WHO-EM/PEH/562/E

Report on the

ROPME/WHO workshop on microbiological monitoring of coastal waters

Teheran, Islamic Republic of Iran
27 July–2 August 2006

World Health Organization
Regional Office for the Eastern Mediterranean

Document WHO-EM/PEH/562/E/05.07/157

CONTENTS

1. INTRODUCTION

Surface and coastal waters are used for a variety of activities including leisure, food production, the generation of hydroelectricity, as a medium for transport and as a repository for sewage and industrial waste. These activities are not always compatible with each other. The recreational use of water may provide a significant financial benefit to certain communities but it also has implications for health and the environment. Water-based recreation and tourism expose individuals to a variety of health hazards, ranging from bathing in potentially contaminated water through to exposure to the sun and UV light. Trends indicate that leisure activities, including water-based recreation, will continue to increase. The effects of the health hazards that recreational water users face are likely to gain more prominence in the future, and therefore, those that are responsible for monitoring and managing recreational waters are likely to face increasing challenges as the number of users increase and recreational uses diversify.

To address these issues the World Health Organization (WHO) Regional Office for the Eastern Mediterranean and the Regional Organization for the Protection of the Marine Environment (ROPME) held a joint training workshop on microbiological monitoring of coastal recreational waters in Teheran, the Islamic Republic of Iran, from 27 July to 2 August 2006. The main objectives of the workshop were to:

- provide practical training in selected methods for monitoring coastal recreational waters and associated quality assurance and quality control; and
- provide information on WHO initiatives in this field.

The message of Dr Hussein Gezairy, WHO Regional Director for the Eastern Mediterranean, was delivered by Dr Houssain Abouzaid, Coordinator, Healthy Environment Programme. Dr Gezairy welcomed the participants to the intercountry training workshop and thanked the representatives of ROPME, particularly its Executive Secretary, Dr Abdul Rahman Al Awadi, for their valuable support in organizing the training workshop.

Dr Gezairy said that while no comprehensive worldwide statistics existed for the health effects of using waters for recreational purposes, an abundance of indicators pointed to a rise in the number of incidents and the number of people affected and to the preventability of this disease burden. The *WHO Guidelines for safe recreational water environments*, the first ever international guidance on the subject, are comprised of two volumes: Volume 1: *Coastal and fresh waters* issued in 2003 include the derivation of guideline values or conditions and explain the basis for the decision to derive or not to derive them. WHO very recently produced Volume 2 of these guidelines, which dealt with swimming pools and similar environments.

Dr Gezairy noted that WHO's collaborative programme with ROPME had included two joint training workshops on microbiological methods for monitoring coastal recreational waters, held in Kuwait in 1998 and 2002. The present workshop was a follow-up to the previous meetings. This illustrated the approach taken by the WHO Regional Office to

concentrate its activities on the matter of marine pollution on dissemination of technical guidelines and cooperation with relevant regional sea programmes.

Dr Gezairy referred to the consultation to plan the preparation of the WHO water quality guidelines for desalination convened in Manama, Bahrain, in May 2001, jointly by ROPME, the United Nations Environment Programme (UNEP), Regional Office for West Asia (UNEP/ROWA), and WHO. A 3-year plan of action to finalize the WHO guidance document on desalination for safe water supply by the end of 2006 or early in 2007 was being implemented after the Regional Director for the Eastern Mediterranean had decided to use his own development funds for that purpose. The draft guidance was being peer reviewed and should be available within a few months for public review.

Dr Gezairy said that the purpose of the present workshop was to present the relevant WHO guidance; to review up-to-date microbiological methods for monitoring coastal recreational waters and associated quality assurance and quality control procedures; to select those that were the most relevant to the monitoring programmes in the subregion; to demonstrate in practical sessions how to execute these tasks correctly; and to show the constraints involved in seawater microbial testing. He said he hoped that when the participants returned to their respective countries that they would ensure in-service training for those already working in the field in order to disseminate the information and skills acquired during the workshop.

The workshop was attended by 27 participants from ROPME Member States. Support was provided by WHO staff from the Regional Office for the Eastern Mediterranean. A list of references and ISO international standards, the programme, the list of participants and the participants' evaluation of the course are included as Annexes 1, 2, 3 and 4 respectively.

