years been active consideration of both organizational and legislative proposals culminating in the Law 319 of 1976 for a comprehensive system of water quality control. A policy of decentralization has been adopted with the central government responsible for general guidance and national coordination through the medium of a minsiterial committee. The regional governments are given responsibility for implementation of the national law and the introduction of the necessary local legislation. At a lower level the provinces and municipalities will undertake certain of the duties required under the law, according to their resources and abilities.

Lebanon

There is no up-to-date information on the situation in the Lebanon.

Libyan Arab Jamahirya

There is legislation for the protection of freshwater but there does not appear to be any control of land-based discharges to the sea. According to reports oil pollution of the sea and coast is a serious and growing problem.

Malta

Legislation currently in force covers various aspects of marine pollution, including sanitary control over bathing beaches and seafood, dumping and disposal of materials in harbours, and regulations controlling the import, sale and use of pesticides. Comprehensive legislation on the prevention and control of marine pollution has recently been enacted, and will come into force late in 1977. This legislation covers every aspect of marine pollution, including control of discharges from land-based sources.

Monaco

The legislation for the protection of water quality is of recent origin and comprehensive.

Morocco

At present there is no up-to-date legislation or executive arrangements for controlling water pollution. A national committee is considering the question of the control of environmental pollution and will be reporting.

Spain

The diversity of legislation on river waters and sea water is reflected in the large number of agencies responsible for its application.

A specific permit is required for any discharge of pollutants. The permissible concentrations have been limited since 1960 in accordance with three different categories, based on the intended use of the water downstream from the discharge. A recently published decree lays down regulations on the technical requirements for the discharge of effluent from undersea outfalls and on the pretreatment required to make this form of discharge acceptable.

Syria

There are two relevant laws, one of 1964 protecting aquatic organisms and the other of 1972 concerned with the prevention of oil pollution in maritime waters. It appears from reports that so far no effective enforcement measures have been taken.

Tunisia

A comprehensive water code, with references to marine pollution, was introduced in 1975. Besides conferring the necessary authority for the exercise of control, it provides for a rate to be levied on all discharges, according to the quantities of water consumed and according to the composition of industrial discharges. However, the domestic user is exempt from this fee if his water consumption does not exceed 40 m^3 per quarter. Responsibility for applying the code is divided among several ministries.

Turkey

The current law is that of 1971 on water derived resources which makes reference to marine waters. A new law is being drafted to cover all waters including the sea and provides for their classification according to use and strict control of all polluting discharges. Responsibility for the law will rest principally with the Ministry of Agriculture and the Ministry of Health will be concerned with public health matters.

Yugoslavia

There is a Basic Law on Waters of 1965 which is a federal enactment. It covers coastal waters which are, inter alia, classified according to use and quality. It includes requirements for the monitoring of all national waters by the Hydrometeorological Institute. The law is operated by the water management authorities of the three republics. The republics have a measure of autonomy and there are differences in their legal and management practices.