UNITED
NATIONS

EP

United Nations
Environment
Programme

UNEP(W)/EAS WG.4/2
14 August 1996

Original: ENGLISH

EAST ASIAN SEAS ACTION PLAN

Land-Based Oil Discharges to Coastal Waters:
Ecological Consequences and Management Aspects
Training Workshop

Penang, 22-26 April 1996

REPORT OF THE TRAINING WORKSHOP ON LAND-BASED OIL DISCHARGES TO COASTAL WATERS: ECOLOGICAL CONSEQUENCES AND MANAGEMENT ASPECTS

RCU/EAS TECHNICAL REPORTS SERIES NO. 9

Prepared in cooperation with:

The Free Hanseatic City of Bremen

Carl Duisberg Gesellschaft e.V.

UNEP
Bangkok, 1996

UNITED NATIONS

EP

United Nations Environment Programme

UNEP(W)/EAS WG.4/2
14 August 1996

Original: ENGLISH

EAST ASIAN SEAS ACTION PLAN

Land-Based Oil Discharges to Coastal Waters:
Ecological Consequences and Management Aspects
Training Workshop

Penang, 22-26 April 1996

REPORT OF THE TRAINING WORKSHOP ON LAND-BASED OIL DISCHARGES TO COASTAL WATERS: ECOLOGICAL CONSEQUENCES AND MANAGEMENT ASPECTS

RCU/EAS TECHNICAL REPORTS SERIES NO. 9

Prepared in cooperation with:

The Free Hanseatic City of Bremen

Carl Duisberg Gesellschaft e.V.

UNEP
Bangkok, 1996

PREFACE

This document is the report of the *Training Workshop on Land-based Oil Discharges to Coastal Waters: Ecological Consequences and Management Aspects,* under the project ES/1100-96-19 (EAS-39) of the same name. The Workshop was the fourth in the COBSEA-approved series on Biological Effects of Pollutants. The EAS-39 project was funded by the Bremen State Office for Development Cooperation, Germany as a contribution towards the development of the East Asian Seas Action Plan. The workshop was organized by the Regional Coordinating Unit for the East Asian Seas Action Plan (EAS/RCU) in cooperation with the Department of Environment (Ministry of Science, Technology and Environment), Malaysia, and in close collaboration with the Bremen State office for Development Cooperation, Germany and the Carl Duisberg Society (Carl Duisberg Gesellschaft/CDG), Bremen. Special thanks are due to the above-mentioned as well as the resource persons who contributed to the success of the Workshop.

TABLE OF CONTENTS

REPORT OF THE TRAINING WORKSHOP ON LAND-BASED OIL DISCHARGES TO COASTAL WATERS: ECOLOGICAL CONSEQUENCES AND MANAGEMENT ASPECTS (PENANG, MALAYSIA, 22 - 26 APRIL 1996)

INTRODUCTION

1. The impact of land-based activities on coastal and marine areas is one of the priorities of the *Action Plan for the Protection and Sustainable Development of the Coastal and Marine Areas of the East Asian Seas*. The Coordinating Body on the Seas of East Asia (COBSEA), as the intergovernmental decision-making organ of the Action Plan, has in the past approved the implementation of a number of projects addressing the issue of land-based activities.

2. The COBSEA, in anticipation of the follow-up of the decision of the United Nations Conference on Environment and Development (UNCED), implemented a project that led to a Regional Programme of Action to address the impact of land-based activities on coastal and marine areas. This document was presented to the 1995 Washington Conference as the Region's contribution.

3. As part of its continued follow-up on land-based activities and sources of pollution, in 1993 COBSEA also approved the implementation of a series of training workshops under the general title of the "Biological Effects of Pollutants".

4. Since then, three training workshops have been convened under this series in Phuket, Singapore and Townsville. The proceedings of these workshops are printed under the Technical Reports series of the Regional Coordinating Unit for the East Asian Seas Action Plan (EAS/RCU). They are:

(a) Proceedings of the UNEP Workshop on Biological Effects of Pollutants (EAS/RCU Technical Reports No.3);

(b) Proceedings of the Workshop on Soft-Bottom Benthic Communities as Indicators of Pollution-induced Changes in the Marine Environment (EAS/RCU Technical Report No.7); and

(c) Proceedings of the Workshop on Eutrophication in Tropical Marine Systems--The Impact and Management of Nutrient Pollution (EAS/RCU Technical Report No.8).

5. The Phuket Workshop was funded through the resources of the East Asian Seas Trust Fund. The Singapore and Townsville Workshops were funded from the UNEP Environment Fund allocations of the UNEP Regional Office for the Asia and the Pacific (UNEP/ROAP), as the Office's contribution towards the development of the East Asian Seas Action Plan.

6. The present workshop, as the fourth in the serious on "Biological Effects of Pollution", is funded by the Bremen State Office for Development Cooperation, Germany. In addition to covering the cost of the workshop, the Bremen State Office for Development Cooperation also covered the participation costs of three resource persons from Germany.

7. The workshop was organised by the Regional Coordinating Unit for the East Asian Seas Action Plan (EAS/RCU) in cooperation with the Department of Environment (Ministry of Science, Technology and Environment), Malaysia, and is close collaboration with the Bremen State office for Development Cooperation, Germany and the Carl Duisberg Society (Carl Duisberg Gesellschaft/CDG), Bremen. The programme of the workshop, including the subjects to be covered in a complementary manner by German resource persons and resource persons from the region, was worked out in advance (Annex II).

8. The workshop was convened in the Casuarina Beach Resort Hotel, Penang, during 22-26 April 1996.

9. The National Focal Points of each of the ten participating countries of the East Asian Seas Action Plan were invited to nominate two middle management decision-makers. It was recommended that one participant be from an Environment institution while the other be from an institution responsible for industry. In addition, the participating countries were also reminded that if they desired, they could send additional trainees provided their participation costs were covered by their own institutions. The National Focal Points were also requested to make certain that the participants prepared and presented a brief "Country Report" on the status of oil pollution from land-based sources.

10. A total of seventeen participants from Kingdom of Cambodia, P.R. of China, Indonesia, Malaysia, The Philippines, Singapore, Thailand, and S.R. of Vietnam attended the workshop. The list of participants (trainees) and resource persons is given as Annex I of this report.

11. This document is the report of the *Training Workshop on Land-based Oil Discharges to Coastal Waters: Ecological Consequences and Management Aspects*.

12. Other annexes of this report consist of the "Country Reports", as Annex III (see paragraph 9 above) and the papers presented by the various resource persons, as Annex IV.

OPENING OF THE WORKSHOP

13. Dr. Reza Amini, Coordinator of the UNEP RCU/EAS, on behalf of the Executive Director of UNEP, opened the workshop. After welcoming the participants he briefly referred to the East Asian Seas Action Plan and provided the background information with regards to the support from the Bremen State Office for Development Cooperation and the technical programming sessions. As the Secretariat of the Action Plan, on behalf of the participating countries of the region, he specifically thanked the Bremen State Office for Development Cooperation in funding this high priority programme of the COBSEA. He also expressed gratitude to the Malaysian authorities for helping to convene the workshop.

14. Mr. Manfred Bode, on behalf of the Bremen State Office for Development Cooperation, also addressed the participants. While welcoming the participants, he outlined his office's activities with specific reference to the region. He presented an overview of the project "Environmental Protection of Coastal Waters and Food Security" which was launched in 1995 as a joint project between the Federal Ministry for Economic Cooperation and Development, Bonn, Germany and the Senator of Ports, Transport and Foreign Trade, Bremen. It comprises long-term advanced training programmes, and a variety of short-term measures with a number of national and international partners such as UNEP's EAS/RCU. The project addresses a wide variety of aspects of integrated coastal zone management, with emphasis on the important linkage between environmental protection and economic development. He finally expressed his satisfaction and thanks for the efficient manner UNEP's EAS/RCU had coordinated the organization of the Workshop in a very tight schedule.

15. At the invitation of the Secretariat, Dr. Hartwig Kremer, Programme Manager of Carl Duisberg Society (CDG), Bremen, outlined the function and involvement of the CDG with regard to this workshop. He referred to the relevant and forthcoming activities within the CDG project and informed the participants about an international symposium and technology exhibition on "Socio-Economic Benefits of Integrated Coastal Zone Management (CZM)" to be held during

9 -14 December 1996, at the World Trade Center, Bremen. The event is to be conducted by CDG in cooperation with GKSS Research Center and supported, among others, by UNEP. The main goal of this Symposium will be to focus on new economic instruments as support to the successful implementation of Integrated Coastal Zone Management plans.

ELECTION OF THE FACILITATOR AND ORGANISATION OF THE WORKSHOP

16. The Secretariat presented the participants with a Provisional Agenda/Programmes and requested them to agree on a Facilitator so the Workshop is organised and coordinated in an efficient manner.

17. The Workshop adopted the Agenda/Programme with slight changes. The adopted Agenda/Programme is attached as Annex II of this report. The participants also agreed that Dr. Beverly Goh and Dr. Hartwig Kremer function as the Facilitators of the workshop and Mr. Valdemar Holmgren with the assistance of the other resource persons help in the compilation of the report of the Workshop.

CONDUCT OF THE WORKSHOP

18. The Secretariat stressed that the success of the Workshop depended on a participatory approach. It was requested that after each resource person's presentation, the participants endeavour to relate the topic addressed to relevant experience(s) from their countries, specifically discussing relevant national policy, legislation, enforcement issues, and possible gaps in them. Furthermore, it was requested that the participants, based on the addresses and discussion, outline recommendations for specific follow-up activities and discuss potential project concepts.

WORKING SESSIONS

19. Dr. Beverly Goh initiated the week's working sessions by giving a lecture on the main issues related to the land-based sources of oil pollution. She stated that based on the most accurate estimates, approximately 75% of marine and coastal pollution is from land-based sources, underscoring the significance of the UNEP Global Programme of Action (GPA) for the Protection of the Marine Environment from Land-based Activities. GPA was adopted in November/December 1995 Washington Conference and includes a specific category for oils (hydrocarbons). Recommended activities of the GPA include:

(a) National actions, policies and measures;

(b) Regional actions, including regional agreements, cooperation, regional plans, regional reception facilities; and

(c) International actions including strengthening and standardisation of inventories and assessments in collaboration with international organisations, as well as cooperation by financial, technical and scientific support.

20. Dr. Goh then focused on the effects of oils on biological communities. She stressed that these detrimental effects could easily develop from causing harm on an individual level (organisms) to causing it on a community level, through disturbances in reproduction cycles.

21. In the second lecture, by resource persons from the region, Professor Law expanded on the topic of the impact of oil on the coastal and marine flora and fauna. He presented the results of studies he and his team carried out in the Straits of Malacca, which is one of the busiest routes for marine traffic, including oil tankers, in the world. These studies were designed to assess the extent of damage of petroleum hydrocarbons on living organisms and ecosystems the tropical waters. The studies indicate that the water-soluble fraction (WSF) of Malaysian crude oil is highly toxic to phytoplankton, macroalgae, seagrasses, crustaceans, and fish. Phytoplankton in the Straits of Malacca were found to be sensitive to petrogenic hydrocarbons even at the very low concentration of 3 ppm. The acute toxicity of WSF crude oil to shrimp larvae was found to be 16 ppm. On the basis of these studies, the research team suggested that an interim water quality standard of 1 mg/l WSF crude oil should be recommended for protecting marine organisms in the region.

22. After the orienting lectures, the participants from each country were invited to present their "Country Report", focusing on the national aspects of land-based sources of oil pollution. It was expected that the "Country Reports" include overviews of the impact on land-based oil pollution on the living marine resources, the management and legislation issues, and institutional and protection measures. With this background information it was hoped that the resource persons could respond directly to specific national issues raised and there would be free interaction between the resource persons and the participants. The country reports presented are reproduced as Annex III of this report.

23. A short discussion session followed the country presentations. Prior to the discussion, the Secretariat suggested that it would be useful if the participants, during the exchanges discussed the common problems of oil discharge to waterways and the seas from land-based sources. One such issue, prevalent throughout the region, is the discarding of used motor vehicle engine and transmission oils, and the associated risks of these entering urban waterways and eventually coastal and marine waters. It was also pointed out that discussion of these common problems could lead to follow-up recommendations at the end of the Workshop.

24. Most of the second day's working session was taken up with presentations by Mr. Karl van Bernem, GKSS Research Centre, Germany, on various aspects of, and relevant experiences related to the land-based sources of oil discharge in Europe, with particular emphasis on the North Sea. Prior to presentation of the "European" experiences as a "case study", however, an overview of the fluxes and fates of the discharged oil in water was presented. In this part of the presentation, the fate of the discharged oil was related to the oil type, weather and water conditions, and the three main paths of oil degradation were discussed in depth. It was pointed out that photo-oxidation, photolysis and microbial degradation were the most important pathways. It has been shown that when oil is introduced in seawater, oil-degrading bacteria increase in number and become abundant. The concentration of these bacteria increase in an environment with higher levels of oxygen and other nutrients as well as higher water temperatures. Therefore, in tropical waters such as Malacca Straits, oil degrading rates are much quicker than in colder climates (e.g. the North Sea). At the same time, however, particularly in warmer tropical waters, some of the products of oxidation and degradation are more toxic to organisms than the oil itself.

25. The presentation then focused on the type and various components of the discharged oil. Water-soluble components of crude oil and refined products include a variety of compounds that are toxic to a wide spectrum of plants and animals. Aromatic compounds are more toxic than aliphatic, and medium molecular weight components are more toxic than high

molecular weight tars. Diesel fuel, with a high aromatic content, is therefore much more damaging than bunker vessel fuel and weathered oil, which have a low aromatic content.

26. To illustrate the subject further, examples of the environmental impact of oil on living resources in the North Sea area were given for different organisms such as barnacles and salt-marsh vegetation. As further examples of oil impact on living organisms, it was shown that bottom-living (benthic) communities were affected by offshore oil rigs for a distance of approximately 5 km. The scale of impact often depended on the type of the polluted habitat. In coastal areas the fate of the oil was dictated by the coastal geomorphology, which affected the impact on flora and fauna. For example oil deposited on rocky shores is to a large extent removed through wave action, whereas in soft substrata, oil components may drain down into the sediments, where low oxygen concentrations hinder bacterial degradation of the oil which, therefore retains its toxicity for a longer period.

27. In the last part of the presentation, an overview was given of existing international policies in relation to prevention and control of oil pollution and pollution by oil-industry-related products and services. Regional agreements such as the Paris and Oslo conventions were presented in more depth. The Paris Convention entered into force in 1978 and covers the control of all discharges into the sea from land-based sources, through rivers, oil platforms, the atmosphere, or directly from the surrounding coasts.

28. Finally, the ongoing local European initiatives in support of Agenda 21 with regard to oil pollution were presented. These included (i) the provision of reception facilities for the disposal of ship waste (a manual submitted by Germany to the Marine Environment Protection Committee) and (ii) reduction of hydrocarbon content in refinery effluent, and reduction of sulphur emissions in oil production (Germany). The participants were informed that in Germany there is a system to collect used oils (e.g. from vehicle engines, lubricant) at certain collection points where oil can be deposited free-of-charge. The charges for central collection is covered in the purchase price of these oils.

29. The Director of the Department of Environment in Penang, Ms. Raja Rokiah Raja Saigon, gave a presentation on the Penang perspective of land-based oil discharges. After an introduction with a socio-economic profile on Penang, she described the sources and extent of land-based oil discharges. She then went on to outline the Malaysian environmental laws regulating these discharges. The participants were informed that the Department of Environment (DOE) monitors Penang's coastal waters through a monthly monitoring programme at 25 sampling stations. The DOE has an inventory of all industrial activities and their discharges, although oil discharges from other sectors are not well recorded. In Malaysia, the Environmental Quality Act is the main legislation in place to prevent, abate, and control pollution from land-based oil discharges. Currently there are only two licensed facilities in Malaysia however, that handle, treat, and recover oil. The types of the oil accepted are mainly hydraulic oil, spent oil or grease, and coolant oil.

30. Based on the country presentations and the detailed presentation of the "European" experience and the local (Malaysian) example, the workshop participants held lengthy discussions and exchanges with the resource persons. A consensus emerged on the importance of defining standard values for permitted levels of oil discharge, and also of defining standard data sampling methods for the region. It was agreed that clear definitions were needed in the use and presentation of data, i.e. for "mean values", where the period of time in these factors is not always clarified. On a less technical, just but as important issue, the participants were reminded of the importance of community involvement at local level in order to control and improve the situation of illegal oil discharge to coastal waters. On the question

of public awareness and participation, many participants spoke of continuing difficulties despite an increase in environmental education at schools.

31. The working sessions of the third day began with Mr. Michael Muller of the Kary GmbH, who provided an in-depth presentation of "Waste Water Treatment Plants for Oil-containing Effluent". Mr. Muller stressed the importance of selecting the right treatment method to solve specific problems. It was pointed out that waste water containing mineral oil is discharged by a large number of industries sites such as: crude oil exploitation and shipment, petrochemistry, metal processing, steel mills, ship yards, train stations, airports, washing stations for vehicles, trains and tanks, fuel stations, fillings of stabilising tanks in ships, bilge water, contaminated surface runoff, contaminated rain and storm, water etc. In addition, vegetable and animal oil and grease come from the food processing industry. Therefore, effluent may vary considerably in quantity and quality. It is crucial to identify the level and type of contamination or pollution in order to treat it with the appropriate technique.

32. The presentation then focused on various forms of "oil in water" effluent. Oil emulsions in water are known to be the most difficult form of oil-polluted water to treat. To complicate the situation, all forms of oil can occur together in one effluent, where each form needs specific treatment technology. For example, dispersed oil must be separated from oil emulsions because chemicals for treating the emulsion will affect the dispersed oil and lessen its value.

33. Mr. Muller pointed out that although stronger legislation is being developed, 90% of waste water problems, including oil pollution, could be solved with approximately 40% of the investment. Waste water technology cannot, however, tackle residuals from treatment of oil polluted water, such as sludge. This would demand a centrally located receiving facility and integrated administration.

34. After addressing the introductory issues, Mr. Muller went on to present the main applicable technology methods such as gravity, flotation, coalescence, membrane, thermal, biological, and their optimum application. He underlined that, although there is effective technology for combating oil in water pollution, there is a need in every case to consider the economic point of view, as well as environmental impact, when developing a solution. Another priority is also the need to involve the residuals that are produced in each process in the choice of treatment combination.

35. In closing this section of the Workshop, Mr. van Bernem presented an example of the German "nil contingency plan", the "Thematic Mapping and Sensitivity Study of the German Wadden Sea". The resulting environmental sensitivity index allows a spatial and temporal differentiation of Wadden Sea areas, with regard to salt marsh and benthic communities, as well as to the distribution of bird and fish species. The various ecosystem components or species (*Arenicola* worms, mudflat crabs, etc.) have their own "sub-values", i.e. feeding, breeding, for each habitat type within the ecosystem. The various values are then aggregated to form a Sensitivity Index. This varies within each main habitat and within the whole area, depending on the sum of the components.

36. Discussion during the third day's sessions included various topics such as how valuation appraisals of the Wadden sea area could be carried out, the present level of development of biodegrading bacteria and the critical issue of planning and managing toxic sludge from oil and waste water treatment facilities. The dangers of poorly planned landfills for toxic sludge was also discussed.

37. During the afternoon the workshop participants visited a waste water treatment station located at Loji Pembersihan Pantai Utara. This is a twenty-year-old station which caters for 20,000 people, and is presently in the process of renovation and not yet fully operational. It is one of 142 plants in Penang whose management has been handed over from local government to a private firm as part of a programme to keep an efficient level of waste water treatment in Penang, where coastal tourism is an important source of income.

38. In the next session of the Workshop, the needs of "Hydrocarbon Monitoring" were presented in depth with respect to the problems of quantification and intercalibration. After a short summary of common analytical methods (IR, UV, GC and GC-MS) and their field of application, Mr. van Bernem introduced QUASIMEME (Quality Assistance of Information for Marine Environmental Monitoring in Europe). The lecture closed with a discussion of the possibilities and problems of chemical and biological monitoring methods with regards to benthic communities, bio-markers, etc., and their applicability in the East Asian Seas countries.

39. Management issues of marine and coastal development were presented by Mr. Valdemar Holmgren. Emphasis was placed on the biodiversity values of the region's natural resources, which should encourage the nations to adopt effective Integrated Coastal Management (ICM) plans, and enforce their implementation. First the concept and the principles of an ICM plan were outlined, followed by guidelines and strategy on how to transfer ICM theories to action. It was stressed that conservation of the coast and marine living resources of the East Asian Seas region is a matter of global significance, as it is now established that this region is the world centre of marine biodiversity. As the per capita availability of marine resources dwindles in the East Asian Seas region's heavily populated coasts, environmentally harmful and illegal practices increase drastically in the absence of efficient management measures.

40. Within the concept of ICM, the importance of incorporating watershed management issues into the formulation of policies and legislation for coastal planning, and in the development of ICM plans was stressed. It was pointed out that the integrated management of watersheds and their related coastal areas and ecosystems is essential to achieving efficient control of land-based sources of pollution, including oil.

41. Dr. Zulfigar Yasin, Coordinator, Marine Research Centre, Universiti Sains Malaysia, Penang, presented a paper touching on various aspects of oil pollution at the national level and illustrated (supported by colour slides) these issues with the situation of Penang. It was pointed out that although Malaysia had developed and established environmental legislation that should be adequate in dealing with various situations, the limiting problem was proper enforcement of the legislation. An additional difficulty was the fact that coastal issues below the low-water mark are handled by State Government Authorities and issues above the low-water mark are handled by National Government Authorities. In conclusion he accentuated the importance of community interests in achieving efficient coastal natural resource management, for their conservation and sustainable use.

42. The following discussion session concentrated on the formulation of suggestions for follow-up activities for the Workshop, based on the drafts that had been initiated earlier during the working sessions. The Secretariat stressed that there was a great need for equal emphasis on ecological as well as economic investment in formulating recommendations. The Workshop participants were requested to refine their suggestions and present their recommendations for detailed discussions on the last day of the Workshop.

WORKSHOP'S RECOMMENDATIONS

43. The final working session of the Workshop was a review of the revised follow-up suggestions which were presented by each country and thereafter discussed in order to sort out redundancies. In view of the vast differences between the ten participating countries of the East Asian Seas Action Plan in the degree of development, planning and implementation of ICM, manpower and financial resources. It was decided that the recommendations for follow-up activities should not be prioritised. They are presented in twelve groups (A-L) as proposed by the participants of each country and resource persons.

A)
- To strengthen the capacity building for theoretical and practical training;
- To support environmentally sound technology transfer;
- To develop and improve penalty law and enforcement;
- To establish appropriate regional standard for oil pollution; and
- To ensure all projects are implemented with appropriate Environmental Impact Assessment.

****

B)
- To support regional emphasis for capacity building and transfer of environmental sound technologies;
- To establish a National Coordinating Unit (NCU) in each member country to monitor pollution from land-based sources, for regional coverage;
- To support the regional development of a synchronised monitoring methodology and strategy;
- To establish database networking, sharing and storing;
- To support the development of environmental accounting and auditing in regard to coastal resources and ecosystem in the region.

****

C)
- To develop environmental management combat strategies;
- To develop coastal management measures for protecting coastal resources and for ensuring the sustainable use of renewable resources;
- To establish an information network, in order to support the development of an environmental sensitivity-index atlas and the development of a GIS data base.

****

D) - To support capacity building for marine and coastal management.

- To support the establishment of centres and programmes of excellence at national and at regional levels concerning conservation and sustainable use of marine and coastal ecosystems.

- To develop a monitoring system for land-based pollution of coastal and marine areas.

- To encourage the collection, analysis and interpretation of information on the status of marine and coastal ecosystems.

- To support the strengthening of national (Integrated Coastal Management) (ICM) plans and management of biodiversity and habitats.

- To support regional legal and enforcement measures.

****

E) - To support policy development and capacity building for planning and management of coastal ecosystems ecological and biodiversity;

- To support technical training of staff;

- To support the formulation of regional standards;

- To support transfer of technology to assist clean treatment and disposal of oil;

- To support the development and involvement of NGOs.

****

F) - To develop the regional standardisation of Monitoring Programmes, including the standardisation of the procedures and analyses within such programmes.

****

G) - To formulate and implement detailed cooperation programmes between countries of the EAS Region, and between these states and Europe, for the development of networking, demonstration sites, and pilot projects, and for database establishment.

****

H) - To develop a National Data Base;

- To support the installation of pollution control for Waste Water Treatment Facilities through *inter alia*, subsidies, tax incentives;

- To strengthen cooperation through the creation of a Regional Coordinating Unit;

- To establish standards (sampling, analysis, intercalibration exercises).

- To develop and implement Pilot Projects for the purpose of in-depth analysis of the extent of oil pollution.

- To organise a follow-up training workshop regarding economic valuation or environmental accounting for land-based oil pollution.

****

I) - To implement National Standardization Measures.

- To give priority to the adoption of policies which enable practical management and control of oil pollution by, for example Three-stage control, namely planning control, project implementation control and operational control.

- To implement the above-mentioned strategy in a manner best suited to the structure of local and national governments.

- To support training to enable countries to acquire and expand expertise.

- To support activities for harmonising and adopting common standards, as well as practices in sampling and analysis.

- To support the development of environmental sensitivity index of coastal resources.

****

J) - To support regional standardisation of monitoring methods, including threshold values and intercalibration .

- To network through the establishment of National Coordinating Units (NCUs), comprising, *inter alia*, the following:

  (a) National environmental authorities
  (b) Scientists
  (c) Technology Centres
  (d) Representative Socio-economists
  (e) NGOs

- To develop capacity building and training, including, *inter alia*:

  (a) appropriate technology (operation and maintenance)
  (b) management
  (c) economic accounting / environmental resource accounting
  (d) training of trainers
  (e) exchange of scientists

- To strengthen national cooperation between universities, polytechnics and institutes, and cooperation between Europe and national universities and polytechnics.

- To support regional cooperation with the existing German - Malaysian and German - Singapore Institutes, and to expand their training programmes to include environmental engineering.

- To develop instruments for Environmental Accounting for Environment Economics, which should become part of the planning procedure and EIA.

- To support national establishment of demonstration sites as Pilot Projects, for the implementation and development of ICM, i.e:

  (a) identify national focal areas or projects
  (b) prepare a sensitivity index of the ecosystem (biodiversity)
  (c) prepare a monetary assessment of resources and utilisation strategies and environment impact
  (d) check the legal basis
  (e) define analytical standards and quality standards for monitoring and control
  (f) select the most appropriate technology for waste water treatment and control (i.e. minimise the impact)
  (g) finalise it in a feasibility study
  (h) implement the project

****

K) - To support the integration of watershed management issues when formulating policy, development and management plans.

****

L) - To strengthen cooperation on the local level to developing and implementing a local Agenda 21.

****

CLOSURE OF THE WORKSHOP

44. The Workshop was closed by the representatives of UNEP and the Bremen State Office for Development and Cooperation. In their closing remarks they thanked the participants for their contribution to the Workshop, and the Government of Malaysia for hosting it. Both representatives gave special thanks to the resource persons.

ANNEX I

LIST OF PARTICIPANTS

Kingdom of Cambodia

Mr. Pich SAM ANG

Engineer of Irrigation and Water Supply, Chief of Wetlands
Ministry of the Environment
48 Samdech Preah Sihanouk
Tonle Bassac, Chamkamon
Phnom Penh, Kingdom of Cambodia

Tel: (85-5) 234 27894
Fax: (85-5) 234 27844

Mr. Ouk SISOVANN

Assistant Minister
Ministry of Environment
No 48 Sandech Preach Sihanouk
Tonle Bassac, Chamkarman
Phnom Penh
Kingdom of Cambodia

Tel: (85-5) 234 27894
Fax: (85-5) 234 27844

The People's Republic of China

Ms. CHEN Shuying

Professor
Water Transportation Research Institute
The Ministry of Communications
No. 48 Beisanhuan Zhonglu Road
Beijing 100088
The People's Republic of China

Tel: (86-10) 201-3399
Fax: (86-10) 201-1659

Mr. YAN Hongbang

Professor
Director of Marine Division
National Environmental Protection Agency
No. 115 Xizhimennei Nanxiaojie
Beijing 100035
The People's Republic of China

Tel: (86-10) 616-5635 ext. 5728
Fax: (86-10) 615-1762

Mr. WANG Yamin

Engineer
Ministry of Agriculture, Bureau of Fishery
Division of Environmental Protection
No. 11 Nongzhanguan Nanli
Beijing 100026
The People's Republic of China

Tel: (86-10) 500-2369, 419-2929
Fax: (86-10) 500-2448, 419-2961
Telex: 22233 MAGR CN
Cable: 7625 BEIJING

Indonesia

Ms. Mustikorini INDRI.J

Staff to the Assistant Minister 1
Ministry of State for Environment
Jl. Merdeka Barat no. 15
Jakarta 10110
Indonesia

Tel: (62-21) 350-7632, 384-6122
Fax: (62-21) 384-6031

Ms. UMIRUSYANAWATI

Staff to the Assistant Minister 1
Ministry of State for Environment
Jl. Merdeka Barat no. 15
Jakarta 10110
Indonesia

Tel: (62-21) 350-7632, 384-6122
Fax: (62-21) 384-6031

Malaysia

Mr. AHMAD Ismail

Assistant Environmental Control Officer
Department of Environment (Penang)
5th & 6th Floor, Wisma Peladang
Jl. Kampong Gajah
12200 BUTTERWORTH
Malaysia

Tel: (604) 333-4441
Fax: (604) 331-6078

Mr. SYED MADHI Syed Junaidi

Environment Control Officer
Department of Environment, Malaysia
13th Floor, Wisma Sime Darby
Jalan Raja Laut
50662 KUALA LUMPUR
Malaysia

Tel: (60 3) 294-7844
Fax: (60 3) 293-1480
e-mail: madhi@jas.sains.my

Philippines

Ms. Teresitha Pamela LIAO

Senior Environmental Management Specialist
Environmental Management Bureau
3rd Floor, Topaz Building
99-101 Kamias Road, Diliman
Quezon City, Metro Manila
Philippines

Tel: (632) 924-7540
Fax: (632) 924-7540, 635-7418

Ms. Adelaida ROMAN

Engineer IV
Environmental Management Bureau
3rd Floor, Topaz Building
99-101 Kamias Road, Diliman
Quezon City, Metro Manila
Philippines

Tel: (632) 924-7540, 928-3773
Fax: (632) 924-7540, 635-7418

Singapore

Mr. POON Chiew Tuck

Executive Engineer
Pollution Control Department
Ministry of the Environment
Environment Building 40
Scotts Road #12-00
Singapore 228231

Tel: (65) 732-7733, 731-9672
Fax: (65) 738-4468, 731-9651

Thailand

Mr. Peeraphol TEJAJATI

Environmental Official, Transportation Section
Environmental Impact Evaluation Division
Office of Environmental Policy and Planning
Soi Phibun Wattana 7
Rama VI Road
Bangkok 10400
Thailand

Tel: (66-2) 279-2792, 279-4765
Fax: (66-2) 271-3226

Mr. Jullapong THAVEESRI

Environmental Engineer
Hazardous Waste Inspection Sub-Division
Office of Industrial Environmental Management
Department of Industrial Works
Ministry of Industry
75/6 Thanon Rama VI
Phayathai, Bangkok 10400
Thailand

Tel: (66-2) 202-4235
Fax: (66-2) 202-4226

Socialist Republic of Vietnam

Mr. Do Ngoc QUYNH

Director Deputy
Marine Environment Center (CMESRC)
224 Doi Can, Hanoi
Socialist Republic of Vietnam

Tel: (84-48) 326-195, 326-382
Fax: (84-48) 333-039

Mr. Hua Chien THANG

Director Deputy of Division
National Environment Agency
39 Tran Hung Dao, Hanoi
Socialist Republic of Vietnam

Tel: (84-48) 242-510
Fax: (84-48) 251-518, 252-733

Mr. Pham Toan THANG

Expert of the Science, Technology
and Environment Department
Vietnam Oil and Gas Corporation
(PETROVIETNAM)
22 Ngo Quyen Street
Hanoi
Socialist Republic of Vietnam

Tel: (84-48) 252-526
Fax: (84-48) 265-942, 249-126

RESOURCE PERSONS

Mr. Karl Heinz van BERNEM
GKSS Research Centre
Max-Planck Straße
21502 Geesthacht
Germany

Tel: (49-4152) 671-884
Fax: (49-4152) 871-888

Ms. Beverly GOH
Project Manager
SARCS Secretariat
Institute of Environmental Research
Chulalongkorn University
Bangkok 10330
Thailand

Tel: (66-2) 218-8126
Fax: (66-2) 255-4967
e-mail: gohb@netserv.chula.ac.th
gohbpl@chulkn.chula.ac.th

Mr. Valdemar Hvidt HOLMGREN
Consultant
Regional Coordinating Unit for
East Asian Seas Action Plan
United Nations Environment Programme
10th Floor United Nations Building
Rajdamnern Avenue
Bangkok 10200, Thailand

Tel: (66-2) 2881894
Fax: (66-2) 2678008

Mr. Hartwig KREMER
Project Manager
Carl Duisberg Gesellschaft e.V.
Burgermeister-Smidt-Strasse 82
D-28195 Bremen
Germany

Tel: (49-421) 16297-0
Fax: (49-421) 16297-20
e-mail: kremer.cdg@aldebaran.org

Mr. LAW Ah Theem
Professor
Fakulti Perikanan and Sains Samudera
Universiti Pertanian Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: (093) 948-6101 ext. 2504
Fax: (093) 948-2697
e-mail: law@ffms.upm.edu.my

Mr. Michael MÜLLER
Dipl. Ing.
KARY GmbH
Verfahrenstechnik
Hemelinger Hafendamm 18
D-28309 Bremen, Germany

Tel: (49-421) 4582-0
Fax: (49-421) 4582-321
Telex: 244128 Kary d

Ms. RAJA ROKIAH Raja Saigon
Director
Department of Environment (Penang)
5th Floor, Wisma Peladang
Jalan Kampung Gajah
12220 Buttworth
Penang, Malaysia

Tel: (604) 333-4441
Fax: (604) 331-6078

Mr. Zulfigar Bin YASIN
Co-ordinator, Marine Research Centre
Centre for Marine and Coastal Studies
Universiti Sains Malaysia
Penang 11800
Malaysia

Tel: (604) 657-7888
Fax: (604) 656-5125
e-mail: zulfigar.my@usm

REPRESENTATIVES OF THE UNITED NATIONS SYSTEMS AND OTHER ORGANIZATIONS

UNITED NATIONS ENVIRONMENT PROGRAMME

Mr. Reza AMINI
Acting Coordinator
Regional Coordinating Unit for
East Asian Seas Action Plan
United Nations Environment Programme
10th Floor United Nations Building
Rajdamnern Avenue
Bangkok 10200
Thailand

Tel: (66-2) 2812428
Fax: (66-2) 2678008
Telex: TH 82392 BANGKOK
e-mail: amini.unescap@un.org

Ms. Unchalee KATTACHAN
Secretary
Regional Coordinating Unit for
East Asian Seas Action Plan
United Nations Environment Programme
10th Floor United Nations Building
Rajdamnern Avenue, Bangkok 10200
Thailand

Tel: (66-2) 2881670
Fax: (66-2) 2678008
e-mail: kattachan.unescap@un.org
Telex: TH 82392 BANGKOK

THE SENATOR OF PORTS, TRANSPORT AND FOREIGN TRADE (STATE OFFICE FOR DEVELOPMENT COOPERATION), BREMEN

Mr. Manfred BODE
The Senator of Ports, Transport
and Foreign Trade
State Office for Development Cooperation
Martinistr. 24
D-28195 Bremen
Federal Republic of Germany

Tel: (49-421) 361-2878
Fax: (49-421) 361-2648

ANNEX II

WORKSHOP'S AGENDA/PROGRAMME

GENERAL

The Training Workshop will be conducted with the assistance of Resource Persons from the regional as well as from German institutions, including a representative from industry covering the examples of applicable, low cost technological solutions to the land-based oil discharge problems. The participants are expected to prepare and present brief national reports on the status of the land-based oil discharges, leading to discussion sessions and recommendations for potential mitigation measures and follow-up activities.

PROGRAMME

Sunday 21 April 1996

All day	Arrival in Penang
17:00 - 18:00	Registration

Monday 22 April 1996

08:00 - 08:30	Welcome and Background leading to the Workshop: Representatives of the EAS/RCU and Bremen State
08:30 - 09:30	Land-based sources of chronic oil discharges (general) *
9:30 - 10:30	Source and extent of land-based oil pollution and oil industry related wastes (Europe) **
10:30 - 11:00	*Coffee/tea break*
11:00 - 12:30	Impact of land-based oil pollution and oil industry based products on marines and coastal living resources, with specific reference to vulnerable coastal and marine ecosystems and the flora and fauna of the East Asian region *
12:30 - 13:30	*Lunch*
13:30 - 15:00	National status reports (15 minutes each) ***
15:00 - 15:30	*Coffee/tea break*
15:30 - 16:30	National status reports (15 minutes each) ***
16:30 - 17:30	General discussion on the day's topics with particular emphasis on the similarities and differences in sources and extent of land-based oil pollution in the region and Europe

Tuesday 23 April 1996

08:00 - 09:30	Fate of land-based oil discharges in coastal and marine environment: (dispersions, evaporation, biodegradation, pathways in benthic communities, etc.) **
09:30 - 10:30	Impact of land-based oil pollution and oil industry based products on marines and coastal living resources: riverain and estuarine systems, coral reef habitats and their assemblages, mud flats and flood plains in coastal zones and their communities, sand beach species and communities **
10:30 - 11:00	*Coffee/tea break*
11:00 - 12:30	Existing policies in relation to prevention and control of oil pollution and pollution by oil industry related products and services: examples from Europe **
12:30 - 13:30	*Lunch*
13:30 -15:00	Local initiatives in support of Agenda 21 (sustainable development and local problems - environment and economy): European examples **
15:00 - 15:30	*Coffee/tea break*
15:30 - 16:00	Local initiatives in support of Agenda 21 (sustainable development and local problems - environment and economy): Penang examples ****
16:00 - 17:00	General discussion on afternoon topics

Wednesday 24 April 1996

08:00 - 09:00	Examples of current industrial safety measures within the land-based petroleum industry and service industries (Lecture I): environmental management strategies (e.g. response to unforeseen events such as leakages, accident, etc.) *****
09:00 - 10:00	Examples of current industrial safety measures within the land-based petroleum industry and service industries (Lecture II): safety aspects of routine operations *****
10:00 - 10:30	General discussion on morning topics
10:30 - 11:00	*Coffee/tea break*
11:00 - 12:30	Development of environmental sensitivity index of coastal resource vulnerability in relation to hydrocarbon pollution (also drawing experience from other industries) **
12:30 - 13:30	*Lunch*
13:30 -17:00	Excursion/Field trip

Thursday 25 April 1996

08:00 - 09:00	Oil pollution from land-based sources and monitoring needs (Lecture I) ** : - parameters worth monitoring; - technological and analytical requirements; - common methods and standards; - intercalibration exercises and their evaluation; - development of a monitoring programme; and - monitoring and comprehensive regional assessment of oil contamination (national and regional\local examples)
09:00 - 10:00	Oil pollution from land-based sources and monitoring needs (Lecture II) ** : - parameters worth monitoring; - technological and analytical requirements; - common methods and standards; - intercalibration exercises and their evaluation; - development of a monitoring programme; and - monitoring and comprehensive regional assessment of oil contamination (national and regional\local examples)
10:00 - 10:30	*Coffee/tea break*
10:30 - 12:30	Management concepts for marine and coastal development activities (Lecture I) * : - principles of an integrated coastal zone management concept; - protection of coastal system functions and sustainable use of renewable resources; - resolving multiple resource-use conflicts (case histories, including oil pollution from land-based sources)
12:30 - 13:30	*Lunch*
13:30 - 15:00	Management concepts for marine and coastal development activities (Lecture II) * : - principles of an integrated coastal zone management concept; - protection of coastal system functions and sustainable use of renewable resources; - resolving multiple resource-use conflicts (case histories, including oil pollution from land-based sources)
15:00 - 15:30	*Coffee/tea break*
15:30 - 16:30	Development of a protocol for the control of the most significant land-based sources of oil pollution in the region **
16:30 - 17:30	General discussion on the days topics

Friday 26 April 1996

08:00 - 10:00	Recommendations regarding policies and national /regional/local strategies to combat land-based sources of oil pollution and follow-up activities
10:00 - 10:30	*Coffee/tea break*
10:30 - 12:30	Free for the participants. Finalization of the proceedings/report of the Workshop by the Secretariat and Resource Persons
12:30 - 13:30	*Lunch*
13:30 - 16:00	(Continue) Free for the participants. Finalization of the proceedings/report of the Workshop by the Secretariat and Resource Persons
16:00 - 16:30	*Coffee/tea break*
16:30 - 17:30	Presentation of the proceedings/report of the Workshop and its adoption
17:30	Close

----

* Presentation by Local Resource Persons
** Presentation by German Resource Persons
*** Presentation by Participants
**** Presentation by the Representative of Penang's Local Government/Authority
***** Presentation by Industries Representative

ANNEX III

Ministry of Environment
Department of Nature Conservation and Protection

Cambodia Country Report
For
Training Workshop on Land-based Oil Discharges into Coastal Waters: Ecological and Management Aspects

Penang 22-26 April 1996

Prepare by

Mr. Pich Sam Ang and Mr. Ouk Sisovann

1. CURRENT STATUS OF MARINE AND COASTAL ENVIRONMENT:

The main issues for the marine and coastal environment of Cambodia are:

- The intensive fishing by local people, and illegal and destructive fishing practices by foreign vessels, that have caused serious decline of fishstocks;

- The clear cutting of mangroves for salt field construction, intensive shrimp farming and charcoal production;

- The collection of corals for exportation to neighboring countries, mainly to Thailand;

- The pollution of coastal water is considered relatively slight, if compared with those in other countries, and caused rather by domestic waste water, than from the other sources.