2. TECHNICAL PRESENTATIONS

2.1 Water recreation and disease

Dr Houssain Abouzaid, Coordinator Healthy Environment Programme

Globalization and changes in human behaviour have increased the use of water for recreational purposes. Recreational users of water may be at risk of serious and potentially fatal diseases. In addition to disease with severe primary disease outcomes (e.g. typhoid, leptospirosis), a number of infections may lead to sequelae with serious consequences. Susceptible populations including people with reduced immune function or lack of immunity to locally-endemic diseases (e.g. tourists) are at higher risk of contracting severe illnesses. Different group of users of coastal and freshwater recreational water environments need to be considered when assessing the health risk associated with recreational waters; children are at particular risk.

In the process of preparing the *WHO Guidelines for safe recreational water environments* the scientific evidence concerning the health issues associated with using waters for recreational purposes was reviewed, including all major epidemiological studies investigating the health effects from exposure to recreational water conducted between 1953

and 1996. It was concluded that there is an association between gastrointestinal symptoms, acute febrile respiratory illness (AFRI) and indicator-bacteria concentrations in recreational waters. In addition, globally, an estimated 382 000 people die annually from drowning, 97% of these deaths occur in developing countries. Other injuries include brain, head, arm, hand, leg, foot and toe injuries.

WHO recently published a review entitled *Water recreation and disease plausibility of associated infections: Acute effects, sequelae and mortality*. This book presents an analysis of potential disease outcomes associated with recreational water activities, including factors that lead to disease severity and pathogen-by-pathogen summaries of health aspects and the evidence of association with recreational water exposure.

2.2 Introduction to the WHO guidelines for safe recreational water environments

Dr Houssain Abouzaid, Coordinator Healthy Environment Programme

The primary aim of WHO guidelines in the area of health and environment is the protection of public health. Volume 1 of the *WHO Guidelines for safe recreational water environments* deals with coastal and fresh waters and describes the present state of knowledge regarding the impact of recreational use of coastal and freshwater environments upon the health of users, specifically, drowning and injury, exposure to cold, heat and sunlight, water quality, contamination of beach sand, exposure to algae and their products, exposure to chemical and physical agents and dangerous aquatic organisms. An important feature is that the guideline values for the microbiological quality of marine recreational waters are proposed in conjunction with associated levels of accepted health risk based on the relationship between the concentration of the microbial indicator (that is, intestinal enterococci) in coastal waters over one bathing season and the burden of diarrhoeal disease associated with sea bathing. This approach stresses the need for more precise and more reliable microbial analysis of recreational coastal water.

Volume 2 of the guidelines deals with swimming pools and similar recreational water environments. It provides an assessment of the health hazards associated with recreational waters of this type; their monitoring and assessment and measures for their control through the education of users, good design and construction and good operation and management. The document addresses a wide range of types of hazard, including hazards leading to drowning and injury, water quality, contamination of associated facilities and air quality.

Both volumes of the guidelines are intended to be used as a basis for the development of international and national approaches (including standards and regulations) to controlling the health risks from hazards that may be encountered in recreational water environments, in addition to providing a framework for local decision-making. The guidelines may also be used as reference material for industries and operators preparing development projects in recreational water areas as a checklist for understanding and assessing potential health impacts of recreational projects, and in the conduct of environmental impact and environmental health impact assessments in particular.

It should be clear that when a guideline is exceeded, the main action is to investigate the cause of the failure, to identify the likelihood of future failure, to assess the possible corrective measures and to liaise with the authorities responsible for public health to determine the best course of action.

2.3 Current legislation/guidelines regarding recreational water monitoring: European Commission (EC), WHO and the United States Environmental Protection Agency (USEPA)

Dr Katherine Pond, WHO Temporary Adviser

There are global standards and guidelines in use around the world. Recent changes to the European Commission (EC) bathing water directive were implemented based on the results of epidemiological studies undertaken to establish the link between swimming in sewage-polluted waters and minor illnesses. The WHO guidelines were derived from these studies. It is important that microbiological parameters are monitored as a measure of health protection. Over 100 types of enteric viruses have been identified from human faeces and sewage. Isolation and identification of some of these viruses is impossible or difficult. Indicator organisms for signalling the presence of pathogens are used although there are advantages and disadvantages of the most commonly-used indicator organisms: *E. coli*, total coliforms and faecal streptococci. Faecal streptococci (intestinal enterococci) is the most suitable indicator for marine waters, and *E. coli*, the most suitable for fresh waters.

