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DRAFT ENVIRONMENTAL QUALITY CRITERIA

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

WORLD HEALTH ORGANIZATION

WORLD METEOROLOGICAL ORGANIZATION

INTERNATIONAL ATOMIC ENERGY AGENCY

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION

Contents

1. INTRODUCTION

As part of the Co-ordinated Mediterranean Pollution Monitoring and Research Programme (MED POL - PHASE I) data were collected on the quality of the Mediterranean environment. In evaluating the data collected through pilot projects, in particular MED POL II : Baseline Studies and Monitoring of Oil and Petroleum Hydrocarbons in Marine Waters, and MED POL VII : Coastal Water Quality Control, the formulation of selected environmental quality criteria, applicable for the Mediterranean Sea, became possible.

In this connection the Intergovernmental Review Meeting of Mediterranean Coastal States and the First Meeting of the Contracting Parties to the Convention for the Protection of the Mediterranean Sea against Pollution and its Related Protocols (Geneva, 5-10 February 1979) recommended [1/] that:

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

Furthermore, the Protocol for the Protection of the Mediterranean Sea against Pollution from Land-Based Sources, adopted at the Conference of Plenipotentiaries of the Coastal States of the Mediterranean Region for the Protection of the Mediterranean Sea against Pollution from Land-Based Sources (Athens, 12-17 May 1980) stipulates [2/] that:

> "1. The Parties shall progressively formulate and adopt, in co-operation with the competent international organizations, common guidelines

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[1/] UNEP/IG.14/9, annex V, paragraph 13.

[2/] Protocol for the Protection of the Mediterranean Sea against Pollution from Land-Based Sources, article 7.

and, as appropriate, standards or criteria dealing in particular with:

.....

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

.....

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

In response to the cited recommendation and provision contained in the Protocol the draft environmental quality criteria contained in this document have been prepared by:

- WHO for environmental quality criteria for recreational waters and for shellfish growing areas; and

- WHO, FAO and UNEP for environmental quality criteria for mercury in seafood.

The purpose of this document is to initiate a wider discussion on the rationale used in drafting the proposed criteria, on the scientific evidence supporting this rationale and on the applicability of the proposed criteria, which may ultimately lead to their adoption and application.

2. ENVIRONMENTAL QUALITY CRITERIA FOR RECREATIONAL WATERS

In the light of the definitions put forward at the United Nations Conference on Human Environment in Stockholm 1972, the following definitions could be drawn up in the context of recreational water quality criteria.

Water quality criterion is defined as a quantifiable exposure-effects relationship between the density of an indicator in the water concerned and the potential human health risks involved in using that water. On this relationship a judgement on the water quality can be based.

Health effects water quality indicator is defined as microbiological, chemical or physical substance which indexes the potential risk of infectious disease coincident with man use of the aquatic environment as a source of recreation. Ultimately the best indicator will be the one whose densities correlate best with associated health effects. It can be selected therefore only on the basis of epidemiological analysis. However before such analysis takes place, potential indicators should fullfil the following requirements:

(i) be consistently and exclusively associated with the sources of the pathogens or noxious substances;

(ii) be present in sufficient numbers or quantities to provide an "accurate" density estimate whenever the level of each of the pathogens is such that the risk of illness is unacceptable;

(iii) approach the resistance to disinfectants and environmental stress, including that resulting from toxic materials deposited in the aquatic environment, of the most resistant pathogen potentially present at significant levels in the source; and

(iv) be quantifiable in recreational waters by reasonably easy and inexpensive methods, and with sufficient accuracy, precision and specificity.

Water quality standard is an acceptable maximum level for the density of the indicator in the water associated with unacceptable health risks. It derives from the water quality

criterion. The concept of acceptability implies that social, cultural, economic and political, as well, as medical factors are involved and that these factors may vary in both time and space.

2.1 Existing national provisions and international arrangements and agreements relevant to the Mediterranean

While the problem of water pollution control in the Mediterranean countries is increasingly recognized and relevant legislation is under consideration and preparation, in the great majority of these countries, only a limited number, at this stage, have issued norms or standards on recreational water quality criteria. From the available information only five Mediterranean countries have issued recreational water quality standards.

Moreover, no one country has the same standards with any other country in the Mediterranean and comparison between the existing standards is difficult if not impossible.

An effort towards the development of an international harmonized approach has been made by the European Economic Community for the countries of the community. In this context, a Council Directive was issued on Microbiological Quality requirements for Bathing Water. This Directive concerns at present two countries in the Mediterranean (France and Italy) and EEC. In 1981 a third country, Greece, will be added. The Directive sets limit values of relevant parameters to be applied no later than 10 years following notification of the directive.

As far as microbiological parameters are concerned it includes the following; total coliforms, faecal coliforms, faecal streptococci, salmonella, and enteroviruses (table 1).

Bathing water shall be deemed to conform to the value of the relevant parameters if the samples of this water taken at the same sampling point and at intervals specified in table 1, show that it conforms to the relevant parametric values for the quality of the water concerned, in the case of:

- 95% of the samples for parameters corresponding to those specified in Column I of the table;

- 90% of the samples in all other cases with the exception of the "total coliform" and "faecal coliform" parameters where the percentage may be 80%.