In some provincial ports, such as Tumnub Rolork in Sihanouk Ville and Koh Sdach in Koh Kong Province, oil can be observed floating on the water surface. The exact amount of oil discharged into coastal waters is unknown due to the shortage of research, monitoring and analysis.

2. NATIONAL INITIATIVES

- Creation and designation of 23 Protected Areas system, totaling almost 4 million ha, of which 8 are in the 3 coastal provinces;

- Proposition of Koh Kapik (in Koh Kong) coastal wetland, as one of the three proposed Ramsar sites;

- Environmental law, including water pollution law, has been formulated and submitted for adoption by the National assembly.

3. INTERNATIONAL COOPERATIONS:

- Some projects have been implemented last year by MoE with financial support of UNEP through RCU/EAS, such as EAS-29 and EAS-35 projects;
- Master plan of development for the Cambodian coast had been implemented by MoE with technical, and financial support of ADB, and ESCAP;
- Attendances of MoE' representatives to many workshops, seminars, meetings, and Training courses on marine and coastal Environment Management and water pollution prevention (with support of UNDP, ESCAP, GEF, IMO, etc.).

4. MAJOR THREATS TO MARINE AND COASTAL ENVIRONMENT MANAGEMENT:

- Insecurity problem in some areas;
- Inadequate public understanding and awareness about environmental issues;
- Careless shipping activities;
- Heavy settlement;
- Inappropriate investment and development activities.

5. MAIN CONSTRAINTS:

- Lack of law enforcement policies and regulations on coastal water pollution;
- Absence of strict control and monitoring;
- Lack of experience and skills;
- Lack of funds;
- Limited assistance.

6. RISKS FOR FUTURE:

- Oil and gas extraction in the seashore areas might have harmful effects (biological impacts of oil pollution) to coastal resources (mangroves, coral reefs, seagrasses, shorebirds and other marine life);
- Concentrations of people (heavy settlement), and industry and manufacture development along the coastline may cause the pollution of coastal waters by waste water and oil spill;
- Intensive fishing activities and other unsustainable development practices (ports, hotels, bar-restaurants, salt pan and shrimp ponds, etc.), might cause alteration of marine and coastal environment, mainly degradation of coastal water quality.

- Deforestation of watershed areas and clear cutting of mangroves on intertidal areas may lead to serious degradation of the marine and coastal environment and a dramatic decline of marine life and coastal biodiversity.

RECOMMENDATION:

- Support and assistance (both technical and financial) for control, monitoring and research on oil pollution management in Coastal areas;
- Strengthening of institutional capacity for staff responsible for coastal and marine environment management;
- Support and assistance for public awareness improvement for effective conservation of marine and coastal resources;
- Development of law enforcement, policies, management and development plans, and pollution prevention programmes for all coastal areas;
- Creation of demonstration sites for marine pollution prevention in coastal areas of Cambodia.

Figure 1. Map of Cambodia

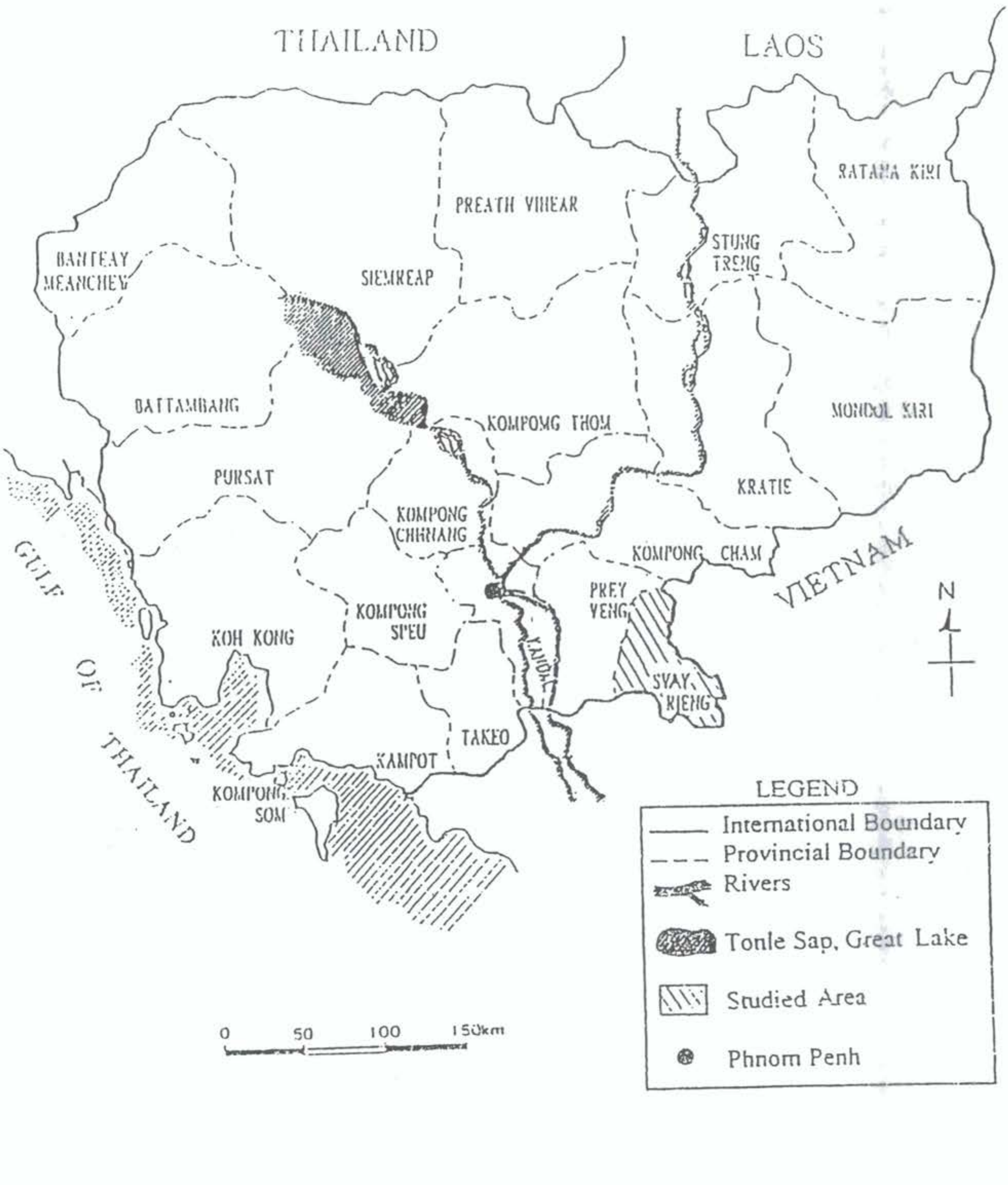
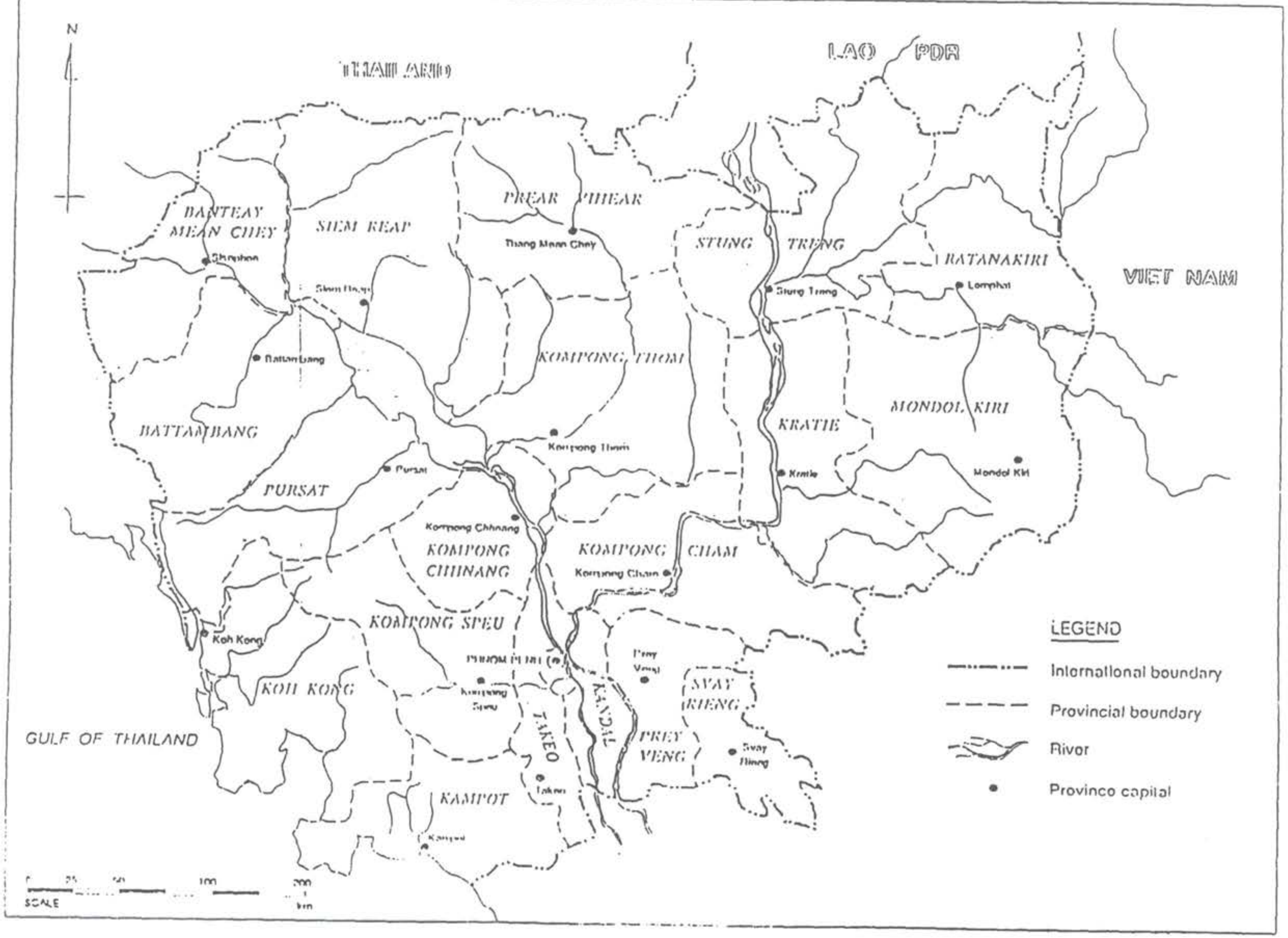


Figure 2. Cambodia Administrative Map



ANNEX IV

Report of the Extent and Impact of Land-based Oil Discharges into Coastal Waters of the People's Republic of China

1. INTRODUCTION

The report is to be submitted by NEPA of China to the Workshop on the Ecological Consequences of Land-based Oil Discharges to Coastal Waters under the EAS-39 Project sponsored by UNEP EAS/RCU.

In view of the time constraint, it is compiled by synthesizing available national information on oil pollution from land-based sources to outline the extent and impact of land-based oil discharges into coastal waters.

In this report, a general description of the physical features and hydrography of major river systems will be given, some remedial measures will be mentioned, and the inflow, extent and impact of land-based oil discharges into coastal waters will be presented.

2. STUDY AREAS

Geographical locations of coastal areas around the East China Sea, and South China Sea including related river estuaries, are shown in Figure 1.

The river estuaries are mainly from the rivers running into coastal areas of East China Sea and South china Sea, among which the major rivers are the Changjiang river, Qiantangjiang river, Minjiang river, Zhujiang river and Lancangjiang river.

There are more than 6500 islands in China, 60% of them are distributed in East China Sea and 30% in South China Sea. This report involves one island (Hainan Province).

3. MAJOR RIVER SYSTEMS

3.1 General

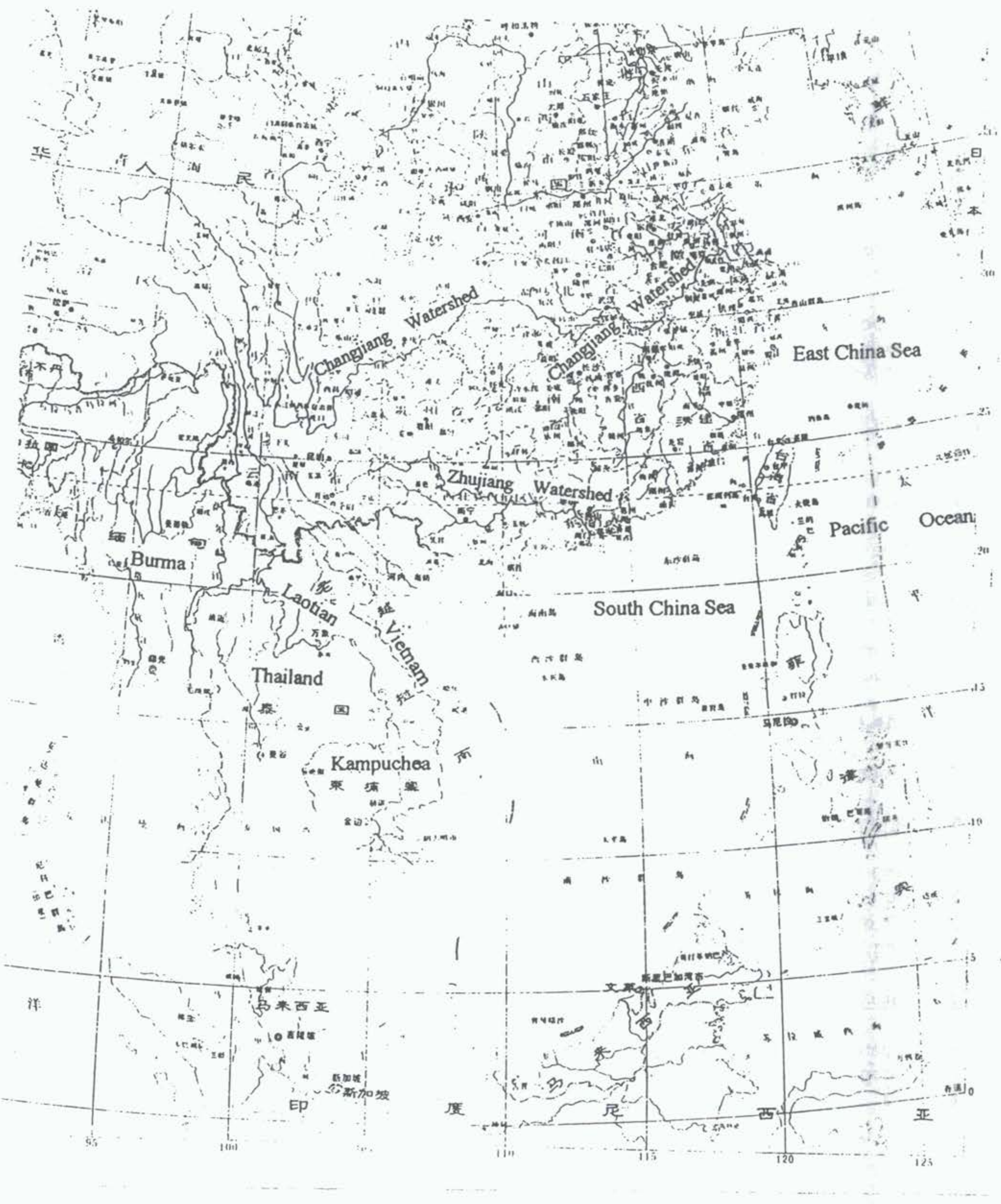
Changjiang river system

Changjiang river is the largest river in China, originating from Tanggula Shan in Qinghai Province. It runs across Xizang Autonomous Region, Sichuan, Yunnan, Hubei, Hunan, Jiangxi, Anhui and Jiangsu Provinces into the East China Sea. Its major tributaries are the Yalongjiang, Minjiang, Jialingjiang, Wujiang, Xiangjiang, Hanshui, and Ganjiang rivers.

Qiantangjiang river

Qiantangjiang river, the largest river in Zhejiang Province, runs into Hangshou Bay. Xinanjiang, Fenshuijinag, Jiangshangang, Wuxijiang, Linshangang, Jinhuajiang, and Puyangjiang are its major tributaries.

Figure 1 - Study areas in China



Minjiang river

Minjiang river, the largest river in Fujian Province, flows into the East China Sea. The main course of the river with its tributaries forms a network in a square shape.

Zhujiang river system

The watershed of Zhujiang flowing into the Lingding estuary is a complex river system including the vast system of the Xijiang and several smaller rivers including the Dongjiang, Peijiang, Tanjiang, Liuxi He and Zangjiang. Water bodies created and developed for irrigation and drainage purposes are also utilized for aqueculture, and in parts of the delta such ponds occupy 30-60% of the land. The watershed of the Zhujiang river covers 453,100 km_2, of which 441,530 km_2 is in China. An area of 11,600 km_2, constituting 2.56% is in Vietnam.

Lancangjiang river

The Lancangjiang river which is called Mekong River outside China is an international river and runs across the Indochina peninsula including Burma, Laos, Thailand, Cambodia and Vietnam.

The zone along the Lancang-Mekong River in China, Laos, Burma, and Thailand is abundant in water power and minerals, and large parts of this area supports tropical rain forest.

3.2 Physical Features

Physical features including watershed, length and volume discharge for the selected rivers are summarized in Table 1.

Table 1. Physical features

River	Water shed (km_2)	Length (km)	Volume discharge
Changjiang	1808500	6300	East China Sea
Qiantangjiang	54394	494	East China Sea
Minjiang	60992	577	East China Sea
Zhujiang	441530	2197	South China Sea
Lancangjiang	167486	1826	South China Sea

3.3 Hydrography

Table 2 and 3 show the hydrography and precipitation data of the rivers.

Table 2. Hydrography Data

Name	Flow (average annual m_3/s)	runoff (average annual x 10_8 m_3)
Changjiang	31060	9793.53
Qiantangjiang	1480	468.00
Minjiang	1980	623.70
Zhujiang	11070	3492.00
Lancangjiang	2410	760.00
Zhejiang, Fujian & Taiwan Provinces	--	2557.00

Table 3. Average annual precipitation Unit:mm

Location	1	2	3	4	5	6
Amount	60-1000	500-1200	600-2300	750-1500	1250-1750	120-1900

Table 3. Average annual precipitation (continued)

7	8	9	10	11	12	13
700-1700	800-1200	1800	850-1700	800-1900	> 1500	1200-1800

Note: #Places related to river systems (refer to Fig.1): 1 - Xiazang Autonomous Region, 2 - Sichuan, 3 - Yunnan, 4 - Hubei, 5 - Hunan, 6 - Jiangxi, 7 - Anhui, 8 - Jiangsu, 9 - Shanghai, 10 - Zhejiang, 11 - Fujian, 12 - Guangdong, 13 - Guangxi,
#Lancangjiang: 400 mm (upstream) up to 1400 mm (downstream).

3.4 Amount of Sand

Data on the sand content of water and the amount of sand transported in the water column are listed in Table 4.

Table 4 Sand content of water and annual average amount of sand

Name	Content (kg/m_3)	Annual average (million m_3)	Discharge into the sea (million m_3)
Changjiang	0.575	510	470
Qiantangjiang	0.1-0.4	--	--
Minjiang	0.135	7.5	--
Zhujiang	0.321	86.0	82.0
Lancangjiang	0.78	59.3	--

4. REMEDIAL MEASURES

4.1 Standards for Water Quality and Waste Water discharge

There are many National and Local standards for water quality and waste water discharge in China, including:

- National marine water quality standard of the P.R. China (GB 3097-82);
- National environmental quality stand for surface water of the P.R. China (GB 3838-88) (Integrated Waste water discharge Standard);
- National effluent standard for pollutants from petroleum exploitation industry of the P.R. China (GB 3550-82);
- National effluent standard for pollutants from ships of the P.R. China (GB 3552-83);
- National effluent standard for pollutants from petroleum and chemical industry of the P.R. China (GB 4281-84).

In this section, the national marine water quality standards of the People's Republic of China are described:

In order to support ecosystems and human-use, the national marine water quality standards in China establishes a three grade system.

Note that under the standards the coastal waters of grade I are suitable for protecting marine biological resources, salt-making, food processing, desalination and raising fisheries, coastal waters of grade II are suitable for swimming, sightseeing and entertainment, and coastal waters of grade III are suitable for industrial uses and harbors.

Table 5 National Marine Water Quality Standards (partial)

Items	Grade I	Grade II	Grade III
SS	10 mg/L or less	50 mg/L or less	150 mg/L or less
pH	7.5 - 8.4	7.3 - 8.8	6.5 - 9.0
COD	3 mg/L or less	4 mg/L or less	5 mg/L or less
DO	5 mg/L or more at any time	4 mg/L or more at any time	3 mg/L or more at any time
Toxic Substances: Max. concentration met with the requirements listed in Table 6.			

Table 6 Max concentration of toxic substances allowed in coastal sea

Items	Allowed max. concentration Unit: mg/L		
	Grade I	Grade II	Grade III
Hg	0.0005	0.0010	0.0010
Cd	0.005	0.010	0.010
Pb	0.05	0.10	0.10
T - Cr	0.10	0.50	0.50
As	0.05	0.10	0.10
Cu	0.01	0.10	0.10
Zn	0.10	1.00	1.00
Se	0.01	0.02	0.03
Oils	0.05	0.10	0.50
Cyanide	0.02	0.10	0.50
Sulphide	Refer to the standard of DO		
Volatile Phenol	0.005	0.010	0.050
Organochlorine Pesticide	0.001	0.020	0.040
Inorganic Nitrogen	0.10	0.20	0.30
Inorganic phosphorus	0.015	0.030	0.045

4.2 Distribution of Monitoring Points

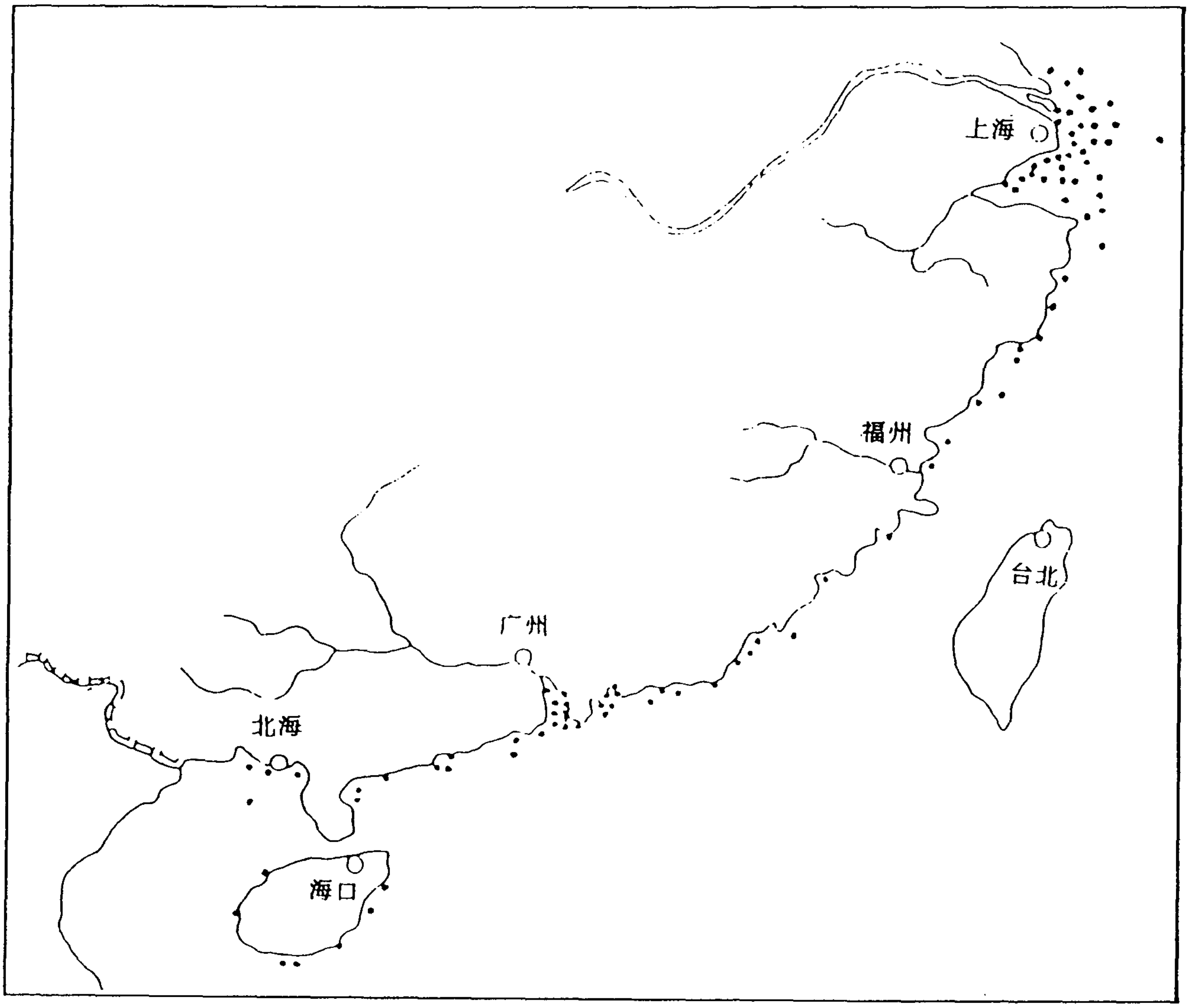
The distribution of marine water quality monitoring points in the study areas is shown in Figure 2.

5. INFLOW OF LAND-BASED OILS

Marine pollution is mainly from land-based sources including livestock waste, sewage industrial waste water, and agrochemicals including fertilizer and pesticide. In the 1980's, approximately 88% of total marine pollutants in China came from land-based sources.

In addition, many assessments have been made of the amount of oil entering the marine environment. All recognize the major contributions from industrial discharge, urban run-off and vessel operation, and the smaller contributions from tanker accidents, the atmosphere, natural sources, and oil exploration.

Figure 2 - Map showing distribution of monitoring points



Similarly, in many coastal waters and offshore environments of China, oil discharges usually become the governing parameter of water quality problems. The first reason is industrialization and urban run-off along the coast line. The second is that the increase of marine activities due to the growth of marine traffic results in marine oil pollution caused by accidents such as oil spills, and that the release during normal loading and discharge from shipping may result in a very large number of small incidents in many ports. The third is that the increase of offshore oil exploration and exploitation as well as oil storage results in oil spills into coastal waters and marine environment. These types of oil release have happened in study areas.

The land-based waste water discharges are illustrated in Table 7.

Note that Shanghai, Jiangsu, Anhui, Hubei, Hunan, Sichuan and Guizhou provinces contribute to the watershed of Changjiang River.

Qiantangjiang River and Minjiang River run across Zhejiang Province and Fujian Province respectively.

Guangdong Province and Guangxi Autonomous Region contribute to the watershed of the Zhujiang River. The Lancangjiang River runs across Yunnan Province. Shanghai, Jiangsu, Zhejiang, Fujian, Guangdong, Guangxi and Hainan are located on the coast.

Table 7 Waste water discharges (1994)

No.	Province	a	b	c	d	e	f	g
1*	Beijing	1123	96249	37021	25860	10716	0	644
2*	Tianjin	2916	41998	21988	14690	3673	860	5280
3	Hebei	2658	118815	84448	57751	37034	1747	7617
4	Shanxi	2140	61950	39035	19317	11770	0	2233
5**	Neimenggu	1295	39330	27051	10122	15986	0	3229
6	Liaoning	2827	225660	147657	99519	59695	27638	3599
7	Jilin	1084	72826	41542	21032	30933	1	4137
8	Heilongjiang	2230	129029	71252	37775	42631	0	3954
9*	Shanghai	2631	203659	118126	83683	84113	974	15390
10	Jiangsu	4992	306545	211577	145504	192291	850	3566
11	Zhejiang	3311	167200	100703	69060	81875	1636	4673
12	Anhui	2112	122444	81510	38762	72149	0	0
13	Fujian	3008	94167	60671	23299	51011	3412	2510
14	Jiangxi	1568	103898	67119	32058	44794	0	0
15	Shandong	4912	147979	87316	43059	40954	8190	969
16	Henan	2255	159463	93239	43144	50532	0	1051

17	Hubei	2611	287666	142685	83943	114534	0	878
18	Hunan	3250	171898	151114	87340	111312	0	1114
19	Guangdong	7218	337207	131531	71930	92367	5831	1735
20**	Guangxi	1277	147052	89887	40197	77264	1112	748
21	Hainan	377	20311	8658	3812	4791	1986	0
22	Sichuan	4545	296657	160075	71034	141145	0	2766
23	Guizhou	2155	40859	27669	11051	20127	0	2
24	Yunnan	1221	76409	45990	14564	35103	0	0
25**	Xizang	31	4200	2711	5	2707	0	0
26	Shanxi	1835	74909	37160	24878	16851	0	3304
27	Gansu	1076	45991	363871	17807	14671	0	5254
28	Qinghai	253	9618	5390	2717	3139	0	0
29**	Ningxia	235	12826	7655	3505	4899	0	0
30**	Xinjiang	860	35741	17943	5796	8021	0	1821
	Total	67956	3652546	2155111	1203215	1476997	54238	76476

Note: a: The number of industrial enterprises
b: Total waste water discharges (x 10_4 ton)
c: Total industrial waste water discharges (x 10_4 ton)
d: Amount of waste water discharge meeting the standards (x 10_4 ton)
e: Direct discharge into rivers, lakes and reservoirs (x 10_4 ton)
f: Direct discharge into the sea (x 10_4 ton)
g: Direct discharge into the waste water treatment facilities (x 10_4 ton)
*: Municipality
**: Autonomous Region, directly under the Central Government

Table 8 Oil within the industrial waste water discharges (1994) listed in Table 7.

No.	Province	Oils (ton)
1*	Beijing	1522.26
2*	Tianjin	656.41
3	Hebei	2187.46
4	Shanxi	1363.44
5**	Neimenggu	1695.61
6	Liaoning	5172.94
7	Jilin	2411.88
8	Heilong jiang	2241.12

9*	Shanghai		6140.00
10	Jiangsu		4481.50
11	Zhejiang		1282.93
12	Anhui		1383.00
13	Fujian		796.50
14	Jiangxi		1167.18
15	Shandong		1483.50
16	Henan		2081.15
17	Hubei		3876.58
18	Hunan		1935.21
19	Guangdong		1759.00
20**	Guangxi		887.75
21	Hainan		22.95
22	Sichuan		3645.82
23	Guizhou		617.00
24	Yunnan		1019.86
25**	Xizang		0.00
26	Shanxi		2645.84
27	Gansu		1295.40
28	Qinghai		346.53
29**	Ningxia		402.00
30**	Xinjiang		1226.74
	Total		55747.57

Note: *: Municipality
**: Autonomous Region, directly under the Central Government

6. EXTENT OF OIL POLLUTION

Coastal areas, especially those near ports, bays, river estuaries, and large or medium sized cities are polluted to varying extents.

In recent years, the water quality of most coastal waters has been good, but pollution has been serious in some estuaries and bays, affecting the ecosystem in some coastal waters.

The Beibuwan Bay, the Eastern and Western parts of Guangdong Province, Hainan's coastal areas, and coastal areas in Zhejiang Province are suffering most seriously from oil pollution.

Based on monitoring results, oil concentrations ranged from undetectable to 1.97 mg/L along the coastal waters of China. 38.6% of the areas exceeded the oil standard of water quality of the national three grade system. For the standard grade II and grade III, exceedance is 21.2% and 1.5% respectively.

The average oil concentrations range in 0.030-0.205 mg /L along the coastal waters in China. The largest one (0.123 mg/L) in the study areas appears in coastal areas of Hainan Province. Oil concentrations exceeded the Grade I in 55.6% of Hannan coastal areas, buy no waters exceeded oil standards in shanghai.

The status and extent of oil pollution in study areas is listed in Table 9. Figure 3 shows locations indicating oil pollution status.

Table 9 The status and extent of oil pollution in study areas

Province (or municipality)	Average (mg/L)	Range (mg/L)		Rate of Exceedance (%)			Monitoring Points
		Min.	Max.	Grade I	Grade II	Grade III	
Shanghai	0.03	0.03	0.03	0	0	0	2
Jiangsu	0.0323	0.008	0.08	13.6	0	0	22
Zhejiang	0.076	<0.025	0.459	26.7	6.7	0	15
Fujian	0.025	0.01	0.06	6.3	0	0	16
Guangdong	0.076	#	0.61	20.5	18.2	2.3	44
Guangxi	0.0415	0.02	0.20	20	5	0	20
Hainan	0.123	0.025	0.57	55.6	33.3	11.1	9

Note: #Undetectable

7. IMPACT OF THE COASTAL WATERS

Oil concentrations exceed the standards of grade I, which would be suitable protecting marine biological resources, salt-making, food processing, desalination and raising fisheries, in some coastal study areas. Furthermore, direct discharges into coastal waters, especially from township and village industrial enterprises, are largely uncontrolled. Although these discharges are small with regard to the total discharge volume in the study areas, their local effects may be significant.

Sensitivity to toxic compounds of oil varies greatly by species, by life stage within a particular species, and by individual. Oil impacts between species groups vary.

Acute toxicity refers to immediate impacts that result in death of the organism. These were not found in coastal and marine areas although the localized oil concentration is high according to Environmental Quality Investigation Report of China.

Information is not available showing that chronic effects ultimately affect the survival rates of species. Chronic effects are harder to detect than acute effects and may require more intensive studies conducted over a longer period of time.

A research project on the impact of some components of oil on nine samples of **Ostrea rivularies gouldi** in coastal waters of Guangdong Province in East China Sea was conducted. The results indicate that amount of BaP and BaA are far lower than the threshold limit value for safety according to "Marine Environmental Science" 1992.

8. REFERENCE

This synthesis of information comes largely from governmental reports and environmental impact assessments.

ANNEX V

Extent and Impact of Land-base Oil Discharge into Coastal Water of Indonesia

Abstract

Protection of the environment against oil pollution through legislation and institutional developments is described to support activities in the marine and coastal zones. It is an attempt to integrate activities to create a multidisciplinary approach, to meet the requirements for sustainable development in Indonesia.

1. INTRODUCTION

The archipelagic state of Indonesia, situated between 94°45'E and 141°45'E longitude and 6°08'N and 11°05'S latitude, stretches 5,110 km from west to east and 1,888 km from north to south, and consists of 17,508 islands, over one-half of which are unnamed. Indonesia is located between two continents, Asia and Australia, and two big oceans, the Pacific Ocean and the Indian Ocean. The length of coastline is about 81,000 km. Approximately two-thirds of the country's territory is covered by tropical oceans, with total area of 5.8 million km^2, which consist of 0.3 million km^2 of territorial sea, 2.8 million km^2, of archipelagic water (perairan Nusantara) and 2.7 million km^2 of Exclusive Economic Zone. To clarify Indonesia's geographical location and natural resources see Figure 1 and Table 1.

Indonesian waters have been an important source of food and economic welfare for centuries due to the rich and diversified life and resources they contain, including minerals and hydrocarbons in the shallower parts of the seas, living and other non-living resources in the marine and coastal environments. These waters also sustain other types of activities such as inter-island, regional and international trade and communication, recreation and tourism. Unfortunately, as a result of strong economic development of the country in almost all sectors, the natural resources have been subjected to severe pressure, both direct and indirect.

These threats to natural ecosystems form our concern. The Evaluation of these problems and implementation of solutions are being carried out in accordance with The Act of the Republic of Indonesia No. 4 of 1982 concerning Basic Provisions for the Management of the Living Environment.

Part the Act states that management of living environment should be based upon the sustainance of the capability of a harmonious and balanced environment to support continued development for the improvement of human welfare. In order to fulfil these objectives, development and management, steps should address policy statements, legal implication, institutional aspects, manpower, coordination activities, and monitoring activities in the country.

This paper is an attempt to support the forum with the interdependency between Development and Environment - with special regard to the EXTENT AND IMPACT OF LAND-BASED OIL DISCHARGE INTO COASTAL WATERS OF INDONESIA.

2. LEGISLATIVE AND INSTITUTIONAL DEVELOPMENTS RELATED TO THE ENVIRONMENT IN INDONESIA

Current environmental legislation originated from principles adopted under the Stockholm Declaration (1972), and a more complete Basic Act for Management of the Living Environment promulgated in 1982, providing for further environmental legislation suited to Indonesia's particular situation. Devising appropriate institutional and legislative frameworks for implementing guidelines and standards in environmental management has received high priority.

Utilization and management of the environment in Indonesia is protected by the Constitution. Every five years, the National Assembly, as the highest political authority, evaluates the provisions and promulgates the broad outline of environment. It is responsible for coordinating national policy implementation, and the Provincial Governor is designated as the Environmental Administrator, assisted by the local Bureau for Environment.

In 1931, Dutch colonialists enacted the Law on Wildlife Protection (Dierenbescheming Ordonantie) protecting rare terrestrial species such as the Javan Rhino. The Law on Nature Resources (Natuurbescherming Ordonantie) of 1941 provided the legal basis for allocating virgin areas as nature reserves in order to protect wildlife though maintaining terrestrial habitat.

Specific Indonesian regulations concerning the coastal and marine environment fall under the following three categories (Djohai, 1989) :

1. Jurisdistional matters
2. Marine pollution
3. Uses of the sea, e.g. navigation, fisheries, offshore oil/gas/mining, tourism.

Recent Republic of Indonesia legislation relating to the management of marine resources including marine parks and reserves is listed below in which the order of precedence is Law (Presidential Decree and Ministerial Decree) :

1. Law No. 4, 1982 : "Basic Provision for the Management of the Living Environment Act" (or "Environment Management Act") in which the sustainable management of the living environment is linked to improvement of human welfare.

2. Law No. 8, 1985 : "Fisheries Act" replacing and updating a body of legislation going back to the Sponge Fisheries Ordinance of 1916.

3. Law No. 5, 1990 : "Conservation of Living Natural Resources and their Ecosystem Act" in which sustainable resource utilization is balanced with ecosystem maintenance.

4. Law No. 24, 1992 : "Spatial Planning Act" in which management of land, sea and air resources are spatially accommodated in a coordinated, integrated and sustainable manner.

5. Presidential Decree No. 43 (1978) concerning the Convention on Internation Trade of Endangered Species (CITES).

6. Presidential Decree No. 32 (1990) concerning protected areas.

7. Ministerial Decree (Forestry) No. 123/Kpts-II/1986 concerning marine nature reserves.

The following types of marine reserves are currently applied in Indonesia and should be protected from oil pollution :

1. Strict Marine Nature Reserve (Cagar Alam Laut)
   Small or large areas with strict protection with use limited to non-manipulative research and monitoring.

2. Marine National Parks (Taman National Laut)
   Areas of outstanding natural value of national, regional or global significance which must be large enough for recreational and educational use without decreasing conservation value.

3. National Marine Recreation Creation Parks/Protected Seascape (Taman WIsata Laut)
   Principal values are natural beauty and recreational potential; may have low value for conservation, but recreational value is always high.

4. Marine Wildlife Reserve (Suaka Margasatwa Laut)
   Small or large areas under strict protection which may require some manipulation of species or habitats as a part of management; use limited to research and education.

3. SOURCES OF MARINE ENVIRONMENTAL OIL POLLUTION

All potential and effective pollutants must be considered as complex inputs to the marine environment contributing to the process of marine environmental degradation. The negative impact of industrial development on land and the marine environment has long been understood by various Indonesian institutions and individuals. The deliberate, incidental and accidental introduction of pollutants, such as oil and heavy metals from industry, into Indonesian coastal waters has increased the load of pollutants to such extent that communities have been warned to take special care in using water and fish. The relatively rapid industrial development, the lack of municipal wastewater treatment, siltation due to deforestation, agricultural practices, mining activities, and lack of adequate institutional mechanism have critically impacted several bodies of water, particularly those that are also a source of domestic water supply.

Traditionally, rivers and water canals have also been considered as "waste baskets". Various forms of waste are directly thrown away into rivers, water canals and ducts, which ultimately will be transported to estuaries and marine waters.

Land-based oil discharges into coastal waters of Indonesia come from refineries, municipal waste water, industrial waste water, urban run-off and rivers. Because Indonesia is an oil-producing country, major land-based oil discharges come from refineries and rivers. Many rivers are used for transportation of the refined product from the refinery to the terminal and harbours. Shipping and shipping accidents are a particularly important source oil pollution. Tainting has occurred in Jakarta Bay due to chronic oil pollution and in Surabaya due to discharges from a petrochemical plant.

Indonesia is one of the world's top oil-producing countries and remains the centre for oil exploration and production in Southeast Asia. The petroleum sector is a vital part of the nation's economy and accounts for over one-quarter of the Gross Domestic Produc.

There are nine refineries in Indonesia : Cepu, Balikpapan, Cilacap, Dumai, Pangkalan Brandan, Plaju, Sungai Gerong, Sungai Pakning and Wonokromo. All Indonesian refineries have been designed according to international safety and environmental standards. Storage tanks are located at all refineries and at some crude terminals and refined products unloading ports. Most storage facilities have been designed to contain most of the petroleum products they contain, should an accident occur. However, human error in combination with severe environmental conditions, could cause oil to enter coastal marine waters. The oil marketing terminals (refined products) are also heavily polluted by oil. Many tanker cleaning operations are often located near the terminal.

Activity in Indonesian waters is increasing in tandem with Indonesian development. This increasing activity and dumping in marine waters will raise pollution in the marine environment not only due routine activities but also operational mistakes or accidents.

The development of oil-related activities in Indonesia, which comprises an increase in the off-shore exploration and exploitation, as well as the transportation between islands and continents, increases the chance of accidents which will cause oil pollution in the ocean and contamination of the marine environment. This will result in both physical and chemical changes to the marine environment and will harm its living resources, especially those located in marine fishery areas, marine culture areas and breeding areas.