2.4 Introduction to laboratory procedures

Professor Athena Mavridou, WHO Temporary Adviser

The programme for the practical sessions was outlined and the methods summarized. Practical problems in the laboratory resulted in alterations to the initial programme. The importance of using standard ISO methods was emphasized and participants were trained to use the following methods:

- ISO 9308-1. Detection and enumeration of *Escherichia coli* and coliform bacteria using membrane filtration method, 1990.
- ISO 9308-1. Detection and enumeration of total coliforms, *E.coli*, 1999.
- ISO 7899-2. Detection and enumeration of intestinal enterococci, 2002.
- ISO 6579. Detection of *Salmonella spp.*, 2004.

2.5 Sampling bathing waters

Dr Katherine Pond, WHO Temporary Adviser

Certain steps need to be taken in order to set up a monitoring programme for recreational waters. WHO and the United States Environmental Protection Agency (USEPA) collaborated in producing an improved monitoring method for recreational bathing areas. This method is unique in that it combines microbiological sampling of the water with a sanitary survey of the associated land to identify potential sources of pollution. The protocol results in a classification system for bathing waters based on a combination of microbiological water quality and the results of a sanitary survey. The importance of carrying out a sanitary survey

was stressed in order to identify all potential sources of pollution and thus allow corrective measures to be undertaken.

It is important that water samples are taken correctly with no contamination and the correct procedures are followed for the storage and transportation of the sample to the laboratory in light of the survival characteristics of indicator organisms.

2.6 Quality assurance in the laboratory

Professor Athena Mavridou, WHO Temporary Adviser

Certain steps need to be followed to establish a quality assurance scheme in the laboratory performing water microbiology. The basic reference document is the document published by the European Accreditation body (EA 04/10, 2002). The factors affecting the reliability of results in the laboratory include: the lack of homogeneity in the distribution of the bacteria in the water (poison distribution); instability of the bacteria and the production of non-culturable forms; the sampling transfer and storage; the planning of the laboratory and the environmental monitoring; the training competence and control of the personnel; the maintenance, quality control and calibration of the laboratory equipment; the quality control of the culture media; the creation of control charts; the use of reference materials and reference strains; the use of the proficiency testing schemes and the specification of schemes dealing with water samples for microbiology, the control of the culture media at the reception; and the preparation and use of the results.

2.7 Accreditation of microbiological laboratories

Professor Athena Mavridou, WHO Temporary Adviser

The accreditation of laboratories in line with ISO 17025 is of vital importance. There are specific requirements for the accreditation of water microbiological laboratories both in the managerial and technical sections.

There are articles dealing with management in the laboratory requiring document control and confidentiality; the establishment of improvement criteria and customer satisfaction; special procedures on contracting and subcontracting, actions for nonconforming actions; procedures for the identification, access, storage, maintenance and disposal of quality and technical records; and the conducting of internal audits. The technical requirements of the standard relate to the capacity of the personnel, the planning of the laboratory, the selection, validation and verification of methods, the calculation of the uncertainty of methods and the calibration of the equipment.

3. GROUP WORK

Practical sessions were undertaken each day. Due to practical problems in the laboratory the participants worked in four groups instead of individually as planned. This is the reason why no intercallibration exercise on statistics was performed as not enough data were produced. Two ISO methods for the detection of coliform bacteria (total coliforms, faecal coliforms and *E. coli*) were practised by the participants using two media for total coliforms.