And, if in the case of the 5, 10 or 20% of the samples which do not comply:

- the bathing water does not deviate from the parametric values

Table 1 : Microbiological quality requirements for bathing water (Council of the European Communities)

	Parameters	G	I	Minimum sampling frequency	Method of analysis and inspection
1	Total coliforms /100 ml	500	10 000	Fortnightly (1)	Fermentation in multiple tubes. Subculturing of the positive tubes on a confirmation medium. Count according to MPN (most probable number) or membrane filtration and culture on an appropriate medium such as Tergitol lactose agar, endo agar, 0.4% Teepol broth, subculturing and identification of the suspect colonies. In the case of 1 and 2, the incubation temperature is variable according to whether total or faecal coliforms are being investigated.
2	Faecal coliforms /100 ml	100	2 000	Fortnightly (1)	
3	Faecal streptococci /100 ml	100	-	(2)	Litsky method. Count according to MPN (most probable number) or filtration on membrane. Culture on an appropriate medium.
4	Salmonella /1 litre	-	0	(2)	Concentration by membrane filtration. Inoculation on a standard medium. Enrichment - subculturing on isolating agar - identification.
5	Entero viruses PFU/10 litres	-	0	(2)	Concentrating by filtration, flocculation or centrifuging and confirmation.

G = guide.

I = mandatory

(0) Provision exists for exceeding the limits in the event of exceptional geographical or meteorological conditions.

(1) When a sampling taken in previous years produced results which are appreciably better than those in this Table and when no new factor likely to lower the quality of the water has appeared, the competent authorities may reduce the sampling frequency by a factor of 2.

(2) Concentrations to be checked by the competent authorities when an inspection in the bathing area shows that the substance may be present or that the quality of the water has deteriorated.

in question by more than 50% except for microbiolgocial parameters, pH and dissolved oxygen;

- consecutive water samples taken at statistically suitable intervals do not deviate from the relevant parametric values.

Considering the usefulness and the necessity to harmonize the evaluation of pollution in the Mediterranean, similar effort was undertaken since the early stage of the MED POL Project VII. At that time, an interim criteria for all the Mediterranean countries was adopted for the purposes for that Project. According to it, "Highly satisfactory bathing areas should show E. coli counts of consistently less than 100 per 100 ml and to be considered acceptable bathing should not give counts consistently greater than 1000 E. coli per 100 ml. However, for new recreational water facilities they should ensure a higher water quality. The criterion of 100 E. coli per 100 ml should also be applied as far as possible for the design of treatment and disposal systems for liquid waste involving large investments and having long-term implications for water quality.

The above criteria of 1000 E. coli per 100 ml should be defined as follows:

- No more than 10% of at least ten consecutive samples collected during the bathing season should exceed 1000 E. coli per 100 ml.

2.2 Quality of the recreational waters in the Mediterranean

From the periodic reports of the Principal Investigators of the National Institutes participating in MED VII project it appears that in their great majority the results of the monitored recreational areas are satisfactory. They further indicate that a first and and substantial step towards harmonization reliability and comparison has been made.

The application of the proposed common indicators and methodology in the evaluation of the microbiological quality of coastal water and of the adopted uniform "Interim quality standards", as these were agreed by the participants in MED VII, (see 2.1), contributed substantially to these results.

On the other hand, in the few instances where the interim quality standards were not met, the cause was clearly traced to the influence of nearly discharged waste waters.

However consistent application of presently accepted EEC standards in two monitored areas classified the majority of sampling stations as unsatisfactory. In the same areas it was found that the standard deviation of the concentrations of the three indicators approaches quite closely that implied by the

Interim Quality Criteria while it disagrees with that implied by the EEC standards. The above needs further investigation and analysis.

Some of the results obtained indicate that microbiological quality of coastal waters can be adequately interpreted by a log normal probability distribution model. Moreover, it appears that the Interim standards need an improved statistical expression.

The above results must not be considered as representative of all the Mediterranean coastal waters but of the specifically monitored areas. In this respect it would be advisable for the proposed new Long-Term programme to have a better geographical representation as well as a substantial coverage of beach attending population. The aim should be to cover the most important recreational areas and to have a network representative of the Mediterranean Coastal Waters.

To this effect, the new monitoring framework should include all the Mediterranean countries.

Such a network will provide a balanced picture of the quality of recreational areas in the Mediterranean.

2.3 Scientific rationale for the criteria applicable to the Mediterranean recreational waters

Although it recognized that microbiological parameters form only one part of the overall standards such parameters will alone be considered in the present context, as being those most consistent with the definition of criteria given here above. Moreover they can easily be applied by all concerned and provide a substantial first step in the necessary harmonized approach towards water pollution control in the Mediterranean.

Existing microbiological criteria and standards are generally expressed in terms of coliforms or portion of the coliform population, faecal coliforms and E. coli, and faecal streptococci. These water quality indicators seem to better index the health hazards. However potential or new indicators better fulfilling the above mentioned requirements (2, (i), (ii), (iii), (iv)) should further be investigated.

In this context a WHO working group (Bilthoven 1975) noted that the detection of E. coli "... was one of the most sensitive indicators of the degree of sewage pollution and sewage dispersion around points of wastewater discharge".

In view of the absence of epidemiological studies to back any guidelines or criteria, the level of faecal microorganisms in bathing waters should, on general public health grounds, be kept at as low a level as feasible.

The consensus view of the WHO working group mentioned above was that since "... potential health risks do exist in connection with bathing or swimming in polluted coastal waters... it was therefore ... generally feasible and desirable to set broad upper limits for the number of faecal indicators organisms in coastal bathing waters ... expressed in broad terms of orders of magnitude rather than rigidly stated specific numbers. The working group concluded, "Highly satisfactory bathing areas should, however, show E. coli counts of consistently less than 100 per 100 ml and to be considered acceptable bathing waters should not give counts consistently greater than 1000 E. coli per 100 ml". The above conclusions were further specified by a meeting of Principal Investigators of the MED VII project and were adopted as an Interim Quality Criteria.