4. CRITICAL OIL POLLUTION

Oil pollution would critically harm the following centres of traditional fishing :

1. Malacca Strait :- a heavily fished area
   - most fish caught are small "pelagic" fauna such as anchovy and shrimp.
   - tools used are gill nets, trawls, and other static fishing tools.

2. The South China Sea
   - small "pelagic" fish caught such as demersal and shrimp.
   - tools used are gill nets, trawls and fish traps.

3. North Java Sea:- a densely fished area
   - small "pelagic", fish caught such as demersal and shrimp.
   - tools used are gill nets, purse seine, trawls, and fishing rods.

4. Bali Strait and Alas Strait :
   - a densely fished area
   - cuttle fish, sardines and tuna caught.
   - tools used are purse seine, trawls, and fishing rods.

5. The Southern part of Malacca Strait :
   - flying fish, coral fish and shrimp caught.
   - tools used are gill nets, trawls and fishing rods.

6. Other areas (Padang, Pelabuhan Ratu, Cilacap, Perigi, etc.)
- a densely fished area
- tuna and shrimp caught.
- tools used are gill nets, trawls, and fishing rods.

5. IMPACT OF OIL POLLUTION IN COASTAL WATERS OF INDONESIA

Ecosystems are composed of various plant and animal species which collectively form a food web, a channel through which energy flows form energy-producing organisms to energy-consuming organisms. The more species involved in the food web as energy consumers or energy producers, the greater the stability of the ecosystem. Oil pollution affects ecosystems by removing the more sensitive species from the food web, which decreases species diversity and ultimately reduces the stability of the ecosystem.

Acceleration of world industrial development has resulted in increased levels of activity associated with the development and utilization of energy sources. In recent years, these activities have resulted in numerous instances of oil pollution that have had significant, if not major effects, on the marine environment. As a result of these oil pollution events, a body of knowledge on the physical and biological impacts of oil pollution has been developed.

5.1. Physical Impacts of Oil Pollution

Sunlight, wind, and ocean currents are the environmental factors which have the greatest effect on the extent of physical impact of oil pollution on marine water.

Physical oil pollution in the ocean, especially crude oil, deteriorates fishing tools such as fish nets, fish traps, and other static fishing tools. As a result, these tools cannot be used for fishing.

Referring to the coral reef ecosystem, oil pollution can physically cover the benthic fauna living in the tidal area, which will get dry periodically when the ebb-tidal comes. Coral, algae, moluscs and sponges will die because the ebb tide leaves the oil pollution over these organisms. Oil pollution in the reef area will also block sunlight needed for photosynthesis.

In mangrove forest, oil pollution physically clogs the pores of pheumatophores, killing mangroves. Oil pollution in mangrove forest will also cause water temperature to increase and oxygen to decrease.

Several studies have been conducted to assess the physical impacts of oil pollution on mangrove swamps. These areas support various important invertebrate species and provide habitat for stages of various fish species. Oil penetrating mangrove swamps settles among the roots, with the habitat being destroyed where large amounts of oil is deposited. The black mangrove (Avicennia sp.) suffered because its pneumatophores became covered with oil. The algae community of red mangrove roots was practically eliminated, as were oysters (Crossostrea sp.), mussels (Brachidontes sp.), barnacles (Balanus sp.), sponges, tunicates and bryozoans. The mangrove habitat hosts fish and crustaceans of economic importance.

5.2. Biological Impact of Oil Pollution

The biological impact of land-based oil discharges depends on the type of oil and length of its exposure to natural conditions. Other effects of oil include a reduction in palatability of organisms resulting from direct exposure to oil. Besides the possible carcinogenic effects from crude oil constituents, the bioaccumulated substances may have certain sublethal effects on vital activities, such as predator avoidance, migration, food-finding and mating for animals inhabiting nearshore areas.

Pollutants are toxic to organisms and alter habitat characteristics. Lethal toxins cause death of organisms over a relatively short period of time. Sublethal effects may reduce an organism's ability to reproduce or obtain food. Non-toxic pollutants, which generally occur as particulate matter, tend to reduce habitat suitability. They may be responsible for the elimination of a particular plant species, the removal of prey species from an area, or the reduction of the suitability of a habitat as a feeding or rearing area.

In estuaries, oil pollution physically causes a decrease in the primary productivity and prevents the migration of anadromous fish.

In seagrass beds, oil pollution physically blocks photosynthesis, and can directly contaminate the seagrasses in the tidal area. The latter may destroy the seagrasses.

Oil in water has been shown to exert toxic effects on phytoplankton. More sensitive species showed a reduction in growth and cell division rates when exposed to oil in concentrations as low as 0.01 pp (part per million). All phytoplankton species studied died at oil concentrations of 0.1 to 1.00 ppm, depending on species sensitivity.

Oil pollution can affect fish populations by reducing the quantity of food resources and by exerting lethal or sublethal toxic effects on various life history stages, i.e. egg, larvae, juvenile and adult. Although it is difficult to provide definite cause-effect data, it appears that heavy oil contamination in the Malacca Strait may be, at least in part, responsible for the lower catches of Toli Shad (Hilsa toli) in the east coast Sumatra fisheries. Decline in fish catches in east Java are also alleged to be caused by oil pollution, although no data is available to support the allegation.

6. SYSTEM OF PROTECTION AGAINST MARINE POLLUTION

In 1970, the National Institute of Oceanology (LON-LIPI) established The Study Group on Pollution (SGP) which is an inter-agency body recognizing the problems of pollution and possible undesirable effects on the environment. The functions of this group include coordinating efforts in pollution abatement and supplying technical data on which the Indonesian Government will formulate policies concerning the pollution problem in Indonesia.

Marine pollution can be caused both by oil and other substances. The different substances that cause pollution can indicate the pattern of action to protect against the pollution. A multidisciplinary and cross-sectoral operation is needed to remedy the problems of marine pollution. This will call for the involvement of various institutions, which should have an integrated system and be alert to undertake action.

Firstly, pollution occurs due to routine activities in the sea and other places. Secondly, it occurs due to contaminated substances that exist suddenly because of an accident in the sea or other places. The first needs a routine action to protect the area against pollution, whereas the second needs emergency action with a conceptional system called the Emergency National System to Protect against Marine Pollution (Sisnas PDPL).

The implementation of the operational mechanism of Sisnal PDPL is based on the idea that it need not require the to formation of a new institution, but can utilize existing institutions. There are two aspects of the action:

1. Physical prevention; this operation is coordinated by The Department of Transportation c.q. The Directorate General of Sea Transport and by Head of Regional Office of Sea Transport which is responsible for the field activities.

2. The prevention of the pollution of the marine environment and rehabilitation action following:

The coordinator of activities is the Ministry of State for Environment.

In every operation towards protection against marine pollution, experts in the field of ecology participate in measuring the extent of waste distribution and its impact on the environment. Protection against marine pollution can be carried out both on the national level and the regional level.

7. MONITORING

Even though marine environmental pollution monitoring has been carried out on a sectoral basis for many years in Indonesia, the results are still generally fragmentary in nature. Therefore the information base is too diffuse to use as a firm and quantitative basis for evaluating pollution in the marine environment in and the extent to which the resulting environmental degradation needs to be controlled.

However on the basis of current sectoral marine environmental pollution and degradation monitoring and taking into account the various known marine pollution and degradation indicators, there is enough evidence to conclude that marine pollution and degradation in Indonesia is:

1. Already at a level which requires serious attention through an effective, intensive and comprehensive marine environmental monitoring action.

2. Going to become more acute and complex so needing to be dealt with through systematic policy involving strategic options and effective action.

3. Bad enough in some places to require marine environmental rehabilitation programmes in order to reclaim the polluted and degraded areas.

4. Going to require interdisciplinary monitoring systems through which legal compliance can be effectively implemented.

5. Sufficiently wide spread that there is a need for establishing and enhancing institutional capacities at the "Central", "Provincial" as well as "Kabupaten" (region) levels in order to conduct law enforcement to control pollution and degradation of the marine environment.

8. INSTITUTIONAL CAPACITY

"Environmentally Sound and Sustainable Development" requires a coordinated effort, effective and efficient allocation of human and financial resources, and responsive institutional capacity building in order to optimize the opportunities and benefits and to prevent or minimize the environmental impacts of those coordinated sectoral marine resource developments or utilization modes.

Structurally, the institutional set up in Indonesia which deals with or is involved with the marine environment and natural resource uses can be subdivided into :

1. Coordinating Ministries e.g. the National Development Planning Board, Environmental Management Agency (BAPEDAL), the Ministry of Population, the Ministry of Environment, Ministry of State for Research and Technology.

2. Central Line Ministries e.g. Ministry Forestry, Min. of Agriculture, Min. of Mining and Energy, Min. of Industry, Min. of Public Works, Min. of Defense and Security, Min. of Home Affairs, Min. of Communication, Min. of Post, Telecommunication and Tourism.

3. Agencies providing marine information infrastructures e.g. Hydrographic and Oceanographic Data Surveyor, the Indonesian Science Institute, the National Coordinating Agency for Surveys and Mapping, etc.

4. Universities with faculties or departments related to marine science and technology, that is about 40 universities.

5. Non-Government Organizations having programmes related to the marine environment and natural resources. Of more than 500 NGOs, 10 to 20 at least belong to this group.

6. Private sectors involved in marine and natural resource development. Hundreds of private companies dealing with oil exploration and exploitation, transportation, tourism, commercial fisheries, mining and energy, and consulting.

7. Multi lateral and Bilateral Assistance and Cooperation involving marine environmental management and natural resources use e.g. World Bank, Asian Development Bank, UNDP, UNESCO, FAO, UNICEF, EMDI.

9. CONCLUSION

Indonesia has carried out considerable activities concerning environmental management and development of natural resources, individually or in cooperation with other countries. However, problems of natural resource management and development have been rapidly increasing due to the development within the country.

The vastness and complexity of the Indonesian waters, together with the myriad problems of natural management faced day by day, compared with the manpower and the implementation of policy Strategies, are among the serious problems for Indonesia.

Therefore, with its ASEAN partners in the region and other international agencies, Indonesia is also seeking to promote effective regional cooperation in environmental management especially in marine park management and development activities.

In enhancing marine parks and related areas in Indonesia, consideration should be given to special matters in Indonesia.

ANNEX VI

Country Report for Malaysia on The Status of Land-based Oil Discharges

1. INTRODUCTION

Malaysia, as a developing country, has been witnessing a steady deterioration of the quality of its marine environment. Despite the public perception of pollution being caused by vessels and oil spills, the major culprit remains land-based sources of pollution. It is recognised that land-based sources of pollution constitute by far the largest of coastal pollution problems and account for 70 percent of the marine pollution, with the majority from discharge of sewage, nutrients, sediments, oil, and grease.

The marine ecosystem and its resources have been responsible for significant contributions to Malaysia's economy. The marine environment is also essential for transportation, industrial, and waste disposal activities. Hence, the marine environment and the wide varieties of activities that it supports are increasingly being threatened by various pollutants from both land-based activities as well as marine activities. One major pollutant is oil.

2. EXTENT AND IMPACT OF LAND-BASED OIL DISCHARGES

2.1 Monitoring Data

Environmental quality monitoring is one of the main activities carried out by The Department of Environment to implement the pollution control strategy. In 1994, a total of 681 samples were collected from 207 marine sites. The environmental quality in 1944 when compared to 1993 had slightly deteriorated. As in previous years, oil and grease the list as the main pollutants of the coastal waters of all states in Malaysia except Perak. About 98 percent of the total number of monitoring sites were polluted by oil and grease. Figure 1 shows 94 percent of the samples exceeded the proposed interim standard for oil and grease.

2.2 Land-based discharges

Land-based oil discharges into coastal waters of Malaysia are numerous. These range from discharges of lubricating oils, municipal discharges, industrial discharges and palm oil from mills and refineries. The single most important source of oil pollution is motor and lubricating oil used in the automotive and other industries. Oil and grease pollution from some land-based sources, such as palm oil mill and refinery discharges, are biodegradable and so long as they conform to environmental quality standards, are not considered as serious as petroleum-based hydrocarbons. Most industries comply to environmental quality standards and discharges of oil and grease from food industries are expected to be biodegradable and not a serious pollution threat. Nevertheless, a large amount estimated as 2300 - 4800 metric tones of used lubrication oils from automobile and other industries are entering the marine environment (figure 2).

3. MEASURES TAKEN AND ENFORCED

Efforts at pollution control have focussed on improving the effectiveness of the enforcement programmes carried out by The Department of Environment. The enforcement of the existing environmental laws and legislation is essential and has been stepped up to ensure compliance and capability of the industries, in particular to control the production of pollutants and to practise effective storage and disposal systems.

More concerted efforts are needed to curb pollution problems resulting from manufacturing industries. With stricter enforcement, it is envisaged that the problems can be minimised. In an effort to improve current enforcement programmes, work has been carried out to review the various environmental laws and regulations within and outside the jurisdiction of The Department and also on the formulation of new regulations.

With regards to monitoring programmes, the water quality monitoring and surveillance programme established since 1978 has been intensified. The National Water Quality Monitoring Programme was periodically reviewed with respect to the network of monitoring sites, frequency of water sampling, and selection of water quality parameters.

Figure 1 - Malaysia: Status of Marine Water Quality, 1994

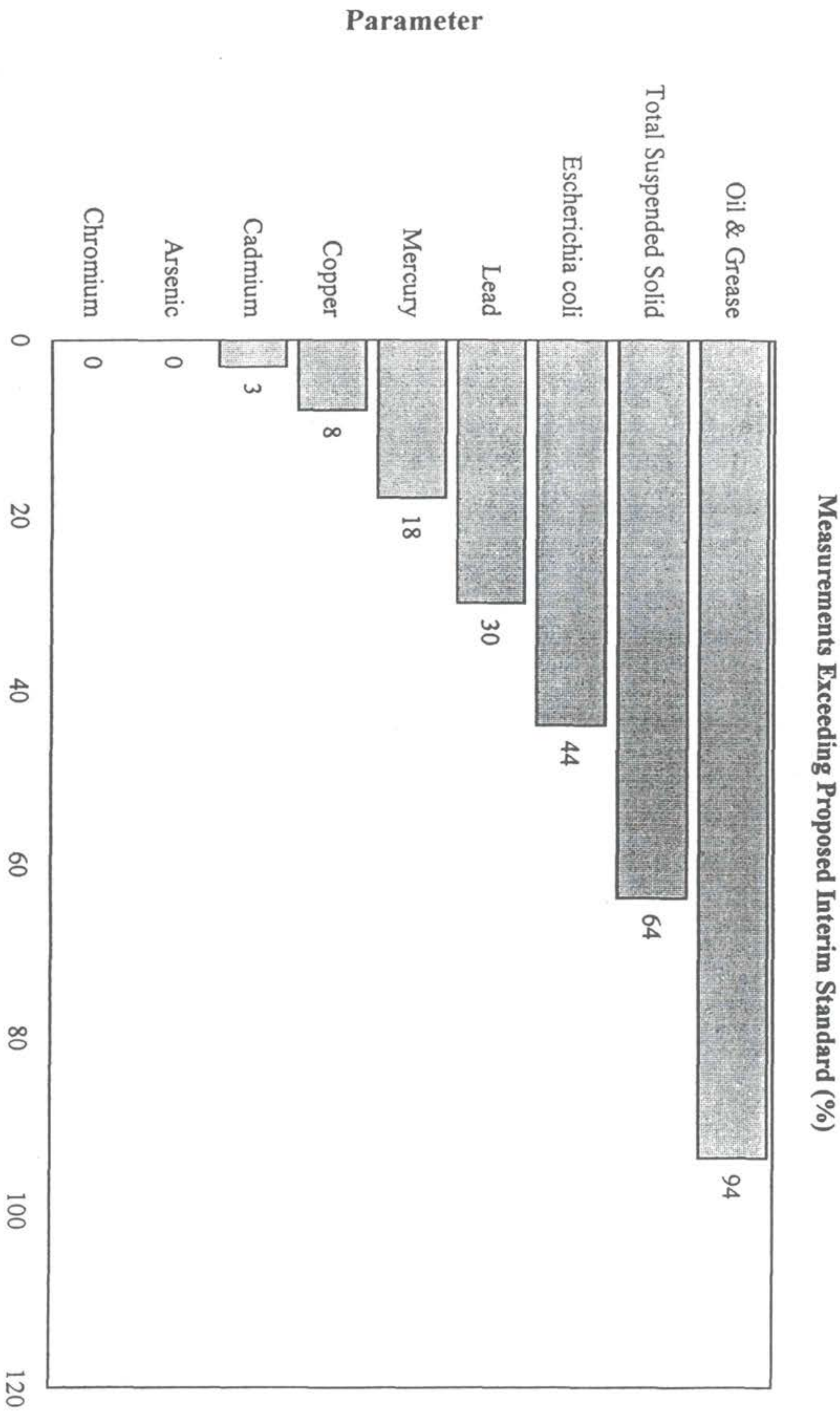


Figure 2 - Malaysia: Estimated loading from Land-Based Sources of Marine Oil Pollution.

No.	Sources	Quantity (tones/year)
1.	Palm Oil Mill & Refineries	10
2.	Oil Refineries	510 - 4900
3.	Crude Oil Terminals	350
4.	Automotive & Other Industries (used lubrication oils)	2300 - 4800 a percentage (ext.) of amount used.

Source: A Study on the Assessment of O&G Pollution in Malaysian Marine Environment, 1995 (IPT-UM/DOE)

ANNEX VII

Extent and Impact of Land-based Oil Discharges into Coastal Waters of The Philippines

1. BACKGROUND

For years, the continuous deterioration of our seas has been related to the belief that they are the ideal repository for all wastes from human activities. The practice of shipboard waste being dumped overboard, of oil discharges from industry, of coastal development for recreational facilities, of installation of refineries near the shore, and of shipping operations are major contributors to pollution.

The amount of oil entering our seas from a variety of industrial sources has generated concern that long-term disruption of the sea and coastal life may result. There is no question that land-based sources of oil pollution from industrial/commercial and shipping activities are detrimental to the natural and recreational resources and aesthetic value of the marine ecosystem on a large scale. The Philippines has valuable and vulnerable marine and coastal resources such as mangroves, coral reefs, fishery spawning grounds, fish, coastal aquaculture sites and marine parks and reserves. Many of these resources are already under stress by sources other than ship-generated pollution. Increased shipping, oil exploration, development and production activities in the country's waters has contributed to damage in the marine environment and its living organisms.

The toxicity of various oils (crude oils and refined products) to different species of marine life varies greatly. Acute toxicity as determined in laboratory tests is related mainly to the content of volatile hydrocarbon components in oil including light paraffins and aromatics (e.g. benzene, foluene, napthalene). (table 1)

2. LAND-BASED SOURCES OF OIL POLLUTION

There are 4 major sources of oil pollution in the Philippines. These sources are:

- refineries;
- tankers and bunkers involved in the transport of oil;
- oil exploration;
- production activities.

Each firm involved in oil exploration has formulated their own contingency plan in accordance with the provisions of Memo Circular No. 01-91. There are four refineries in the country and from the terminal the products are distributed all over the country to six major depots.

The most important factors influencing the seriousness of land-based oil pollution in the Philippines are the volume and type of oil, weather and sea conditions, the season and the body of water where the oil contamination occurs from ships and industrial sources. (Table 2)

Biological damage to marine life is estimated by the following factors:

- amount of oil impacting the sea
- type of oil contaminant/spilled
- weather condition
- physical geography of the sea
- type of local marine flora and fauna
- previous exposure of the area to oil
- exposure to other pollutants
- kind of treatment applied (in case of recurrence)

In the case of oil spills from ships, application of dispersant is sometimes the only effective means available for treating an oil spill under high seas conditions. However, dispersant does not cause oil to sink, but converts oil slicks into small droplets which are then driven into the water column. Application of dispersant in confined shallow water leads to increased biological damage from the presence of oil in the watercolumn and sediments. Improper application of dispersants to oil stranded on beaches (sand) or in coastal waters can drive such oil deep into the substrate and promote instability and subsequent erosion of shoreline. Excessive amounts will be likely to increase biological damage.

In developing countries like the Philippines, industrial discharges are the major causes of water pollution in urban areas, and domestic wastes are the largest component of pollutive materials entering our receiving waters. (Table 3)

The Philippines' total coastline is 34,600 km. Along its extensive sea coasts are a large number of harbors, navigable rivers and lakes. There are 61 natural harbors, 132 rivers and 59 lakes which serve as a valuable resource for fishery production, transportation and irrigation.

3. STRATEGY FOR THE PROTECTION OF THE SEA From LAND-BASED SOURCES OF POLLUTION

The strategy recognizes the importance of coastal waters and the sea for food, livelihood, transport and recreation. The irony is that its use as a receptacle for by-products of human activities will eventually lead to the end of its life-supporting functions.

This need calls for the strengthening of the following strategies:

- stringent legislation on pollution control

- adoption of international standards in matters concerning prevention and control of land-based sources of oil pollution

- strengthening the capacity for national and regional cooperation and promoting technical cooperation to address pollution control in our seas

- assistance and full support of the UN Body and relevant international organizations to ensure a coordinated approach to problems related to oil pollution

- training in oil pollution preparedness at the local, international and regional level
- participation of the Government, Industry, NGO's and the Community in the protection of our seas.

4. INTERNATIONAL COOPERATION

The Philippines has been actively participating in the activities of the UN agencies concerned with preventing marine pollution and the following international and regional programmes:

1972 - Convention on the Prevention of Wastes and Other Matters (LDC 1972)

1973 - International Convention for the Prevention of Pollution from Ships (MARPOL)

1978 - Protocol of 1978 Relating to the International Convention for the Safety of Life at Sea

1981 - Networking for Oil Spill counter Measures in the Lombok/Makassiar Straits and Celebes Sea

1985 - Montreal Guidelines for the Protection of the Marine Environment against Pollution from Land-Based Sources

1986 - Convention for the Protection of the Natural Resources and Environment of the South Pacific Region

1990 - Oil Spill Preparedness and Response (OPRC)

1994 - IMO Global Waste Survey Programme

1994 - United Nations Convention on Law of the Sea (UNCLOS)

The Philippines is also committed to the ASEAN Programme. (Table 4)

5. RULES, REGULATIONS AND ENFORCEMENT

The fundamental law of the Philippines mandates the protection, preservation and conservation not only of the marine environment and its resources but also all natural resources, and defines the rights and obligations for its exploitation (PD 1151).

In the Philippines the principal enforcers of laws, rules and regulations for prevention, mitigation and control of land-based pollution are the Environmental Management bureau (EMB) and the Philippine Coast Guard-National Operation Center for Oil Pollution (PCG-NOCOP), each having distinct responsibility. EMB is mainly the policy making body that promulgates national environmental management policies that encompass the broad spectrum of environmental management to prevent, abate and control all sources of pollution of which the marine environment is a special segment. The PCG-NOCOP has the primary responsibility to enforce laws, rules and regulations governing marine pollution and protecting the long coastline of the country. (Table 5)

6. CONCLUSION

The Philippine Government in its efforts to properly manage and protect its seas and coastal resources from land-based sources of oil pollution has drawn up and implemented a programme in the past. It did not turn out to be such a success as expected, and efforts are still being made to assess and identify missing factors.

Control of oil-pollution from industrial activities is beset with problems. Aside from issues related to depleted resources, others are caused by policies addressing the problem.

Studies on Toxicological Assessment of environmental contaminants in the Philippine seas and coastal marine waters are few and fragramented. Pollution arising from rapid industrialization and urbanization adds stress to the marine environment already strained by problems related to incidental spills from ship collision, fishing, agricultural run-off, oil refineries, off-shore drilling/extrusion and others. Coastal activities create environmental contaminants such as crude oil derivatives, pesticides, heavy metals and various organic compounds which enter the marine environment.

The need to develop a more comprehensive action plan to protect our seas from oil pollution sources is a must. The developed countries and international bodies should assist our country in developing realistic and ecologically sound responses to address oil pollution from land-based sources.

Although there are national and local regulations pertaining to control such discharges, enforcement has not always been effective.

REFERENCES:

- **Tropical Coasts, July 1995 (Newsletter)**
- The Regional Programme for Marine Pollution Prevention and Management in the East Asian Seas, Bi-annual Report 1994-1995
- Effects of Oil on Marine Resources 1993, Sloan
- Alternative Routes to the Straits of Malacca for Oil Tankers. 1995, Sien
- Off-shore Exploration for Hydrocarbon and its Impacts on Marine Environment, 1993
- Oceanographic Features and Meteorological Phenomena of the EAS Region, 1989 UNEP Report
- Marine Pollution in Northern Coastal Waters of Java, 1987, Thajib

TABLE 1 ESTIMATED HAZARDOUS AND TOXIC WASTES IN MMA (1992)

Sector	Acidic & Alkaline (m_3/yr)	Heavy Metals (t/yr)	Solvent (m_3/yr)	Infectious Wastes (t/yr)	Oils & Greases (t/yr)	Biological Wastes (t/yr)	Other Wastes (t/yr)
Automotive		951	950				100
Battery Manufacture	780	3			17,500		
Dyes & Textiles						700	10
Electronics	22MM	440	100				
Hospitals				100		40	
Leather Tanning		1			550	210	10
Metal Finishing	2.5MM	125	600				30
Paints & Solvents		20	160				100
Petrochem & Chem	0.11MM	10			90	500	40
Pharmaceuticals						150	
Pulp & Paper						580	
Total	24.6MM	1,550	1,80	100	18,140	2,180	390

Source: Based on IEPC Study 1992

Table 2 **POLLUTION INCIDENTS FROM JANUARY TO DECEMBER 1993**

DATE	SPILLER/SOURCE	PLACE	APPROXIMATE QUANTITY	POL/CHEM PRODUCTS
February 1993	Undetermined source	Sitio Alas Asin Brgy. Marina Mariveles Bataan	Undet amount	Bunker oil
8 March 1993	LCT Melveric	Danao Port Negros Occidental	Undet amount	Oil mixture
19 April 1993	M/T Calumpit	Petron Chemical Pandacan, Manila	20 drums	Lube oil
23 April 1993	Gen. Milling Corp.	GMC Wharf, Lapu-lapu City, Cebu	Undet amount	Oil Mixture
24 April 1993	Batangas Power Plant	Pinamucan, Batangas City, Batangas	25 ltrs.	Used oil
1 May 1993	Shell Refinery	Mapul, Taysan, Batangas City (Bunga River)	20,000 ltrs.	Used oil
12 June 1993	M/T Helena	Cargolift Shipping Corporation	10 Barrels	Diesel oil
9 July 1993	Batangas Power Plant Corp.	Pinamucan, Batangas City, Batangas	25 ltrs.	Used oil
19 July 1993	M/V Nekkei Challenge	Manila Bay, South Harbor, Manila	Undet amount	Grain Chaff
24 Sept. 1993	Iligan Cement Corp.	Kiwakan, Iligan City	50 ltrs.	Bunker oil
29 Sept. 1993	Caltex Phils. Refinery	San Pascual, Batangas	420 ltrs.	Bunker oil
21 Nov. 1993 to present	National Power Corp. Aplaya, Jasaan	Brgy. Aplaya, Jasaan and Brgy. Looc, Villanueva, Misamis Oriental	3 to 4 drums	Bunker oil

Source: IMO - Phil national Profile (Global Waste Survey 1994)

Table 3 NUMBER OF LARGE MANUFACTURING ESTABLISHMENTS IN THE PHILIPPINES AND SELECTED REGIONS

Manufacturing Sub-sectors	Total Phils.	Metro Manila	Region III	Region IV
Food	1,165	339	132	121
Beverage	80	17	0	0
Textiles	297	221	12	34
Leather/Tanneries	17	1	15	0
Pulp and Paper	106	82	4	10
Chemicals	475	260	11	27
Paints	30	24	0	0
Pharmaceuticals & Others	176	147	8	8
Non-metallic & Minerals	191	90	16	40
Basic metal Industries	121	95	0	9
Fabricated metal prod.	888	639	33	56
TOTAL	5,000	2,803	356	473

Source: IEPC, 1992

Table 4 INTERNATIONAL COMMITMENTS

* ASEAN *Senior Officials* on the Environment (ASOEN)
* Montreal protocol on Substances that Deplete the Ozone Layer
* Basel Convention on the Control and Transboundary Movements of Toxic Hazardous Wastes
* United Nations Framework Convention on Climate Change (UNFCCC)
* Programme of Action on Land-Based Sources of Marine Pollution
* London Guidelines for the Exchange of Information on Chemicals in International Trade

Table 5 REGULATIONS CONCERNING MARINE POLLUTION

REGULATIONS CONCERNING MARINE POLLUTION	
Presidential Decree (P.D.) 600 - Marine Pollution Decree (December 9, 1974)	-makes it a national policy to prevent and control pollution of the areas within the territorial jurisdiction of the country. The decree also empowers the Philippine Coast Guard (PCG) to subscribe, promulgate and enforce rules for prevention and control of marine pollution. PD 600 was later amended by PD 979 (August 19, 1976).
PD 601 - Revised Coast Guard Law of 1974 (December 9, 1974)	-provides for the revision of Republic Act No. 5173, commonly known as the Coast Guard Law, modifying the organizational set-up of the PCG to enable it to discharge its functions efficiently and effectively.
PD 602 - National Oil Pollution Operations Center Decree (December 9, 1974)	-creates the National Operations Center for Oil Pollution (NOCOP) in PCG Headquarters.
To implement the provisions of PD 600 as amended by PD 979, the PCG, on April 16, 1975, promulgated Memorandum Circular No. 02-77 and amended by Memorandum circular 01-91 on January 1991 which contains the rules and regulations for the prevention, containment, abatement and control of marine pollution, and provides for administrative penalties for violations thereof. The circular covers all bodies of water within the territorial jurisdiction of the country, including ports, harbors, coastline, lakes, rivers and their tributaries.	

Figure 1 - Major Coastal Cities of the Philippines
(figures in parenthsis refer to population size)

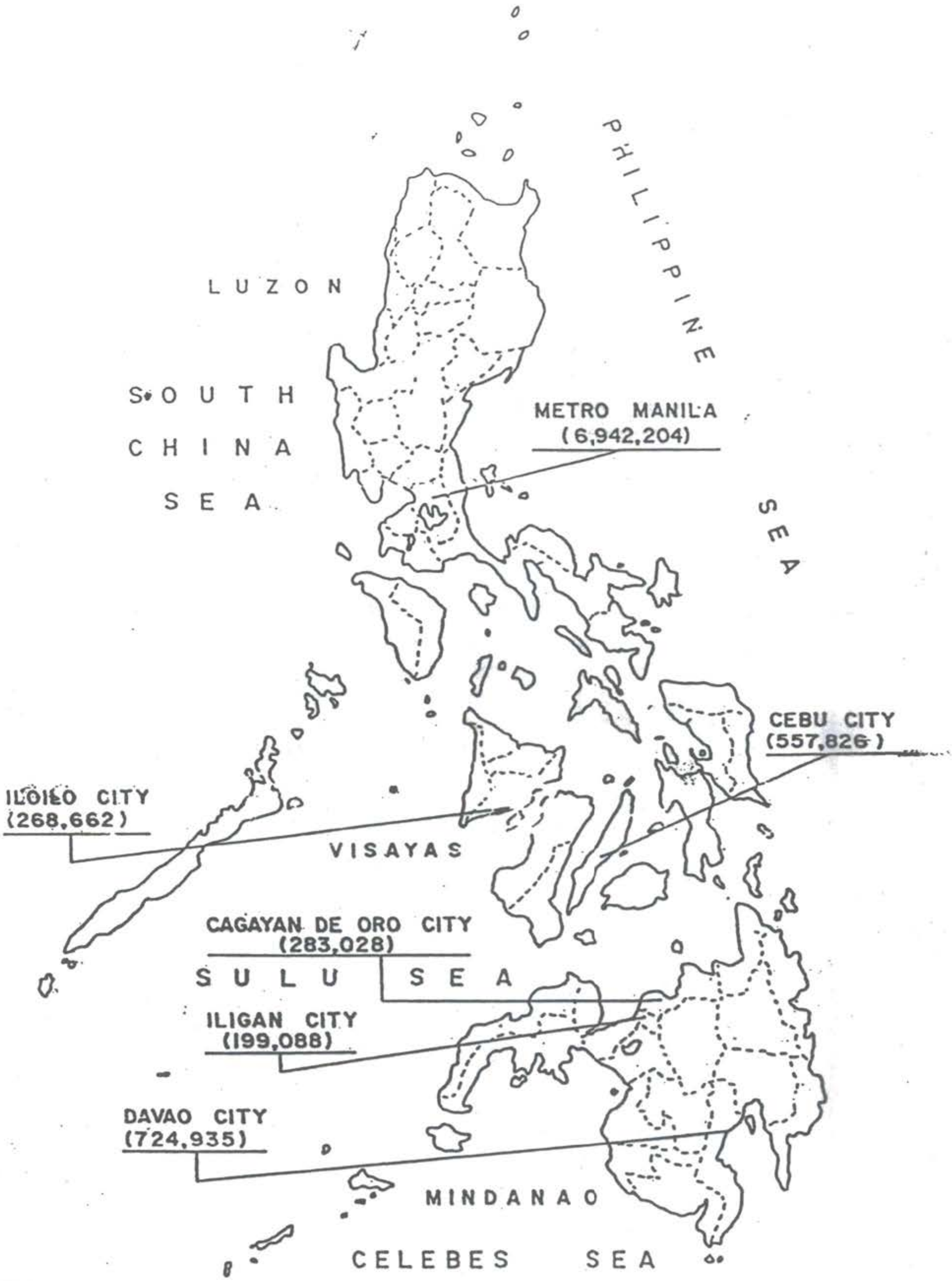


Figure 5 - Marine waters affected by oil contamination

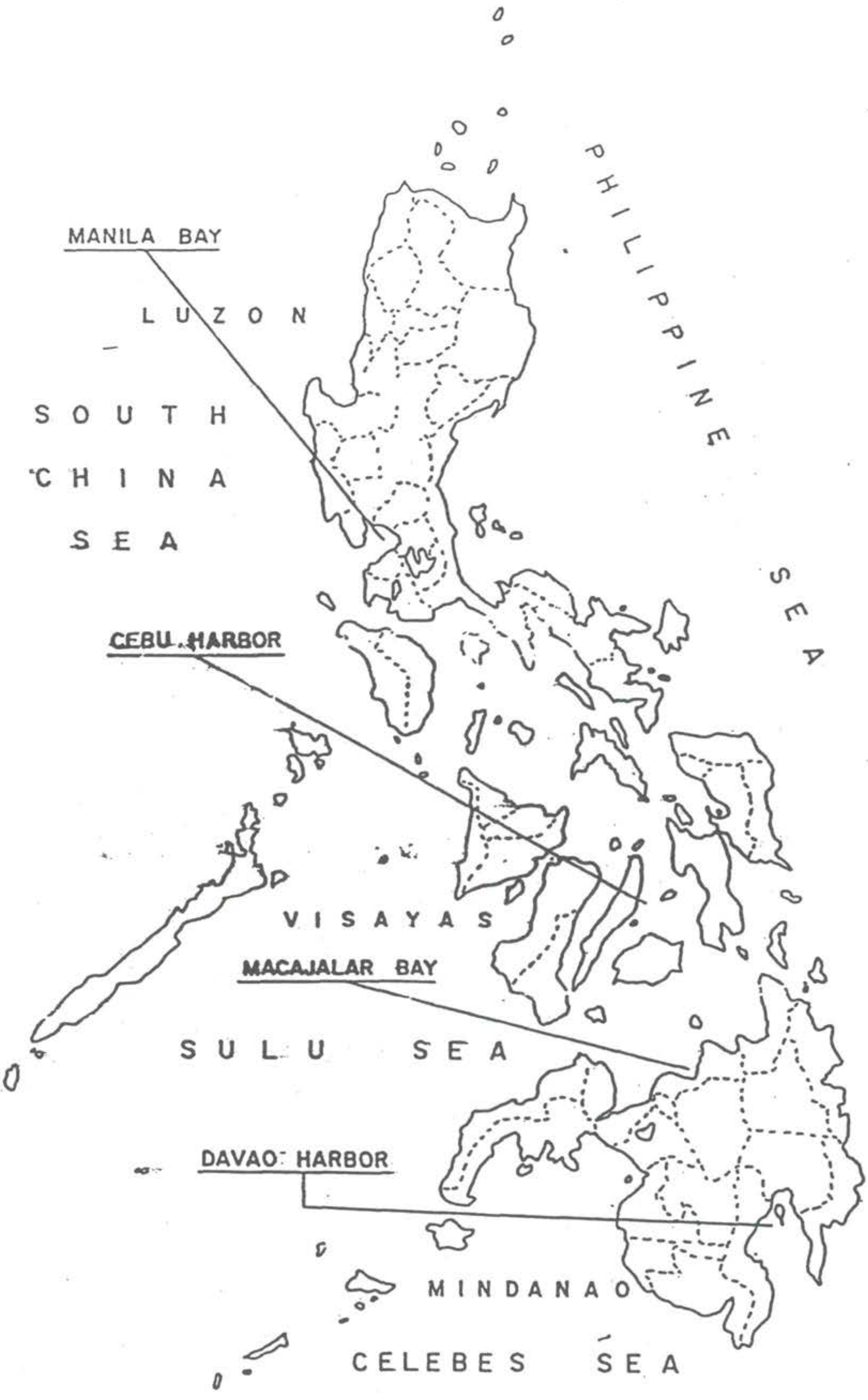
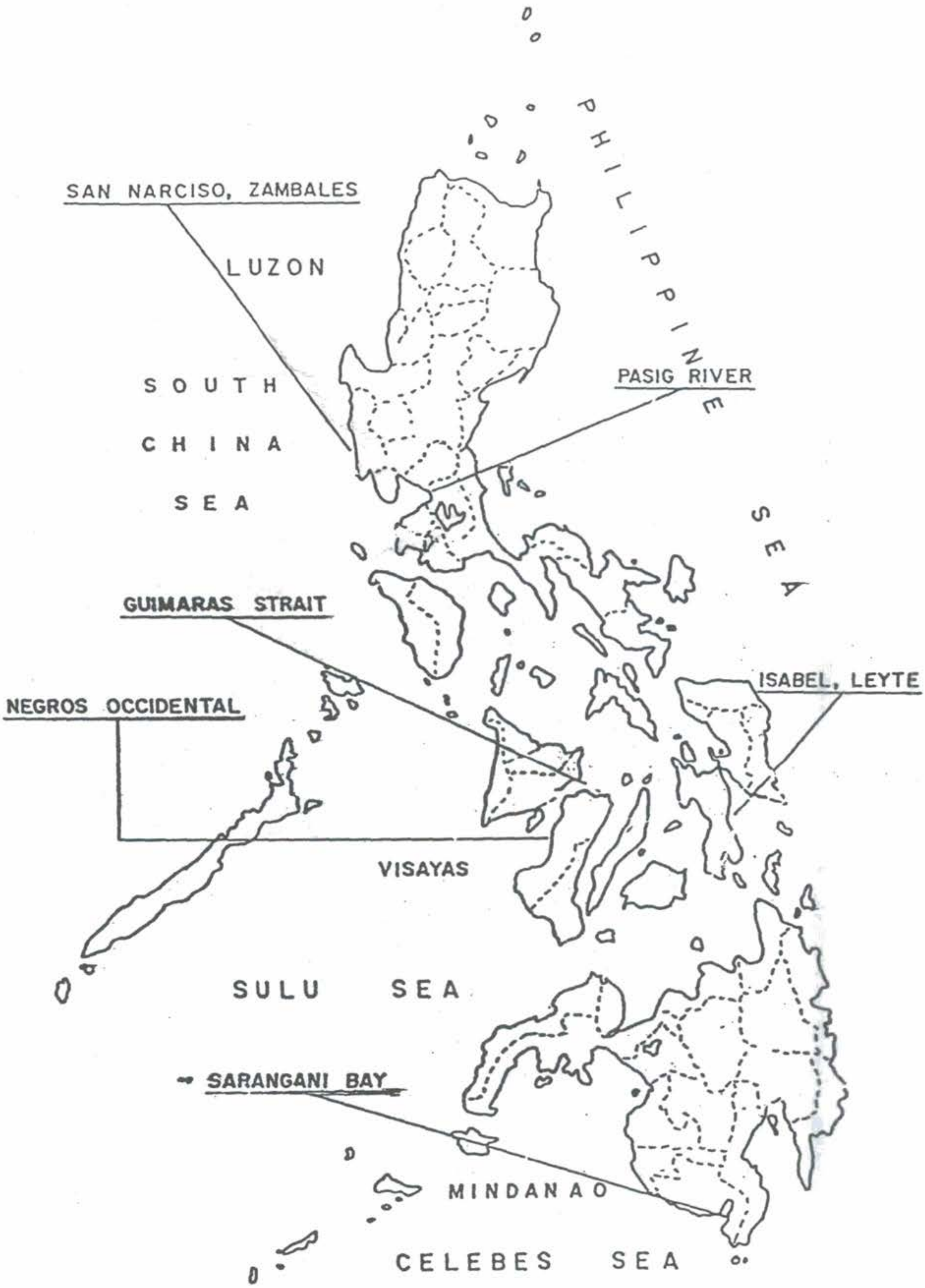


Figure 6 - Oil Spill-affected Areas



ANNEX VIII

Control of Land-based Oil Discharges into Coastal Waters of Singapore

1. INTRODUCTION

1.1 Singapore is a small country with very limited natural resources but with a high population density. The problem of controlling pollution in Singapore is therefore a difficult and delicate one. On the one hand, there is a need to promote industrial growth to ensure continued growth of the national economy. On the other hand, there is also a need to protect the environment from industrial pollution. The approach to pollution control must therefore be pragmatic yet effective.

1.2 Many pollution problems can be avoided or their impacts mitigated if careful and proper consideration is given to land use development and the siting of new industries. For this reason, the Singapore Government places great emphasis on prevention control of pollution through land use planning and the provision of environmental infrastructure.