Unfortunately, only one culture medium was available for faecal coliforms due to practical problems in obtaining the second media proposed. One method for the detection of *Salmonella spp.* was practised by the participants. Unfortunately, due to some difficulties in obtaining the media required there was a shortage of time and one method for the detection of enterococci was demonstrated by the trainers rather than practised by the participants. For the purposes of the training, samples were spiked with strains provided by the laboratory and reference materials produced by the Health Protection Agency (HPA), United Kingdom (UK), and provided by the invited experts. Appropriate dilutions were undertaken in order to meet the requirements of the international regulations. Each step of the method the reasons for using spiked samples, the calculation of presumptive results followed by confirmed results and the expression of the results were thoroughly explained, demonstrated and discussed. For practical reasons the method for the detection of *Salmonella spp.* did not include the detection of *S. typhi, S paratyphi A* and *S. paratyphi B.*

3.1 Preparation of samples, dilutions and filtrations

Two water samples, spiked with reference materials (sample A: average concentrations of 50 coliforms/100 ml, and sample B: average concentrations of 500 coliforms/100 ml), were diluted using peptone water. One decimal dilutions were prepared. Participants were shown how to undertake membrane filtrations as described in the ISO methods.

Using samples A and B:

- Total coliforms: (a) 10 ml and 100 ml of sample A were filtered and plated onto mLSA media and incubated for 24 hours at 37°C.
  (b) 10 ml and 100 ml were filtered and plated onto m-endo agar and incubated for 24 hours at 37°C.
- Faecal coliforms/*E. coli*: (a) 10 ml and 100 ml of sample A were filtered and plated onto mLSA media and incubated for 24 hours at 44°C.

3.2 The use of reference materials

A demonstration was carried out on the use of reference materials. Several types of reference materials provided by the invited experts were demonstrated for their recovery, types and use.

3.3 Confirmation

Participants selected plates with between 20 and 80 colonies.

Total coliforms: all yellow colonies on the mLSA agar and m-endo agar were counted and recorded as presumptive results.

Two confirmatory tests were undertaken for faecal coliforms/*E. coli*:

- (a) the oxidase test. One colony from the mLSA agar was subcultured into lactose broth and incubated at 37°C for 24 hours.
- (b) One colony grown on the mLSA agar and one from the m-endo agar were subcultured into tryptophan broth and incubated at 44°C for 24 hours.

For intestinal enterococci Slantez and Bartley agar was used and samples were incubated at 37°C for 44 hours. (This method was demonstrated rather than practised by the participants due to lack of time.)

3.4 Calculation of results

- Faecal coliforms: Production of gas in the lactose broth confirmed the colonies as faecal coliforms.
- *E. coli*: A few drops of Kovacs reagent was added to the typtophan broth. A pink ring confirmed the results as *E. coli*.
- Intestinal enterococci: The membrane was transferred onto previously prepared bile esculine azide agar and incubated at 44°C for 2 hours. A black ring around the colonies confirmed the results as intestinal enterococci.

3.5 *Salmonella spp.*

100 ml of sample C was filtered and incubated in 90 ml of peptone water for 24 hours at 37°C. One tube containing 10 ml of RVS broth was inoculated with one colony and incubated at 41.5°C for 24 hours. Following incubation one plate containing XLD medium was inoculated with a colony and incubated at 37°C for 24 hours. The first step of confirmation with TSI agar was inoculated and incubated at 37°C for 24 hours. A demonstration on the use of API galleries was undertaken. These are biochemical tests used to confirm the presence of *Salmonella*. Serological confirmation with the use of polyvalent antisera was demonstrated.

The results show the reliability and ease of use of the methods used. Most of the participants did not have a background in microbiology but obtained consistent results with each other and against expected results. The results also support the use of intestinal enterococci as a robust and reliable indicator of faecal pollution under environmental conditions. This indicator is now recommended by WHO and others as the most suitable indicator for recreational coastal waters and the WHO guidelines are based on this.

4. NATIONAL MONITORING PROGRAMMES

Participants were given the opportunity to present their own national experiences of microbiological monitoring of recreational waters. Very few countries were undertaking such analysis at present but several participants showed an interest in setting up monitoring programmes following the training course.