Interim criteria can be developed and applied for a certain period based on available experience and circumstantial evidence. During the interim period, such criteria should be evaluated by appropriate epidemiological studies. The studies should follow one of the following ways:

(i) predictive models;

(ii) restrospective epidemiological studies of case reports and disease outbreaks; and

(iii) prospective, controlled epidemiological-microbiological studies.

The last method gives the best and most reliable results.

Following such evaluation, the interim criteria may be adopted or adjusted as required.

The next step will be the derivation of standards from criteria. At that stage a decision should be made as to the "acceptable risks" of symptons of varying degrees of severity or of specific diseases. This decision will be influenced by social, economic, political and health factors.

The above approach will lead with time and study to identify the best indicators fulfilling the established requirements at the lowest cost. In addition, the adoption by the Mediterranean States of parallel indicators and methodology for the recuperation of indicators will provide appropriate contact among the Mediterranean Scientists, exchange of knowledge and experience, comparability of results, coordinated approach of control methods, and better control of pollution in the recreational coastal water.

2.4 Proposed environmental quality criteria for recreational waters in the Mediterranean

The working group on "Health Criteria and Epidemiolgical Studies Related to Coastal Water Pollution" convened within the frame of MED VII (Athens 1-4 March 1977) in dealing with the subject of "interim criteria" after examining the available information and evidence concluded that there is no basis for recommending changes in the above conclusion of the WHO working group. However the Athens meeting to better adapt the proposed criteria to the Mediterranean conditions complemented the recommendation of the WHO meeting described in item 2.1 and 2.3 above.

The proposed interim criteria were unanimously adopted by a meeting of the Principal Investigators of the National Collaborating Institutes participating in MED VII. Moreover, in order to further promote comparability and accuracy it was agreed that all the Collaborating Institutes follow a given methodology and use the same nutrients for the recovery of the selected indicators.

In this respect, not only the faecal coliforms indicators are investigated in MED VII but also "total coliforms" and "faecal streptococci" are included in the faecal indicators compulsory list. The purpose is to evaluate and compare the relevant results and undertake some screening process or additions to the proposed indicators and "interim criteria".

Other water quality indicators such as pathogens and viruses are also being investigated, and should continue to be so, with the aim to get more reliable, consistent, representative, simple and economic indicators to index human faecal contamination.

As no scientific basis exists at present to define criteria for coastal bathing waters in a rational way, the applied guideline approach is considered to be the best practicable one.

The "interim criteria" are therefore proposed to be applied for a period of 3-4 years when it is estimated that the results of the required epidemiological studies become available.

In the meantime the experience gained through the pilot project MED VII should be used for reorganizing and expanding the established pilot network and for providing the long-term approach which is required for further consolidation and harmonization of the work carried out and for attaining the objectives of defining and adopting adequate quality criteria for recreational waters.

3. ENVIRONMENTAL QUALITY CRITERIA FOR SHELLFISH-GROWING AREAS

The major health hazards associated with shellfish are those caused by the consumption of raw shellfish polluted by human faecal material. Therefore it is important to consider the marine environmental factors which affect the sanitary quality of molluscs. These factors may be broadly divided into factors of a physical and a biological nature.

Physical factors:

The pollution of shellfish growing waters by faecal bacteria may occur in any area where the water is contaminated by human faeces, sewage outfalls, drainage from polluted rivers or drainage of polluted places. Sewage outfalls constitute the major sources of shellfish growing areas pollution.

The extent to which shellfish growing areas are affected depends mainly on:

- the location of the sewage discharge relative to the shellfish growing areas;
- the quantity and concentration of the sewage effluent;
- the quality of the sewage effluent relative to the degree of treatment;
- the dilution and dispersal characteristics of the receiving waters.

Biological factors:

The degree of contamination of shellfish growing waters and of shellfish depends on:

- the bacterial content of the sewage discharge;
- the viability of microorganisms in the sea;
- the biological processes of shellfish;
- the development of toxic algae.

The present document is limited to the environmental quality criteria for shellfish growing areas which constitute a crucial point for the protection of human health.

3.1 Existing national provisions and international arrangements and agreements relevant to the Mediterranean

To ensure the production and distribution of safe shellfish, an elaborate system of control with ad hoc support services is required. However such systems are justifiable and should be provided mainly whenever there is any substantial shellfish industry. Such systems should cover all aspects of production from the growing area to the processing and the wholesale and retail trade. This is the case in a limited number of Mediterranean States where such efficient systems have been evolved or where a similar approach is justifiable and should be developed.

In some countries, emphasis is placed upon categorization of shellfish growing areas as approved or otherwise, on the basis of detailed investigations of the topography and of the water quality. In other countries more emphasis is placed on the quality of mulluscan shellfish taken from an area. However, when an assessment is being made of the suitability of an area for production, then topographical factors and the bacteriological quality of water are taken into account.

One of the problems in assessing the suitability of an area for the production of shellfish, by examining shellfish growing waters, is that there is no direct correlation between the bacterial content of waters and that of the shellfish. However in some countries effective control has been exercised by using an assessment of shellfish growing waters as the main basis of sanitary control.

Very few countries in the Mediterranean have appropriate legislation or have developed quality criteria for water quality in growing shellfish areas and for shellfish flesh. On the other hand, wherever they exist they are not harmonized among countries.

In France, for example, water from shellfish growing areas is classified in four categories.