1.3 The success of Singapore's pollution control programme is reflected in the state of its environment today. Singapore now has an environment that compares well with many countries of the world.

1.4 The water quality of rivers and streams is good. All inland waters support aquatic life and coastal waters meet recreational water standards.

2. POLLUTION CONTROL STRATEGIES

2.1 In Singapore the strategy in managing environmental pollution comprises three key elements: prevention; enforcement; and monitoring.

2.2 Potential environmental pollution can be prevented by proper land use planning. For example, legislation prevents pollutive industries and industries that can cause accidental discharge of toxic chemicals from being sited in water catchment areas.

2.3 Once preventive measures are established, controls are enforced to ensure that pollution control equipment is properly operated and maintained. Checks on the quality of air and water discharges from industries are routinely carried out.

2.4 To assess the effectiveness of our pollution control programme, the quality of the ambient air and water in watercourses is monitored regularly. With this information, we are able to determine if our pollution control measures are adequate and if pre-emptive measures need be taken.

3. PLANNING CONTROLS

3.1 The Ministry of the Environment is consulted when any new industrial investment is being considered and before any factory is allocated land for it to set up. In this context, the Ministry works very closely with other authorities such as the Urban Redevelopment Authority, which is the land use planning authority in Singapore, the Housing & Development Board, the Jurong Town Corporation and the Economic Development Board.

3.2 At this early stage, the Ministry of the Environment acts as a screen to prevent the establishment of industrial developments that may pose intractable problems of waste disposal, pollution and other environmental hazards. The proposed industrial development will be allowed only if it could comply with emission and discharge standards, if wastes generated could be safely managed and properly disposed of, and if the development is properly sited in a suitable industrial area away from housing and congested public areas.

3.3 To protect our water supply from accidental discharges of toxic chemicals and pollution, industries and related activities, such as storage of toxic chemicals, may not be sited in water catchment areas.

3.4 In addition, industries are encouraged to use clean technology so as to conserve resources and minimize adverse impact and pollution.

3.5 For major industrial development such as major chemical plants, the developer is required to carry out an impact assessment. The Ministry will issue clearance for the development only if the assessment confirms that pollution and hazards from the proposed development could be maintained at acceptable levels.

4. ENVIRONMENTAL INFRASTRUCTURE

4.1 The provision of comprehensive environmental infrastructure is essential in water pollution control. In Singapore, a comprehensive sewerage infrastructure to collect and treat wastewater has been built. Wastewater from residential and industrial premises is channelled through a network of sewers and pumping stations to sewage treatment works for effective treatment before being discharged into the sea.

4.2 Through proper planning and expansion, the sewerage system has been able to keep pace with new industrial, housing and commercial developments. Today, this infrastructure serves all the industrial estates and 100% of our population.

5. ENFORCEMENT

5.1 Before any factory begins operating, checks are made to ensure that the pollution control measures proposed at the planning stage have been implemented.

5.2 Industries must also apply and obtain the necessary written permission, licence or permits as legislated before they are allowed to operate. Appropriate conditions are imposed where necessary to further ensure that emissions and discharges from the industrial operation comply with stipulated standards and will not cause environmental pollution.

5.3 After the factory starts operating, regular inspections are conducted as part of the enforcement programme to control pollution. During these factory inspections, checks are conducted to ensure that air emissions and trade effluent discharges meet stipulated standards. Samples of trade effluent generated by the factories are collected and checked for compliance with the allowable limits. Pollution control facilities and equipment are also checked to ensure that they are being operated in a proper and efficient manner.

5.4 Besides factories, enforcement work is also carried out on hawker centres, hotels and other commercial establishments to ensure that all wastewater is discharged into public sewers for treatment.

6. MONITORING

6.1 The quality of inland and coastal waters is monitored regularly. The main parameters monitored are pH, Dissolved Oxygen, Biological Oxygen Demand, Total Suspended Solids, ammonia and sulphide. Hydrocarbons such as benzene, toluene, xylene and other pollutants like chloroform, trichloromethane and chlordane are also monitored. These pollutants are either not detectable or found only in low concentrations and are within the World Health Organisation (WHO) guidelines.

6.2 The monitoring showed that the water quality in the catchment and non-catchment areas is good. The pollution level in coastal waters is low. The water in rivers and streams is able to sustain aquatic life.

7. LEGISLATION

7.1 The legislation which has been enacted to facilitate water pollution control in Singapore includes:-

a) The Water Pollution Control and Drainage Act (Chapter 348)

b) The Trade Effluent Regulations, 1976

c) The Environmental Public Health (Toxic Industrial Waste) Regulations, 1988

d) The Prevention of Pollution of the Sea Act (1990)

e) Merchant Shipping (Oil Pollution) Act, 1981

7.2 The Water Pollution Control and Drainage Act (Chapter 348) empowers the Director of Water Pollution Control and Drainage to control the discharge of wastewater from domestic, industrial, agricultural and other trade sources. Under the Act, the Director can require the occupier of owners the premises to divert wastewater into sewers. The Act also provides for a severe penalty for offences that result in serious water pollution.

7.3 The Trade Effluent Regulations (TER), 1976 specify the standards of water which may be drained into watercourses. Standards are also prescribed for wastewater discharged into public sewers in order to protect the sewerage system. The discharge limits for oil and grease in the watercourses and public sewers are 10 mg/L and 60 mg/L respectively. For discharges into watercourses in water catchment areas, there is a more stringent limit of 5 mg/L.

7.4 Industries and other trade premises are required by the provisions in the TER to obtain written permission from the Director of Water Pollution and Drainage to discharge their trade effluent into the sewers or watercourses. Without such a written permission, the discharge of trade effluent into sewers or watercourse constitutes an offence and the occupier can be summoned to Court.

7.5 The Environmental Public Health (Toxic Industrial Waste) Regulations of 1988 control the generation, collection, transportation and disposal of toxic industrial wastes. A licence is required for the collection, treatment and disposal of toxic industrial wastes. The disposal of used contaminated oil is subject to these Regulations.

7.6 The legislation described above is enforced by the Ministry of the Environment, with the exception of the Prevention of Pollution to the Sea Act and the Merchant Shipping (Oil Pollution) Act, which cover the area of marine pollution from ships at sea, and are enforced by the Port of Singapore Authority.

8. CONCLUSION

8.1 With controls at the planning stage through enforcement of comprehensive legislation and regular monitoring, we have been able to keep the pollution level low and maintain a clean and green environment in Singapore. However, to ensure that our environment continues to be clean, there is a need to review our strategies from time to time to take into account changing standards and to incorporate new technology into the pollution control effort.

ANNEX IX

Extent and Impact of Land-based Oil Discharges Into Coastal Waters of Vietnam

Do Ngoc Quynh, Pham Van Ninh,
CMESRC, Hanoi
Hua Chien Thang,
NEA, Hanoi

1. INTRODUCTION

In Vietnam, oil pollution is considered as one of the most serious problems for the coastal water quality. Land-based oil discharges into the coastal waters are from two sources: land outside coastal area activities and land within coastal area activities.

In this report, a primary assessment of the extent and impact of oil discharges of the two above mentioned sources will be presented. Some information on remedial measures taken and enforced will be also given.

2. THE GROSS FLUX OF OIL AND ITS PRODUCT

It can be said that almost all land based oil and related products into the coastal water of Vietnam are transported by rivers flows. The country's river network consists of about 250 rivers of the length more than 10 km each, making an average density for the whole country of 0.6 km/km^2. Along the coastal line, every 15-20 km there exists a river mouth. In general the Vietnamese rivers are small and moderate. There are only 9 big river systems, each with catchment areas of more 10,000 km^2, and comprising in total about 70% of the country's territory. Apart from the Kycung-Caobang river system, the 8 others (Red, Thai Binh, Ma, Ca, Thu Bon, Ba, Dong Nai-Sai Gon, Me Kong) flow to the sea. Due to a rather high density of rivers, any oil and its products discharged into the environment can easily enter waterways and thus be transported to coastal areas. Characteristics of the main river systems are presented on the following table:

Table 1. Characteristics of the main river systems

River system and river	Watershed area (km²)	River length (km)	Annual average discharge e(m³/s)	Total annual water volume (km³)	Annual oil discharge (T)
1. Red River system					
1-Thao	51,750	902	796	26.4	
2-Da	52,610	1,013	1,744	56.4	
3-Lo	38,970	469	980	32.2	
4-Hong	154,720	1,126	3,630	85	7000-8000
2. Thai Binh system					
1-Cau	6,064	288	43.7	4.7	
2-Thuong	3,580	164	32.8	1.76	
3-Luc Nam	3,066	175	38.6	1.8	
4-Thai Binh	15,520	385	318	38	2500-3000
River system and river	Watershed area (km²)	River length (km)	Annual average discharge e(m³/s)	Total annual water volume (km³)	Annual oil discharge (T)
3. Kycung-Bac Giang system					
1-Bac Giang	4,565	108	73.5	2.4	
2-Kycung	6,663	243	26.9	0.85	
4. Ma system					
1-Chu	7,552	325	135	4.9	
2-Ma	28,370	538	326	10.8	450-750
5. Ca system					
1-Ngan Sau	3,813	135	124	4.0	
2-Hieu	5,330	228	112	3.82	
3-Ca	27,224	531	430	13.6	600-1000
6. Gianh	4,676	158	60.8	2.0	
7. Quang Tri	2,500	156	104.6	3.3	
8. Thu Bon system					
1-Tra Khuc	3,180	135	162	5.1	
2-Ve	1,260	91	44	1.4	
3-Thu Bon	10,590	205	444	14.0	450-750
9. Ba system	13,814	388	184	5.8	180-300
10. Dong Nai-Sai Gon system					
1-Dong Nai	29,520	586	693	29.7	
2-La Nga	4,000	272	83	5.3	
3-Be	8,200	344	240	10.3	
4-Sai Gon	5,560	256	167	5.2	2700-3300
11. Mekong system					
1-Se San	17,500			12.5	
2-Sre Pock	18,280			10.6	
3-Cuu Long	795,000	4,200	13.974	550	27500-55000

It is worth to note that Vietnam belongs to the high rainfall countries, receiving an average value of 2000 mm/year. The rainy season occupies 6 - 7 months per year and for most of Vietnamese territory occurs from May to December, when 70 - 80% of the total annual rainfall is concentrated. The river discharge for the rainy season is approximated as indicated in Table 1.

In the frame work of the National project KT-03-07 "*Assessment of Riverine Pollution Inputs into the Sea*" an evaluation has been made of the oil discharge transported by rivers to coastal and marine areas, including estuaries. The study has been conducted for Thai Binh, Red, Thu Bon, Dong Nai-Sai Gon, Mekong river systems. Based on the results of the field surveys conducted for some typical rainy and dry time period the gross flux of oil has been estimated:

The oil discharge into coastal waters through an fixed across section for thefield survey time period. R_o is calculated as follows:

$$R_o = Q_T \frac{\sum_{i=1}^{n} Q_i C_i}{\sum_{i=1}^{n} Q_i}$$

where: Q_i - water discharge at i time
Ci - oil concentration at i time, i=1, 2, 3, ..., n
Q_T - total water discharge from the beginning to the end of sampling period.

C_i is determined by two rays photosphectrum analyzer (Japanese, SHIMABZU, IR-470). After that an extrapolation has been made for the dry and rainy seasons, and for the annual period.

The calculated annual oil discharge from the main river systems into coastal areas is shown in the column to the far right of Table 1.

3. OIL DISTRIBUTION IN THE COASTAL WATER

The gross flux of oil from land-based sources entering coastal waters includes local urban and industrial sources. In Vietnam, due to low status of economical development, there are only few suchlike oil pollution sources located in coastal areas. Among them, the most important are cities such as Ha Long, Hai Phong, Da Nang, Qui Nhon, Ho Chi Minh, that have the function of both urban industrial and habour areas. Water way transported oil discharges and daily city activities in general, quite significantly increase oil levels in coastal waters and sediments. For example, figure 1 shows the oil of the upper layer of water in Thai Binh-Hai Phong coastal area, during November 1994. It is clear that the oil range from 0.095 to 0.680 mg/l here. In the southern coastal areas, similar values can be found, oil levels at Nha Be (Ho Chi Minh city) ranges from 0.06 to 0.15 mg/l, in the Genh Rai bay from 0.03 to 0.25 mg/l (near to the coast 0.15 0.25 mg/l) in November 1995.

It is still difficult to today assess oil discharges from land within coastal areas. However, some figures can be provided. In 1992, it was estimated that 74 tons of oil enter the coastal area from Hai Phong - 231.5 tons from Da Nang - 300.6 tons from Ho Chi Minh city - 2100 tons.

Coastal waters affected by land-based oil pollution can be defined by remote sensing methods and mathematical modeling. The clear boundary between turbid river water and clean sea water observed in almost the estuarine areas of Vietnam is quite helpful for this purpose. It is understood that there areas scale and appearance depends on each particular river is flow discharge, topography, tidal cycles, coastal circulation and other weathering conditions, including of course the monsoon seasons.

4. ECOLOGICAL IMPACT

An attempt has been made for seeking relationship between pollutants and zoo plankton and phytoplankton biomass. Unfortunately, only some recursive equations for other toxic parameters, not for the oil, were found. It is true for all of the main river systems. Study on other ecological impacts are not carried out.

5. THE NECESSARY MEASURES FOR REDUCING OIL POLLUTION IN THE COASTAL ZONE

The extent and impact of land-based oil pollution depends on many factors, especially the oil volume entering sea water, which increases, in view of the increasing annual consumption of oil and lubricants. In Table 2. the estimated annual consumption of oil and lubricants for the whole country and each region is shown for the years 1995 and 2000.

Table The annual consumption of oil and lubricant (x 1000 T)

Region	1995	2000
Whole country	4999.3	8086.0
North part	1986.0	3054.5
Middle part	640.0	972.3
South part	2373.3	4059.2

It is clear, that a part of the annual amount of consumed oil enters the environment, including coastal waters and this part is increasing rapidly. According to regulations today, the allowed loss - ratio of oil and lubricants in Vietnam is still high, ranging from 0.2% to 2%. It is necessary to minimize it. In addition, due to the rapid increase of oil consumption, wastes, especially liquid waste must be treated before discharging it into water environments. This kind of work is still very rare in Vietnam.

Recognizing the danger of oil pollution, the Government has taken the following measures:

1. It has issued sublaw regulations for reducing oil pollution.

Among them there are:

- Any important socioeconomic development project has to provide EIA.
- If such a project could be an oil polluter or a potential victim of oil pollution, especially of oil spills, it has to carry out an oil spill contingency plan.
- Any existing industrial unit has to carry out present environment status assessment.
- Standards for oil concentration in wastes.

2. It is implementing some other activities such as:

- Preparation of oil contingency plans for the whole country.
- Raising peoples' awareness of water environment protection from contaminants, first of all from oil and lubricants, in the coastal zone.
- Raising capacity building for managing and monitoring the coastal zone waters.

ANNEX X

Training Workshop on LAND-BASED OIL DISCHARGES TO COASTAL WATERS, ECOLOGICAL CONSEQUENCES AND MANAGEMENT ASPECTS
22-26 April 1996, Penang, Malaysia

LAND-BASED SOURCES OF OIL DISCHARGES: GENERAL ISSUES

Dr. Beverly Goh

BACKGROUND

Before a determination of the extent of pollution and impacts on the environment is carried out, it is important to distinguish contamination from pollution. The United Nations Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP, 1969) defined "contamination" as "the presence of increased levels of substances above natural background levels in water, sediments and organisms", and "pollution" as "direct and indirect anthropogenic inputs of substances to the marine environment resulting in deleterious effects like harm to marine life, danger to human health, hindrance to marine activities including fishing, and a reduction in the quality and usefulness of seawater".

Present day scientific opinion agrees that our open oceans are contaminated, but are not yet seriously polluted. More importantly however, due to the shallow nature of the coastal areas, and comparably less mixing, many coastal zones are under serious threat of pollution, in particular from industry and human settlements (Clark, 1986).

Sources of marine pollutants may be divided into five categories, each contributing different estimated percentages of total pollutants into the marine environment (GESAMP, 1990). These are: run-off and land-based discharges (44%); the atmosphere, which is largely understood to originate also from land-based sources (33%); maritime transportation (12%); dumping (10%); and offshore production (1%) Land-based marine pollution is regarded as having three main routes of entry, namely, the air, rivers and other run-off, and direct pipeline discharges.

With regard to pollution from oil in the marine environment, a UN conference on the law of the sea (Timagenis, 1980) distinguished persistent from non-persistent oils. It defined "persistent oils" (black oils) to include "crude oils, fuel oils, heavy diesel oils and lubricating oils, which when released, form coherent masses which persist and can travel for some distance under the action of wind and current". Persistent oils may contaminate or pollute the sea surface, coastline and seabed. "Non-persistent oils" (white oils) were defined as "refined petroleum products, more volatile and dispersable compared with persistent oils, which do not persist on the surface of the sea for more than a very limited period of time".

More specifically, a United Nations Environmental Programme (UNEP) intergovernmental conference in 1995 defined land-based sources of oil to "include operational and accidental discharges and emissions from oil exploration, exploitation, refining and storage facilities; urban, industrial and agricultural run-off; transport; and the inappropriate disposal of used lubricating oils" (UNEP, 1995). The main pathways to the marine environment are believed to include atmospheric dispersion of volatile fractions, storm sewers and sewage treatment works; and rivers.

OIL IN THE MARINE ENVIRONMENT

Estimates on the input of oil into the marine environment have been routinely conducted. A recent report by UNEP estimates that petroleum in the marine environment may originate from several sources (UNEP, 1992a, b). These inputs include, in descending order of magnitude, land-based industrial and municipal discharges (approx. 1.2×10^6 t/yr, e.g. coastal oil refineries and terminals, industrial and municipal waste, urban and river run-off including outputs from land transportation, vehicle emissions, fuel stations), marine transportation (encompassing oil tankers, bilge and sludge transportation), atmospheric fallout (which is also considered land-based), natural seepages and offshore production.

What kinds of oil products are used, which may contribute to contamination and pollution of the environment? Crude oil processed in refineries usually include "cuts" of different molecular sizes, namely, petroleum gases, light gasoline and benzine (used as petrol in the automobile industry), naphtha (for the petrochemical industry), kerosine, gas oil (diesel), and fuel oil and residues (used in ships, power stations, tars, etc). All these oil products are biodegradable by bacteria, some yeasts and fungi, but at varying rates, depending on their molecular weights (Clark, 1986).

Routine measurements of hydrocarbon levels have been conducted in the coastal waters of Southeast Asia, which form part of the East Asian Seas. These estimates report various -- hydrocarbon-contamination levels in the Strait of Malacca, the East Coast of Malaysia, Jakarta Bay, and the Andaman Sea (Cheevaporn, 1995). One possible reason for these elevated levels of hydrocarbon in these waters is the high production of crude oil and its transport in the region, centring around Malaysia, Thailand, Indonesia and Singapore.

Levels here may also reflect oil discharges originating from land, from industries, refineries, etc. In comparison to the large amount of literature available on oil contamination from shipping (particularly oil spills), much less has been carried out with regard to oil discharges from land. Owing to the fact that there is a dearth of data in the East Asian Seas region concerning oil in the marine environment originating from land-based sources, and crude estimates of contamination levels have been high, this is clearly an area that must be addressed, in particular by nations bordering the East Asian Seas.

IMPACTS ON BIOLOGICAL COMMUNITIES

From a scientific point of view, oil contamination and pollution in the marine environment may have various degrees of impact on biological communities. The study of the effect of pollutants on organisms and communities may be carried out at several organismic levels. These levels range from biochemical enzymatic pathways, the study of molecular and cellular effects, physiological and histopathological effects (e.g. abnormalities), effects on whole organisms (e.g. reproductive capacity), to entire population and community effects.

Experiments carried out to study the effects of pollutants on organisms, called bioassays traditionally involve observing lethal toxicity effects of pollutants on test organisms, where the death of the organism is the unit of measurement. Hence, LC_{50} values, or the concentration at which 50% mortality is observed, is a measurement from which a threshold or sensitive concentration level can be extrapolated. Increasingly, ecotoxicological sublethal tests which look at the lower order effects (e.g. biochemical, physiological, reproductive responses) are being conducted, as these identify more realistic threshold limits at which effects can be observed in organisms, before death occurs. The measure of sublethal effects is the EC_{50}, or effective concentration at which a response is observed in 50% of the test organisms, e.g. reduced reproductive capacities, reduced respiration, etc.

The biological effects of oil in the environment have been well studied in lethal toxicity, as well as sublethal ecotoxicity tests. Experiments on the effect of oil have been conducted on many groups of marine organisms ranging from plankton to echinoderms, and fish (Patin, 1982). An interesting point to note is that similar experiments using oil emulsifiers (which are often used to manage oil spills in the marine environment) as the pollutant, also indicate lethal and sublethal effects on organisms (Patin, 1982). Thus, caution should be practised in the deployment of oil dispersants in the marine environment, particularly in areas where sensitive ecosystems exist.

ECOSYSTEMS AT RISK

There are limitations to laboratory-based bioassays studying the effects of oil on individual organisms, one of which is the realistic extrapolation of results to field conditions. In the light of these limitations, scientists have also conducted research on the effects of oil pollution on entire ecosystems or communities. Coastal ecosystems that have been identified in the literature as being sensitive to oil pollution are estuaries, wetlands (including mangroves, mudflats and peat swamps), coral reefs, and seagrass beds. These ecosystems not only serve as natural shoreline protection, but more importantly are spawning, nursery and feeding grounds for many fish species, and their continued preservation is therefore important for the fisheries industry (Paw & Diamante, 1995). The effect of oil on mangrove and coral reef ecosystems is particularly highlighted in the literature .

Mangrove ecosystems are particularly important to the countries bordering the East Asian Seas region, and have been directly linked to fisheries and aquaculture production (GEF/UNDP/IMO, 1995). The scientific literature supports evidence of the vulnerability and degradation of mangroves and its ecosystem by oil pollution, ultimately affecting the livelihood of coastal populations that depend on mangrove forests for survival (Paw & Diamante, 1995).

Coral reefs are similarly sensitive to pollution by oil. A comprehensive review of the effects of petroleum hydrocarbons on corals conducted in 1987 (Loya & Rinkevich, 1987) reported detrimental effects of petroleum hydrocarbons on coral reproduction, growth rate, photosynthesis, cell structure, colonization capacities, feeding and behavioural responses, in addition to deleterious effects caused by oil dispersants and drilling muds associated with oil exploration. This review also presented recommendations of mitigative measures and management principles for oil pollution on coral reefs. The following recommendations were highlighted: the use of mechanical means to remove oil over dispersants, regular monitoring and standardization of methods to measure levels of oils in the marine environment, baseline studies on effects of chronic oil pollution, public education, and enforcement of environmental laws dealing specifically with oil discharges.

In addition to the study on the impacts of oil pollution on ecosystems directly, the indirect effect that the degradation of these ecosystems have on fisheries must be borne in mind. Direct effects of oil pollution on the fisheries industry have also been reported through occur rences of contamination or tainting of seafood (fish, shellfish). This can ultimately affect human health, when if there economically important marine organisms are consumed with accumulated hydrocarbons in their bodies.

MANAGEMENT & MONITORING

One of the basic principals of management of pollution is regular monitoring of the environment for the presence of pollutants. Commonly, this involves a system of measuring concentrations of pollutants, e.g. petroleum hydrocarbons, in sea water, sediment, as well as the tissue of marine organisms.

Oil products are not particularly difficult to measure in the environment. A Programme for Global Investigation of Pollution in the Marine Environment (GIPME), established by the International Oceanographic Commission (IOC), UNEP and the International Maritime Organization (IMO), is carried out to provide scientific inputs for the assessment and regulation of contamination and pollution of the marine environment, regionally and globally. GIPME has established that althrough petroleum oils have medium impacts on ecosystems, it is relatively easy to measure this in the environment (Ross, 1994).

Activities proposed by experts in the GIPME programme on the management of pollution (including oil) in the marine environment include measurements of physical and chemical parameters; laboratory-conducted inter-calibration exercises which include examination of biological effects; and the use of tropical ecosystems (mangroves, coral reefs, seagrass beds) as biological and ecological indicators of changes (i.e. monitoring of entire communities) in the marine environment. An example of the activities associated with GIPME is the International Musselwatch programme, in which measurement of pollutant levels in the tissue of "sentinel" bivalves are conducted regularly by scientists and various government ministries. Phase I of the International Musselwatch programme concentrated efforts on South and Central America, while Phase II includes monitoring activities in the East Asian Seas region (Ross, 1994).

<u>INTERNATIONAL, REGIONAL, NATIONAL LEGISLATION & COLLABORATIVE PROGRAMMES</u>

Pollution is an important issue not only at a national level, but also at regional and global scales, and many initiatives, supported by the UN in particular have taken place since the 1960's. These initiatives include conventions, agreements and protocols, and are efforts aimed at addressing the need for legislation and joint programmes to manage pollution in the environment. The more recent initiatives advocate a scientific basis to the assessment and regulation of contamination and pollution in the marine environment. All there initiatives are directed towards the principle of resource management for sustainable development.

International

The following are relevant international UN initiatives on pollution addressing oil in the marine environment in recent years:

1) The *London Dumping Conventio*n, or London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matters (1972), which deals with pollution from shipping activities.

2) *MARPOL*, the International Convention for the Prevention of Pollution from Ships (1978).

3) The *Third UNCLOS*, or UN Conference on the Law of the Sea (1982). A declaration resulting from this conference stipulated that "States shall, consistent with the rights of other States, endeavour, as far as practicable, directly or through the competent international organizations, to observe, measure, evaluate and analyze, by recognized scientific methods, the risks or effects of pollution of the marine environment".

4) The *OPRC*, or International Convention on Oil Pollution Preparedness, Response and Cooperation (1990), which is also related specifically to shipping activity.

5) The *Montreal Guidelines* for the Protection of the Marine Environment against Pollution from Land-Based sources (1985), which was adopted by the UN Conference on Environment and Development (UNCED). These guidelines were prepared by UNEP as

a checklist to help nations develop international agreements and national legislation. They essentially recommend that "States should develop, adopt and implement comprehensive programmes and measures for the prevention, reduction and control of pollution from land-based sources". This would involve the identification of desired present, medium, and long-term uses of a water body, drawing up control strategies for those uses, and the establishment of black and grey lists.

6) The *UN Convention on Biological Diversity*, or Agenda 21 (1992), an UNCED Earth Summit in Rio. Two important developments in this convention are:
   - the recognition of the importance of land-based sources of marine pollution, and
   - priority actions for nations to take individually, collectively and globally.

7) The *Washington Declaration* on the Protection of the Marine Environment from Land-Based Activities, and a *Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities* 1995, resulting from a UN Intergovernmental Meeting held in Washington, DC, in October/November 1995. This was a UNEP Intergovernmental Conference convened to adopt a global programme of action for the protection of the marine environment from land-based activities, with the goals of:
   - raising awareness about the growing impact of land based sources of pollution on coastal waters, and
   - gaining consensus and commitments to action from the participating countries.

   The Washington Declaration particularly addressed two specific issues, namely:
   - persistent organic pollutants, and
   - inadequate treatment of waste water.

Regional and National Approaches

On the regional level, many joint programmes and agreements exist addressing the problem of pollution. The following are some examples from the East Asian Seas region related to pollution by oil:

1) Management of shipping traffic and the prevention of oil spills in the Malacca Strait, jointly organised by Indonesia, Malaysia and Singapore, who share the Strait (UNEP, 1988):
   - the Traffic Separation Scheme (TSS, 1980) developed by a Tripartite Technical Expert Group;
   - the oil spill preparedness and response plan (OSPAR).

2) Research initiatives for joint activities by countries bordering the South China Sea, e.g. natural resource studies and activities on the prevention of pollution.

3) The UNEP Regional Seas Programme established since the 1970's, specifically to promote regional marine protection agreements. This programme has so far implemented 10 Action Plans involving over 100 countries, of which the East Asia Seas region is one. A recent activity for this region coordinated by the Regional Coordinating Unit of the East Asian Seas (RCU/EAS), is the Regional Programme of Action on Land-Based Activities Affecting Coastal and Marine Areas in the East Asian Seas (Koe & Aziz, 1995). This programme draws upon country specific plans of action for land-based pollution, and proposes how a regional programme may be developed. The proposed implementation of the regional programme comprises four main components, namely:

- planning control and environmental management,
- capacity building activities,
- regional assessment and monitoring of coastal waters, and
- public education and community participation.

4) The GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas (MPP-EAS), which encompasses the countries Brunei Darussalam, Cambodia, China, Indonesia, DPR Korea, Rep. Korea, Malaysia, Philippines, Philippines, Singapore, Thailand, Vietnam. This regional programme targets management issues pertaining to pollution in the seas of East Asia.

On the national level, nations in the East Asian Seas region independently implement national legislation, regulation and enforcement to address pollution of their coasts. This also includes in part, the ratification and implementation of international conventions in line with national development strategies. Countries participating in this workshop will no doubt elaborate further on existing national programmes dealing with land-based sources of oil pollution in their coastal waters.

In conclusion, it is agreed that present levels of land-based sources of oil discharges into the marine environment have impacts on coastal ecosystems, and the well-being of communities in the East Asian Seas region. This problem will have to be addressed at national, regional and international levels, and efforts have already begun at these particular levels. The UNEP Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities (UNEP, 1995) has identified a category for oils (hydrocarbons), with recommendations that the East Asian Seas region may well adopt, in its management of land-based sources of oil in the coastal environment.

SOURCES & FURTHER READING

Baker, J.M., ed. (1976) Marine Ecology and Oil Pollution. Applied Science Publishers Ltd., UK.

Cheevaporn, V. (1995) Oil Pollution in the Strait of Malacca. Tropical Coasts, Vol.2 , No. 1.

Clark, R.B. (1986) Marine Pollution. Oxford University Press, UK.

Dicks, B, ed. (1989) Ecological Impacts of the Oil Industry. The Institute of Petroleum, John Wiley & Sons, UK.

GEF/UNDP/IMO (1995) Tropical Coasts. A Newsletter for Policymakers, Environmental Managers, Scientists and Resource Users. Vol. 2., No. 1.

GESAMP (1990) IMO/FAO/Unesco/WMO/WHO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Pollution: The State of the Marine Environment. UNEP Regional Seas Reports and Studies No. 115.

ITOPF (1987) Response to Marine Oil Spills. The International Tanker Owners Pollution Federation Ltd. UK.

Koe, L.C.C. & Aziz, M.A. (1995) Regional Programme of Action on Land-Based Activities Affecting Coastal and Marine Areas in the East Asian Seas. RCU/EAS Technical Report Series No. 5.

Loya, Y. & Rinkevich, B. (1987) Effects of petroleum hydrocarbons on corals. In: Salvat, B. (ed.) Human Impacts on Coral Reefs: Facts and Recommendations, Antenne Museum E.P.H.E., French Polynesia, pp. 91-102.

Moore, J.W. & S. Ramamoorthy (1984) Organic Chemicals in Natural Waters. Applied Monitoring and Impact Assessment. Springer-Verlag, USA.

Neff, J.M. & Anderson, J.W. (1981) Response of Marine Animals to Petroleum and Specific Petroleum Hydrocarbons. Applied Science Publishers, Ltd., UK.

Patin, S.A. (1982) Pollution and the Biological Resources of the Oceans. Butterworth Scientific, UK.

Paw, J.N. & Diamante, D.A.D. (1995) Environment and Enterprise: The Case of Malacca Strait. Tropical Coasts, Vol. 2, No. 1.

Ross, A. (1994) Marine Pollution Experts Meet in London. Tropical Coasts, Vol. 1, No. 1.

Salvat, B. ed. (1987) Human Impacts on Coral Reefs: Facts and Recommendations. Antenne Museum E.P.H.E., French Polynesia.

Timagenis, G.J. (1980) International Control of Marine Pollution, Oceana Publications, Inc., USA.

UNEP (1985) Montreal Guidelines for the Protection of the Marine Environment against Pollution from Land-Based Sources. Summarized in: World Resources 1992-3, World Resources Institute, 1992.

UNEP (1988) Oil Pollution and its Control in the East Asian Seas Region. UNEP Regional Seas Reports and Studies No. 96.

UNEP (1992a) Saving our Planet, Challenges and Hopes.

UNEP (1992b) Marine Pollution from Land-Based Sources. Industry & Environment, Jan-Jun 1992, UNEP IE/PAC Vol. 15, No. 1-2.

UNEP (1993) Training Manual of Assessment of the Quantity and Type of Land-Based Pollutant Discharges into the Marine and Coastal Environment. RCU/EAS Technical Report Series No. 1.

UNEP (1995) Intergovernmental Conference to Adopt a Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities. 23 October - 3 November 1995, Washington, DC.

Vernberg, F.J. & Vernberg, W.B. eds. (1974) Pollution and Physiology of Marine Organisms. Academic Press, Inc, USA.

Wardley-Smith, J. ed. (1983) The Control of Oil Pollution. Graham & Trotman Ltd., UK.

ANNEX XI

PETROLEUM HYDROCARBONS IN THE SOUTH CHINA SEA AND STRAITS OF MALACCA AND THEIR TOXICITIES TO ORGANISMS

Law Ah Theem

Faculty of Fisheries and Marine Science
University Pertanian Malaysia
43400 UPM, Serdang, Selangor
Malaysia

1. INTRODUCTION

Malaysia is surrounded by seas comprising of Straits of Malacca, South China Sea and Sulu Sea. These seas are vulnerable to oil contamination and pollution due to the substantial amount of oil released into the marine environment through various activities such as shipping operation, oil and gas exploration and production, and the discharge of industrial and sewage effluents.

Activity of dislodging of oily waste waters into the Malaysian seas by oil tankers is frequently reported. This has alerted the public concerns since petroleum hydrocarbons can be damaging to the marine ecosystem and tourism industries. To assess these effect, the acute and long-term chronic effects of oil on the various trophic levels of marine organisms in the tropical seas are required for the effective management and protection of the marine environment. This paper will attempt to summarize the findings of the oil pollution studies that have been conducted in the Malaysian seas especially for those studies which have been carried out at the Universiti Pertanian Malaysia, Serdang for the last decade.

2. MATERIALS AND METHODS

Study areas: In South China Sea, the studies were conducted in the exclusive Economic Zone (EEZ) off Trengganu, Pahang, Sarawak and Sabah Coast in the year of 1985, 1986, 1987 and 1989 respectively. the duration of each cruise was about two weeks. In straits of Malacca, the distribution of petrogenic hydrocarbons in water and sediment off the coast of Pertis. Penang and Johor were done in 1991, 1992 and 1994 respectively. In Port Dickson Coastal Waters, the study has been carried out since 1985.

Sampling techniques: A dichlorsmethane cleaned 4 litres glass regent bottle was used for taking surface water sample ai a depth of 0.5 meter. An Ekman grab was used for collecting the marine sediment.

Analytical techniques: Petrogenic hydrocarbon contents in water and sediment were determined by using the fluorospectrometric methods of Parsons et. al. (1984) and USEPA (1979) respectively. dichlonomethane was used for the hydrocarbons extraction from water and Soxhlet extraction from the sediment. The excitation and emission wavelengths used for the fluorospectrometric analysis were 310 mm and 374 mm respectively. The percentage of recovery of Petroleum hydrocarbons were 93 $\pm$ 3.6% in water and 96 $\pm$ 4.9% in sediment.

3. PETROGENIC HYDROCARBONS IN THE STRAITS OF MALACCA

The Straits of Malacca is the busiest route for vessels and oil tankers traffic in the world. There are about 100,000 vessels comprising 40% of oil tankers passing through the straits with a load of about 200 million metric tones of crude oil annually. The mean oil level in the coastal waters is less than 200 μg/L, while in the desiment the value is less than 70 mg/kg dry sediment. The petrogenic hydrocarbon levels in the coastal waters of Port Dickson, Penang and Perlis are in the rage of 14.69 - 150.28 μg/L, 10 - 120 μg/L and 28.88 - 284.34 μg/L respectively. The petrogenic hydrocarbon contents in the sediment off the coastal waters of Port Dickson, Penang, Perlis and Johor are in the range of 7.26 - 55.20 mg/kg, 8.79 - 206.62 mg/kg, 4.68 - 46.90 mg/kg and 0.16 -46.76 mg/kg dry sediment, Tapis A blend crude oil equivalent. There was an increasing trend of oil pollution in the Port dickson coastal waters from 15 μg/L in 1986 to about 200 μg/L in 1993. Thereafter, the level declines to about 40 μg/L. The decline of oil pollution level in Port Dickson coastal waters is probably due to the strict enforcement and control of the dislodging activity by the Malaysian government.

4. PETROGENIC HYDROCARBONS IN THE SOUTH CHINA SEA

The South China Sea is rich in oil deposits and this area is active in oil and gas exploration and production. There are about 32 oil and 6 gas fields in operation which produce about 630 Kilo Standard Barrel per day (KSTB/d) of oil and 2.9 Billion Standard Cubic Feet per day (BSTCF/d) of gas.

The oil levels in water and sediment of the EEZ of South China Sea are generally lower than that detected in the Straits of Malacca. However, a considerable higher level is found in some areas of Terengganu and Sarawak where there is active oil and gas production. The average level of oil found in surface waters of Terengganu, Pahang, Sabah and Sarawak are 960 μg/L, 33 μg/L, 68 μg/L and 143 μg/L Tapis A blend crude oil equivalent respectively. For the sediments, the values are in the range of 6.43 - 1332 mg/kg, 10.73 - 60.69 mg/k, 9.84 - 226.42 mg/kg and 7.43 - 1089 mg/kg Tapis A blend crude oil equivalent respectively. In the Terengganu coastal waters, the range of oil level in water is between 62.43 - 114.35 μg/L, while in sediment the range is between 15.12 - 24.17 mg/kg. In the open sea close to Vietnam waters, a very low level f oil in waters in the range of 1 μg/L is detected.

5. PETROGENIC HYDROCARBONS IN THE SULU SEA

There is no study of the petroleum hydrocarbon distribution and pollution in the Sulu Sea.

6. TOXICITY OF WATER SALABLE FRACTION OF CRUDE OIL TO MARINE OR ORGANISMS.

Extensive studies have been carried out to assess the extent damage of petroleum hydrocarbons to living organisms and ecosystem in the tropical waters. The water soluble fraction of a Malaysian crude oil (WSF) is highly toxic to phytoplanktons, macroalgae, seagrasses, crustaceans and fish.

a. Phytoplanktons in the Straits of Malacca are sensitive to petrogenic hydrocarbons. The results of the Toxicity Study of hydrocarbons to phytoplankton primary productivity reveal that the EC_{50} WSF crude oil is about 3 mg/L.

b. The acute toxicity (96h LC_{50} of WSF crude oil to a shrimp post larvae (PL30 P. Monodon) is 16 mg/L. The chronic toxicity of WSF crude oil on this shrimp for a exposure period of 42 day suggestion that the safety level of WSF crude oil to P.monodon post larvae is 2 mg/L. For other marine organisms such as mollusc, crabs and fish, the 96h LC_{50} values of WSF crude oil range between 15 and 30 mg/L.

c. The EC_{50} value of WSF crude oil on rosenbergi hatchingrate is 5 mg/L. Eggs which have been exposed to oil produced tail deformed larvae and the larvae died immediately after hatching. From the result of these studies, an interim water quality standard of 1 mg/L WSF crude oil is recommended for protecting marine organisms in the tropical seas.

ANNEX XII

Land-based Sources of Oil Pollution in Malaysia: the present status of knowledge, its control and future directions for the understanding and abatement of land-based pollutants in the Malaysia.

by

Zulfigar Yasin Ph.D
Centre for Marine and Coastal Studies
Universiti Sains Malaysia
Penang 11800

1. INTRODUCTION

Marine pollution in Malaysia

The problem of marine oil pollution in Malaysia waters has recently attracted considerable public interest. This has resulted from the 'green consciousness' of the nation which was further accentuated by several oil spill events that had occurred in the Straits of Malacca in the early nineties.

A summary of the annual report from the Department of Environment (DOE), Ministry of Science Technology and the Environment, the main regulatory body in Malaysia dealing with the environment infer several major sources of marine pollution in the nation. These are:-

- Raw sewage that enters the marine water bodies from untreated sources especially from the major industrial townships which are located in the coastal belt of the country.
- Oil, grease and its derivatives that arise from industrial and domestic effluents.
- Solid wastes as a by product of the growing costal population
- Land based sediments that enter the marine system as a result of coastal development.

Although oil and its derivatives, as a result of major oil spills from shipping is small this has attracted the bulk of the attention from the public and the government. There has been very little attention paid to the oil pollution from land based sources moreso with respect to its effect in the marine environment.

2. THE PRESENT STATUS OF KNOWLEDGE

Sources of land based oil pollution

We can categorise the land based oil pollution in Malaysia into four categories with respect to the source of this pollution. These are:-

1. <u>Domestic source of oil pollution</u>

Domestic source of oil pollution arising and mixed with the raw sewage discharge into the coastal water bodies. The amount of oil pollutant contributed by this component is unknown.

2. <u>Oil from the road vehicles</u>

Used motor oil as a by-product of motor vehicles is a major contributor to the total of oil pollutants found in coastal waters. A real estimate of the amount of oil that enters coastal waters has not been published but an estimate of the number of vehicles on the roads would reveal the amount oflubricant used per year.

There is almost no public receptacle for the discharge of used motor oil. Although many garages within the country are licensed the number of backstreet service stations that deal with lubricant change to motor vehicles are significantly large to contribute to the significant discharge of used motor oil into sewers that ultimately empty into the sea.

Several garages have attempted to collect and used the recycle the used motor oil. Some of the novel use of the used motor oil is as herbicides.

3. <u>Oil as a by product of the agro-based industries</u>

These represent the oil that enters the marine waters from Malaysia agro-based industries particularly the palm oil industry and the rubber industry. These are usually discharged into local streams after treatment. Even though each effluent point may conform to the prescribed limits of the water quality standards the cumulative pollutant levels of several effluents may exceed these limits.