4.1 United Arab Emirates country report

Mohammed Ali Al Hussain, Environment Officer, Fisheries, Environment Protection and Safety Section

The municipality of Dubai conducts inspections of physical conditions for swimming pools as well as coastal lagoons and areas. Samples are taken by inspectors and delivered to the Dubai central laboratory where they are analysed for chemical and biological parameters. Monitoring is carried out weekly and the results are sent to the concerned department for action. Every city in the United Arab Emirates is responsible for environmental issues and there is sharing and an exchange of information between local emirates.

Swimming pools are inspected regularly for chemical parameters and microbiological analysis is undertaken by the Dubai central laboratory.

The inspection of lagoons and coastal monitoring is undertaken once a week by a certified member of staff of the Department of the Environment. Chemical parameters are analysed automatically by Áutolab or a mobile laboratory unit. Analysis is also conducted by the Dubai central laboratory.

4.2 National experience of Bahrain in the monitoring of recreational waters

In response to increasing public concerns, fresh water in swimming pools in Bahrain is subjected to annual microbiological monitoring. Action has been taken against the owners of swimming pools who violate WHO guidelines.

Recently, the quality of coastal waters bordering the areas proposed for development as resorts (dramatically spreading around the country) is assessed as part of the environmental impact assessment (EIA). Permission is granted only when the microbiological investigations of recreational waters show compliance with WHO and European Union (EU) standards and guidelines and directives.

Bahrain has recently launched a project aimed at establishing the health impact assessment (HIA) to be undertaken in parallel with the EIA. The HIA shall hopefully facilitate more efficient and efficient management of recreational waters which should also include continuous monitoring programmes.

4.3 Kuwait's Environmental Protection Agency monitoring programme for the marine environment

In common with many countries Kuwait has developed a marine monitoring programme in response to environmental events, proposed constructions in the coastal zone or suspected risks to human health and the quality of the marine environment from anthropogenic activities.

Such monitoring programmes provide useful data on the state of the environment in terms of water, biota quality (including their hydrocarbons, trace metals, nutrients and organic matter content), bottom sediment, bathing beach quality and harmful algal blooms.

The Environmental Protection Agency has three departments involved in the monitoring of waters in Kuwait: the water pollution monitoring department which is divided into two sections (chemistry and microbiology); the living resources department which takes samples for examination of phytoplanktons, zooplanktons and meiofauna; and the marine pollution monitoring department which is responsible for the in situ sampling and sample collection of coastal and seawater.

The microbiology section of the water pollution monitoring department analyses samples for coastal and seawater from 12 and 13 stations, respectively. The water is analysed for total coliforms, faecal coliforms, faecal streptococci and *salmonella spp.* by membrane filtration. *Clostridium perfringens* and fungi are also analysed. WHO/ROPME methods are followed for media selection and quality control and assurance.

Bathing water samples are collected weekly from 12 stations and seawater samples monthly from 13 stations located in Kuwait Bay and the Kuwait coastline. The Environmental Protection Agency has set some standards for bathing waters and ambient water quality.

It is hoped that ROPME can arrange external quality assessment (proficiency testing) for micro laboratory, and also conduct more training courses for microbiological monitoring of seawater, sediments, fish and biota.

4.4 Oman

Monitoring of coastal waters in Oman is carried out by the Ministry of Regional Municipalities, Environment and Water Resources. The aim of the monitoring programme is to carry out a proper inspection of the status of the environment to ensure safe use of seawater. Environmental inspectors are assigned to regulate water quality and safety. Furthermore, strict standards have been set through many ministerial orders for the proper disposal of sewage treated effluent to seawater. The Director General of Environmental Affairs conducts studies on the ecology of coastal areas, and all aspects of conservation and protection are well documented. The recommendations have been strongly implemented. However, the sampling of coastal water is not conducted through regular programmes. Representative samples are sent to the laboratory occasionally when certain events take place, such as the sudden death of fish or turtles. This is mainly due to the lack of established standards and specifications of the quality of coastal waters.

4.5 Islamic Republic of Iran: Mazandran province, Gilan, Golestan

Mazandran province, Gilan and Golestan have a long coastal zone in the north of the Islamic Republic of Iran, heavily frequented by people for visits and bathing. Sources of pollution include industry and residents who use the rivers and coastal zone for the discharge of wastewater.