Class I	: satisfactory:	No	*E. coli*
Class II	: acceptable :	1-60	*E. coli*
Class III	: suspicious :	60-120	*E. coli*
Class IV	: unfavourable:	over 120	*E. coli*

Values are not rigid standards but are considered in conjunction with the topography. Analysis is undertaken to ensure that there

is no deterioration in the sanitary quality of water in an area where shellfish of acceptable quality is produced.

In Italy, approved shellfish growing waters should contain no more than 2 E. coli per 100 ml in 90% of the samples taken during one year. Not more than 10% of the samples taken during one year should contain more than 6 E. coli per 100 ml.

As for water in growing areas the standards for shellfish where these exist do also differ from one country to another.

In France the standards for shellfish provide:

- E. coli less than 1 per ml. for oysters or molluscs normally eaten raw; and

- E. coli less or equal to 2 per ml. for mussels and molluscs normally eaten cooked.

- Salmonella:- Nil per 25 ml sample of flesh and fluid.

In Italy shellfish from approved areas should conform with the following:

- MPN of 160 per 100 ml. should not be exceeded in 90% of samples taken in one year;

- MPN of 500 per 100 ml. should not be exceeded in 10% of samples taken in one year.

Few additional Mediterranean countries have also developed standards for shellfish growing waters as well as for water of shellfish flesh but they also differ from country to country.

While the quality criteria developed by each Mediterranean country may fill its relevant needs, no harmonization and coordinated action may be promoted under the present conditions. Thus appropriate assessment of the quality of shellfish growing areas and rational control of pollution sources for the Mediterranean as a whole will be deficient.

Under present conditions the great majority of Mediterranean countries are concerned with shellfish production without having facilities for treatment and handling of polluted shellfish. In this case an appropriate surveillance of shellfish production areas may go a long way in ensuring that shellfish leave the production area in a safe and wholesome state. In these circumstances the sanitary control of the shellfish after leaving the growing area can be carried out by national public health officers involved in food hygiene control.

Part of the MED VII UNEP/WHO pilot project "Coastal Water Qualtiy Control" dealing with shellfish quality control aimed at applying and assessing the above simplified approach and at the same time promoting a necessary harmonization in the Mediterranean area. To this end a monitoring programme of waters of growing areas and of shellfish flesh for the Mediterranean states was organized and carried out. For the needs of this pilot monitoring programme, common interim criteria for growing waters and for shellfish flesh were investigated and agreed upon by the participating National Principal Investigators in MED VII pilot project(see 3.4).

International arrangements and agreements satisfactorily covering the Mediterranean as a whole do not exist. However some international arrangement concering the quality of shellfish growing waters and sanitary requirement for shellfish, intended for human consumption, have or are being developed. These arrangements are as follows:

(i) A Council Directive of the European Economic Community on the quality required for shellfish waters dated 30/10/1979 has been adopted by the Council. The Directive established the parameters to be applied, their relevant guide values, G, and mandatory ones, I, the reference methods of analysis and the minimum sampling and measuring frequency.

The standards established by the Directive of the EEC on the quality required of shellfish waters, as far as microbiological parameters are concerned, stipulate:

Faecal coliforms: Less than or equal to 300 per 100 ml. as guide (G).

This standard is given for shellfish flesh and intervalvular liquid. However, this is applicable also to growing waters pending the adoption of a Directive on the protection of customers of shellfish products.

According to the Directive, the member States shall, initially, within a two year period following notification of the Directive, designate shellfish waters. Futher provisions are made for additional designations and for revisions. Within six years from the designation of shellfish waters, these should conform to both G and I values.

Member States should set values for the designated waters. These values should not be less stringent than those given in the Directive.

The above Directive concerns at present two Mediterranean countries, namely France and Italy, and in 1981, a third country (Greece) will be added.

Under these conditions the Directive doesn't help to avoid the shortcomings experienced in the Mediterranean and due to unharmonized individual national criteria.

(ii) A proposed draft code of hygiene practise for molluscan shellfish has been prepared by the Codex Alimentarius Commission (12th Session, Rome 17-28 April 1978).

The draft code in its appendix III provides general environmental sanitation recommendations. These concern:

- Sanitary disposal of human and animal wastes;
- Determination of pollution types and sources;
- Classification of the growing water areas;
- Control of the growing water areas;
- Reclassification of growing water areas;
- Animal, plant, pest and disease control.

Moreover in an Annex to the Appendix III of the Code, current laboratory procedures and standards are given. This is a list of bacteriological standards and methods currently in operation in several developed countries. Of the Mediterranean countries, only France and Italy are included in the above list. The Committee on Food Hygiene considered that:

(a) successful shellfish control programmes have been in operation in a number of member states for many years using a wide range of bacteriological standards and methods, and;

(b) that it was virtually impossible to reach agreement at this time on any specific set of standards and methods.

The Committee concluded that a listing of bacteriological standards and methods currently in force in several developed countries would serve a useful purpose.

The Code of Hygienic Practise for molusean shellfish has a universal character and therefore also concerns the

Mediterranean area. However, it is of a general nature and doesn't provide, at this stage, valuable possibilities to cover the specific needs and conditions of the Mediterranean as a whole. In this respect it doesn't alleviate the shortcomings that the national criteria and the Directive of the EEC present.

3.2 Quality of the shellfish-growing areas in the Mediterranean

It is evident that with the existing various national criteria which are applied in few Mediterranean countries, it is not possible to make an assessment of the quality of the shellfish growing areas in the Mediterranean as a whole and to take appropriate concerted action. However, in countries where national quality criteria exist and are applied, satisfactory results as far as health protection is concerned are usually experienced.