4. <u>Oil from land based petroleum industry installations</u>

Several petroleum industry installations are to be found on the coastal areas of the country. Amongst the larger sites for example are located at Kerteh (in the state of Terengganu on the east coast of peninsular Malaysia), Bintulu and Lutong (Sarawak) and at Labuan. Many of these sites are involved with the processing of crude oil and natural gas. Discharge from these installations has received attention by the oil companies and the government alike. This has lead to several studies carried out to determine the impact of the discharge waters on the prevailing marine communities.

Scope of the scientific work on the effect of oil pollution on the biota in Malaysia.

1. <u>Studies on the effects of acute and chronic oil pollution</u>

Much of the studies carried out on the effect of oil pollution on marine communities has centred on specific organisms. The most common trials involved the determination of LC50 and LD50 of known oil products and derivatives. Typical compounds tested are the effluent waters of crude oil terminals and refinery discharges. The effect of specific constituents of the discharge waters such as some heavy metals are also tested.

Typically the animals used in the studies are the molluscs (such as the green mussel *Perna viridis* and the blood cockle *Anadara granosa*), the crustaceans (various life stages of the tiger prawn, *Penaeus monodon* and the freshwater crayfish, *Macrobrachium rosernberghii*) and the fries of some marine fish (the grouper, *Epinephelus sp.* and the sea bass (*Lates calcarifer*)).

Many of the tests were carried out at pollutant concentration ranges higher than those normally found in the marine environment.

Studies on the effect of chronic oil pollution on marine species are quite rare. There are some studies on the chronic effect of oil pollution on the growth of larval fishes and the mysids of some shrimps. This probably represent one of the areas that need further investigation.

2. <u>Field based studies</u>

Much of the field base studies pertaining to oil pollution in the field once again dealt with the levels of oil commonly associated with spills. In Malaysia this has concentrated on mainly the mangrove ecosystem. To a certain extent the effect of oil pollution on the botany and the macrobenthic community had been carried out since the 1980's. There were also some trials on the benthic communities of mudflats. I have not come across trials on the other major representative communities such as the sea grass beds and coral reef communities although with the rising tide of coastal development associated with the tourism and resort industries the threat to these ecosystems are very real.

The effect of oil discharges from crude oil terminals located on the mainland had been investigated. There were earlier studies on the effects of effluent water discharge from the crude oil terminals in Labuan, Bintulu and Lutong on the macrobenthic communities. Since some of these sites are located at a distance from major human settlement the study is useful in providing some baseline as to the extent of pollution affecting the prevailing benthic communities of the area.

The studies carried out at these crude oil terminals indicate an inverse relationship between the biological parameters (total number of organisms and total number of species) with the level of hydrocarbon in the study area. Table 1 indicates a typical example of some of the studies of the effect of oil pollution on the intertidal marine environment in Malaysia.

Table 1. A summary of the various parameters for the Bintulu, Labuan and Miri crude oil terminal study site (modified from Leong Tak Seng et. al. (1985)).

	STUDY SITE					
Parameters	**Bintulu**		**Labuan**		**Miri**	
	Control	*Discharge*	*Control*	*Discharge*	*Control*	*Discharge*
Total organic extractables	14 ppm	43 ppm	107 ppm	5972 ppm	16 ppm	371 ppm
Total aliphatic and aromatic hydrocarbon	0.14 ppm	2.6 ppm	7.7 ppm	1348 ppm	4.1 ppm	117.4 ppm
Vanadium	10 ppm	10 ppm	20 ppm	20 ppm	10 ppm	10 ppm
Nickel	1 ppm	2 ppm	3 ppm	3 ppm	3 ppm	3 ppm
Chromium	2 ppm	2 ppm	6 ppm	36 ppm	2 ppm	2 ppm
Total no. of organisms	588±389	185±70	36±43	71±129	2546±5194	608±727
Total no. of species	11±3	6±2	1.8±1.8	1.3±1.0	13±7	8±3
Total no. of crustaceans	331±229	47±48	21±31	69±131	322±281	11±224
Total no. of molluscs	180±150	80±73	0	0	2118±5189	402±704
Total no. of polychaetes	74±118	46±53	15±12	0	97±120	40±43

3. <u>Ecosystem and trophic levels</u>

There has not been any detail study on the effect of oil pollution on the trophic relationships and ecosystem (inter-habitat) dynamics in Malaysia. Some modelling studies are carried out in the reef and mangrove habitats. These dealt mainly with material and carbon transfer models but does not incorporate the manipulative and experimental aspects of increased oil introduction on the existing floral and faunistic components of the ecosystem.

Monitoring the marine environment for oil pollution.

Monitoring of the environment for oil pollution whether from land based sources or otherwise is the responsibility of the DOE. Regular monitorings are conducted by the DOE officers on the ground at a multitude of sampling locations.

Coastal locations number about 177 altogether. The distribution of these stations along the coasts are given in table 2. Of this total 52 stations (27%) recorded values of oil concentrations and its derivatives higher than the prescribed level. Permissible levels for oil and grease in marine waters are 80 ppm for fishery and protected areas such as Marine Parks and 23 ppm for diving and contact water recreations.

Table 2. The distribution of coastal sampling stations by the Department of Environment, Malaysia. (Drawn from data from the DOE, 1993).

	Total no. of sampling stations	No. of stations where oil and grease has exceeded the prescribed limits set by the DOE
Peninsular Malaysia		
West coast	87	25
East coast	60	18
Sarawak	17	2
Labuan	3	2
Sabah	10	5

Many of the stations located near population centres had oil and grease values far exceeding the stipulated levels set by the DOE. All the marine sampling stations in Penang sampled in 1993 recorded oil and grease concentrations either equal to or greater than the concentration where fishing is prohibitive.

In addition to the DOE other departments are also involved in the monitoring of the water quality in the country. These include the Health Department, the Department of Internal Drainage, the Fisheries Department, the Department of Agriculture and the local councils. These have their own monitoring stations with their respective standards depending on the objective of the monitoring exercise.

3. LEGISLATIVE CONTROL OF SOURCES OF LAND-BASED OIL POLLUTION

There is no direct legislation pertaining to land based oil pollution and its effect on the marine environment. Even so a wide range of legislation already exist to handle the problem of land based oil pollution. Of notably importance is the Environmental Quality Act 1974 which encompasses most of the aspects of land, atmospheric and water pollution. With respect to the marine environment the Act deals with pollution from marine vessels, floating structures (such as derricks and drilling platforms) and pollution from land-based sources.

The following sections of the Environmental Quality Act 1974 are relevant to the control of land-based oil pollution. These are:-

Section 18 - Controls the discharge of by products of the rubber and oil palm industry into river systems which would ultimately be discharged into the sea.

Section 24 - Controls the pollution of the land (therefore includes the foreshore) and the discharge of materials on these areas.

Section 25 - Together with the Environmental Quality (Scheduled Wastes) Regulation 1989 and the Environmental Quality (Sewagw and Industrial Effluents) Regulations 1979 controls the disposal of pollutants into rivers.

Section 27 and 29 - Although pertains to the control of pollution from vessels could also include land based sources of pollution from the land-based oil refineries and petroleum installations.

In addition to the above the Environmental Quality Act (Section 34A) stipulates that an Environmental Impact Assessment (EIA) be carried out for a number of prescribed activities. The prescribed activities relevant to the land-based sources of oil pollution are:

1. The construction of resorts or hotels in the coastal area of 80 room and above.

2. Coastal land reclamation above 50 hectares.

3. Conversion of mangrove swamps of 150 hectares and above for housing and industry.

4. Construction of offshore and onshore pipelines of 50 km and above

5. Harbour expansion involving an increase of 50% or more of fish landing capacity.

6. Construction of petrochemical industries.

7. Construction of new ports and port expansion involving an increase of 50% handling capacity.

8. Oil and gas field development

9. Development of recreational facilities on islands which are National Marine Parks.

10. Construction of municipal sewage with marine outfall.

The administration, regulation and enforcement of the Act falls under the jurisdiction of the Director General of the DOE.

4. FUTURE DIRECTIONS

The abatement of land-based pollution in Malaysia is dependent on several key factors. Some of the issues pertaining to its success is discussed below.

1. There is a need for research to further understand the behaviour of natural biotic communities and coastal resources exposed to land-based oil pollution. The chronic effect of oil pollution are largely unknown as are the effects on particularly sensitive habitats which are now exposed to the pollution threat such as sea grass beds and coral reef communities.

2. The source and sink of the land-based pollution needs to be identified. In addition the behaviour of the pollutant in the field needs further study.

3. The type and methodology of monitoring needs to be assessed. Currently only the water component is monitored for oil and grease. The sediment and the living benthic are seldom monitored. Monitoring of these latter parameters are important to reveal the condition of the environment.

4. The discharge of used motor oil from service stations and garages throughout the country should be addressed. The enforcement of regulatory measures for the disposal of motor oil is a daunting task.

5. Although the existing legislation are deemed adequate for the abatement of land-based sources of oil pollution some areas of the legislation are open to wide interpretation. The issue of land-based oil pollution is not dealt with directly. Perhaps there is a need to address the current legislation to rectify the above comments.

6. Public awareness on the issues of the environment is currently high in Malaysia. This may be used to educate the masses on the magnitude of land-based pollution and how they can play a role in its abatement.

ANNEX XIII

Land Based Oil Discharges: Penang's Perspective

Raja Rokiah Raja Saigon
Director
Department of Environment (Penang)

1. INTRODUCTION

Development is a desired goal of any nation, as it brings with it an elevation of the quality of life as well as improved health status and material well-being. Nevertheless, technological changes and development inevitably impinges on the environment, destroying the eco-system and the resources by which man's existence depends. The resulting consequences are often not obvious and are difficult to address. However, there is increasingly a global recognition and move towards sustainable development that will strive to preserve the ecological base for future generations and hence protect the well being of the people.

Malaysia, as a developing nation, has progressed from its economic standing as a producer of raw materials and commodities into a leading exporter of technology-intensive products. The process of development, spanning from the 1850s with the discovery of tin deposits, to the present day's high technological input into development has brought about unavoidable environmental stress. Rivers, coastal waters, the urban ecology and the atmosphere in industrially active areas have begun to exhibit signs of deterioration.

The extent and nature of pollution problems in Malaysia are closely tied to its industrial development. Thus safe treatment and disposal of the waste products of the industries would be one of the most serious challenges that Malaysia would face in the course of its economic development towards an industrialised and developed nation status. In terms of local context, Penang, one of the most industrialised state's in Malaysia, would face the same challenges.

2. PENANG IN GENERAL

Economy

The manufacturing sector has been leading Penang's economic growth with its first industrial estate in Mak Mandin set up in 1969 and the establishment of the first Free Trade Zone (FTZ) at Sungai Kluang, Bayan Lepas in 1972 to encourage foreign investments. In 1995 itself, the manufacturing sector contributes 56% of the Gross Domestic Product (GDP) as compared to 13% in 1970 (Table 1). Penang has been largely transformed from an agricultural-based economy in the seventies to a mainly industrialised one. In terms of average annual growth, the agriculture sector has registered a declining rate of 0.89% during the period 1970 to 1995 while the manufacturing sector's GDP has been increasing at 15.34% annually during the same period.

Land Area

In terms of land area, agricultural use still dominates about 57% of the state's land area while industrial areas have been increasing rapidly. In 1970, total land area under agricultural activities was about 76,000 hectares but this has reduced to 59,000 hectares in 1991 (Table 2). According to the Penang Development Corporation (PDC), the state agency responsible for industrial development, the development of industrial estates has increased from 210 hectares in 1970 to 763 hectares in 1991, which is about 0.73% of total land area. Industrial land in Penang is obtained either by conversion of land from agricultural use to industrial use or by land reclamation from the sea. For example, the Free Industrial Zones (FIZs, formerly known as Free Trade Zones or FTZs), Bayan Lepas Industrial Park and the Sg. Penang Industrial Estate are located on reclaimed land while the other industrial parks such as the newly established Bukit Minyak Industrial Park and Bukit Tengah Industrial Park were once agricultural land.

Industrial Areas and Type

At present there are 8 industrial parks with a total land area of 948 hectares which is managed and operated by the Penang Development Corporation. Apart from these industrial parks, there are no less than 18 other industrial areas developed/planed by the private sector. Most of these industrial parks are situated in Seberang Perai. Appendix 1 lists the industrial areas in Penang. The location of these industrial areas are shown in Figure 1.

In terms of numbers, Penang had only 31 factories in 1970 as compared to an increase in 706 in 1995 (Table 3). Three type of industries have been dominating the manufacturing sector namely the electronics and electrical sector, the textiles and apparel and the food and beverage industry (Table 4).

These industries account for 66% of the total manufacturing output and 67% of the value added goods.

Most of the factories under the electronics and electrical sector are producing semiconductors, computer and peripherals while the fabricated metals sector manufacture jigs and fixtures, stamped metal parts, injection steel mould, wire harness, bolts, nuts and screws. Plastic injection moldings are the main products under the plastic sector while the paper and paper products sector is mainly factories producing packaging materials, corrugated carton boxes, stationery and labels. The chemicals/fertilizers sector are factories producing palm kernel oil, fatty acids, resins and pharmaceutical. Under the food processing sector, the big factories produce confectionery, chilly sauce, instant noodles and frozen food. Basic metal sector consists of factories that produce steel bars, steel sheets and aluminum powder while transport equipment sector produces dry shaft, steering gears, bicycle spokes. Furniture making and plywood are the main activities under the wood and wood products.

3. SOURCES AND EXTEND OF LAND BASED OIL DISCHARGES

Based on the nature of the industries operating in Penang, sources of land based oil discharges are mostly from transport; petrochemical storage facilities, urban, industrial and agricultural run off.

The Department of Environment (Penang) has an inventory of all industrial activities and their discharges. However, oil discharges from other sectors such as transport, urban and agricultural run-off are not captured by the Department nor by any other government agency in the State specifically. On top of this, Penang is fortunate as compared to other States in the sense that the sewage from major urbanised centres in Penang such as Georgetown, Bayan Baru and the coastal areas are already connected through a sewage network with treatment systems already in operation in Bayan Baru and Batu Feringghi whilst for Georgetown, treatment facilities are anticipated to be completed in 1998. As such, the extend of land based oil discharges are further reduced by these sewage network available. Thus the proceeding paragraphs will focus on industrial sources of land based oil discharges.

The Department of Environment (Penang) monitors the extend of pollution from its rivers and seas. Within Penang itself there are as much as 25 permanent monitoring stations covering 4 zones to check the extend of marine pollution (Figure 2). Samples are taken monthly along the coast by glab sampling techniques. Figure 3 shows the trend of oil and grease from 1993 to 1995 for all stations concerned.

Based on the DOE's monitoring data, samples of oil and grease along the coasts falls between 5-12.5 ppm. between 1993 to 1995. Although it is desirable that the coastal waters should not have any presence oil and grease especially Penang being a tourist destination, the values obtained within Penang waters are still comparatively low. The present of oil and grease along the coastline may also be contributed by water skies and fishing boats manoeuvering along the stretches of beaches of Penang, especially within the resort areas.

4. ENVIRONMENTAL LAWS PERTAINING TO LAND BASE OIL DISCHARGES

The Environmental Quality Act (EQA), 1974 enforced by the Department of Environment is the only piece of comprehensive legislation that tries to prevent, abate, control pollution and enhance the environment for the related purpose.

A number of regulations are already in place under the EQA related to the control of land based oil discharges especially from industrial related activities. However there are no specific legislation at the moment to control discharges from other sources mentioned earlier. The following regulations have in one way or another provided some form of control of oil discharges from industrial activities. These are:

(i) Environmental Quality (Sewage and Industrial Effluent) Regulations 1979;

(ii) Environmental Quality (Schedule Wastes) Regulations 1989;

(iii) Environmental Quality (Prescribed Premises)(Schedule Waste Treatment and Disposal Facilities) Order 1989;

(iv) Environmental Quality (Prescribed Premises)(Schedule Waste Treatment and Disposal Facilities) Regulations 1989;

The following described in brief, important feature of these regulations:

(i) <u>Environmental Quality (Sewage and Industrial Effluent) Regulations, 1979</u>

This regulation control the discharges from industries as well as from sewage treatment plants. Standards for oil discharges are set at 10 mg/l (Standard B) or 0 mg/l (Standard A).

(ii) <u>Environmental Quality (Scheduled Wastes) Regulations 1989</u>

The Environmental Quality (Scheduled Wastes) Regulations 1989 prescribed a list of 107 categories of toxic and hazardous wastes defined as "scheduled wastes". In this piece of legislation, land based oil discharges are classified as scheduled wastes under the "mineral oil and oil contaminated wastes" category. Table 5 gives the codes and types of waste under this category. The regulations specify the following:

a) Responsibility of waste generators:

(i) Notify DOE the categories and quantities of wastes generated;

(ii) Reduce to the maximum extent waste generated using the best practicable means;

(iii) Keep an up-to-date inventory of scheduled wastes generated, treated and disposed of;

(iv) Monitor and ensure the waste transported from premises reaches the approved destination; and

(v) Prepare waste card (information on nature of waste and actions to be taken in case of emergency) and provide such information to his appointed transport contractor.

b) Handling of schedule wastes

(i) Scheduled waste should, as far as practicable, prior to disposal, be rendered harmless;

(ii) Wastes can be stored, recovered and treated within the premises of a waste generator;

(iii) Scheduled wastes must be kept in proper container, properly labelled and stored in designated storage area and avoid storage of incompatible wastes.

Note: Standard A - where industries are located above water intake points

c) Responsibilities of waste transporter/contractor

(i) Apply to the DOE a license to transport scheduled wastes;

(ii) conform to the consignment note system

d) Responsibilities of treatment/disposal site operator

(i) Off site treatment, off site storage and disposal are allowed only at licensed premises.

(iii) Environmental Quality (Prescribed Premises)(Scheduled Wastes Treatment and Disposal Facilities) Order 1989

Six types of premises are prescribed for which their occupation and use will require a written permission and a license from the DOE. The premises are:

(i) land treatment facilities such as a sludge farm;

(ii) off site recovery facilities;

(iii) off site treatment facilities such as a centralised physical/chemical waste water treatment plant;

(iv) scheduled waste incinerator;

(v) off site storage facilities including the transporting vehicles; and

(vi) secure landfills designated for the disposal of scheduled wastes.

(iv) Environmental Quality (Prescribed Premises)(Scheduled Wastes Treatment and Disposal Facilities) Regulation 1989

The regulations specify the procedures for license application, renewal and ownership transfer, requirements for record keeping and submission to the DOE.

The penalty for non compliance of any of the regulations above may fall within the following categories:

(i) compounding an offence not exceeding five hundred ringgit (rule No. 2 - Environmental Quality (Compounding of Offenses) Rules 1978;

(ii) a fine not exceeding ten thousand ringgit or to imprisonment for a period not exceeding two years or to both (Section 18, 24, 34A, Environmental Quality Act, 1974);

(iii) a fine not exceeding fire thousand ringgit or to imprisonment for a period not exceeding one year or to both (Section 14, Environmental Quality Act, 1974).

5. FACILITIES FOR RECOVERY AND DISPOSAL OF OIL

Currently there are only 2 licensed facilities in Malaysia that treat, handles and recovers oil. The nature of oil accepted are mostly hydraulic oil, spent oil or grease and coolant oil. Of course for the petro-chemical industries, (depos in Penang's case) in house land farming are being practice to handle the oil sludges from these facilities. However, it should be noted also that there are illegal back yard recovery centres that handles waste from petrol service stations which are not being licensed by the DOE. Although such action has violated the Environmental Quality (Scheduled Waste) Regulation 1989, and the DOE has a hard time in tracking these culprits, it could not be denied that due to the economic value of the waste, they are not discharged direct to waterways.

Currently also, the Government has signed a memorandum of understanding with a private company to establish an integrated waste management centre to treat waste and render them harmless as well as the final disposal of these waste. This centre which would be fully operational in 1998 would also provide incineration facilities to cater for mineral oils.

6. CONCLUSION

Although comprehensive data on the extend of pollution form oil based discharges are still available in total for Penang, captured data from industrial sources have shown that the pollution problem may increase over the years due to Penang's aggressive move towards urbanisation and industrialisation.

In view of this, a comprehensive inventory of all sources that could contribute to oil discharges from land based sources is required as an initial move to grasp the extent of the problem and the provide to baseline data be used to plan strategically actions be undertaken to be undertaken by the respective government agencies and local authorities, if required, to address the problem.

Table 1

Penang: Gross Domestic Product (RMmil at 1978 constant price)

GDP(RMmil)	1970	1980	1990	1995
Agriculture	264	223	195	211
% composition	19.5%	6.5%	3.2%	1.9%
% growth rate 1970-95				-0.89%
Manufacturing	172	1,399	3,107	6,090
% composition	13%	41%	51%	56%
% growth rate 1970-95				15.34%
Total	1,351	3,413	6,130	10,856

Source: Penang Development Corporation

Table 2

Penang: Land Area for Agriculture and Industrial Estate

Land Area (hectares)	1974	1981	1991
Agriculture	75,941	72,078	59,449
% of total	74%	70%	57%
PDC Industrial Areas	210.4	382.5	763.49
% of total	0.2%	0.4%	0.73%
Total Land Area	102,985	102,218	104,043

Table 3

No. of Factories in Penang's Industrial Areas 1995

SECTOR	No. of Factories	%	Land Area (ha)	%
Electronics/Electrical	160	22.7%	323.45	34.1%
Fabricated Metal	131	18.6%	96.21	10.1%
Plastic & Plastic Products	72	10.2%	55.82	5.9%
Paper & Paper Prod/Printing Works	50	7.1%	31.82	3.4%
Chemicals/Fertiliser	49	6.9%	68.6%	7.2%
Others	38	5.4%	14.16%	1.5%
Food Processing/Canning	30	4.2%	16.24%	1.7%
Machinery	28	4.0%	34.87%	3.7%
Textiles/Garments	27	3.8%	100.39%	10.6%
Rubber-Based	26	3.7%	39.83%	4.2%
Basic Metal	25	3.5%	75.19%	7.9%
Transport Equipment	12	2.4%	15.02%	1.6%
Wood & Wood Products	15	2.1%	13.22%	1.4%
Non-Metallic Mineral	14	2.0%	22.75%	2.4%
Processing of Agricultural Product	13	1.8%	23.72%	2.5%
Professional, Scientific, Measuring etc	6	0.8%	9.83%	1.0%
Feedmeal	5	0.7%	7.43%	0.8%
Total	**706**	**100.0%**	**948.21%**	**100.0%**

Source: Penang Development Corporation

Table 4

Main Industries in Penang (in terms of manufacturing output)

1973	1981	1992
Food & beverages	non-ferrous metal	electronics & electrical
electronics & electrical	food & beverages	metal
textiles & apparel	electronics & electrical	textiles & apparel
iron & steel	textiles & apparel	food & beverages

Source: Penang Development Corporation

Table 5

Codes and Types of Mineral Oil and Oil Contaminated Wastes

N011	Spent oil or grease used for lubricating industrial machines
N012	Spent hydraulic oil from machines, including plastic injection molding machines, turbines and die-casting machines
N013	Spent oil-water emulsion used as coolants
N014	Oil tanker sludges
N015	Oil-water mixture such as ballast water
N016	Sludge from oil storage tank

Regulation 2 - Fifth Schedule, Environmental Quality (Scheduled Wastes) Regulations 1989

Appendix 1

LIST OF INDUSTRIAL AREAS IN PENANG

A. PDC Industrial Areas

1. Bayan Lepas Free Industrial Zone
2. Prai Free Industrial Zone
3. Bayan Lepas Industrial Park
4. Prai Industrial Park
5. Bukit Tengah Industrial Park
6. Seberang Jaya Industrial Park
7. Sg. Pinang Industrial Estate
8. Mak Mandin Industrial Estate

Source: Penang Development Corporation

B. Private Industrial Estates

1. Raja Uda Light Industrial Park, Butterworth
2. Light Industrial Area, Jalan Bagan Lallang/Sg. Puyu
3. Sungai Lokan Industrial Area
4. Taman Industri Asas, Bukit Minyak
5. Jalan Rozhan Industrial Area, Bukit Mertajam
6. Merger Pollution Free Industrial Park (Jalan Sg. Lembu, Bukit Mertajam)
7. Permatang Tinggi Industrial Park
8. Tasek Industrial Area
9. Valdor Industrial Area
10. Bukit Panchor Industrial Park
11. Diamond Valley Industrial Park, Permatang Damar Laut
12. Handersons Industrial Park, Butterworth
13. Pusat Perindustrian Ringan DRB, Mak Mandin, Seberang Perai
14. Sri Rambai Light Industrial Centre, Bukit Berapit
15. Sg. Pinang Flatted Factories, Penang
16. Malaysia Kuwaiti Light Industrial Park, Permatang Tinggi
17. Asas Jaya Light Industrial Area
18. Permatang Tinggi Light Industrial Area

Source: Majlis Perbandaran Seberang Perai (MPSP) and various sources

ANNEX XIV

Principles of an Integrated Coastal Management (ICM) Concept

for

Protection of Coastal System Functions and Sustainable Use of Renewable Resources

by

Valdemar Holmgren,

1. INTRODUCTION

This paper is the basis for a presentation at the Training Workshop on Land-based Oil Discharges into Coastal Waters: Ecological Consequences and Management Aspects, Penang, Malaysia, during 22-26 April 1996. The aim of the presentation is to encourage the participation of those present at the workshop in discussions on issues of Integrated Coastal Management (ICM) and national case-studies. This paper is divided into two main parts. The first presents principles of an ICM concept and the second part suggests a strategy on how to transfer the theories of ICM to action, i.e. "making ICM work", through a set of guidelines. Here, ways of how to resolve multiple-use conflicts and tackle inherent ICM weaknesses are brought up.

Land-based sources of pollution in coastal waters are by far the most significant. Oil-pollution from land-based sources enter the seas in many ways, often imperceptibly, and offer therefore complex problems to solve. The ICM presentations in this paper cover broad areas, and it is hoped that the exchanges between the workshop participants on these wide-ranging problems will be productive for national ICM policy development.

This paper is based on the reasoning that it is the biological diversity ("biodiversity") value of the region's natural resources that should compel nations to adopt effective ICM plans, and to enforce their implementation. This reasoning is supported by the following acknowledgements made globally, and regionally in the EAS region:

* The East Asian Seas Region is well endowed with economically important renewable and nonrenewable resources, i.e. areas which are today recognized as being the global centre of coral reef biodiversity[1]. Seagrass and mangrove species diversity is equally impressive, with the highest numbers in the world for these plants occurring in the EAS region[2]. Thus the conservation of the region's coastal and nearshore marine biodiversity is a matter of global significance.

[1] Kelleher et al 1995. Chua and Scura 1992.

[2] RCU/EAS 1996 b. ICRI East Asian Seas Regional Strategy.

* Few areas of the world are as dependent on their coastal resources as are the nations of the EAS region. Here, marine life sustains many millions of people and 60 % of all animal protein consumed by people is said to be derived from the sea[3]. Recent estimates from several nations have recently stated that between 60 to 75 % of their populations live in the coastal areas[4]

* The East Asian Seas region is also experiencing a strong economic development while the population growth has not significantly slowed down yet. Thus, pressures to exploit, and overexploit, coastal resources intensify. As the per capita availability of marine resources dwindles, environmentally harmful and illegal pracices increase drastically when efficient management measures are lacking.

If the East Asian Seas coastal natural resources are to continue to contribute to the nations' economic growth and to provide a livelihood and well being to the nations' peoples, it is clear that these resources must be managed so that their use does not jeopardise their current or future productivity.

2. A CONCEPT OF ICM

2.1. Overview

The importance of ICM, what its activities should comprise, and how it should be implemented, are issues that urgently need to be addressed. This is evident when one considers the state of mangroves in order to exemplify the serious deterioration of the region's significant coastal ecosystems. The main causes of mangrove depletion and degradation in the East Asian Seas region are the following:[5]

(a) reclamation and conversion of mangroves into industrial and housing developments, aquaculture and agricultural development, tourist resort development, and beach improvement;

(b) uncontrolled and unsustainable cutting of mangroves for poles, construction materials, firewood, and charcoal;

(c) loss of diversity through the establishment of mangrove monoculture to support local construction and charcoal industries;

(d) oil pollution, including discharges from ships (both accidental and operational), coastal refineries and urban areas, as well as various other land-based sources;

---

[3] Yong 1989, in Chua and Scura 1992.

[4] Tobin 1989, in Chua and Scura 1992.

[5] RCU/EAS 1996 a.

(e) watershed development upstream (land-based activities), such as deforestation, agriculture, industry, housing expansion, mining, damming and irrigation development which substantially increase sediment, nutrient and pollutant loads downstream and to the coast;

(f) reduction of water volume available to mangroves due to uncontrolled and/or excessive damming and irrigation activities upstream; and

(g) increased runoff of pesticides and herbicides associated with intensive agricultural activities.

The variety of the activities listed above indicate that in the processes of exploitation for economic and social objectives, many sectors are involved: industry, urban, tourism and recreation, fisheries including aquaculture, energy production, transport, etc. These combined sectoral operations produce the environmental impacts which are evident along the region's coasts: water and air pollution, loss of natural resources on land, at sea and in the freshwater marinewater interface, noise and congestion, loss of public access to coasts, and loss of cultural heritage. And added to all this are the natural hazards, which pose further dangers to the coastal areas'people and natural resources.

2.2. Integration and Coordination of ICM activities

It is now generally accepted that coastal systems are far too complex to be managed through independent, sectoral policies, which have produced only limited results in mitigating environmental degradation. Traditional governmental policies designed on a sectoral approach have often been ineffective because this approach cannot take into account the aggregate effect of negative environmental impacts from many sources.

However, there are also some important, general features which do encourage success. Due to the multifaceted aspect of coastal environment issues and the multi-disciplinary nature of potential solutions to these issues, it has become clear that effective coastal management must embody two essential mechanisms: integration and coordination. The planning process for this should be multi-disciplinary and integrate all relevant issues and parties. However, the existing political and administrative realities make integrated implementation difficult, if not practically infeasible in some cases, and management activities will in reality have to be implemented by various sectoral agencies. Coordination of these agencies is thus essential in order to maintain overall ICM plan integrity.

In addition, the management process must be well organized and well structured to allow for implementation fine-tuning (periodic updating and adjustment). Ultimately, ICM programmes must be tailored to fit the national institutional framework including political and administrative structures, cultural patterns and social traditions, although there is certainly no single way to organize, plan and implement ICM.

Two issues common to all the countries in the region which contribute to the failures in the management of coastal and marine resources and containment of the land-based impacts are identified in a recent Australian study[6]. One is a fragmented management arrangement arising

[6] Australian Country Report for the ICRI Regional Workshop in RCU\EAS 1996 a.

from a sectoral governance structure. In several of the countries this is further complicated by the existence of several tiers of government, each having its own sphere of jurisdiction (sometimes overlapping) in coastal and marine areas[7]. The second is that the influences of many small and insignificant decisions over time accumulate and interact to result with significant impact on the coastal and marine areas. Added to this is a situation prevalent in many countries of the region in which environmental management is a new subject matter for decision-makers and planners.

The management of coral reef, mangroves and seagrass beds and associated ecosystems within the integrated coastal zone management, including land-based and marine-based activities, involves legislation, multiple agencies and several tiers of government. Therefore, initially there is a need to develop a national policy and strategy with, most importantly, common goals and guidelines regarding the conservation of critical marine and coastal habitats within the region. Secondly, there is a need to establish a focal point and formal mechanisms for coordination of efforts to address these strategies and goals. Finally, it is essential to integrate the policies, strategies and goals into the national and local development plans. To address these priority needs, countries in the region should consider to undertake the following[8]:

i. development and management of resources must be planned and implemented within a multidisciplinary, holistic, and integrated approach. Integrated national river-basin (watersheds) and related coastal and marine zone management policies, strategies, programmes and activities must be established and rigorously implemented;

ii. mechanisms need to be established for coordination in planning and implementation, horizontally between sectors and vertically between the several tiers of governments (federal/national, regional/state and local); and

iii the national watershed (river-basin) and related coastal and marine area management plans must be integrated into national economic and development plans.

Within integrated management plans for watersheds (river-basins) and related coastal and marine areas the following issues should be addressed:

(a) effects of coastal development: e.g. destruction of coastal and marine habitats resulting from increased sedimentation, excess nutrient levels, etc.;

(b) absence of non-point (diffuse) pollution controls resulting in chronic and cumulative negative effect due to constant low levels of various pollutants from multiple, non-point and often diffuse sources of discharges from catchments.

(c) impact of tourism development;

(d) poor management practices and unsustainable use of coral reefs;

(e) the unsustainable levels of extractive use of coral reef resources, especially by fisheries;

---

[7] A-Rahim and M-Pauzi 1996. In RCU/EAS 1996 a.

[8] RCU/EAS 1996 a.

(f) the destructive methods of fishing, such as the use of explosives, muro-ami, cyanide, etc.;

(g) the incidental catch of non-target species and the effects of trawling on inter-reef communities;

(h) the threat of oil spills from refineries, off-shore exploration and exploitation and transportation as well as shipping and maritime activities;

(i) the oil pollution, organochlorides and heavy metal contamination from urban and industrial sources;

(j) the introduction of exotic species and microbial contamination through the discharge of ballast water;

(k) the outbreaks of crown-of-thorns starfish;

(l) the degradation of estuaries and coastal lakes through eutrophication, sedimentation, acid-soil run-off, coastal developments, loss of habitats and overfishing;

(m) the unsustainable use of associated ecosystems: i.e. mangroves and seagrass beds;

(n) the conversion of mangrove areas to other uses (shrimp farms) and the effect of catchment modifications on mangroves;

(o) the socio-economic and commercial costs due to the loss of coral reefs, seagrass beds and mangroves;

(p) the overlapping jurisdictions and administrative responsibilities for natural resources and activities in the watershed, coastal and marine areas. The need to establish clearer responsibilities for management and enforcement in these areas through administrative guidelines and legislation; and

(q) the lack of environmental criteria and objectives in laws and government administrative procedures.

2.3. An ICM concept - a current example

2.3.1. The following is a concept of ICM based on the recently articulated ICRI strategy of Framework for Action[9].

This states that the main threats to coral reefs and related ecosystems in the East Asian Seas region are:

- pollution from land-based sources - particularly sewage, fertilizers, sediment, biocides, toxic wastes, solid wastes and oil discharges;

[9] RCU/EAS 1996 b.

- siltation due to soil erosion resulting from unsustainable and inappropriate land-use practices;
- unsustainable exploitation of coral reef resources, including overfishing and unsustainable tourism;
- destructive fishing and collecting methods, such as the use of cyanide and explosives;
- land filling and inappropriate coastal construction;
- coastal and marine development projects undertaken with inadequate environmental impact assessment;
- channel blasting and dredging activities; and
- natural disasters (e.g. crown-of-thorns starfish infestations, cyclones, possible climate change).

It is acknowledged that although it addresses related (coastal) ecosystems the ICRI Strategy proposal for ICM measures has been developed on the basis of the values of coral reefs, the damage that has been done to them, and the prevailing threats they face. However, the ICRI Strategy ICM plan is presented in this paper because it is the most recent, regional articulation of ICM measures underscored with biodiversity priorities.

2.3.2. The ICRI Strategy ICM proposal

Coastal Management

The conservation and sustainable use of coral reefs and related ecosystems requires that human-related uses must be addressed through improved and sustained management practices to minimize or eliminate impacts. The ICRI *Framework for Action* outlines a range of management actions to achieve this, with effective Integrated Coastal Management clearly identified as the priority approach.

ICM is a process to ensure that development and management decisions in coastal areas are integrated with environmental goals and are made with the participation of those affected. ICM also is the means to ensure that maximum benefit can be derived from sustainable use of the resources of coral reefs and related ecosystems, while minimizing conflicts and harmful effects of resource use.

Effective management of the coral reefs and related ecosystems of the East Asian Seas will require regional, national and local action. At the regional level it will involve coordination to support countries in developing and implementing management programmes. At the national level, it will require developing and implementing national policies and legislation which can provide for effective ICM, and implementing programmes which give effect to these policies and legislation. The success of these management initiatives and effective implementation will depend upon the support and involvement of all stakeholders, particularly local people and resource users.

Goal I: ***To provide for the conservation and sustainable use of coral reefs and related ecosystems through Integrated Coastal Management.***

2.3.2.1. Policy and legislation for ICM

Objective: To develop and implement effective policies and legislation for ICM in all countries in the East Asian Seas region.

Actions

a. Adopt the ICRI *Call to Action*, *Framework for Action* and the ICRI East Asian Seas Regional Strategy and incorporate their principles, objectives and actions into national policy priorities.
b. Develop national policies and legislation for ICM.
c. Promote coordination of agencies and cross-sectoral planning and decision-making in the policy development process.
d. Promote linkages of national, regional and international policy and legislation.

2.3.2.2. Implementing ICM programmes

Objective: To develop and implement effective integrated coastal management programmes.

Actions

a. Develop mechanisms for effective coordination between national, state and local agencies with responsibilities relevant to coral reef management.
b. Develop and implement measures to control and minimize pollution from land-based and sea-based activities, bearing in mind the Global Plan of Action for the Protection of the Marine Environment from Land Based Activities.
c. Ensure that marine resource harvesting is sustainable, including adopting a precautionary approach when information on sustainable levels of harvest is lacking.
d. Prohibit destructive fishing methods, such as the use of cyanide and explosives.
e. Ensure coastal and marine development is environmentally sound, through practices such as:

    - EIAs of development projects;
    - effective management of tourism and recreational activities;
    - minimizing and controlling land filling activities;
    - minimizing the adverse impacts of mariculture;
    - ensuring coastal engineering and construction practices are environmentally sound;
    - minimizing the adverse impacts of dredging, channel blasting and mining.

f. Develop effective marine protected area systems including the preparation and implementation of management plans.
g. Monitor and evaluate the success of ICM programmes.
h. Encourage member countries, through agreements, to participate in regional projects and programmes which address ICM.

2.3.2.3. Access and equity in the use of the resources of coral reefs and related ecosystems

Objective: To address issues relevant to social equity, poverty, access and rational resource utilisation in the conservation and sustainable use of coral reefs and related ecosystems.

Actions

a. Develop and implement resource management strategies which ensure equitable, reasonable and sustainable resource allocation and use.
b. Ensure that ICM programmes address social, economic and cultural considerations, particularly the needs of local people.
c. Develop income generation alternatives to unsustainable use of coral reefs and related ecosystems.
d. Develop and promote the use of appropriate environmentally friendly technology in the conservation and sustainable use of coral reefs and related ecosystems.

2.3.2.4. Reflecting the economic and other values of coral reefs in decision-making

Objective: To ensure that the economic and other values of coral reefs and related ecosystems are reflected in decisions about the use and development of coastal and marine resources.

Actions

a. Adopt resource accounting and include the value of coral reef and related resources in these calculations.
b. Develop and apply techniques of economic and other forms of valuation of coral reefs and related ecosystems to ensure the long term values are considered in the development planning process, e.g., coastal tourism, and resource use, fisheries.
c. Develop and apply economic incentives and instruments which promote the conservation and sustainable use of coral reefs.

Capacity Building

The ICRI *Framework for Action* stresses the importance of capacity building in order to strengthen the human resources and institutional capabilities for ICM, research and monitoring, training and education.

The national reports presented at the ICRI East Asian Seas Regional Workshop make it clear that the capacity of countries in the East Asian Seas region to conserve and sustainably use coral reefs and related ecosystems varies from country to country.

It is essential to develop the capacity of governments, institutions and individuals to levels necessary to achieve the conservation and sustainable use of coral reefs and related ecosystems. Increasing the capacity of governments, institutions and individuals will be facilitated by increased awareness and understanding of the importance of these ecosystems. The development and dissemination of relevant information and knowledge on the environmental, social and economic importance of these ecosystems is therefore an essential element of capacity building.

Co-ordination and adequate financing are also critical to implement and sustain the development of human and institutional capacities.

Goal II: ***To strengthen the capacity of governments, institutions, communities and individuals to conserve and sustainably use coral reefs and related ecosystems.***

2.3.2.5. Developing and strengthening public awareness and education

Objective: To develop and strengthen public awareness and education on issues relevant to the conservation and sustainable use of coral reefs and related ecosystems.

Actions

a. Develop co-operative public awareness, education, and training programmes involving NGO groups, scientists, the private sector and government agencies.
b. Improve linkages and co-ordination between NGOs, scientists, the private sector and government agencies, in order to transfer relevant ICM skills and knowledge.
c. Facilitate the exchange of information, experts, managers, and government officials between and within countries.
d. Utilise educational materials to educate relevant stakeholders, including the private sector and its clientele, and encourage their participation in public awareness and education.
e. Utilise all forms of media to promote awareness of unsustainable activity and of positive actions that can be adopted by all user groups and develop programmes and initiatives to train media people involved in environmental issues.
f. Identify the co-ordinating organisations to facilitate the development of co-operative public awareness, education, and training programmes, e.g., IUCN, EAS-RCU.
g. Develop an East Asian Seas regional coral reef awareness campaign as part of activities carried out under the International Year of the Reef in 1997.

2.3.2.6. Enhancing community participation in ICM

Objective: To ensure the effective participation of all sectors of society in the conservation and sustainable use of coral reefs and related ecosystems.

Actions

a. Ensure effective consultation with and among all interest groups in the management of coral reefs and related ecosystems.
b. Promote and implement community-based management as a means to involve the local population, NGOs and interest groups in the conservation and sustainable use of coral reefs and related ecosystems.
c. Implement programmes and initiatives, including training, to develop and strengthen community organisations and regional networks and facilitate community involvement in ICM.
d. Document traditional community management practices and uses of marine organisms and habitats.

e. Improve opportunities for consultation on coastal and marine issues between local organisations, private sector, academic institutions, other user groups and the general public, through fora and public symposia on ICM.
f. Promote successful pilot demonstration programmes and projects and the transfer of information on the successes and failures of efforts to conserve and sustainably use coral reefs and related ecosystems.
g. Further develop information exchange networks, e.g., Internet, workshops, symposia, to improve the opportunity for informed decisions to be made, for successes to be replicated and to learn from mistakes.