Four types of water sample testing are conducted in the laboratory: total coliforms and faecal coliforms by MPN, streptococcus by membrane filtration according to the standard method and the ROPME's manual method samples such as freshwater, river water and Abbandan's water (wetland), mineral water and coastal water.

Some additional parameters for water sample testing include fungi and parasites in coastal waters. Recently GPS and GIS have been used for monitoring in order to identify the centre of the sources of contamination and following this establishment of a master plan and the development of water management plans.

5. EVALUATION OF THE COURSE

Evaluation forms were distributed to participants. Overwhelmingly, the 25 participants agreed that the course had fulfilled its objectives and was either adequate or excellent. Annex 4 provides details of the evaluation results.

6. DEVELOPMENT OF REGIONAL AND NATIONAL COASTAL WATER MONITORING STRATEGIES AND PLANS

Following discussions regarding current national monitoring programmes and laboratory facilities in each country, it was agreed that ROPME would lead the establishment of a pilot project to set up monitoring programmes throughout the Region. ROPME will undertake the necessary administrative arrangements and each participant was encouraged to support the initiative.

Regarding training in the future, it was agreed that the most productive approach would be to hold training courses every couple of years to train regional coordinators who would then return to their respective countries and train the local laboratory staff. Follow-up visits in countries could be made by international consultants as required and requested by ROPME.

Annex 1

REFERENCES

WHO. *Guidelines for safe recreational-water environments: coastal and freshwaters.* Draft for consultation. Geneva, October 1998.

WHO. *Health-based monitoring of recreational waters: the feasibility of a new approach (the Annapolis Protocol).* WHO/SDE/WSID99.1. Geneva, 1999.

European Accreditation 2002: EA-04/10 Accreditation for microbiological laboratories.

ISO 17025: General requirements for the competence of testing and calibration laboratories, 2005.

ISO 8199: Water quality general guidance on the enumeration of micro-organisms by culture, 2005.

ISO 7899-1. Water quality: detection and enumeration of intestinal enterococci Part 2: membrane filtration method, 2000.

ISO 9308-1. Water quality: detection and enumeration of coliform organisms, thermotolerant coliform organisms and presumptive *E.coli*: Part 1: membrane filtration method, 1990.

ISO 6340. Water quality: detection and enumeration of *Salmonella*, 1995.

ISO 19458 Working document. Water quality sampling. General guide for sampling, transport, preservation and handling of samples for microbiological analysis, 2002.

Bartram J and Rees G. *Monitoring bathing waters. A practical guide to the design and implementation of assessment and monitoring programmes.* Published on behalf of WHO, CEC and EPA by E and FN Spon, 2000.

Lightfoot NF and Maier EA. *Microbiological analysis of food and water: Guidelines for quality assurance.* Elsevier, 1998.

Pond K. *Water Recreation and Disease. Plausibility of associated infections: Acute effects, sequelae and mortality.* Published on behalf of WHO by E and FN Spon, 2006.

Annex 2

PROGRAMME

Saturday, 29 July 2006

09:30–10:30	Opening session
10:30–11:30	Health risks associated with recreational environments *Dr Houssain Abouzaid, Coordinator, Healthy Environment Programme, WHO/EMRO*
11:30–13:30	Introduction of the *WHO Guidelines for safe recreational environments* *Dr Houssain Abouzaid, Coordinator, Healthy Environment Programme, WHO/EMRO*
13.30–14.30	Current legislation/guidelines regarding recreational water monitoring: EC, WHO and USEPA *Dr Kathy Pond, WHO Temporary Adviser*
14:30–15:30	Introduction to laboratory methods *Dr Athena Mavridou, WHO Temporary Adviser*
15.30–17.00	Practical session. First stage of *Salmonella* detection *Dr Athena Mavridou* and *Dr Kathy Pond, WHO Temporary Advisers*

Sunday, 30 July 2006

09:00–09:45	Sampling bathing waters (including factors such as spatial and temporal variation of indicators) *Dr Kathy Pond, WHO Temporary Adviser*
09:45–11:00	Quality assurance in the laboratory *Dr Athena Mavridou, WHO Temporary Adviser*
11:30–13:30	National experiences in sea water monitoring and national requirements
13:30–17:00	Practical session *Dr Athena Mavridou* and *Dr Kathy Pond, WHO Temporary Advisers*