As mentioned in 3.1 above, a coordinated assessment of the quality of the shellfish growing areas in the Mediterranean was undertaken on a pilot basis through the establishment of a monitoring programme of shellfish growing areas as part of MED VII. To this end common quality criteria of growing waters and of shellfish flesh and similar relevant methodology were applied.(see 3.4)

The results of the monitoring showed that in the great majority the studied shellfish growing water conformed to the established criteria, and that the related shellfish flesh was also meeting the relevant quality criteria. In the few cases where these standards were not met, the influence of detrimental physical factors was easily detected.

However in view of the relatively small number of monitored shellfish growing areas, the above results do not cover all the prevailing conditions in the Mediterranean as a whole. Further investigation is necessary in order to attain the objectives of an appropriate assessment and control of pollution in shellfish growing areas. In this respect, it would be advisable to continue the initiated work in that direction and to expand the network of monitoring shellfish growing areas to better cover both the Mediterranean as a whole and the important growing shellfish areas in the Mediterrean. In addition, the value of the indicators as health effects are concerned, should be evaluated. This is best achieved by means of epidemiological studies which should be undertaken at an early stage.

3.3 Scientific rationale for the criteria applicable to Mediterranean shellfish-growing areas

The development of criteria applicable to Mediterranean shellfish

areas should be based on indicators which should be:

- consistently and exclusively present in human faecal wastes at reasonably high densities;

- capable of survival during sewage treatment and various transport to an extent comparable to that of the pathogens potentially contained therein.

Moreover considering that such criteria should be applicable to the Mediterranean as a whole they should be based on:

- a minimum number of indicators;

- a simplified and limited number of recovery of indicators procedures;

- the possibilities and facilities availabile in each of the Mediterranean States.

Various indicators in routine monitoring are being applied in one country or another where shellfish growing areas are followed up. These indicators include E. coli, faecal coliforms, faecal streptococci, cl. perfringens and Salmonella. However in certain circumstances, for instance, after a disease incident associated with shellfish, the range of tests should be expanded to include pathogens likely to be implicated. Among them are Salmonella typhi, other Salmonella spp., V. parahaemolyticus and V. cholerae. Considering the universality of E. coli this indicator is being retained for routine monitoring. However the study of other applied indicators as well as new ones should be included in any monitoring exercise with the aim to further improve results by better indicators, simplified methodology and more economic procedures.

The usually applied methodology includes MPN method, MF method and total plate count method. Similarly the nutrients used for recovery of the indicators are various. Here again the aim is to apply appropriate reference method which will be used by all concerned in the Mediterranean area and will provide more satisfactory results.

In addition to simplification and applicability all over the Mediterranean, the proposed harmonization of quality criteria and methodology is aiming at promoting comparability, uniform evaluation, exchanging of knowledge and experience, gradual improvement of approach and of results, development of control methods, certification and recognition of results. Gradually the quality criteria may be subject to refinement and additions in order to meet the requirements defined by different species of shellfish and/or conditions in the Mediterranean.

Purification of shellfish may also be expanded in the Mediterranean in the future. In this respect quality criteria should be developed and applied for sea water in storage basins and in purification plants. There also, quality criteria for shellfish flesh will be needed.

In view of the absence of epidemiological studies to back any criterion the proposed ones are based on the available experience in European countries and in the U.S.A. Such interim quality criteria are proposed to be evalued by appropriate epidemiological studies. These should follow one of the following ways:

- Predictive models;
- Retrospective epidemiological studies of case reports and disease outbreak; and
- Prospective controlled epidemiological microbiological studies.

Following such evaluation, the interim criteria may be adopted or adjusted as required.

The next step will be the establishment of standards based on the criteria. At that stage a decision should be made as to the "acceptable risks" of symptoms of varying degrees of severity or of specific diseases. This decision should be influenced by social, economic, political and health factors.

3.4 Proposed environmental quality criteria for shellfish-growing areas in the Mediterranean

As mentioned in 3.3 the monitoring of shellfish growing waters and shellfish included in the WHO/UNEP pilot project on "Coastal water quality control in the Mediterranean" provided the ground for an harmonized and coordinated assessment of the quality of shellfish growing areas in the Mediterranean.

To this end, a minimum number of compulsory indicators to be monitored were selected, namely, total coliforms, E. coli and streptococcus faecalis. Monitoring procedures, location of samples, frequency, sampling methods and reference methods of analysis were prescribed. Moreover based on the available experience in various countries the Principal Investigators of the National Laboratories participating in the project on "Coastal Water Qualtiy Control in the Mediterranean" agreed on an interim quality criteria which stipulates:

(a) for waters of shellfish-growing areas:

- less than 13 faecal coliforms/100 ml. in 80% of samples;

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

(b) for flesh of shellfish:

- 0-2 faecal coliforms per gram of shellfish flesh: sale permitted;

- 3-10 faecal coliforms per gram of shellfish flesh: temporary prohibition of sale;

- above 10 faecal coliforms per gram of shellfish flesh: sale prohibited.

The proposed indicator for the assessment of the quality is only the E. coli. However the pilot investigation includes also the "total coliforms" the "faecal streptococci" as indicators. The purpose is to evaluate and compare the relevant results and undertake some screening process or additions to the proposed "indicators" and "interim criteria".

It is also proposed to investigate other indicators such as Salmonella.

The above proposed "quality criteria" should constitute the minimum requirement that any shellfish growing area should meet. Its application, should include appropriate investigations of other indicators and related quality criteria, in order to promote adequacy, acceptability, comparability and harmonized approach in solving pollution problems.