2.3.2.7. Strengthening institutional capacity for ICM

Objective: To strengthen the capacity of institutions with responsibilities relevant to the conservation and sustainable use of coral reefs and related ecosystems.

Actions

a. Develop programmes and initiatives to train ICM trainers at the regional and national level in applicable fields.
b. Encourage and assist countries to become self-sufficient in developing institutional capacity for ICM.
c. Develop, strengthen and expand country training programmes in the EAS region, e.g., seagrass and mangrove management, reef restoration and protection.
d. Establish and identify centres and programmes of excellence within the region and within countries and develop networks between centres.
e. Enhance the capabilities of regional organisations to support in-country programmes through assistance in identifying funding sources, arranging travel support and providing training.
f. Strengthen the capability of research institutions to address management issues, e.g., better facilities for addressing cyanide fishing.
g. Develop, distribute and maintain a directory of institutions and organisations (e.g., on their capabilities, expertise) to encourage the exchange of personnel, information and publications.

2.3.2.8. Regional co-operation for co-ordination of ICM policies and programmes

Objective: To develop and strengthen co-ordinated policies and programmes for ICM through increased regional co-operation.

Actions

a. Integrate inland, coastal and offshore management initiatives and mechanisms to optimise synergies.
b. Assist in the adoption and implementation of regional and global conventions and protocols and use these fora to address the conservation and sustainable use of coral reefs and related ecosystems.
c. Seek to minimise or resolve environmental conflicts and impacts in the region through co-operative efforts.

2.3.2.9. Legal and enforcement measures

Objective: Develop and strengthen the capacity to adopt and apply legal, enforcement and policy measures relevant to the conservation and sustainable management of coral reefs and related ecosystems.

Actions

a. Recognise community-based sustainable management practices in the development of legal enforcement measures.
b. Facilitate the sharing of experience and expertise in the conservation and management of coral reefs and related ecosystems to aid in developing legal and enforcement capacity.
c. Develop and disseminate optimal enforcement methods to assist in the effective management of coastal resources.
d. Enforce the prohibition of destructive fishing methods, such as the use of cyanide and explosives.
e. Explore opportunities for regional co-operation on enforcement relevant to the management of coral reefs and related ecosystems.
f. Compile information on the valuation of coastal ecosystems and identify mechanisms to assess accountability for and damages to coral reefs and related ecosystems.

2.3.2.10. Networking

Objective: To have the capacity for effective intra-regional communication through the establishment of a regional node and a communication network of universities, research institutes, scientific museums libraries, management and government authorities.

Actions

a. Hold regular regional workshops of scientists, resource managers and stakeholders to intercalibrate methods, examine case studies, and share experiences.
b. Establish the capacity to respond to urgent regional environmental needs through workshops and establishing regional task groups.
c. Set up a system of networking that provides continuous and open channels of communication within and between countries.
d. Provide mechanisms for training at all levels on resource use assessment and management including establishing standard sites to allow truly regional comparisons.
e. Establish a regional node to coordinate communication, training, workshops and database operations, including permanent reference sites.
f. Encourage coordination and communication among regional scientific museums and libraries, universities and institutes.
g. Encourage systems of communicating important resource and monitoring issues, problems and solutions, through multimedia mechanisms including Internet, newspapers, radio, television, posters, school kits, etc.

2.3.2.11. Databases

Objective: To have the capacity to develop and maintain functional regional and national databases that contain current data, literature references, and inventories of research and management resources.

Actions

a. Encourage the establishment of suitably equipped and staffed national and regional environmental databases with links to the Global Coral Reef Monitoring Network and ReefBase that contain standardized structures to incorporate updated data holdings, relevant literature, and research and management resources.
b. Develop national and regional repositories of all coral reef and related ecosystems literature with an emphasis on materials that are difficult to obtain, e.g., NGO reports, grey literature.
c. Train people from the region in the principles and protocols of database operations and continually upgrade this training at all levels.
d. Ensure that all countries have facilities to access regional databases.

Research and Monitoring

There are distinct regional problems and issues in the East Asian Seas that require directed question-driven research to ensure that coastal resources can be sustainably maintained and managed. Many of these issues need to be addressed collectively on a regional scale, utilising and developing the expertise and facilities of countries throughout the region. Environmental and social scientists, and managers involved in research and monitoring need to ensure that the questions they tackle are developed in consultation with all stakeholders. The answers and benefits arising from this research must be disseminated to the wider community at all levels from government through to subsistence fishers and users.

The nature of the information required to support well-informed management decision-making is such that inter-disciplinary programmes are essential. This is reflected in many of the actions identified below.

Goal III: ***To answer key management questions for the conservation and sustainable use of coral reefs and related ecosystems through the effective use of existing research and monitoring information, and the further development of appropriate research and monitoring activities.***

2.3.2.12. Research and monitoring to support management programmes

Objective: To utilise strategic research (including social research) to provide decision makers with appropriate information to facilitate informed management decisions and ensure sustainable use of coastal resources.

Actions

a. Ensure that managers and scientists work together to:

   - define management questions for which research and monitoring can provide answers; and
   - design and develop research and monitoring programmes to address these questions.

b. Promote strategic research and encourage cooperative research on the basic biology of reef communities (fishes, corals, diseases and predators including *Acanthaster* and *Drupella*).
c. Promote research on the impacts of land-based pollution.
d. Encourage multi-national, inter-disciplinary, intra-regional research addressing large scale issues such as interconnectivity of larvae, transboundary pollution, migratory species, and effects of global climate change.
e. Develop scientific criteria to assist in resource management planning, MPA establishment and management and develop and refine methods for predictive assessment, monitoring and management of Environmental Impact Assessment (EIA).
f. Assist in the conservation of endangered and threatened species by providing information on their biology, ecology, migration patterns, and identifying habitat areas that require special protection.
g. Conduct research on the extent of destructive fishing methods such as explosive and cyanide fishing and their specific impacts and rates of recovery.
h. Conduct scientific and social research on the impacts of tourism and aquaculture.
i. Encourage research on alternative sustainable uses of coral reefs and related ecosystems such as the search for bioactive compounds.

2.3.2.13. Monitoring

Objective: To establish a regional monitoring network to provide regular reports on ecosystem status and trends.

Actions

a. Encourage the collection, analysis and interpretation of information on the status of coral reefs and related ecosystems to enhance the management and sustainable use of these resources.
b. Use standardised methodologies to establish and develop monitoring programmes in countries, to assess resource status and trends.
c. Encourage participation in monitoring as a regional node of the Global Coral Reef Monitoring Network.
d. Where appropriate, encourage institutions across the region to introduce and develop the capacity for monitoring and remote sensing, and to assist others with analysis and interpretation of the resulting data.

2.3.2.14. Research and monitoring methodology

Objective: To ensure that standard methods are applied consistently and evenly across the region to improve the capacity to assess and manage resources and to allow questions on a regional scale to be addressed.

Actions

a. Promote the training and equiping all countries across the region for underwater marine research.
b. Recognise the need to use standard methods within all countries of the region.
c. Encourage research cooperation to intercalibrate and exchange methodologies.
d. Assist countries in efforts to translate and adapt methods for use at the local level whilst maintaining the basic methods of monitoring.
e. Encourage the development of new and appropriate methods for assessing degradation; the level of sustainability; and mariculture of critical species.

2.3.2.15. Biodiversity of the East Asian Seas.

Objective: In recognising that the East Asian Seas region is the global centre of marine biodiversity, to understand further the processes that contribute to this biodiversity so that it can be maintained through time.

Actions:

a. Develop and update inventories of the species of the EAS region, emphasising those species that are endangered and threatened.
b. Identify areas important and suitable for the effective protection of coastal and marine biodiversity.
c. Encourage basic research in taxonomy and biogeography.
d. Establish and encourage the maintenance of museum collections and curatorships through the provision of scholarships and employment opportunities.
e. Encourage the establishment of regional networks of marine protected areas to ensure maintenance of marine biodiversity.

2.3.2.16. Recovery and rehabilitation

Objective: To accelerate rates of natural recovery of coastal resources and restoration of natural processes through rehabilitation.

Actions

a. Identify sites within countries and the region that are suitable for rehabilitation.
b. Ensure that causes of degradation are removed where possible and ensure protection of areas during and after rehabilitation.
c. Encourage research and develop techniques to rehabilitate coral reefs and related ecosystems.

d. Share information within the region and with other regions through cooperative research on the effectiveness and methods of rehabilitation.

e. Monitor and evaluate both the beneficial and adverse effects of ecosystem rehabilitation.

3. TOWARDS SUSTAINABLE USE OF COASTAL NATURAL RESOURCES

Guidelines for Best Environmental Practice and Best Available Techniques in Integrated Coastal Management (ICM).

The aim of this paper is to provoke exchange of experiences among the workshop participants and support discussions on issues the paper covers. This section on sustainable use of coastal natural resources is therefore presented in an active format of directives and questions in order to invite such participation. Much has already been written on the necessity of sustainable use of natural resources, indeed, with the support of Agenda 21 this crucial issue has globally been rightly placed more prominently in national development plans, and land-use and water-use assessments.

It is hoped that these guidelines for action can contribute to efforts of conserving natural resources with the objective of their wise use. The following Guidelines are adapted from Harger 1995 **FN** and UNESCO 1994 **FN** .

Guidelines for Best Environmental Practice and Best Available Techniques in Integrated Coastal Management (ICM).

3.1. Ecosystem assessment - What is the present status ? Is there information on previous status ?

3.1.1 The interpretation of data based on indices and aggregate measurements must be done with care. For instance, a low percentage of ecosystem components (i.e. coral species) cover does not necessarily mean a damaged ecosystem.

3.1.2 Assessment of processes involved with ecosystem change and transformation is important. Is the ecosystem in decline or under expansion ("recruiting") ?

3.1.3 Modes of assessment should be related to specific objectives, not every form of measurement will result in data that can be used to answer all questions. Measurements of diversity may not necessary help in the estimation of productivity under different management systems.

3.1.4 Bulk assessment is required to relate local measurements to an overall pattern. Remote sensing should be made operational and used in conjunction with ground-truth mapping.

3.1.5 Ecological communities should be related to physical and environmental variables, i.e, aspects of topography, morphology and responses to climate pressures.

3.1.6 Major questions arising from consideration of the implied status of ecosystems

a) What condition is the ecosystem in now? Is the ecosystem (or components) dying? where? extent? numbers?

b) How long does it take for the ecosystem under consideration to recover from damage such as that inflicted by: typhoons? ship grounding? oil spills? dynamite damage? larva flows? drought? various aspects of damage induced by human action? flooding? human presence? etc.

c) What tolerance levels to disturbance do coastal ecosystems have resulting from excess nutrients, fishing, sediments, specific forms of exploitation, etc.

d) How can we rehabilitate the ecosystems: corals? fish? shore vegetation? birds? other desirable species which have been depleted by excessive exploitation or pollution.

3.2. Strategies for evaluating sustainable use

I.e.: What is sustainable use for "ecological systems" such as mangroves, seagrass beds, coral reefs, etc ? What are the principal economic relationships and the major variables affecting the ecology ? the use-patterns and "demands" ? the existing community relationships? manageable components or adjustments that can be made by the human community ?

3.2.1 Information needed:

3.2.1.1 Critical sites and times of replenishment, e.g., location of serranid (a form of coral reef fish) spawning grounds (breeding grounds), closed season for dredging (coral recruitment), close season for tourists (mating cues and sequences), multi species ecosystem channels used for spawning, migration routes, current patterns and drainage influences etc.

3.2.1.2 What is the sustainable yield for the prevalent species being exploited?

3.2.1.3 What are the existing use patterns?

3.2.1.4 Learn from the older people - How have things changed? Has the potential for natural resource use been exceeded? What are long-term trends?

3.2.1.5 What immediate problems does management of the resource face ? (political, social, ecological). Whatare the potential problems ?

3.2.1.6 Document areas of interest in the coastal environment and interactions among neigbouring habitats.

3.2.1.7 What are the relevant aspects of the sociopolitical and economic systems in relation to prevalent use patterns? What boundaries are recognized by local people?

3.2.2 Effective management approaches

3.2.2.1 Exemplify with successful regional examples. I.e. fish catches per unit effort as well as absolute amounts caught were greater on a Philippines coral reef when a village protected 25% of the ecosystem.

3.2.2.2 Demonstrate the need to conserve by documenting or referring to local, site-specific over-use and resource depletion.

3.2.2.3 Emphasize the methods of community-based or village-based decentralized resource management (communities may need government enforcement assistance to deal with strong outsiders).

3.2.2.4 Document the diversity of used resources, alternative livelihoods, and latent resources not used at present.

3.2.2.5 Document aquaculture and agriculture, as practiced locally, particularly as these practices interact with ecological systems.

3.2.3 Assessment protocols (see 3.1.)

What assessment protocol is required to answer each of the following questions: ? Are local ecosystems dying? What impact level can ecosystems tolerate? How could recovery be assured?

Activities for overall assessment:

3.2.3.1 Evaluate the status of the ecosystems under consideration

a) Biophysical assessment of local resource (e.g. algae, corals, fish, other) levels and trends

b) Assessment of current use levels and perceptions of extent and rate of loss of resource utilized by human communities.

c) Classification of ecosystem components (e.g. inshore vs offshore, etc), physical conditions (habitat types, successional stages etc.).

d) Identification and quantification of the context in which natural disturbances and stresses are active (i.e. frequency, duration, intensity of natural destruction).

e) Uses by local people including collectors of for "grow out", (this kind of information depends on local knowledge of stocks and environment features), medicinal and food-organisms use of specific areas.

f) Assess regional distributions of fauna and flora as an indication of underlying evolutionary/biographic linkages in order to understand mechanisms of replenishment and other aspects of coral reef ecosystem connectivity.

g) Search for ecosystem history, look for "founder effects" - include these in classification of ecosystem types.

h) Place emphasis on traditional placement of particular organisms, take this into account during ecosystem assessment.

i) Take all aspects of ecosystem functions into account, including the interactions with humans, i.e. look at relations involving heterotrophy/autotrophy, abundance of bioeroders, algae, grazing animals etc.

j) Assess ecosystems and species used by local human communities in terms of classification adopted.

k) Identify and characterize sources of stress, determine of they are manageable or unmanageable.

l) Identify the additive effects of human actions on top of natural impacts.

3.2.3.2 Evaluate the major ecological processes that affect local natural resources

a) Explicit attention should be devoted to identifying replenishment sources on which local resources depend (i.e. upstream or out-of-region refugia). Assessment must be established in a regional context.

b) Include assessment predictions, model resource trajectories under various scenarios, (present use, modified use etc).

c) Define fertility periods, breeding seasons, reproduction conditions, settlement, etc.

d) Identify the physical context, weather, physiographic conditions, hydrographic regime etc.

e) Assess age and size classes of organisms in relation to reproduction and stock replenishment.

f) Assess size frequency under different conditions, classification of health of individuals and colonies to give predictive power.

g) Assess the following questions: will stress be removed once human activity is stopped?

h) Determine the impact that can be sustained by ecosystems.

- use natural gradients to classify expected responses
- use experiments to determine thresholds for "indicator species" or other important organisms.

3.3. Management for sustainable use

Objective:Sustainable use of coastal ecosystems / natural resources

Criteria for success

* Traditional uses and opportunities for economic development are sustained
* Ecological values (biodiversity, productivity, biomass) are sustained.
* Community ownership and implementation is maintained.
* Socio-political/legal aspects are satisfied or changed to permit sustainable natural resource exploitation

Methods for achieving objectives

Measures should be focused on manageable scales, i.e. of islands, naturally bounded systems (seagrass meadow, defined coral reef "units", mangrove, stands) etc, using ecologically significant units and appropriate spatial scales.

3.3.1. Information required for management

Resource uses by humans should be determined, and the effects of human verses natural influences on ecosystem structure and function should be evaluated.

3.3.1.1 The total organisms captured or harvested (biomass) should be assessed.

3.3.1.2 Market catch assessment should be practiced at the local market - 20 (say) of the most abundant ecosystem species i.e key fish groups or species should be counted. Key economic species, or predefined taxonomic categories should be prioritized and monitored.

3.3.1.3 Evaluate the ratio of local use vs export market demand. Assess subsistence/household use of a fishery or other productive unit. Check landing and transfer points for harvest estimates.

3.3.1.4 Assess existing and potential income from tourism. Calculate cost/person involved and evaluate tourism/ecotourism leakage to the capital source. Define different tourism options, gather immigration data, count hotels, conduct private personal expenditure interviews and so forth.

3.3.1.5 Assess and evaluate non-renewable resources

3.3.1.6 Evaluate blast damage, pollution impact and other human induced and natural damage using census techniques.

3.3.2 Ecological values

3.3.2.1 Evaluate the distribution of natural resource systems or other natural resources of interest. Map through use of aerial photography, remote sensing. Consult existing charts and evaluate local knowledge.

3.3.2.2 Assess condition of ecosystem communities (e.g. corals, fish, invertebrates, others). Map existing uses and impacts, land use patterns (run off, pollution, land, sea), key fish, trees or other useful organisms. Conduct ecosystem and video surveys. Assess damage, size frequency of organisms (midpoint to suitable distance towards beach and towards sea, down reef slopes). Take into account exposure, angle of slope, aspect, weather, currents etc. as appropriate.

3.3.2.3 Conduct rapid assessment and causal analysis, considering the following elements:

a) size distributions and abundances of the main organisms, including edible and useful life-forms, (key species) together with identification of probable causes of observed distribution patterns.

b) size frequency, distributions, and patterns of damage in the ecological community and identification of causes (e.g., disease, anchor-damage, log-impact. etc)

c) quality of the physical environment (sediment, substratum, water quality etc). For aquatic environments visibility (secci disk extinction depth) total suspended solids, light-transmission, salinity, oxygen, temperature etc.

d) opinions obtained from users of the ecosystem (e.g. talk to divers, fisher-people, traditional people) concerning longer term status and trends.

e) identification of critical sites and times of stock replenishment e.g., location of spawning grounds, closed season for dredging (coral recruitment), closed season for tourists (mating cues and sequences), multi-species eco system channels used for spawning, migration routes, current patterns, closed season for other sensitive areas etc.

f) learn from the elders: How have things changed? Has the potential for resource use been exceeded? What are long-term trends?

g) monitoring: Is the situation getting better or worse? (e.g. harvest of useful organisms, catch per unit effort, changes in abundance, size, and damage levels in ecosystems). The method used will depend on question asked. Permanent transects or observation sites should be established, replicate comparisons should be used to establish differences, use physical environmental gradients to investigate trends and influences from specific locations such as sewage etc. Use settlement plates or follow recovery of naturally damage areas to estimate capabilities for "ecosystem healing".

h) estimate possible yield for important exploited species. Look at trends shown by census techniques, size distribution, landings, recruitment (in 20 major species). Do not lump species in such assessments.

i) calculate thresholds beyond which ecosystem populations do not recover, and recovery times for those which can. Research will often be required to answer such questions.

j) develop a shared definition of terminology to enable information transfer among scientists, managers, policy makers and community leaders. I.e. the term "marine park" in Japan or Australia has a different meaning. Determine the meaning of % cover of living organisms for particular areas. Remove jargon from descriptive accounts but not the ideas. Run workshops for managers, scientists and anthropologists.

3.3.3 Community "use rights" and ownership of a management plan and its implementation

3.3.3.1 Ownership

- consultation with 'stake-holders' is required
- involvement of stake-holders and representatives is required for the formulation of "in development plans
- information sharing requires the evolution of a common terminology
- Council of community leaders should be involved

3.3.3.2 *Implementation*

- Community use rights should be established
- Community leaders and environment managers should be in charge of any "plan"
- Public education concerning goals and rationale for achieving sustainable use is required
- Enforcement should be considered and evaluated

3.3.4. Socio-political legal aspects

- identify all relevant institutions
- identify legal framework for management
- involve all relevant agencies and stake-holders in planning.

REFERENCES

Chua, T-E., and L.F. Scura, eds. 1992. Integrative Framework and Methods for Coastal Area Management. Proceedings of the Regional Workshop on Coastal Zone Planning and Management in ASEAN: Lessons Learned. ICLARM Conf.Proc. 37, 169 p. Manila.

Kelleher, G., C. Bleakley, and S. Wells. (eds). 1995. A Global Representative System of Marine Protected Areas . Great Barrier Reef Marine Park Authority, The World Bank and the World Conservation Union (IUCN). Vols. III and IV.

RCU/EAS in press. Integrated Coastal Zone Management Training Manual. Regional Coordinating Unit for the East Asian Seas Action Plan, United Nations Environment Programme. Bangkok.

RCU/EAS 1996 a. East Asian Seas Regional Report on the Issues and Activities Associated with Coral Reefs and Related Ecosystems. Regional Coordinating Unit for the East Asian Seas Action Plan, United Nations Environment Programme. Bangkok.

RCU/EAS 1996 b. Report of the International Coral Reef Initiative (ICRI) Regional Workshop for the East Asian Seas (Bali, 18-22 March 1996). ICRI.RW (EAS). Regional Coordinating Unit for the East Asian Seas Action Plan, United Nations Environment Programme. Bangkok, March 1996.

UNEP 1985. Marine Pollution from Land-based Sources. Environmental Law Guidelines and Principles No. 7. United Nations Environment Programme, Nairobi.

Yong, S.K.T. 1989. Coastal resources management in the ASEAN region: problems and directions. ICLARM Conf. Proc. 19.
In Chua and Scura 1992.

Tobin, R. 1989. The next challenge:designing and implementing effective strategies for coastal areas management. Tropical Coastal Area Management 4 (1). In Chua and Scura 1992.

Waste Water Treatment Systems for Oil Containing Effluents

Dipl.-Ing. Michael R. Muller
KARY GMBH
Hemelinger Hafendamm 18
28309 Bremen
Germany

1. INTRODUCTION

Effluents containing oil and grease will cause major damage to the environment if they are released without treatment. Waste water containing mineral oil occur in a large number of industries and places, as: crude oil exploitation and shipment, petrochemistry, metal processing, steel mills, ship yards, train stations, airports, washing stations for vehicles, trains and tanks, fuel stations, fillings of stabilizing tanks in ships, bilge water, contaminated surface runoff, contaminated rain and storm water etc.. Vegetable, animal oil and grease come from the food processing industry. Therefore the effluents vary considerably in quantity and quality. It is most important that the right treatment method is chosen to solve the specific problems. The following paper will give an overview of technologies available to treat oil containing effluents in order to release the cleaned water safely into the environment. Advantages and disadvantages of the different techniques will be listed and design criteria for choosing the right combination will be given. Although the treatment technologies shown in this paper deal with an "end of pipe" solution, the author would like to stress that these treatment methods must be part of an integrated system where the "end of pipe" solution is been replaced by a "source reduction and avoidance" policy. The amount of oily waster water can often be drastically reduced by very simple methods. Rain and wash water are one of the main sources for oily waste waters in the above mentioned industries. Simple covering of oily surfaces can reduce the rain and storm water effluent. Washing procedures with optimized sequences and carefully selected chemicals may avoid a complicated waste water at the end of the pipe.

2. PHYSICAL AND CHEMICAL FUNDAMENTALS OF "OIL IN WATER" EFFLUENTS

In order to understand the choise of the right treatment technologies for waste water containing oil and grease, a few basic physical and chemical fundamentals will be given.

Oil in water can occur in 5 different forms:

1. Free Oil: Drops of oil in water big enough to rise to the top of the water surface ($> = 150\ \mu m$). A clear phase separation between oil and water surface.

2. Physical emulsion or dispersion:

   Little droplets ranging from micros to fractions of millimeter of oil mechanically dispersed into the water (high sheer stress through mixing). Unstable; separation of oil drops due to electrical charges;

can be transferred into free oil through coalescence.

3. Chemically stabilized emulsion:

Little droplets similar to those in physical emulsion stabilized through surface active chemicals (detergents), or solvents.

4. Dissolved oil: Oil dissolved according to saturation solubility listed in table 1. Droplets less than 0.03 μm which cannot be separated by phymechanical treatment methods.

5. Oil-wet solids: Oil adheres to suspended solid surfaces.

Table 1: Solubility of Hydrocarbons in water (2)

Benzol:	1.700	mg/l
Car fuel:	50 - 500	mg/l
Diesel:	5 - 50	mg/l
Toluol:	450 - 511	mg/l
Hexan:	30 - 50	mg/l
Heptan:	3	mg/l

All forms of oil can occur together in one effluent. Every form of oil appearance in the water need its specific treatment technology which will be discussed in chapter 3.

The optical appearance of the oil in water emulsion gives an indication about the droplet size of the oil:

milky white	droplets > 1 μm
blue white/half transparent	droplets < 1 μm
light blue transparent	droplets 0.1 - 0.03 μm
transparent	droplets < 0.03 μm

Water is a very strong dipole, oil consists mostly out of saturated hydrocarbons which have practically no dipole. Therefore oils are unsoluble in water, they are hydrophobic. Oil and water separate and the oil appears as free oil if no mechanical or chemical energy is introduced to the system.

Physical emulsions

Through high mechanical stress (centrifugal pumps, pressure nozzles etc.) little oil droplets are produced. The work $\triangle A$ is used for increasing the surface $\triangle o$ between the two phases. The correlation

$$\triangle A = \delta \triangle o$$

where δ is the surface tension between the two phases express the relation between mechanical work and surface produced. Once the droplets are formed they act like particles and are subject to electrostatical and Van de Waals forces. Figure 1 shows the energy barrier between two oil droplets. The technical implication of this physical effect will be discussed in chapter 3.4 coalescing separators.

Chemical emulsions

Chemical emulsions are created when emulsifying chemicals are added to an oil in water mixture. Emulsifying chemicals are surfactants (detergents), organic solvents and specific organic emulsion stabilizers. Detergents and solvents are mostly added for cleaning reasons whereas organic emulsion stabilizers are added to create stable emulsions in cutting fluids. The oil droplets in a chemical emulsion are surrounded by the emulsifying detergents which create a hydrophile layer around it. The oil droplet becomes electrically charged on the surface. The electrical charge and the layer around the droplet inhibits the coalescence of droplets and the separation of oil water through mechanical devices. Treatment methods for such oil in water systems are described in chapter 3.6 - 3.8. Chemical emulsions can be very strong and treatment is much more difficult than free oil and dispersed oil water systems. It must be first priority of an integrated process that emulsions are avoided, and that mixing with non emulsified effluent does not take place.

3. TREATMENT TECHNOLOGY

A number of different well proven technologies are available to treat effluents containing oil. In most cases a combination of two or three treatment steps will be necessary to achieve an oil-free effluent. An effluent is considered as "oil-free" if the concentration of oil is less than 20 mg/l. With the right combination of technologies an effluent with 1 - 5 mg/l will be possible.

A careful analysis of the effluent situation is necessary to make the right choise of process combination. The form in which the oil is present and the desired oil contents after treatment gives only a first guide line. Much more important for oil containing effluents is the question concerning the use of the oil and sludge recovered from the effluent. The treatment method must make sure that a maximum of recovered oil can be re-used in one or the other way. that toxic wastes are avoided and that all produced sludges and loaded adsorbents can be handled carefully. In other words the treatment method chosen should solve the problems in an integrated system and not transfer the effluent problem into a solid waste or air pollution problem.

3.1 Gravity Separation

Free oils can easily be separated through gravity separation devices the American Petroleum Institute (API) has established design criteria for the so-called API Separator. The principal behind this separation technology is that free oil droplets larger than 150 μm will rise to the surface of the water if an adequate detention time is given. At the same time parts of the suspended solids will sink to the ground.

The rise velocity of an oil droplet is given by the well known Stockes Law:

$$V_R = \frac{g*d*(P_W - P_O)}{18*V_W}$$

V_R :	rise of velocity
g :	gravity constant 9,81 m/s^2
d :	diameter of oil drop
P_W :	density of the water P_W = F(T) = (1.0 - 0.98 kg/m^3)
P_O :	density of the oil
μ_W :	viscosity of the water μ_W = F(T) = (0.015 - 0.005 poises)
T :	temperature

The gravity separator must be designed to allow enough detention time for a droplet of oil to rise to the surface while flowing through the separator. Following the Stockes Law the time needed for a droplet to rise to the surface is the dominant criteria for the size of a gravity separation surface. This let to the design of the Parallel Plate Interceptor (PPI) and Corrugated Plate Interceptor (CPI). The PPI has parallel plates in 45° in 10 cm distance to each other which creates an effective surface of about 5 times higher in the same volume compared to the API separator. In emsequence the PPI needs only 20% surface of the API separator. In the CPI system the corrugated plates have only a distance of about 3 mm of each other. The CPI needs only about 50% of the surface of the PPI design. Disadvantages of both systems are the danger to clog through adhesive sludges and bigger objects. A sedimentation pretreatment in particular for the PPI should be considered.

A combination of coalescence and gravity separator is the Coalescence Plate Separator (CPS) which is discussed in chapter 3.4.

3.2 Flotation

Chapter 3.1 showed that natural flotation is used in the gravity separator designs API,PPI, CPI and CPS. In the technical flotation process fine air bubbles are used to support the natural floating process for small droplets (20 - 100 μm) of dispersed oil. The small bubbles brought into the water, either through induced air (Induced Air Flotation IAF) or dissolved air (Dissolved Air Flotation DAF), attach themselves to the hydrophobic oil droplets and raise them to the surface. There they coalescence to an oil film which can be easily separated from the water. DAF plants produce much smaller gas bubbles than IAF plants and can separate therefore finer oil globules. On the other side DAF plants consume more energy because the dispersion stream has to be compressed to 5 to 6 bar. Floatation plants are often used in combination with gravity separation to skim of the free oils first and use the more energy consuming process for the dispersed phase. The DAF processes are possible. Full flow operation, split flow operation, recycle flow operation. Although the recycle flow requires more surface according to recycle rate, the process is of advantage in oily water because the mechanical dispersion of the oil is kept to a minimum. Chemically emulsified oil-water systems do require a chemical pretreatment first to break the emulsion. Electroflotation, where the gas bubbles are produced through electrodes, are only used for small water streams.

3.3 Centrifugal Separators

Centrifugal separators use centrifugal force to separate fluids and solids with different density. The heavier particles move to the outside of the rotating fluid, the lighter phase (oil) can be collected in the inside near the vortex. The benefit of centrifugal separators is in the outside region where the centrifugal force has its maximum. For oil water separation in an oil in water system the technique loses its advantages. Therefore these systems are rarely used in this application. However, for solid separation and dewatering oil in water in oil systems, the techniques are used because of its simple and inexpensive reliable design.

3.4 Coalescence Separator

In case the diameter of oil droplets in an oil in water system become smaller than 100 μm they cannot be separated in gravity separator, DAF becomes ineffective when the dispersed droplets become smaller than 20 μm. The aim in an coalescing operator is, to bring the find disports droplets together to form drops big enough to rise to the surface. This physical effect is called coalescence. The energy barrier described in chapter 2 has to be overcome before coalescence happens. Coalescence Plate Separators consist of plates with oilohile surface where oil droplets attach themselves and grow to bigger droplets through inter droplet contact. Coalescence separator use fibrous media to provide the surface where inter droplet contact can take place. A thin oil film with be attached to the fibrous material in which oil droplets will coalesce. When the oil film becomes too thick it will be unstable and big oil drops will separate and rise to the surface. The technology needs very good pretreatment to avoid clogging of the material.

3.5 Adhesion Technology

This treatment technology is used to remove a free oil layer on the surface. An oiliophile coated surface (belt) is moved vertical through the oil and a film will attach and can be mechanically skinned of.

3.6 Chemical De-emulsification and electro-coagulation

As described in chapter 2, oil droplets in chemical emulsions are surrounded by chemicals which gives and electrical charge to their surface. This layer inhibits the flotation and coalescence of the droplets. Chemicals have to be added to break the emulsion. This flocculation, coagulation process is then followed by classical sludge removal technologies as sedimentation, floatation and filtration. The big disadvantages are the creation of oil containing metal hydroxide sludge which is difficult to dewater and causes problems in their disposal.

The chemicals added are either acids (sulfuric or hydrochloric acid), metal salts (aluminium or iron salts) or organic coagulants (organic polymers or polyelectrolytes). The acid method is most effective but expensive. Metal salts leave a voluminous hydroxide sludge. The organic demulgators reduce the sludge volume however are more expensive than the metal salts. The use of metal salt chemical leads to high salt concentration in the cleaned water. This however is not a problem for discharge into the sea. In practice 2 - 8 g $Fe(OH)_3$/g oil for flotation (5). Polyelectrolytes differ between o.5 - 4 mg/l. The best mixture for the specific problem has to be determinate in laboratory tests.

The disadvantages of the sludge production in chemical de-emulsification plants let to a new development, the electro-coagulation. Through electrical discharge of electrodes into the oil water system the electrical charge of the oil droplets can be neutralized. This open the possibility for coalescence as described in chapter 3.4.

3.7 Membrane Technology

In recent years the membrane technology has gained more and more attention in the oil water separation problems. The major disadvantages as fouling, clogging and high investment costs have been decreased through the development of new membranes. All three membrane methods, Microfiltration, development of new membranes. All three membrane methods, Microfiltration, Ultrafiltration and Reverse Osmosis are sued to create so-called "closed circuits" where no or very little water has to be discharged into the environment. Ultrafiltration is also used as pretreatment for an evaporation step.

In an Ultrafiltration process the oil water system is passed with 3 to 10 bar through a membrane. The small molecules (water, dissolved salts etc.) pass the membrane where as the bigger molecules (emulsified oil) will concentrate on the other side. This concentrate has than to be treated further. The oil concentration in water will be below 20 mg/l depending on the nature of the emulsion. The major advantage of the UF-process is that no chemicals have to be added and that no sludge is produced. the major disadvantages are the high investment cost for big plants and high energy consumption.

3.8 Thermal Process

Thermal process use the different evaporation temperature of oil and water which is higher for mineral oils. The water evaporates and is used in multiple vacuum evaporation steps to heat the next evaporator. The final condensate has in general an oil residual of less than 20 mg/l. The major disadvantages, the high energy and investment costs have been compensated in recent years by t he advantage of producing a very cleaning recyclable oil phase. Particularly where the sludge disposal costs are high costs are high, the evaporation process in combination with UF should be considered.

3.9 Biological Process

For large quantities of water, as produced in the petrochemical industry, activated sludge systems are the standard cleaning method. The process combination must make sure that high quantities of free oil are not released into the activated sludge process. Bacteria are only able to digest "dissolved" oils and free oil will be adsorbed by the biomass faster than it can be digested. This will lead to a rapid decrease of biological activity. The concentration of hydrocarbons in the effluent from the activated sludge plant can be around 5 mg/l. The major advantages of the process are the cheap running costs.

3.10 Adsorption Technology

For dissolved molecules of hydrocarbons the adsorption on activated carbon is possible. However, due to the difficulties in recycling the loaded coal and the fact that the before described processes lead to an effluent that meets the legal requirements, the adsorption on activated carbon is practically not used in oil water separation.

4. CONCLUSIONS

The form in which the oil is present in the oil in water systems determinants the first guideline for the treatment process. Free oil can be separated through gravity separators. Dispersed oil will be treated through flotations, membranes or evaporation physical coalescence. Emulsified oil needs chemical breaking, membranes or electro coagulation. The residuals produced in each process have to be involved when choosing the process combination. Sludge disposal proves to be very expensive and with our specific infrastructure unsafe.

References:

(1) Paul N. Cheremisinoff et. al.
Encyclopedia of Environ Control Technology Wastewater Treatment
Technology Wastewater Treatment Technol. 1989
V3 p 355 (12) book chapter

(2) Proceeding of the
ATV-Seminar fur die Abwasserpraxis BITZ 13/89
"Behandlung olhaltiger Abwasser"
11th and 12th October 1989

(3) A.J. Englande, Jr.
Status and Direction of Waste Minimization
in the Chemical and Petrochemical Industries
Wat. Sci. Tech. Vol. 29, No 8. pp. 25-36, 1994

(4) Kee Kean Chin
Evaluation of Treatment Efficiency of
Processes for Petroleum Refinery
Wastewater
Wat. Sci. Tech. Vol 29 No. 8 pp. 47-50, 1994

(5) Proceeding of the ATV-Seminar Abwasserpraxis 1996 "Behandlung olhaltiger Abwasser" 27/28 Marz 1996

(6) Grundsatze fur Bemessung und Betrieb von
Abwasserreinigungsanlagen in Erdolraffinerien
ATV arbeitsblatt A 701

Treatment	Separation Limit	Advantage	Disadvantage
<u>Gravity Separation</u>			
ALI Separator	globules of free oil larger than 150 pm specific gravity of the oil 0.7 - 0.95 70 % - 80 % separation of oil free	● sedimentation in one unit ● well established technology ● no chemicals ● low energy if no heating is required ● recyclable oil out put	● large space required ● difficult to cover ● sludge removal can cause problems
Parallel Plate Interceptor (PPI)	globules of free and dispersed oil larger than 20pm specific gravity of the oil 0.7 -0.95 over 80 % separation 70 - 100 mg/l possible	● no chemicals ● low energy if no heating required ● recyclable oil out put ● 20% space requirement of ALI separator	● danger of clogging through solids ● pre-treatment necessary
Corrugated Plate Interceptor (CIP)	globules of free and dispersed oil larger than 20 pm; specific gravity 0.7-0.95 over 80 % separation 70-100 mg/l oil possible	● no chemicals ● low energy if no heating required ● recyclable oil out put ● 50% less space required than PPI	● danger of clogging through solids ● pre-treatment necessary

Treatment	Separation Limit	Advantage	Disadvantage
<u>Flotation</u>			
Induced Air Flotation (IAF)	dispersed oil droplets up to 70 pml/l 10 - 30 mg/l oil possible free oil should be skimmed first	● no chemicals ● recyclable oil out put	● higher energy consumption than gravity separation ● bigger gas bubbles than DAF
Dissolved Air Flotation (DAF)	dispersed oil droplets up to 30 pm 10 -30 mg/l oil possible free oil should be skimmed first	● no chemicals ● recyclable oil out put	● higher energy consumption than IAF ● dispersion stream necessary
Electroflotation	dispersed oil droplets up to 30 pm free oil should be skimmed first 10-30 mg/l possible	● no chemicals ● recyclable oil out put	● only for small quantities unable

Treatment	Separation Limit	Advantage	Disadvantage
Coalescence separator	globules of dispersed oil larger than 20 pm	● no chemicals added ● low energy consumption ● recyclable oil output	● Clogging of fibrous material ● requires very good pretreatment
Adhesion	skimmer for free oil on surface	● no chemicals added	● rotating parts
Membrane	for dispersed and emulsified oil	● no chemicals ● produces concentrate that can be treated further ● no discharge circuit possible ● very high water quality possible	● high investment costs for big plants ● requires effective pretreatment ● requires extensive supervision and maintenance ● possibility of membrane damage ● high energy costs
Evaporation	for dispersed and emulsified oil less than 20 mg/l Hydrocarbon possible	● no chemicals used ● produces a very clean oil phase ● very high water quality possible	● high investment costs ● complicated process requires supervision and maintenance ● high energy costs

Table 2: over view of treatment technologies

Treatment	Separation Limit	Advantage	Disadvantage
<u>Chemical De-emulsification</u>			
Acidification	de-emulsification of stable emulsions 5 mg/l Hydrocarbons possible	● very effective ● simple process technology ● possible for wide range of flow rates	● expensive chemicals compared to metal salts
Salting out	de-emulsification of stable emulsions 5 mg/l Hydrocarbons possible	● inexpensive chemicals ● simple process technology ● possible for wide range of flow rates	● voluminous Hydroxide sludge difficult to dewater ● high salt content of the effluent ● difficult dosage of effluent varies in quality
Organic de-emulsifier	de-emulsification of stable emulsions 5 mg/l Hydrocarbons possible	● very effective ● simple process technology ● reduced sludge compared to salting out ● salt content in water is not increased ● possible for wide range of flow rates	● expensive chemicals ● sludge is produced
Electrocoagulation	de-emulsification of stable emulsions 5 mg/l Hydrocarbon possible	● no chemicals need ● no sludge production ● no dosing problems	● high energy costs ● process is still in development phase

Table 2: over view of treatment technologies

Treatment	Separation Limit	Advantage	Disadvantage
Activated Carbons Filters	adsorption of dissolved hydrocarbons only	● high water quality ● simple filter technology	● loaded coal must be recycled ● expensive coal replacement
Biological Treatment	dissolved Hydrocarbons 5 mg/l Hydrocarbons possible	● inexpensive treatment method for large quantities of water ● bio sludge may be used as fertiliser	● produces bio-sludge ● large space requirements ● effective pre-treatment necessary ● disturbed by high fluctuation of quantity and quality

Source and extent of land-based oil pollution and oil industry related wastes in the North Sea Region (Europe).

Karlo van Bernem, GKSS-Research-Centre, Max-Planck-Straße, D-21502 Geesthacht, Germany

The sources of land-based oil pollution and oil industry related wastes can be focused threefold:

1. Communal (including traffic) as diffuse sources
2. Refinery effluents and
3. Effluents of offshore industries (oil and gas) as point sources.

A great number of singular substances is part of this kind of pollution: Crude oils and their products, for example, comprise much more than some 10.000 singular compounds. The main part is presented by hydrocarbons, but in addition there are substances containing sulphur and nitrogen, heavy metals, phenols and organic acids, just to mention a few of them. Additionally there are the substances due to the industrial processing coming out of combustion, degradation ... and so on. Following an estimation of the North Sea Quality Status Report from 1993 (based on an estimation of the year 1987), there are 13 sources discharging "oil" as a summarised parameter into the sea (Table 1).