Monday, 31 July 2006

09:00–09:45	Laboratory accreditation *Dr Athena Mavridou, WHO Temporary Adviser*
09:45–17:00	Practical session (Results from previous day for coliforms, faecal coliforms, *E.coli* and *Salmonella spp.* second step. Confirmation for coliforms, faecal coliforms. *E. coli*) *Dr Athena Mavridou and Dr Kathy Pond, WHO Temporary Advisers*
09:00–11.00	Practical session *Dr Athena Mavridou and Dr Kathy Pond, WHO Temporary Advisers* Reading the confirmations for the coliforms group Reading and confirmation for the enterococci. *Salmonella spp.* third step *Salmonella spp.* final step
11:30–12:30	Discussion of results of practical work and evaluation of workshop Lead *Dr Houssain Abouzaid, Coordinator, Healthy Environment Programme, WHO/EMRO*

Wednesday, 2 August 2006

09:00–12:30	Development of regional and national coastal water monitoring strategies and plans *Dr Hassan Mohammadi, Coordinator, ROPME*

Annex 3

LIST OF PARTICIPANTS

BAHRAIN

Mr Ali Abdul Shahid Fardan
Laboratory Technician
Public Commission for the Protection of Marine
Resources, Environment and Wildlife

Mr. Abdulqader Khamis
Senior Environmental Specialist
Public Commission for the Protection of Marine
Resources, Environment and Wildlife

ISLAMIC REPUBLIC OF IRAN

Ms Mozhgan Niroomand
Laboratory Staff
Department of the Environment
Environmental research centre, Bandar Anzali

Mr Abdolshaker Mirshakkak
Manager
Mahshahr Marine Environment Office
Department of Environment Mahshahr, Khouzestan

Ms Fariba Sarabi
Marine Biology Expert
Marine Environment Bureau
Department of Environment
Teheran

Mr Gholamabbas Rezai
Marine Pollution Expert
Marine Environment Bureau
Department of the Environment
Teheran

Mr Isaac Zamani
University Instructor
Department of Marine Biology
University of Marine
Science and Technology
Khoramshahr

Ms Shabnam Mollakarami
Laboratory Staff
Laboratory Bureau
Department of the Environemtn
Teheran

Mr Ghasem Ghorbanzadeh Zaferani
Laboratory Staff
Laboratory Bureau
Department of the Environment
Teheran

Mr Siavash Shamsipour
Head of Laboratory
Hormozgan Provincial Office
Environmental Research Centre
Department of the Environment
Resalate Jonobi. Bandar Abbas

Ms Soghra Eskandari
Laboratory Staff
Laboratory Bureau
Department of the Environment
Teheran

Ms Somayeh Danesh Monfared
Bushehr Provincial Office
Department of the Environment
Bushehr

Mr Ali Ghaemi
Marine Environment Expert
Golestan Provincial Office
Department of Environment

Mr Seyyed Mohsen Kazemitabar
Laboratory staff
Mazandaran Provisional Office
Department of the Environment
Mazandaran

Ms Zohreh Kasmaee
Laboratory Staff
Laboratory Bureau
Department of Environment
Teheran

KUWAIT

Ms Fatima Mohammad Malallah
Director of Water Pollution Monitoring Department
Environment Public Authority
Kuwait

Mr Mohamed Ghloom M. Ali
EPA Marine Pollution Monitoring Department
Kuwait

OMAN

Ms Jamilla Ali Masoud Al-Hinai
Head of Microbiology Laboratory
Food and Environment Monitoring Centre
Ministry of Regional Municipalities
Environment and Water Resources
Muscat

Mr Abdullah Masoud Al Obeidani

QATAR

Ms Sara Ali Al Shahwani
Biology Laboratory Technician
Qatar environmental Central Laboratory Reserves
Doha

Mr Alwaleed Fadol Alsalahi
Supreme Council for the Environment and Natural Reserves
Doha

Ms Deena Al-Abdulla
Environmental specialist
Qatar petroleum
Environmental and sustainable development
Doha