The "quality criteria" developed by the Mediterranean experts under Project MED VII is proposed as an interim quality criteria for shellfish growing areas throughout the Mediterranean basin

The presently proposed interim "quality criteria" and its intended further study and development are closely tied up and depended on a long-term programme of monitoring shellfish growing areas. Participation of all relevant Mediterranean countries and adequate representation of characteristic Mediterranean conditions is of great importance for attaining the expected results.

4. ENVIRONMENTAL QUALITY CRITERIA FOR MERCURY IN SEAFOOD

4.1 Existing national provisions and international arrangements and agreements relevant to the Mediterranean

The mercury poisoning which occured in Minamata and Agamo in Japan and Iraq, as well, as other similar occurences stimulated the concern of governments for the hazards of the ingestion of mercury by humans.

In this context various efforts were undertaken to investigate sources and levels of mercury in the environment, especially related to food contamination, and to establish regulatory action for the control of mercury in the environment as a health measure.

Fish and fish products were found to be the major if not the only source of intake of mercury for all but a small minority of people. Therefore most of the regulatory approach is primarily directed to limit ingestion of mercury and secondly emmission of mercury in the environment. The present limited knowledge of the cause and effect relationship of mercury in the physical environment and in living organisms, implied the need of an important safety margin for ensuring human health protection.

In studying the need for setting maximum levels for mercury in food a number of countries conducted surveys of the dietary intakes of their populations in order to assess the health risk from ingestion of mercury in food. Such major studies relating mercury levels and the amount of fish consumed by the population in the Mediterranean area were conducted by France and Italy.

Data or annual per capita consumption of fish and shellfish are available for the following Mediterranean countries: Albania (1.1 kg), Algeria (0.5), Cyprus (2.6), Egypt (1.3), France (7.9), Greece (9.1), Israel (6.5), Italy (6.1), Lebanon (2.0), Libya (2.9), Malta (3.3), Monaco (-), Morocco (1.4), Spain (17.0), Syria (0.7), Tunisia (2.2), Turkey (2.5), Yugoslavia (1.5).

In the Mediterranean the countries which establish regulations mainly place an overall limit on mercury concentration in fish. Here below is a summary of current maximum permissible levels of mercury in fish apolied in Mediterranean countries where action levels have been set.

France, 0.7 ug/kg (ppm)	This limit is for fish expected to have a high level. For other fish 0.5 ug/kg applies. There is no legislation in force but random tests are made on imported fish and fish exceeding these limits are barred from the market.
Greece, 0.7 ug/kg	This is the limit for all seafood caught in Greek waters or imported and intended for local consumption. Legislation is still being drafted and the intention will be to change the limit to 0.5 ug/kg. Studies with the scope or target of specifying the mercury pollution and content of fish and shellfish are under way.
Israel, 0.5 ug/kg	Maximum level for both domestic and imported fish; tuna receives special attention. New legislation is being prepared.
Italy, 0.7 ug/kg	There are no recommendations made regarding sizes and quantities per head per week. There are no fishing locale prohibitions.
Spain, 0.5 ug/kg	-

At the international level, FAO, WHO and the OECD, have been periodically involved in studying the problem of food contamination by mercury. In 1967 the Joint FAO/WHO Expert Committee on Food Additives first considered the problem and recommended that "any use of mercury compounds that increases the level of mercury in food should be strongly discouraged". In 1972, the same committee met again and recommended a provisional tolerable weekly intake (PTWI) of 0.3 ug total mercury per person of 70 kg, of which no more than 0.2 ug should be present as methylmercury (expressed as weight of mercury) (Joint FAO/WHO Expert Committee on Food Additives 1972).

The Scientific Committee of the EEC agrees to the FAO/WHO recommendation of a provisional tolerable weekly intake (PTWI), however, it would not impose legal action limits for mercury in food stuffs because any risk of mercury poisoning is related to

mercury intake and thus a function of the mercury contents in the product and the quantity of the product consumed rather than the mercury level in the product alone.

Since fish eating habits in populations or subgroups and mercury levels in different fish and shellfish species var considerably, the problem should be tackled with respect to intake levels. Although, it is understood that it may be very difficult to change taste preference patterns, particularly while fish may be an easily accessible source of protein for certain populations that cannot even partly be easily substituted for.

4.2 Mercury in Mediterranean seafood

The two principle pathways for mercury intake by aquatic organisms are via the ingestion of organisms containing mercury and by direct uptake of mercury from the drinking water.

The concentrations of total mercury in fresh tissue of fish, of which usually the greater part is present in the organic form, may show marked variation according to the geographical area and the age or size of the fish.

Irrespective of the area, some species tend to have higher mercury levels per unit fresh weight than others caught in the same area, as is usually the case in tuna, swordfish, elasmobranchs and norway lobster. However, tuna, i.e. had a higher average protein or dry weight content than other fish species (roughly 25-30 per cent as compared to 18-20 per cent respectively) so that at least part of the differences may be attributed to the reference unit and might disappear if mercury load would be expressed in relation to dry weight or protein content.

Still, interspecific comparison yields some remarkable differences between mercury levels in specimens caught in the Mediterranean and those from the Atlantic with usually lower concentrations in the latter. For hake, Merluccius merluccius i.e., the International Council for the Exploration of the Sea (ICES) baseline study in the North Atlantic gave mean concentrations between 0.03 and 0.13 mg/kg (ICES, 1977b.) whereas Mediterranean specimens analysed had a much broader range of concentration with an upper limit of 0.85 mg/kg and an average of about 0.23 mg/kg.