Table 1: Total amount of oil input (10^3 t/year)

Source	Input (10^3 t/year)
Natural seeps	1
Atmosphere	7 - 15
River/land run-off	16 - 46
Coastal sewage	3 - 15
Coastal refineries	4
Oil terminals and reception facilities	1
Other coastal industrial effluents	5 - 15
Offshore oil and gas production	29*
Sewage sludge	1 - 10
Dumped industrial water	1 - 2
Dredged spoils	2 - 10
Operational ship discharges	1 - 2
Accidental or illegal discharges from ships	15 - 60**
Total	**86 - 210**

* 20-30 x 10^3 t/year over the period 1984-1990 (PARCOM estimates)
** from subregional assessment report for subregion 4.

(Source: North Sea Quality Status Report 1993, Oslo and Paris commissions, International Council for the Exploration of the Sea)

The reliability of an estimation like this is generally poor, but the ranges are probably representative and sufficient to show the relative proportions which each source represents.

Especially hard to estimate are the high amounts of 15.000 tonnes coming out of the atmosphere. They are the result of the burning of fossil fuels in plants, traffic (marine and terrestrial) as well as in communities (i.e. heating).

With growing understanding of the mechanisms of the transport and deposition of air pollutants it became clear that atmospheric inputs are one of the largest contributions to the inputs into the open sea.

Using polycyclic aromatic hydrocarbons (PAH) as a parameter (Table 2 shows a list of them, monitored in some international programmes), new measurements support the assumption, that the largest amounts are deposited in particular when there is a combination of long range air transport and heavy precipitation. PAH deposition mostly occurs in particulate form.

Table 2: PAH in several monitoring lists: 1-16: EPA; S: SIME list (OSPARCOM); U: Environmental Specimen Bank Programme. (c: carcinogenic, m: mutagenic)

Parameter	Program	carcinogenic/mutagenic	Boiling Point
1. Naphthalene			218
2. Acenaphthylene	S		280
3. Acenaphthene	S		279
4. Fluorene	S		294
5. Phenanthrene	S		340
6. Anthracene	S		340
7. Fluoranthene	S/U	/m	375
8. Pyrene	S/U		393
9. Benz(a)anthracene	S/U	c/m	435
10. Chrysene	S/U	c/m	448
11. Benzo(b)fluoranthene	/U	c/m	
12. Benzo(k)fluoranthene	/U	c/m	
13. Benz(a)pyrene	S/U	c/m	495
14. Dibenz(a,h)anthracene	/U	c/m	535
15. Benzo(ghi)perylene	S/U	/m	542
16. Indeno(1,2,3-cd)pyrene	S/U	c/m	
Benz(e)pyrene	/U	/m	
Perylene	/U	/m	375
Dibenzothiophene			332-333
Coronene	/U	/m	525
Anthanthrene	/U	/m	
Cyclopenta(cd)pyrene		c/	
Benzo(b)naphthol(2,1-d)thiophene	/U	/m	
Benzo(ghi)fluoranthene	/U		

(Source: OSPARCOM, INPUT (2) 95/5/9-E, 1995)

The data for the North Sea Status Report were submitted on a fairly large number of PAH. After conducting a statistical review of the data, the following compounds were chosen as representatives of various types of PAH´s: Benzo(a)pyren (BAP), a high molecular weight PAH, mainly produced during combustion, Phenanthrene (PA) and Naphthalene (NA), lower molecular weight compounds arising from combustion and oil sources, and C_1-alkyl derivatives of naphthalene (NAPC1), as a further representative of oil sources. Concentrations of BAP were in the range of 0.0006 to 0.24 mg/kg, with the distribution showing the highest concentrations in the Western Scheldt, the Skagerrak, the Kattegat (including areas along the Swedish Coast), the Oslofjord and the Hardangerfjord. Normalisation to organic carbon evened out some of the differences, leading to a relative decrease in the values in the Skagerrak and Kattegat and to higher values for sediments in the central parts of the North Sea. Concentrations of phenanthrene ranged from 0.001 to 0.15 mg/kg, with the highest values in the Skagerrak, Oslofjord and Kattegat; the results of normalisation were similar to that ones above. Concentrations of naphthalene ranged from 0.001 to 0.055 mg/kg and the distribution was similar to that of phenanthrene, also after normalisation to organic carbon (North Sea Quality Status Report, 1993).

Other sources where information and reliability is rather poor are: River/land run off, Coastal sewage and "other coastal industrial effluent". The general sum is about 31 - 91.000 t/year.

Input of hydrocarbons by the river Elbe.
As it is very difficult to calculate inputs into the North Sea with the data available, let us focus as an example on the river Elbe and spend some time to look at the difficulties of such estimations. THEOBALD et al., (1995) calculated the input figures in table 3 very conservatively, in order to not underestimate the inputs: The mean concentrations of the sampling period (Nov. 89 to March 92) were multiplied by the long-term mean annual flow rate at the freshwater edge of 800 m^3/sec.. These calculations imply the following uncertainties: The annual reproducibility lies between 5 and 10% and is much smaller than the variation of the different samples or of the annual flow rates (coefficient of variation: 60%). The accuracy of the composite value THC is difficult to define, the THC represents an upper limit value - as a reasonable lower limit value the sum of the GC determinations (sum aliphatics + aromatics) can be considered (average: 43% of THC). The standard deviation of the accuracy of the GC-MS determinations is considered to be better than 10%, that of the GC analysis better than 20%.

For two reasons the values in Table 3 are systematically too high:

1. None of these calculations takes into account that a great part of the hydrocarbons are bound to the suspended matter and thus do not reach the North Sea but are sedimented earlier.

2. During the sampling time unusually low flow rates were observed, therefore the input amounts would be reduced by about 40% (± 14%) when the actual flow rates would be considered.

Although the uncertainties in the estimated annual inputs are quite high (ca. +30 -70%) - partly due to analytical difficulties, but mainly due to a high natural variation - the authors conclude that a reasonable range for the inputs can be given: Between 500 t and 2.000 t of hydrocarbons are annually transported by the river Elbe toward the North Sea.

Table 3: Mean concentrations and input of hydrocarbons by the river Elbe

Type of hydrocarbons	Method	Concentration mean (µg/l)	Input - amount (t/year)
Total hydrocarbons (THC)	UV-Vis-fluor.	78	2.000
Sum aliphatics	GC	32	800
Sum degraded oil	GC	26	650
Sum biological aliphatics	GC-MS	1.9	50
Sum aromatics	GC	1.1	30
Sum PAH (EPA, 16)	GC-MS	0.2	5

(Source: Theobald et al., 1995)

A typical distribution of the total hydrocarbons (THC) in the German Bight is shown on the following Figure:

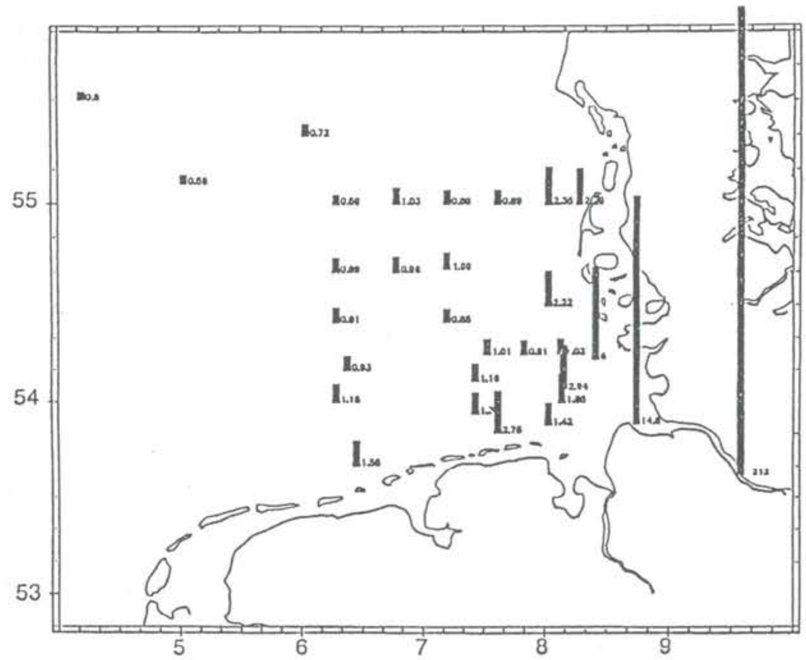


Figure 1: THC distribution in the German Bight, Jan. 1990 in μg/l (Source:THEOBALD et al., 1995).

This distribution is mainly influenced by the Elbe plume which generally moves northwards as a narrow band along the North-Frisian Coast.

Discharges of oil from offshore oil and gas production.
The most reliable estimates of oil discharged to the North Sea emanate from the regular reporting within OSPAR on offshore oil and gas production and refineries.

Since the late 1960s, when oil and gas exploration and production in the North Sea started, a large number of wells have been drilled, using diesel-based drilling muds (up to 1985), low aromatic oil-based muds, and water-based muds.

Sources of contaminants arising from the offshore oil and gas industry are:

- drilling muds and cuttings from the use of water-based muds;
- cuttings containing oil from the use of oil-based muds;
- production water;
- spills and flaring.

A major component of these sources is oil, but other substances are also involved: barite with variable amounts of toxic heavy metals, bentonite, inorganic salts, surfactants, a variety of organic polymers, detergents, corrosion inhibitors, biocides, and lubricants in the form of oil-in-water (oil-based mud) or water emulsions (water-based mud). The chemical composition and amount used in any mud system depend on factors such as the type of rock being drilled, the depth of the well, and the angle of deviation. Chemicals are also used during oil and gas production and in pipeline protection. Some of the chemicals are totally discharged (e.g. water-based mud) and others are partially discharged. The total amount of oil discharged shows no real trend over the period from 1984 to 1990. Fluctuations merely reflect responses to economic factors. Figure 3 shows the discharges of oil from offshore installations per country in 1992.

The amount of oil discharged via cuttings is by far the largest source (Figure 2). In addition to dissolved hydrocarbons from crude oil, production water, as a very complex mixture of oil and chemicals, (substantial amounts of organic matter mainly, salts of acetic, propionic and butyric acids) is discharged. At peak production it has been estimated that the United Kingdom sector alone contributes 10.000 to 20.000 tons of organic acids each year.

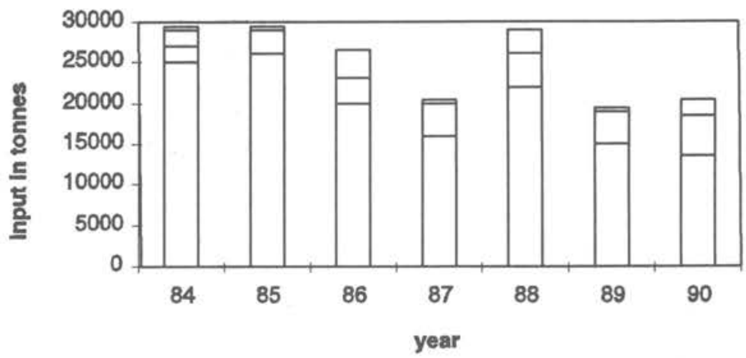


Figure 2: Total quantities of oil discharged by the offshore industry via cuttings (lower part of the columns), production water (striped area), and accidental spills (pointed), 1984-1990. Oil based drilling muds using diesel oil (white) were not used after 1984 (OSPARCOM, North Sea Quality Status Report, 1993).

Typical concentrations of oil (THC) in sediments are in remote areas normally at the range of 0.2 - 5 mg/kg dry sediment. In some areas of the United Kingdom sector values in the range of 15 mg/kg are found. Very close to platforms (ca. 50m) even oil concentrations as high as 10-100 g/kg have been detected.

The size of the area with elevated levels depends on several factors (input, type of cutting discharged, bathymetry, current regime). The estimated total area in the North Sea of contaminated sea bed ranges at about 8.000 km^2.

Oil concentrations in sea water are generally low (about 0.2-3 μg/l). Elevated levels were found in the inner German Bight (see above, Figure 1) and around some northern platforms.
To conclude this list of sources it should be noted that besides oil and the chemicals mentioned, the main sources of heavy metals are the barite and bentonite minerals used in drilling muds.

Figure 3: Discharges of oil from offshore installations per country in 1992
(Source: OSPARCOM, INPUT(2) 95/5/10-E(L)).

Discharges of oil from refineries.
The amount of oil discharged by refineries was estimated to be about 4.000 t/year in 1987.

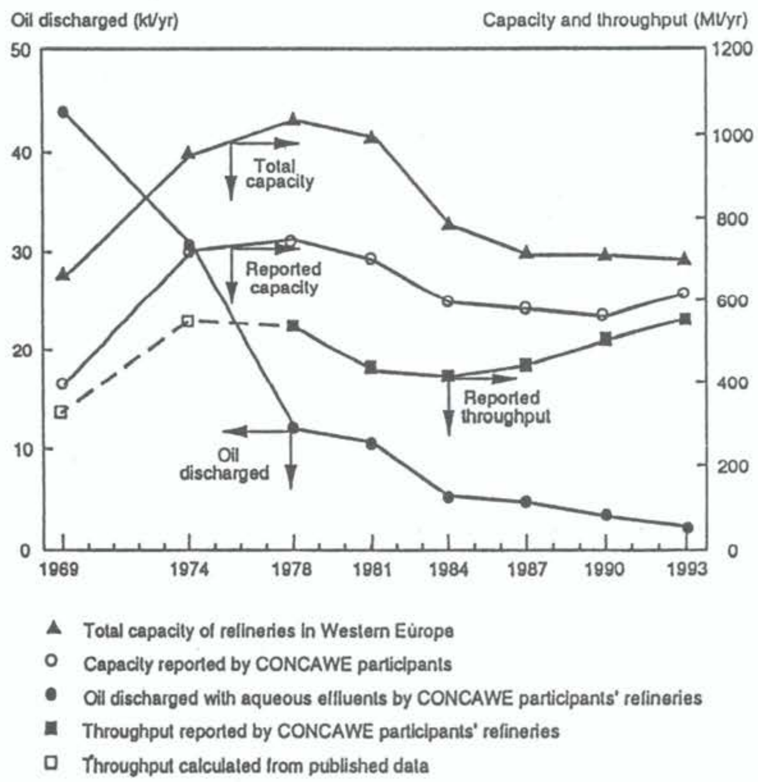


figure 4: trends in oil discharged, refining capacity and throughput 1969-1993. (Source: CONCAWE report no. 3/94).

In 1993, 95 refineries responded to the CONCAWE (The oil companies' European organisation for environment, health and safety) questionnaire, representing 90% of the oil refinery capacity in Western Europe. Even though a limited number of refinery closures have occurred since 1990 and are missing from the 1993 data, the number of refineries reporting has remained the same and the reported capacity has increased. This is the result of the participation of refineries which had not previously supplied data. Figure 5 shows Discharges of oil from refineries per country in 1993.

The evaluation of the questionnaire shows that:

- 2018 tonnes of oil were discharged with the aqueous effluents from 95 refineries in 1993 compared with 3340 tonnes from 95 refineries in 1990 (65 hereof were in operation in the convention area of PARCOM). This represents a reduction of 40% although the amount of oil processed in 1993 was 9% higher than in 1990.

- There has been a 46% reduction in the ratio of oil discharged to oil processed since a 1990 survey, i.e. it fell from 6.7 tonnes/million tonnes of oil processed in 1990 to 3.6 tonnes/million tonnes in 1993.

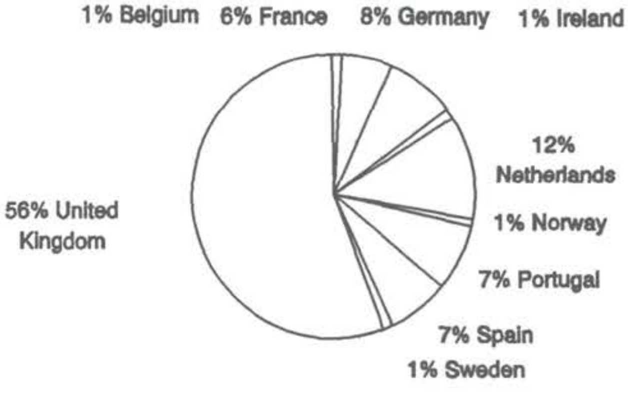
- Thus there has been a 95% reduction in oil discharged in refinery effluents since the 44 000 tonnes reported in the initial survey conducted in 1969.

- The 1993 reported total amount of aqueous effluent discharged has risen significantly, but this is due to a few more refineries with once-through cooling water reporting.

- About 85% of the refineries surveyed are equipped for biological treatment of their aqueous effluents.

The evolution tends clearly towards less oil discharged per tonne of processed oil. The average ratio between the quantity of oil discharged and processed (tonne per million tonne) was 31.0 in 1981 and 4.2 in 1993, which means that the efficiency of treatment systems for oil effluents has been improved significantly since 1981 (CONCAWE report no. 3/94).

Figure 5: Discharges of oil from refineries per country in 1993
(Source: OSPARCOM, INPUT(2) 95/5/10-E(L).



Of much more greater concern, if for no other reason than that the effects are more obvious, are the quantities of oil entering the sea from ships as illegal discharges and from incomplete gas flaring operations on oil platforms. These causes surface films that can lead to the oiling of seabirds and the death of so affected birds. The assessment report for subregion 4 (coast of Netherlands and Belgium) suggests that as many as 40.000 birds die each year on the Dutch coast alone as the result of oil contamination, much of this arising from such illegal discharges. (Source: North Sea Quality Status Report, 1993).

References:

1. Dando, D.A.J. & D.E. Martin (1994): Trends in oil discharged with aqueous effluents from oil refineries in Western Europe. CONCAWE Report no. 3/94

2. North Sea Quality Status Report (1993), North Sea Task Force, Oslo and Paris Commission, London, 1993.

3. OSPARCOM, INPUT(2) 95/5/9-E (1995): Input of polycyclic hydrocarbons (PAHs) to the Convention Area by debouching rivers in the Netherlands and Germany, atmosphaeric deposition in Germany as well as the dumping of dredged material from Dutch harbours. Presented by the Netherlands and Germany (INPUT), London 1995.

4. OSPARCOM, INPUT(2) 95/5/10-E (L) (1995): Overview of available information on inputs of oil to the marine area. Presented by Norway (INPUT), London 1995.

5. Theobald, N., Rave, A. & K. Jerzycki-Brandes (1995): Input of hydrocarbons into the North Sea by the river Elbe. Fresenius J Anal Chem (1995) 353: 83-87.

Captions:

Table 1: Total amount of oil input (10^3 t/year) (Source: North Sea Quality Status Report 1993, Oslo and Paris commissions, International Council for the Exploration of the Sea)

Table 2: PAH in several monitoring lists: 1-16: EPA; S: SIME list (OSPARCOM); U: Environmental Specimen Bank Programme. (c: carcinogenic, m: mutagenic). (Source: OSPARCOM, INPUT (2) 95/5/9-E, 1995).

Table 3: Mean concentrations and input of hydrocarbons by the river Elbe. (Source: THEOBALD et al., 1995)

Figure 1: THC distribution in the German Bight, Jan. 1990 in µg/l (Source:THEOBALD et al., 1995).

Figure 2: Total quantities of oil discharged by the offshore industry via cuttings (lower part of the columns), production water (striped area), and accidental spills (pointed), 1984-1990. Oil based drilling muds using diesel oil (white) were not used after 1984 (OSPARCOM, North Sea Quality Status Report, 1993).

Figure 3: Discharges of oil from offshore installations per country in 1992. (Source: OSPARCOM, INPUT(2) 95/5/10-E(L)).

Figure 4: Trends in oil discharged, refining capacity and throughput 1969-1993. (Source: CONCAWE report no. 3/94).

Figure 5: Discharges of oil from refineries per country in 1993

•(Source: OSPARCOM, INPUT(2) 95/5/10-E(L).

Fate of land-based oil discharges in coastal and marine environments: (dispersions, evaporation, biodegradation, bioaccumulation, etc.)

Karlo van Bernem, GKSS-Research-Centre, Max-Planck-Straße, D-21502 Geesthacht, Germany

The fate of oil discharged in aquatic environments is very complex. So only some of the most fundamental events can be presented in the following. Using a strongly simplified classification, crude oil contents the following compounds:

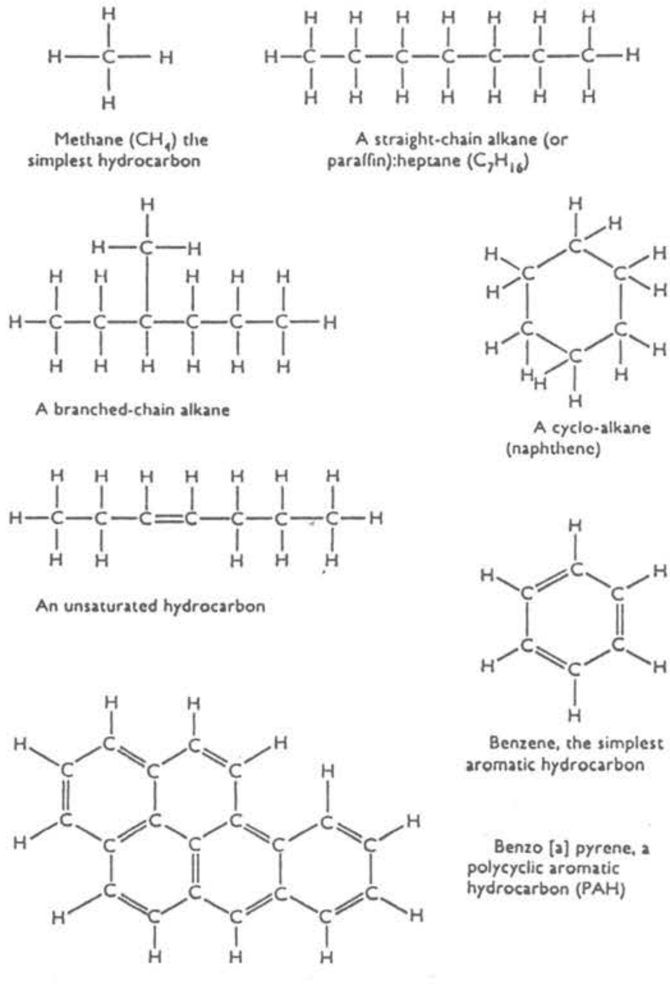


Figure 1: The structure of some hydrocarbons. (Source: CLARK, 1992).

In fact there are more than 10.000 components not including the substances admitted during for example refinery processes or changed in following combustion or degradation, as mentioned already in: "Source and extent of land-based oil pollution...".

Mainly the components of crude oil belong to a few homologue chains of hydrocarbons besides non-hydrocarbons (heterocyclic compounds like thiophene and pyridine and derivatives like phenols) These compounds containing oxygen, nitrogen and sulphur usually form just a few percent of the crude oil. The main compound classes are the straight or branched chains of aliphatics, the naphthenes (cyclic aliphatics with saturated rings), and, to a more less extent, the aromatic compounds with one or more unsaturated rings.

The composition of these compounds changes with each crude oil - there are not two oils being completely identical.

Because of this complexity and the different behaviour of the single substances after being discharged into the sea (different ways of solubility, photolysis and microbial degradation) the chemical investigation of these subjects belongs to the most difficult and complicated tasks of the organic chemistry. - To further complicate the situation, a wide range of hydrocarbons are biogenic, produced by plants, algae and animals. They can be distinguished from petroleum hydrocarbons by their special composition. For example the predominance of odd chain length of n-alkanes.

As another very simplified example let us follow the history of an oil slick spilled on the sea (Figure 2).

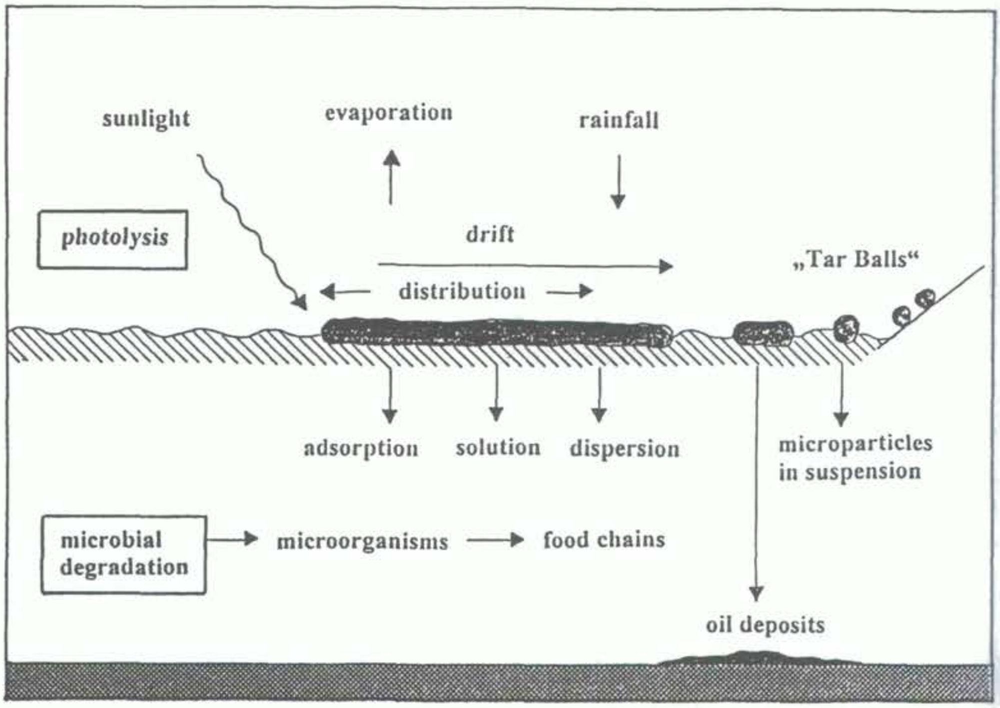


Figure 2: Simplified patterns of oil spilled on water. (Source: GUNKEL, 1988).

When liquid oil is spilled on the sea, it spreads over the surface of the water to form a thin film - an oil slick. The rate of spreading and the thickness of the film depend on the sea temperature and the nature of the oil; a light oil spreads faster and to a thinner film than a heavy waxy oil.

The composition of the oil changes from the time it is spilled. Light (low-molecular-weight) fractions evaporate, that means most substances boiling beneath 160 °C go into the atmosphere within a few hours (for example 50% after 24 h following the blow out of the platform "BRAVO", in the Ekofisk field, 1977). Water soluble components (mainly the low boiling aromatics) dissolve in the water column, and immiscible components become emulsified and dispersed as small droplets. Emulsification is the process, whereby a liquid is dispersed into another one. Two different types can be distinguished: oil-in-water and water-in-oil emulsions. The first one is formed as a result of wave action or chemical dispersants. Small oil droplets are dispersed in the surrounding water. The latter is formed, when water is mixed with a relatively viscous oil by wave activity alone. This type of emulsion is extremely stable and may persist for month or even years (chocolate mousse). Only crude oil can form water-in-oil emulsions (- containing 80% of water), the volume being up to 4 times the originating, with also increasing viscosity. The heavy residues of crude oil form "tar balls", ranging in size from less than 1 mm to 10-20 cm in diameter. Viscosity is the property of a fluid by which it resists to a change in shape or movement. Viscosity denotes a fluid´s opposition to flow. It is strongly influenced by the relative temperature and increases with density. Orders of magnitude for some of the most important products (mm^2/s at 20°C) are:

gasoline	<	1
water	=	1
petroleum		2
diesel and heating oil		2-8
heavy fuel oil		450

Both, the speed and the spreading and the final thickness of an oil film or sheen on the water depend on the viscosity. Emulsified oil is in microscopic drops and therefore presents a large surface area at which bacterial attack and adsorption to organic and inorganic particles can take place. "Tar balls" and "mousse" present a small surface area compared to their volume, and degrade extremely slowly for this reason.

An oil slick travels downwind at 3-4% of the wind speed except in enclosed waters and estuaries where tides and water currents have a greater influence on its movements.

Light oils and the middle-boiling range of crude oil distillates are the most potent source of "tainting" (deriving from superficial contamination and bioaccumulation), but all crude oils, refined products, refinery effluents, wastes from petrochemical complexes, the exhaust from outboard motors burning oil-petrol mixture, and a host of other sources can impart an unpleasant flavour to fish and seafood which is detectable at extremely low levels of contamination.

Concerning the sedimentation, several studies of intertidal and subtidal sediments reveal that they play a major part in determining the long-term fate of chronic oil pollution. In core samples, petrogenic hydrocarbons increase in concentration in sediments with repeated contamination (VAN BERNEM, 1984).

Two processes are capable to "destroy" oil in the marine environment: biodegradation, done by bacteria and some higher organisms and photolysis (better: photooxidation), done by the light.
Despite the chemical interactions I will show you an older attempt (MACKAY, 1982) of a mass-bilance as a simple model during 1.000 days of an marine oil contamination:

The fate of 100 parts of volume is depicted graphically. It is supposed, that the main changes take place within the first 100 days - The time scale is in logarithmic measure.

It is just a very rough model, which cannot be applied to each kind of oil pollution, but it may give a good impression of fundamental changes that will take place.

In this model the entire amount of oil which has been evaporated to the atmosphere is oxidised by photolysis to CO_2 and CO after a few days. - Newer investigations show, that photooxidation leads among others to products like aldehydes, ketones, hydroperoxides, alcohols, phenols, polyphenoles, organic acids and sulphoxides. Some of these products being even more toxic to organisms than the former compounds.

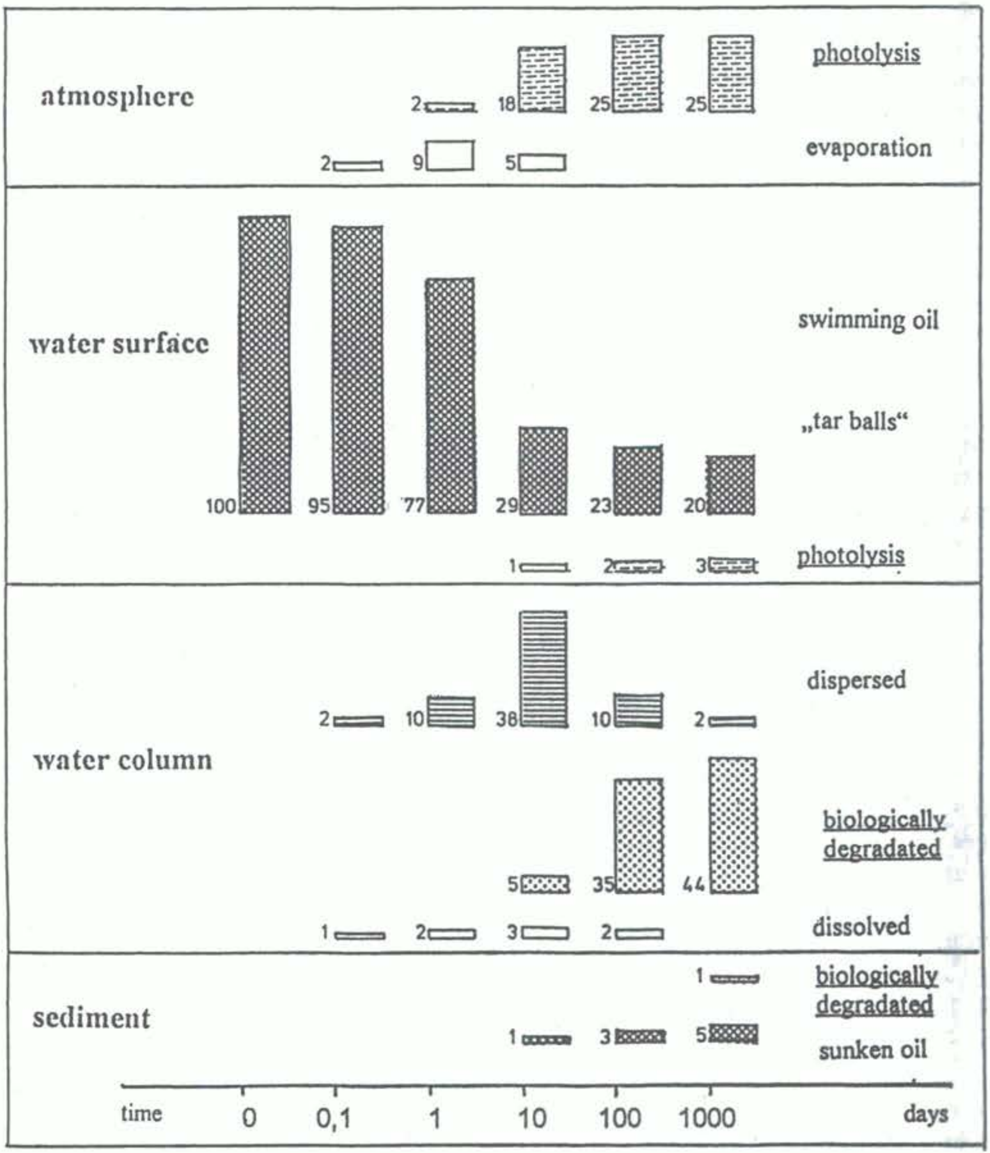


Figure 3: Mass-bilance of an marine oil contamination. (Strongly changed, following: MACKAY, 1982).

The swimming oil is photooxidised only to a very small amount. Biodegradation and dispersion are the main processes here, being connected very closely: A high rate of dispersion will enlarge the surface of the oil and so give more room to the bacterial attack.

Besides that, the rate of the microbial degradation is defined by the environmental properties: "le microbe - n´est rien, le milieu c´est tout" (PASTEUR).

One of the main properties is the oxygen content: To completely degrade 1 kg of crude oil the oxygen content of 400 m^3 of seawater is necessary.

Another environmental property is the temperature: It can influence the speed of degradation twofold: Firstly, at higher temperatures the low-boiling aromatics evaporate faster. These compounds are toxic to bacteria (among other organisms). Secondly, the activity of degrading micro-organisms increases with higher temperatures.

In the open sea the nutrient concentration is usually low and may limit the rate of degradation. This is surely not the case in rivers and coastal waters - here the oxygen demand may be limiting.

Estimations of degradation rates show very wide variations. MINAS (1985) found 1.4 $mg/m^3/day$ at 4 °C and 5.2 $mg/m^3/day$ at 18 °C in laboratory experiments. These rates meet point 4 in another estimation (GUNKEL & MINAS, 1987), showing much higher rates for "in situ" degradation in contaminated areas.

Table 1: Microbial degradation rates of hydrocarbons

	System	Rates ($g/m^3/day$)
1.	monocultures (fermenter) optimised conditions	10.000 - 100.000
2.	mixed marine population with addition of nutrients	5 - 2.500
3.	"in situ" degradation contaminated area	0.5 - 60
4.	"in situ" degradation uncontaminated area	0.001 - 0.03

The growth-adaption of bacteria in contaminated areas is also shown clearly by a large scale investigation done in the North Sea (GUNKEL et al., 1980).

In another investigation oil degrading microorganisms were present in all of the water samples, but the ability to degrade naphthalene in unpolluted water did not seem to be widespread. Naphthalene-degrading bacteria are, however, always present in stronger polluted water. It was found, that intensive microbial oil degradation in the German Bight only occurs very near to the coast, because of high nitrogen and phosphorus levels there. The results showed, that the percentage of micro-organisms involved in PAH degradation in the open sea is very small. Photooxidation may indeed play a more important part in the degradation of PAH´s than microbial degradative processes (BRUNS et al., 1993). In this affair the study of BURNS, 1993 provides evidence that the O-PAH´s should be included in the estimates of petroleum derived contamination in organisms and other samples from oil contaminated ecosystems.

Table 2: Concentrations of benzo(a)pyrene (μg/kg) in seafood from unpolluted and relatively polluted water

	Unpolluted	Polluted
Clam (Mercenaria)	0.38 - 1.1	8.2 - 16.0*
Shrimps	ND - 0.5	ND - 90.0
Crabs	ND - 5.0	ND - 30.0
Plaice	ND	0.05*
Herring	ND - 0.1	0.4 - 13.0
Cod	ND - 3.0	ND

ND = none detected; * = Evidence of tainting. (Source: CLARK, 1992).

Table 3: Concentrations of benzo(a)pyrene (µg/kg) in various foodstuffs

	Benzo(a)pyrene content
Cooked meats and sausage	0.17 - 0.63
Cooked bacon	1.6 - 4.2
Smoked ham	0.02 - 14.6
Cooked fish	0.0
Smoked fish	0.3 - 60.0
Flour and bread	0.1 - 4.1
Vegetable oils and fats	0.4 - 36.0
Cabbage	12.8 - 24.5
Spinach	7.4

(Source: CLARK, 1992).

Uptake and metabolism of hydrocarbons by phytoplancton and marine algae is reported for several species: Unlike microorganisms, animals tend not to utilise petroleum hydrocarbons as a carbon source, but generally oxidise and conjugate the products, rendering the end-products more water soluble, thereby facilitating their elimination via the usual modes of excretion of dissolved substances.

All animal groups tested have been capable of taking up petroleum hydrocarbons through the general body integument, across respiratory surfaces (gills, lungs, or other gas-exchange surfaces), and via the gut. Table 2 and 3 show some simple examples concerning the variability of hydrocarbon content in marine organisms and food (adopted from CLARK, 1992).

Although the precise mechanism of availability of hydrocarbons is a topic about which we still know little, uptake may be a simple, nonmediated transport across epithelial layers.

Bioavailablilty depends to a considerable degree on whether the hydrocarbons are dissolved in the water column, sorbed by or bound up in food. The organic content of sediments or particles, for example, can determine the sorption characteristics for hydrocarbons and therefore the amount of hydrocarbons in solution in natural waters. In bivalves the sorption of specific hydrocarbons and their apparent bioavailability have been found to vary with hydrophobicity. In fish and some invertebrates, factors related to solubility of hydrocarbons may well be responsible for the greater accumulation or retention of alkylated aromatics as compared to the unsubstituted forms. The degree of correlation between accumulation of some lipophilic foreign compounds by fish and octanol-water partition coefficients supports the idea that partitioning into, and uptake via the gulls is a major pathway into these animals. The nature of the compound may also dictate the absorption of hydrocarbons via the gut. Indeed in mammals the absorption of aliphatic hydrocarbons by the gut was found to be dependent on carbon number. In two species of marine fish, the absorption of hexadecan from contaminated food differed markedly from that of benzo(a)pyrene, and the patterns of absorption for the two compounds were quite different in various species. The bases for such differences are not yet apparent. The role of bacteria in the guts in metabolising ingested hydrocarbons in marine vertebrates is also unknown.

References:

1. Bernem van, K.H. (1984): Behaviour of penetration and persistence of crude oil hydrocarbons in tidal flat sediments after artificial contamination. Senckenbergiana marit.; 16 (1/6): 13-30.

2. Bruns, K., Dahlmann, G. & W. Gunkel (1993): Distribution and activity of petroleum hydrocarbon dagrading bacteria in the North Sea and Baltic Sea. Dt. Hydrogr. Z. 45: 359-369.

3. Burns, K. (1993): Analytical methods used in oil spill studies. Mar. Poll. Bull., Vol. 26, No. 2: 68-72.

4. Clark, R.B. (1992): Marine Pollution. Oxford University Press, Oxford. ISBN 0-19-854685-8.

5. Gunkel, W., Gassmann, G., Oppenheimer C. & I. Dundas (1980): Preliminary results of baseline studies of hydrocarbons and bacteria in the North Sea. In: Ponencias del Simposio Internationalen: Resistencia a los Antibioticos y Microbilogia Marina. Santiago de Compostela: 23-247.

6. Gunkel, W. & Minas, W. (1987): Oil degradation in the marine environment. UBA Texte 6/87: 140-154.

7. Gunkel, W. (1988): Ölverunreinigungen der Meere und Abbau der Kohlenwasserstoffe durch Mikroorganismen. In: Angewandte Mikrobiologie der Kohlenwasserstoffe in Industrie und Umwelt, R. Schweisfurth (ed), Kontakt & Studium Band 164, Technische Akademie Esslingen, Expert Verlag: 19-36.

8. Mackay, D. (1982): Fate and behaviour of oil spills. In: Oil and Dispersants in Canadian Seas Research Appraisal and Recommendation. J.B. Sprague, J.H. Vandermeulen & P.G. Wells (eds.), Environment Canada.EPS 3-EC-82-2.

9. Minas, W. (1985): Temperaturabhängigkeit des Ölabbaues in der Nordsee durch natürlich vorkommende Mikroorganismen-populationen am Beispiel eines Schweröls (Bunker C). Diplomarbeit Universität Saarbrücken.

Captions:

Figure 1: The structure of some hydrocarbons. (Source: CLARK, 1992).

Figure 2: Simplified patterns of oil spilled on water. (Source: GUNKEL, 1988).

Figure 3: Mass-bilance of an marine oil contamination. (Strongly changed, following: MACKAY, 1982).

Table 1: Microbial degradation rates of hydrocarbons

Table 2: Concentrations of benzo(a)pyrene (μg/kg) in seafood from unpolluted and relatively polluted water

Table 3: Concentrations of benzo(a)pyrene (μg/kg) in various foodstuffs

Impact of land-based oil pollution and oil industry based products on marine and coastal living resources

Karlo van Bernem, GKSS-Research-Centre, Max-Planck-Straße, D-21502 Geesthacht, Germany

The number of case studies and laboratory investigations on the impact of land-based oil pollution is immense. In many cases it is not easy to judge the data quality gained. CLARK (1992) summarized some expressive studies, of which most of the following examples are adopted:

Many environmental impacts are accidental and thus it is unusual to have the luxury of a time-series of data from the site prior to the pollution. Good spatial control samples may also be difficult to obtain in a heterogeneous environment.

All studies are selective with regard to which components and attributes of the biota should be investigated. The choice frequently depends on local expertise and research interests, rather than on an objective decision about what biological data are most appropriate for the problem at hand.

Each case study has its own history and good results of long-term monitoring are relatively rare. Therefore it is in some cases only possible to describe some fundamental experiences.