Mr Sadiq Ghuloom Faraj Abdulla
Qatar Petroleum
Environmental Affairs and Sustainable Development
Doha

SAUDI ARABIA

Mr Ali Saeed Al-Ghubari
Environmental Specialist
Dahran City

Mr Taha M. Makki Almaimani
Environmental Specialist
Ministry of Defence and Aviation
Presidency of Meteorology and Environment
Natural Resources Department

UNITED ARAB EMIRATES

Mr Mohamed Alzarouni
Senior Fish Specialist
Umm Alquwain

Mr Mohamed Ali Hashem
Environment Officer
Fisheries

ROPME Secretariat

Dr Hassan Mohammadi
Coordinator
ROPME

WHO Secretariat

Dr Houssain Abouzaid, Coordinator, Healthy Environment Programme, WHO/EMRO
Dr Kathy Pond, Researcher, WHO Consultant, WHO/EMRO
Dr Athena Mavridou, Professor of Microbiology

Annex 4

PARTICIPANTS' EVALUATION OF THE COURSE

The evaluation was considered to be of adequate length (both the theoretical and practical components) by the majority of the participants. Some participants did not feel that the laboratory facilities were adequate, but the majority agreed that the facilities were acceptable. Tables 1 and 2 show the evaluation results.

Table 1. Presentations which were found most useful by the participants

Aspect (Participants from the Islamic Republic of Iran)	**Number of mentions**
Sampling bathing waters	9
Quality assurance in microbiological laboratories	6
Introduction to laboratory methods	6
Aspect (Other participants)	
Quality assurance in microbiological laboratories	10
Introduction to laboratory methods	6
Sampling bathing waters	4

Table 2. Presentations which were found least useful by the participants

Aspect (Iranian participants)	**Number of mentions**
Guidelines/legislation	3
Health risks associated with recreational water environments	1
Quality assurance in microbiological laboratories	1
Aspect (Other participants)	
Guidelines/legislation	2
Health risks associated with recreational water environments	1
National presentations	1

There were many suggestions for presentations which may also have been included: field work (sampling), identification methods for bacteria, new techniques in microbial analysis, case studies, rapid methods for microbial analysis, data presentation and risk assessment.

Regarding the laboratory work, all participants found the work acceptable, with eight finding the sessions excellent. Table 3 shows the aspects of laboratory work which were found most useful by the participants.

Table 3. Laboratory work found most useful

Aspect (Participants from the Islamic Republic of Iran)	Number of mentions
Methods for total and faecal coliforms	4
Methods for *Salmonella*	3
Identification methods for bacteria	1
Sterilization of the laboratory	1
Presentation of results	1
Aspect (Other participants)	
Methods for *Salmonella*	5
Methods for total and faecal coliforms	4
Quality assurance in the laboratory	2

Table 4 shows the aspects of the laboratory work that participants would like to have seen included. Table 5 shows proposed future activities suggested by the participants.

Table 4. Laboratory work which may have been included

Aspect (Participants from the Islamic Republic of Iran)	Number of mentions
Waterborne diseases	4
Other methods (non ISO, MPN)	2
Parasitology	1
More on sampling and dilution techniques	1
Confirmation methods	1
Laboratory safety	1
Differentiation tests for Vibrio and Pseudonomas	1
Enhanced digestion of oil by bacteria	1
Aspect (Other participants)	
New techniques in laboratory analysis	2
Proficiency testing for microbiology laboratories	1
Virology and mycology tests	1
Management aspects	1
Case studies	1

Table 5 shows the proposed future activities suggested by the participants

Aspect (Participants from the Islamic Republic of Iran)	Number of mentions
Field work (sampling)	3
More workshops on bathing waters	2
Microbiology of industrial sewage	1
Development of laboratory manual	1
Inter-laboratory calibration	1
Freshwater microbiology	1
Aspect (Other participants)	
Field work (sampling)	3
New techniques in laboratory analysis	3
More workshops on bathing waters	2
Risk assessment	1
Industrial wastewater monitoring	1
Quality assurance	1
Microbiology of sediments, fish and biota	1
Microbiology of drinking-water	1