Bluefin tuna (Thunnus thynnus thynnus) caught off the French coast in the Mediterranean displayed average levels of mercury 1.10 mg/kg with a range of 0.02 to 6.29 mg/kg (MED POL II data). Equivalent samples from the Bay of Biscay ranged from 0.02 to 0.08 mg/kg with the bulk of the data around 0.5 mg/kg. The same has been found in other tuna species ie. Thunnus alalunga in

which mercury levels are about three times higher in the Mediterranean.

In the Mediterranean itself two populations of bluefin tuna can be distinguished, the smaller ones staying in the Mediterranean with higher mercury concentrations and the bigger ones migrating to the Atlantic with lower contaminant levels. Table 2 below summarizes the average of methylmercury level values for marine fish published during the past five years.

Mercury levels in Mediterranean specimens are not in all species superior to those caught in other seas. Average levels in Trachurus mediterraneus, the Mediterranean horse mackerel, which are between 0.093 and 0.345 mg/kg, are similar to the mean values between 0.17 and 0.33 mg/kg reported for Trachurus trachurus, the common horse mackerel, in the North Sea (ICES, 1977a.). The anchovy, Engraulis encrasicolus, and the pilchard, Sardina pilchardus, generally show levels below or near 0.15 mg/kg.

All of the above mentioned species do migrate to some extent at least within the Mediterranean. Thus contamination levels can be considered as an integration over space and as representative for the whole Mediterranean.

Species that are more stationary or even sessile like the Mediterranean blue mussel, Mytilus galloprovincialis, are more likely to reflect the 'local situation.' Consequently levels in mussel sampled at 'hot spot' areas will be higher than the average. Mussel collected in rather polluted sites in the Adriatic generated an outstanding mean value of 1.1 mg/kg. Other high values are reported from the Tyrrhenian, 0.52 mg/kg. All other results are below 0.2 mg/kg fresh weight. These local differences are reflected in high standard deviations sometimes even exceeding the average.

Mercury concentrations in the striped mullet, Mullus barbatus, are generally around 0.2 mg/kg or less. In MED POL areas II, IV and V, however, in samples from the Tyrrhenian Sea and the Adriatic, averages are elevated (see MED POL II scientific evaluation report). Bacci et al. (1980) showed increased mercury levels in the mullet caught in the Mount Amiata region (area IV) with cinnabar rich bedrock and mercury extracting industries. The average mercury concentration in area IV in 405 samples is 1.3 mg/kg ranging from 0.06 to 7.05 mg/kg.

4.3 Scientific rationale for the criteria applicable to the mercury in Mediterranean seafood

It is recognized that an evaluation of health hazards through the consumption of Mediterranean seafood is difficult due to the very limited data for those populations considered likely to have an

Table 2 : The range of published* approximate average values of methylmercury expressed as ug Hg/kg wet weight in muscle tissue of various species of fish. Where an analysis of methylmercury was not available, the data on total mercury have been used instead. MARC (to be published)**

Fish species	Ocean/Sea			
	Atlantic	Pacific	Indian	Mediterranean
Mackerel	70-200	160-250	5	240
Sardine	30-60	30	6	150
Unspecified number of edible (non-predatory) spp.	80-270	70-90	20-160	100-300
Predators				
Tuna spp.	300-800	300	65-400	1200
Swordfish	800-1300	1600	-	1800
Shark) Dogfish) spp. Ray)	1000	700-1100	40-1500	1800

*As reviewed in MARC (to be published); see also IRPTC (1978, 1980).

**MARC (to be published). Health Effects of Methylmercury - Progress Report 1975-1979. Prepared by Monitoring and Assessment Research Centre, Chelsea College, University of London, U.K., with the support of the United Nations Environment Programme. Manuscript submitted to the Consultation to Re-examine the WHO Environmental Health Criteria for Mercury, Geneva, 21 - 25 April 1980.

However, it is agreed that the intake of methylmercury in seafood may constitute a health hazard.

On the basis of the best available data, it can be assumed that most of the general population has a low methylmercury intake and is therefore not at risk. The two following hypothetical calculations based on table 2, referred to above, give a practical justification to this assumption.

(i) For the majority of seafoods (excluding certain species of tuna, swordfish and elasmobranchs, for example) an average methymercury content of up to 300 ug/kg wet weight is assumed; one meal of 150 gr. would be equivalent to a methylmercury content of 45 ug. For a 70 kg body weight of an adult this would mean that with an intake of less than four fish meals per week, the WHO PTWI would not be exceeded. (10-20 per cent of the PTWI should be allowed for methylmercury intake from other sources).

(ii) For "predatory fish" (including tuna, swordfish and elasmobranchs) an average methylmercury content of up to 180 ug/kg is assumed; one meal of 150 gr. would be approximately equivalent to a methylmercury intake of 270 ug. In this case, therefore, fish consumption would have to be less than one meal per week to give an intake below the WHO PTWI.

Although the above tentative calculation suggests a low methylmercury intake for the general population, it is considered that the following groups of the population have high methylmercury intake which may, in some cases, exceed the WHO PTWI;

(i) Fishermen and their families

(ii) Employees of the fish industry and their families

(iii) Employees of fish restaurants and their families

(iv) Consumers of seafood with especially high concentration of methylmercury

Within the above groups special attention should be paid to women of child bearing age as pre-natal life is considered as the most sensitive stage of the lifecycle to methylmercury.

There are very limited data available on the level of methylmercury intake by the above groups. Data from Italy suggest that some intakes may be up to 3.5 ug/kg body weight per day.

Actual measurements by biological monitoring of mercury in blood of such populations in Italy have ranged up to 400 ug/ml RBC (red blood cells). This corresponds to levels of up to 200 ug/ml of whole blood. Some additional data from other Mediterranean countries may be available but they are not published. The few studies undertaken have not detected health effects due to methylmercury intake through seafood. However, this doesn't exclude the possibility of cases of mild methylmercury poisoning in the studied areas.

In summary, the main gaps in knowledge which need to be filled for appropriate evaluation of health hazards and protection of the population at risk are as follows:

(i) Biological monitoring data on mercury levels in populations with high methylmercury intakes.

(ii) The patterns of seafood consumption in various sectors of the Mediterranean area, including seasonal variation.

(iii) Athropogenic sources of mercury and other selected pollutants and their contributions to methylmercury in fish.

(iv) Methlymercury concentrations in various types of seafood in certain areas of the Mediterranean sea.

(v) Identification of populations with relatively high methylmercury intake and estimation of their size.

4.4 Proposed environmental quality criteria for mercury in Mediterranean seafood

The Consultation to re-examine the WHO environmental health criteria for Mercury (Geneva 21-25/4/80) and subsequent studies, acknowledged that the WHO Provisional Tolerable Weekly Intake of 200 ug methylmercury for a person of 70 kg body weight remains a valid recommendation in the light of presently available data. Based on present data on fish consumption in the Mediterranean area and concentration of methylmercury reported in fish, as mentioned in paragraph 3 above, it is considered that a part of the population in the Mediterranean area may have an intake of methylmercury through seafood which exceeds the WHO PTWI. However, the major part of the population is believed to have an intake below the WHO PTWI.

Therefore it should be recommended that the total intake of methylmercury through seafood should be limited to protect segments of population believed to exceed the WHO PTWI.

In principle, this may be achieved through various options:

(a) Advice on dietary intake, including:

  (i) choice of fish species;
  (ii) frequency and number of fish meals;
  (iii) other sources of protein.

(b) The establishment of standards which limit the mercury concentration in:

  (i) all seafood; or
  (ii) selected species used as seafood.

(c) Restrictions on the size of fish allowed for consumption for certain species where certain concentrations are known to be a function of fish size.

(d) The banning or limitation of fishing in certain areas for all or selected species used as seafood.

(e) Limitation of anthropogenic mercury discharges.

Member States have to choose from these or any other possibilities, evaluating the efficacy, costs and benefits of alternative actions for each of the specific situations.

Table 3 gives the pros and cons of possible administrative action that could be taken.

It is considered that the information list herebelow will significantly assist in selecting and formulating the appropriate regulatory action.

(a) Evaluation of all available data to select populations likely to have a high intake of methylmercury.

(b) Studies of mercury levels in hair in populations thus selected, to identify groups whose methylmercury intake exceeds the WHO PTWI.

(c) For each group thus identified, further studies should be performed to determine:

  (i) the size of the group;

  (ii) the patterns of individual consumption of seafood;

  (iii) the actual concentrations of methylmercury in various species consumed.

Table 3 : Pros and cons of administrative action that could be taken to reduce mercury intake by risk populations

Possible administrative measures to reduce mercury exposure	Pros	Cons
I. Measures addressed to the fishery (indirect)		
Establishment of standards in all seafood	Equal handling of all seafood; rejection of commodities with contaminant levels higher than the action level from the market according to enforcement	High costs of monitoring system as prior condition of enforcement; little chance of enforcement for those with direct access to the resource, such as fishermen; thus, little protective effect and negative on the fishery and the marketing of fish products in general or of selected species
Establishment of standards in selected species	More specific towards only some or few species; reducing enforcement costs	
Restriction on the size of fish allowed for consumption for certain species in which Hg concentrations are known to be a function of size	Reduction of amount of commodities that need to be rejected from the market or discarded from the catch; reduction of enforcement costs; could partly be achieved through mesh size regulation	Difficult to enforce due to high appreciation of big specimens
Ban or limit fishing in certain areas	Selective exclusion or reduction of availability of seafood species from 'hot spot' areas to consumers	Difficult and costly to enforce if many large areas are affected; possible negative side effect of reduced fishing pressure could be increase in average size of the specimens and of the total fish population with subsequent migration due to increased intraspecific competition
II. Measures addressed to the anthropogenic mercury discharge (indirect)		
Limit anthropogenic discharges of Hg	Reduce the number of anthropogenic 'hot spots' in which seafood tend to have elevated mercury levels because of contaminant discharge	Since anthropogenic discharge of mercury accounts for a minor part of total Mercury in the Mediterranean, control measures towards the sources alone cannot solve this problem.

continues

Table 5 continued.

Possible administrative measures to reduce mercury exposure	Pros	Cons
III. Measures addressed to seafood consumption (direct)		
Advice on dietary intake: Choice of species	No necessity to reject any fish or shellfish with relation to mercury levels, but spread the distribution of species with known high mercury levels, substitute them by species with lower levels as much as possible	Food consumption patterns are generally very conservative and taste preferences are particularly difficult to change: requires costly information campaigns, if large populations have to be addressed
Advice on dietary intake: Frequency of fish meals and other available sources of protein	As above; reduce the frequency of consumption especially of species with high mercury load and substitute by other sources of protein	In view of easy and cheap accessibility, a reduction in total seafood consumption or in some species is difficult to achieve unless the message convincingly comes across and either low level fish species or other protein sources become as readily available

(d) As the human foetus is considered to be the most sensitive target special attention should be given to the estimation of methylmercury intake by pregnant women.

It is considered that the effectiveness of any governmental regulatory actions mentioned above would need to be evaluated by follow-up biological monitoring of hair for mercury.

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