Water-soluble components of crude oil and refined products include a variety of compounds that are toxic to a wide spectrum of plants and animals. Aromatic compounds are more toxic than aliphatics, and middle-molecular-weight constituents are more toxic than high-molecular-weight tars. Low-molecular-weight compounds are more or less unimportant because they are volatile and thus evaporate rapidly into the atmosphere.

- But, as we heard in the last lesson ("Fate of land-based oil discharges..."), their oxidation-products, part of which are more toxic than the hydrocarbons, can recontaminate the environment.

Diesel fuel, with a high aromatic content, is therefore much more damaging than bunker fuel and weathered oil, which have a low aromatic content. Petrol or other "white spirit" may present a serious fire hazard, but have little impact on marine organisms in the water.

The discharge of offshore platforms and refineries, both belonging to - following OSPAR - "land-based" polluters, are good studied in Europe, some of their possible effects shall be presented first.

Impact of offshore platforms

Despite any accidents, routine inputs of oil to the sea are from production water and from small amounts of spilled oil washed off the platform by rain. The oil that is extracted from the seabed invariable contains some water (i.e. production water) which must be extracted before the oil is transported to the refinery. This is done by oil separators on the platform and the oil concentration in the water that is discharged should be usually less than 40 parts per million, but aggregated this amounts to a considerable quantity.

Drilling muds are pumped down the well, when an oil well is being drilled. These maintain a head of pressure and prevent a blow-out when oil is struck, lubricate the drill bit, and carry the cuttings back to the surface. The drill muds contain water or, if the nature of the strata demands it, 70-80% oil; formerly the oil was diesel, but since 1985 increasingly low toxicity oils are used. While there is some attempt to separate the drill cuttings from the oil-based-muds before they are dumped on the seabed beneath the platform, they are inevitably still heavily contaminated and 90% of petroleum hydrocarbons entering the North Sea as a result of offshore oil extraction comes from this source. However, there are movements to ensure that oil-contaminated cuttings are brought ashore for disposal.

Where oil-based drill muds are used, bottom sediments receive a considerable amount of oil from contaminated cuttings. No effect has yet been detected from oil discharged in production water or washed off platforms, and even the Ecofisk blow-out had no detectable environmental impact. (Regard the problems, I mentioned above: It is not said, that there was no impact, it is just said, that it was impossible to detect one). Drill cuttings dumped on the seabed, however, have a profound effect on the benthic fauna. They blanket the seabed, create anoxic conditions and lead to the production of toxic sulphides in the bottom sediment resulting in the almost total elimination of the benthic fauna. Surrounding this area, there is a recovery zone, showing a succession of, first opportunistic species such as *Capitella capitata* (polychete worm), then of species able to tolerate stressful conditions and to out-compete the less tolerant species, which gradually reappear further from the centre of disturbance.

This disruption of the biological system extends for about 0.5 to 1 km around the drilling platform in the North Sea oil-fields (Figure 1). Occasionally there are detectable effects up to 5 km from the installation. In regions where bottom currents are stronger, it is likely that the discarded drill cuttings are more widely dispersed and there is less blanketing of the seabed. At a number of platforms, once the drilling has ceased, the area in which biological effects or oil contamination are detectable decreases. Macrobenthos-recovery in the moderately affected zones usually takes place within two to three years.

The oil of production-water discharges, limited by PARCOM regulations to less than 40 ppm, is, as said above, not expected to have any toxicological effects, However there are some reports of oil being detectable in the tissues of fish, well away from oil production platforms, and this has been identified as stemming from oiled drill cuttings (North Sea Quality Report, 1993).

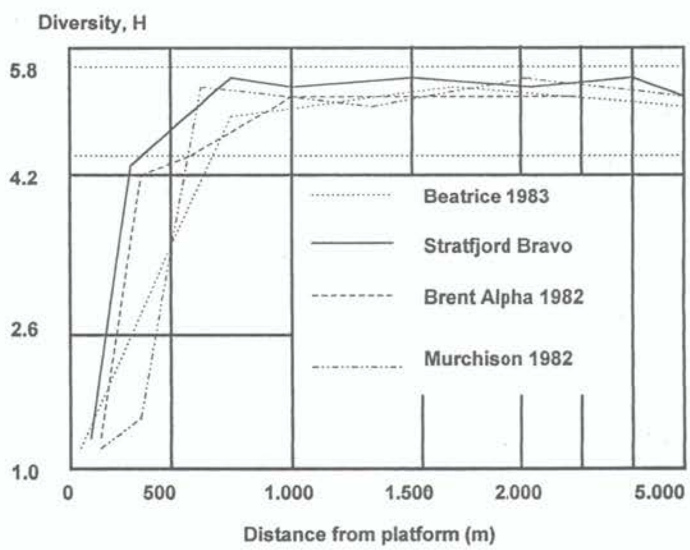


Figure 1: Diversity of the benthic fauna (Shannon Wiener) in relation to distance from North Sea oil production platform. Broken lines indicate the maximum and minimum values obtained in studies made before operations began. (Source: CLARK, 1992, slightly changed).

Impact of refinery waste water.
Oil refineries discharge waste water containing some petroleum hydrocarbons. The receiving waters are therefore under influence of a low-level, chronic pollution.

The refinery at Fawley in Southampton Water (UK) used a steam cracking process in which water comes in contact with oil and therefor the effluent inevitably has a high oil content. From 1953, two effluent streams were discharged into creeks running across a **saltmarsh-system**. Oil and chemicals, normally present in refinery effluent, as well as oil from accidental spillages in the refinery and at the unloading jetty, entered the stream from time to time. Between 1953 and 1970, these discharges caused the loss of vegetation from a considerable area of the marsh. In 1970 a programme of effluent improvement was instituted and, by 1975, the oil content of the effluent had been reduced from 31 ppm to 10 ppm and the quantity of the discharge from 28.000 m^3/h to 21.000 m^3/h.

The salt marsh was monitored from 1970 onwards and by 1980 vegetation had become re-established over a considerable part of the area (Figure 2), while the seabed macrofauna had not recovered. It was assumed at this time, that full recovery of the previously damaged marshes is likely to require a further 5-10 years, although transplantation of a dominant grass species (*spartina anglica*) had accelerated the recovery process (DICKS & LEVELL, 1989; adopted from CLARK, 1992).

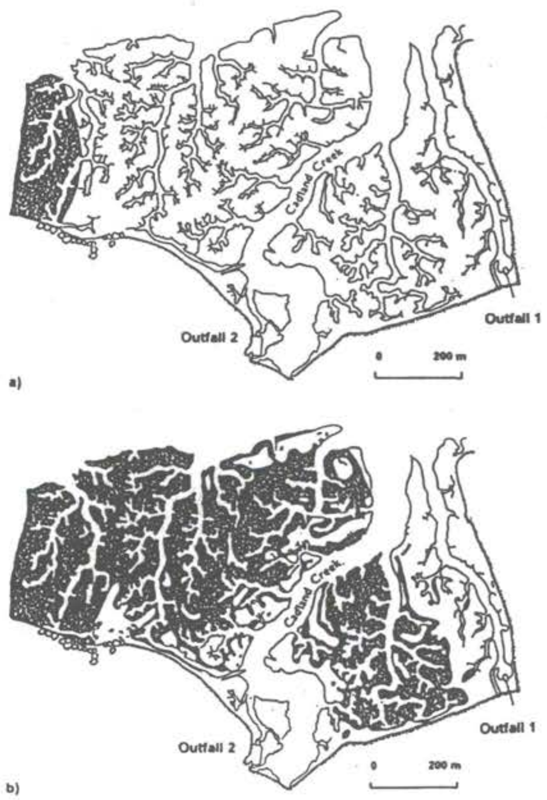


Figure 2: Fawley salt marsh: (a) distribution of vegetation (black) in 1970, (b) distribution of *Salicornia spp*. in 1980. (Source: CLARK, 1992).

The sediments, however, remained contaminated and in 1980 their content of aliphatic hydrocarbons ranged from 340 to 17.750 ppm. The fauna of the area, previously denuded of vegetation, remains impoverished and consists mainly of enchytraeid and tibificid oligochaetes. They are found in large numbers in soil containing up to 4.750 ppm aliphatic hydrocarbons, but only in small numbers in the heavily contaminated areas (Figure 3).

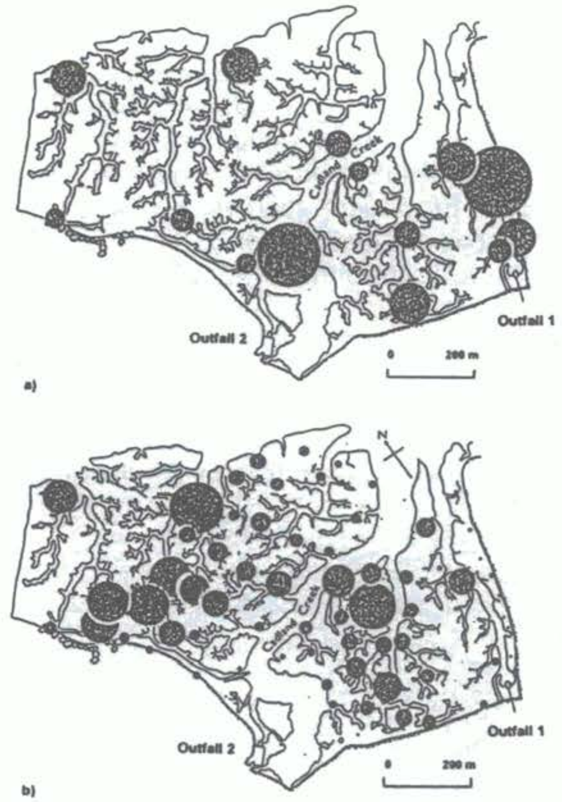


Figure 3: Fawley salt marsh: (a) hydrocarbon and (b) oligochaetes in the substratum in 1980. (Source: CLARK, 1992).

Inshore sediments were also contaminated and contain reduced numbers of the polychaete *Nereis diversicolor*.

In 1987 the recovery-process of salt-marsh plants was still ongoing. Only small areas remained, where the annual species (*Salicornia spp*. and *Suaeda maritima*) didn´t grow, notably close to outfall 1 and 2 (Figure 1 and 2), probably reflecting the extent of impact of the current effluent quality.

The perennial species *Spartina anglica* had spread more slowly than the annual by 1980 (probably caused by poor seeding success and vegetative spread, rather than inhibitory effects of the contaminants in the effluents). But the continuing lower abundance in the area of the creeks carrying the water from outfall 1 and 2 suggest that there are ongoing inhibitory effects on re-colonisation.

Rocky shores are high-energy beaches and stranded oil usually is quickly removed from the intertidal region by wave activity and water movement, but most slowly from extreme high- and low-water levels and sheltered crannies, where wave energy is least. Because of the elimination of herbivores (molluscs and crustaceans, a.o.) the establishment of an algae coverage can occur, which may persist for several years, thus changing the properties of systems for a long time.

Concerning the chronic pollution of land-based discharges, there is another example from Great Britain, where rocky shore communities were affected. In Milford Haven, Pembrokeshire is the site of the largest deep water oil terminal in Europe. Five refineries have been constructed around it, all discharging waste water into the Haven. It has an exceptionally rich marine fauna and flora and is part of the Pembrokeshire Coast National Park. Hydrocarbons have become incorporated in sediments (Figure 4).

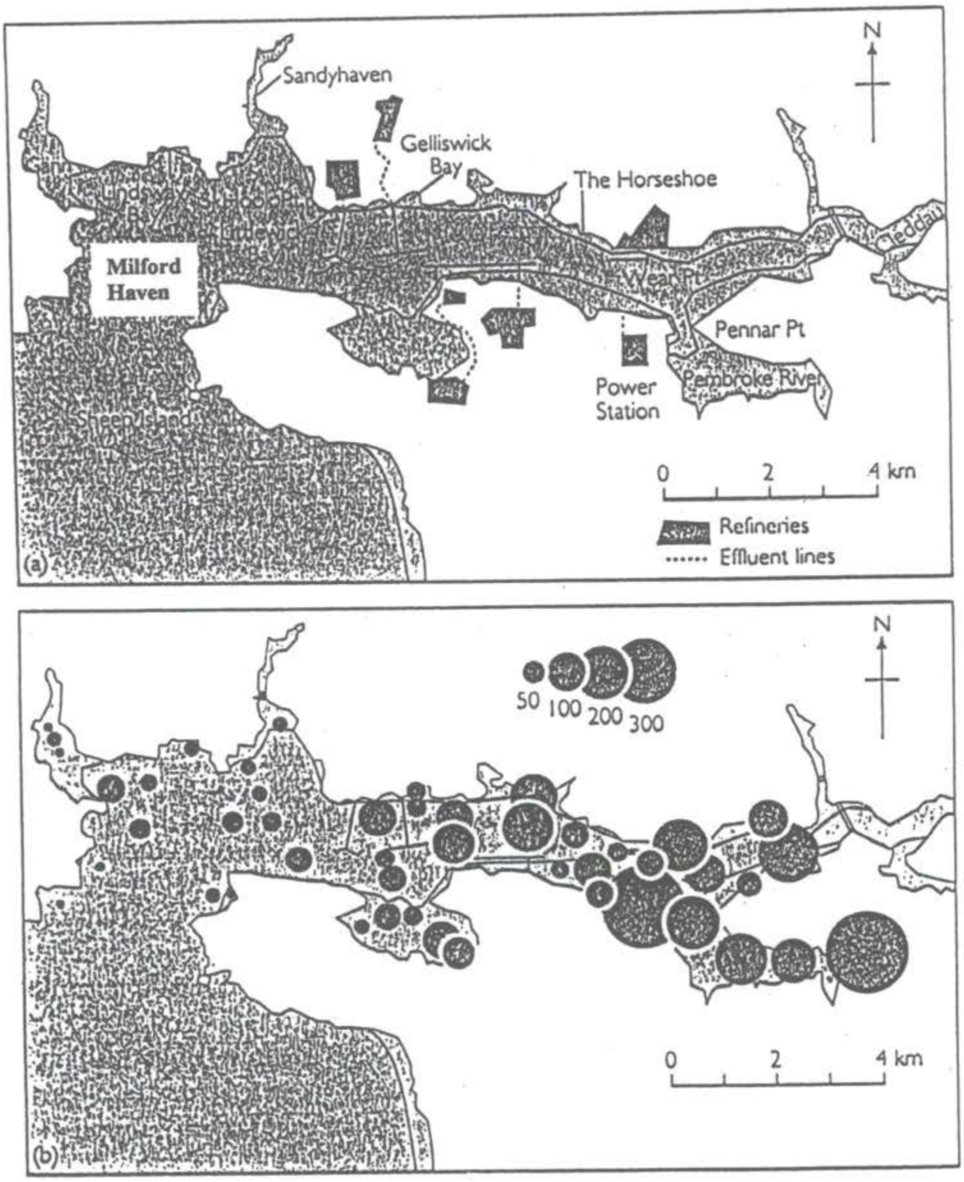


Figure 4: Milford Haven. Pembrokeshire: (a) location of oil terminals and refineries, (b) hydrocarbons (μg/g) in sediments. (Source: CLARK, 1992).

But their distribution is related to the proportion of mud in the substratum rather than the sources of industry-input. The subtidal benthic fauna remained rich throughout the area and is not obviously affected by the level of contamination.

One of the refineries, which discharged a fairly low volume of effluent (250-360 m^3/h) at an oil content of 15-25 ppm, was closed in 1983. As an example for low level effects on rocky substrates the recovery of barnacles may hold (Figure 5).

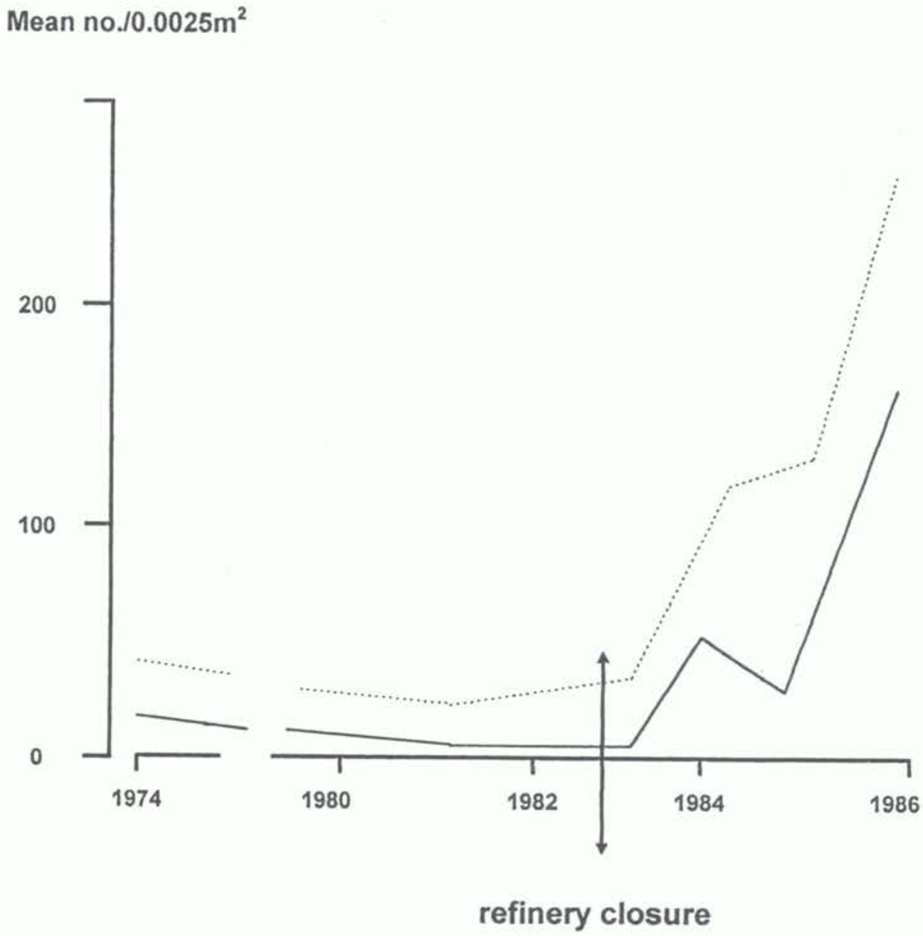


Figure 5: Littlewick Bay, Milford Haven: Number of barnacles per 0.0025 m2. (all species, adults and juveniles) at a station close to the discharge and remote from the discharge (broken line) for the period 1974-1986. (Source: DICKS & LEVELL, 1989, slightly changed).

The density of all species, which were affected over a few hundred meters in the surrounding of the outfall, rose rapidly after the plant has ceased to work.

In 1983 there were only 3 species at 4 of 12 stations, while in 1986 all 4 species had spread over the area of the 12 stations.

In **soft substrata**, oil components may drain down into the sediments. Here the low oxygen concentration hinders bacterial degradation of the oil, which may therefore retain its toxicity.

The recolonisation response of intertidal mud flat fauna to oil contaminated sediments was tested in experimental boxes on a mudflat in Norway (CHRISTIE & BERGE, 1995). The oil was added in five different concentrations (100, 400, 1.000, 4.000 and 10.000 ppm wet weight oil in sediment). The oil content persisted at about the same level in each treatment throughout the experimental period of 4.5 month. Concentrations above 1.000 ppm resulted in a reduction of redox potentials in the sediments.

Most species showed decreasing densities with increasing oil concentrations. Among the meiofauna (specially ostracods) significant effects were found at 400 ppm and higher, while effects on macrofauna were most pronounced above 1.000 ppm. However, not only tolerance towards oil, but differences in exposure to the oiled sediment due to differences in behaviour or distributional patterns seem to be of importance for the species response in the oiled sediment. Due to high persistence of the oil, the results indicate prolonged effects on mudflat communities.

To summarise the results of several field experiments on tidal areas in the German Wadden Sea: Important endofauna populations (a.o.: *Macoma baltica, Heteromastus filiformis, Peloscolex benedeni*) as well as meio- and microbenthos are affected by small scale and low level contaminations. Especially the recruitment or development of young animals is impeded. Benthic amphipods are highly sensitive (DÖRJES et al., 1984; VAN BERNEM, 1987).

Sublethal effects of oil pollution on **coral reefs** may not become manifested except over very long periods of time. Most detectable mortality of the sessile biota occurs where the oil is able to accumulate. The regeneration depends on re-growth from local survivors. So control and cleanup should be designed to maximize the survival of resident populations (CUBIT, 1993).

In Aruba (Caribbean Sea) uniform reefs with an *Acropora palmata* belt (2m depth) and a *Montastrea annularis* community (4 m depth) were originally present along the coast near an oil refinery that has been in operation for more than 60 years. Quantitative surveys of reef structure, coral cover, and numbers of juvenile corals along 15 km of the coast showed that the characteristics of these reefs vary significantly in relation to the location of the refinery and the very persistent local current direction. The spatial structure of the reef has deteriorated, living coral cover is low, and less juveniles are present in front and downcurrent of the refinery. Some coral species, such as the above mentioned *A. palmata* and *M. annularis*, show a large gap in their distribution along the coast. But a species such as *Diplora strigosa* is relatively abundant in the polluted area. The results of chronic oil pollution are, after 60 years, clearly discernible over a distance of 10 to 15 km along the reef (BAK, 1987).

Concerning Mangroves Kathryn Burns from the Bermuda biological station (she has been chairman of the IOC/UNEP Group of experts on methods standards and inter-calibration since 1982), summarises the results from long term assessment of an oil spill into a coastal fringe mangrove ecosystem in Panama and demonstrates that a time period of up to 20 years or longer is required for deep mud coastal habitats to recover from the toxic impact of heavy oil pollution, due to the long term persistence of oil trapped in anoxic sediments and subsequent release into the water column BURNS et al., 1993).

References:

1. Bak, R.P.M. (1987): Effects of chronic oil pollution on a Caribbean coral reef. Mar. Poll. Bull. Vol. 18, No. 10: 534-539.

2. Bernem van, K.H. (1987): Field tests on the effects of oils and dispersants in tidal flats. UBA Texte 6/87: 65-74.

3. Burns, K.A., S.D. Garrity & S.C. Levings (1993): How many years until mangrove ecosystems recover from catastrophic oil spills? Mar. Poll. Bull. Vol. 26, No. 5: 239-248.

4. Christie, H.C. & J.A. Berge (1995): In situ experiments on recolonization of intertidal mudflat fauna to sediment contaminated with different concentrations of oil. Sarsia 80: 175-185.

5. Clark, R.B. (1992): Marine Pollution. Oxford University Press, Oxford. ISBN 0-19-854685-8.

6. Cubit, J.D. & J.L. Connor (1993): Effects of the 1986 Bahia Las Minas oil spill on reef flat communities. 1993 Oil Spill Conference: 329-335.

7. Dicks, B. & D. Levell (1989): Refinery-effluent discharges into Milford Haven and Southampton Water. In: Ecological Impacts of the Oil Industry, B. Dicks (ed). 1989 Institute of Petroleum: 287-316.

8. Dörjes, J. (1984): Experimental investigations about effects of crude oil and dispersed crude oil in tidal flats environments. (ed.), Senckenbergiana marit.; 16 (1/6): 271 pp.

9. North Sea Quality Status Report (1993), North Sea Task Force, Oslo and Paris Commission, London, 1993.

Captions:

Figure 1: Diversity of the benthic fauna (Shannon Wiener) in relation to distance from North Sea oil production platform. Broken lines indicate the maximum and minimum values obtained in studies made before operations began. (Source: CLARK, 1992, slightly changed).

Figure 2: Fawley salt marsh: (a) distribution of vegetation (black) in 1970, (b) distribution of *Salicornia spp*. in 1980. (Source: CLARK, 1992).

Figure 3: Fawley salt marsh: (a) hydrocarbon and (b) oligochaetes in the substratum in 1980. (Source: CLARK, 1992).

Figure 4: Milford Haven. Pembrokeshire: (a) location of oil terminals and refineries, (b) hydrocarbons (μg/g) in sediments. (Source: CLARK, 1992).

Figure 5: Littlewick Bay, Milford Haven: Number of barnacles per 0.0025 m2. (all species, adults and juveniles) at a station close to the discharge and remote from the discharge (broken line) for the period 1974-1986. (Source: DICKS & LEVELL, 1989, slightly changed).

Existing policies in relation to preventation and control of oil pollution and pollution by oil industry related products and services

Karlo van Bernem, GKSS-Research-Centre, Max-Planck-Straße, D-21502 Geesthacht, Germany

According to the article 21 of the Stockholm Declaration, following the 1972 UN Conference, all states have a responsibility to ensure that activities within their jurisdiction do not cause pollution in other states or in areas outside national jurisdiction.

In sea areas like the Baltic and the North Sea, which are surrounded by heavily industrialised and densely populated regions, international cooperation developed first. About ten such agreements have been concluded within the framework of the UNEP Regional Seas Programme. The most important conventions for the protection of the marine areas of Northern Europe are two global and five regional conventions (Table 1) in addition there are a number of bilateral agreements between countries sharing a particular sea area. In the following I'll shortly present the objectives and the organisation of these Conventions. Most chapters are adopted in summarizing the "Report to the Nordic Council's International Conference on the Pollution of the Seas, October 1989".

Table 1: Conventions for the Protection of the Marine Environment

Global Conventions:

- **London Dumping Convention - 1972**
- **MARPOL Convention - 1973/78**

Regional Conventions:

- **Paris Convention - 1974/78**
  (Prevention of Marine Pollution from Land-based Sources)
- **Oslo Convention - 1972/74**
  (Prevention of Marine Pollution by Dumping from Ships and Aircraft)
- **Helsinki Convention - 1974/80**
  (Protection of the Marine Environment of the Baltic Sea Area)
- **Bonn Agreement - 1969/70**
  (on cooperation to combat spills of oil and chemicals)
- **North Sea Conferences** (every three years since 1984)

The Conventions have several common characteristics. They are written as framework conventions, where the basic obligations of the contracting parties are laid down. These obligations include an expression of the common responsibility to protect the marine environment and the willingness to cooperate in solving the problems affecting the geographical area covered by the convention. These principles include measures for the protection of the marine environment, the establishment of joint monitoring programmes, reporting etc. Regulations regarding emissions, or measures to completely stop certain discharges are specified in more detail in special annexes to the conventions. the annexes seek to regulate certain activities or the handling of certain substances or groups of substances. The polluting or contaminating substances are generally classified into three different groups:
Blacklisted substances. Must not be discharged or dumped into the marine environment in

principle. Mercury, cadmium, stable halogenated organic substances and high-level radioactive waste generally belong to this group.

Greylisted substances. Are only allowed to be discharged with special - case by case permission from the competent authorities in the relevant countries. They generally include heavy metals as well as medium and low-level radioactive waste.

Other substances. Are those which can be emitted into the marine environment in accordance with more general permits.

The annexes to the conventions also generally contain regulations for the selection of dumping sites as well as articles dealing with the exchange of information and scientific cooperation, including the establishment of joint monitoring programmes. The conventions operate through *commissions, which have secretariats to assist them, and working groups and ad hoc groups* that can give greater attention to the details of various issues and problems.

To a certain extent it is possible to see how fully the obligations of marine environmental conventions penetrate into the economic and industrial structure of a country by studying how long it has taken for a certain convention to enter into force and how it is implemented. Figure 1 illustrates in a schematic way how a marine convention is supposed to function.

Global Marine Conventions
The first global convention with respect to pollution at all was OILPOL, signed already in 1954. Later on, since 1973/78 MARPOL was brought into force, covering all oceans and seas, with different standards, however, due to the declaration of "special areas" (s.b.). The objective of MARPOL is to prevent polluting discharges of oil and chemicals, and also garbage from ships in operation and in harbours. MARPOL also contains detailed regulations concerning the construction and equipment of ships.

- Annex 1 deals with oil. It entered into force in 1983.

- Annex 2 regulates chemicals transported in bulk. Entered into force in 1987.

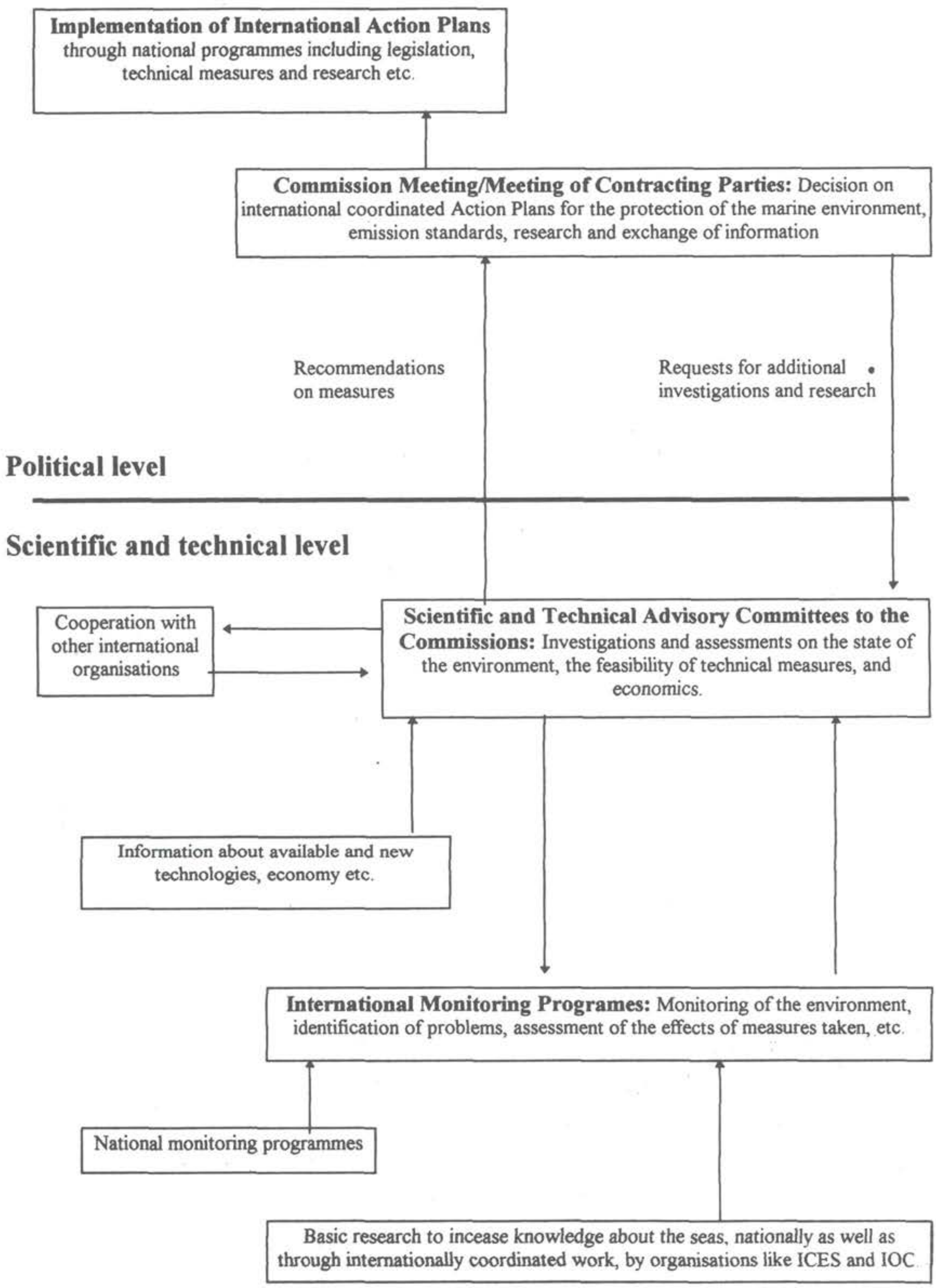
- Annex 3 applies to the transport, in packaged form, of solid as well as liquid hazardous substances. Entered into force in 1992.

- Annex 4 regulates the disposal of sewage. It has not yet entered into force.

- Annex 5 concerns garbage, especially plastics and other non-biodegradable materials. Entered into force in 1989.

It has been difficult to bring MARPOL into force, because of the global character of international shipping. One demand for which acceptance has been especially difficult to obtain is for the construction and above all the use of reception facilities for oil and chemical wastes in ports. The Ministerial Declaration from the North Sea Conference (s.b.) in 1987 stressed the great need for such installations as well as for measures to stimulate their use (see also: "Local initiatives in support of Agenda 21..."). This requirement has existed within the Helsinki Convention (s.b.) for a long time. The use of reception facilities should be stimulated through reasonable fees and without specific demands on the ships. It costs time and money to stay in port to clean oil tanks and unload wastes, and the reception facilities must thus function smoothly and efficiently.

Figure 1: Schematic way, how a marine convention is supposed to function (adopted from: *Report to the Nordic Council's International Conference on the Pollution of the Seas,* October 1989)



Illegal discharge of oil is still a major problem in the North Sea, despite the MARPOL rules. Airplanes are now used for surveillance and a considerable number of illegal discharges have been discovered. There is agreement that this surveillance should be strengthened.

The Marine Environment Protection Committee (MEPC) is the decision-making body for MARPOL. MEPC meets approximately every nine month. The MARPOL secretariat is located in London within the headquarters of IMO (the International Maritime Organisation, the United Nations agency for maritime technical issues).

The London Dumping Convention (LDC), also a global convention, regulates dumping of wastes and pollution at sea from ships and aircraft, including the incineration of wastes at sea.

The global LDC shares responsibility for regulating dumping of wastes with the regional Oslo Convention and the regulation of discharges of radioactive substances with the regional Paris Convention. Besides a number of specific environmentally hazardous substances from ships and aircraft, the dumping of wastes includes halogenated, non-biodegradable organic substances, carcinogenic compounds like some PAH (polycyclic hydrocarbons) and certain heavy metals.

The decision-making body of the LCD is the annual Consultative Meeting of the Contracting Parties. The LCD secretariat is located along with the MARPOL secretariat at IMO headquarters.

Regional Conventions

The **Bonn Agreement**, which entered into force in 1970, is an agreement among states to cooperate in combatting pollution - e.g. oil or other substances - in cases of accidents or other major spills. The agreement contains a system for mutual warnings in the case of accidents and cooperation and assistance in the practical work in cleaning up after a spill has occurred. It also allows for aerial surveillance of the convention area with a view to prevent, as far as possible, illegal discharges. The Contracting Parties are: Belgium, Denmark, France, Germany, Ireland, the Netherlands, Norway, Sweden and the United Kingdom. The European Community participates as an observer. It has a joint secretariat with OSPAR (Oslo and Paris Commissions) in London.

The **Helsinki Convention** covers the Baltic Sea, an area, which is heavily stressed by oxygen problems because of the closed character of it's deep basins (Figure 2, Convention Area). The objectives are to protect the Baltic marine environment against all forms of pollution - emissions from land-based sources (including discharges of radioactive substances), discharges from ships, atmospheric fall-out, dumping and pollution caused by exploration or exploitation of resources on the seabed. The Baltic Sea is a Special Area within MARPOL, Reception facilities for oil and chemical residues exist in most harbours. There are rules and guidelines for cooperation in combatting oil or chemical spills and a prohibition of dumping. The Convention area is shown in Figure 2, members are all states bordering the Baltic Sea. The decision-making body of the Helsinki Convention is the Helsinki Commission (HELKOM), and its secretariat is located in Helsinki. HELCOM has three permanent Committees - the Scientific and Technical Committee (STC), the Maritime Committee (MC), and the Combatting Committee (CC). In adition there is a number of working groups. The Helsinki Convention entered into force in 1980.

Figure 2: Sketch map of the geographical area covered by the Helsinki Convention, the Convention area. (adopted from: Report to the Nordic Council's International Conference on the Pollution of the Seas, October 1989)

The **Paris Convention** - The Convention for the Prevention of Marine Pollution from Land-based Sources (rivers, oil platforms, the atmosphere or directly from the surrounding coasts) - was opened for signature in 1974 and entered into force in 1978. It has been signed by the European Economic Community and Luxembourg and has been ratified by the following states: Belgium, Denmark, France, Germany, Iceland, Ireland, the Netherlands, Norway, Portugal, Spain, Sweden and the United Kingdom of Great Britain and Northern Ireland. The geographical coverage is shown in Figure 3.

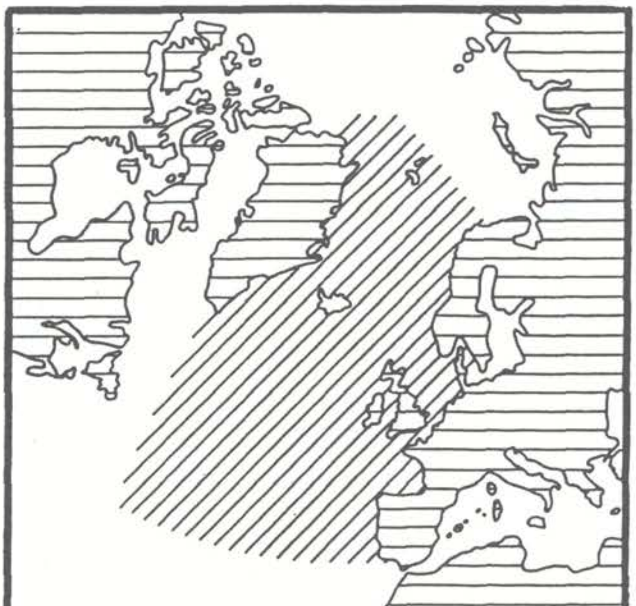


Figure 3: Sketch map of the geographical area covered by the Paris Convention, the Convention area. (adopted from: Report to the Nordic Council's International Conference on the Pollution of the Seas, October 1989)

The Paris Commission controls discharges into rivers and the sea by agreeing on programmes and measures to eliminate, reduce or prevent the input of pollutants. It has successfully tackled problems caused by mercury, cadmium and oil from various sources. For those parts of the Convention waters which are affected by eutrophication problems the Paris Commission has agreed on a coordinated set of measures to reduce the input of nutrients. More recently, the Commission was also enabled to adress measures for the reduction of emissions of pollutants to the atmosphere. It is also defining and implementing the best available technology for preventing hazardous discharges from particular industries.

Priority has been given, among others, to petroleum based persistent oils and hydrocarbons (Annex 1, blacklisted substances) and non persistent petroleum based oils and hydrocarbons (Annex 2, greylisted substances). Emission reductions from refineries, oil platforms, reception facilities and air pollutants have been targetted.

The "Working Group on Oil Pollution" is actively adressing off-shore issues. Standards have been set concerning discharges of oil from platforms and oil in production water. Regulations have been agreed to limit the discharges of oil-contaminated rock cuttings.

Activities of the Working Group on Oil Pollution:

- Examination and review of the amounts, frequency, importance and effects of hydrocarbon discharges and other substances from land-based sources.

- Programmes and measures to reduce, and as appropriate, eliminate marine pollution, from these sources.

- Recommendations to the Commission via the Technical Working Group (TWG) exept in cases where the TWG authorises the Working Group to report directly to the Commission.

The **Oslo Convention** - the Convention for the Prevention of Marine Pollution by Dumping from Ships and Aircraft - was opened for signature in 1972 and entered into force in 1974. The Contracting Parties to the Oslo Convention are Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, the Netherlands, Norway, Portugal, Spain, Sweden and the United Kingdom of Great Britain and Northern Ireland. The Convention area meets that of the Paris Convention (Figure 3).

A system of national licensing was set up through which each country could report its dumping and incineration operations to the Commission. The Commission publishes statistics on all dumping and incineration operations in annual reports. In 1989, the Oslo Commission has agreed that the disposal at sea of all hazardous industrial waste should cease. Dumping of these wastes was scheduled to cease in the North Sea by 31.12.1989, and in the rest of Convention waters by the end of 1995. (In the North Sea incineration at sea really ceased in February 1991, - North Sea Quality Status Report, 1993).

In 1989, the Oslo Convention was amended in order to control also internal coastal waters which originally were not covered by that Convention.

The Oslo and Paris Commissions administer the Conventions from their headquarters in London, supported by a joint Secretariat.

Part of the Conventions are the following principles: Precautionary Principle, Polluter Pays Principle, Best Environmental Practice (BEP), Best Available Technique (BAT). The Oslo and Paris Commissions (OSPAR) will, each year, consider the need for meetings of each of its subsidiary bodies in the following intersessional period. Figure 4 shows the working structure of OSPAR.

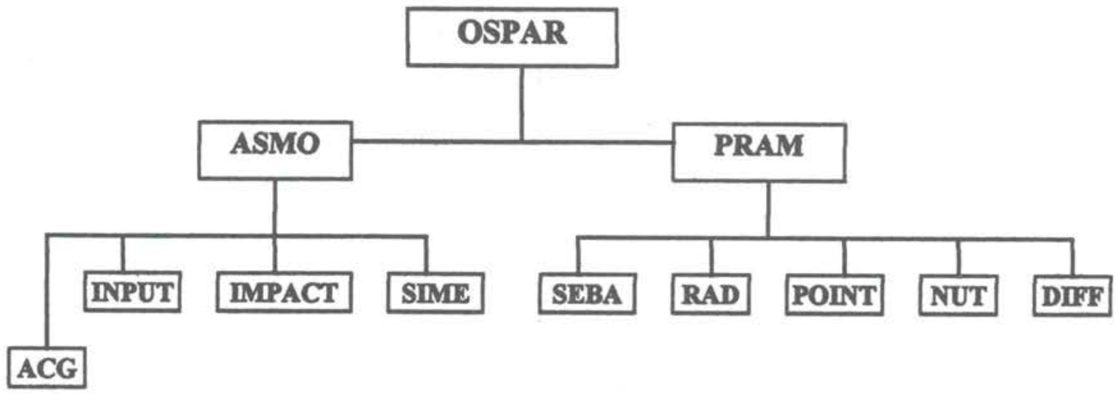


Figure 4: Working structure of the Oslo and Paris Commissions. (Terms of reference for the individual working groups in the following text).

INPUT (Inputs to the marine environment): Shall arrange for the monitoring of, or collection of information on, inputs of substances from all sources to the marine environment and shall evaluate this information with regard to geographical distribution, temporal trends and the proportion which is of anthropogenic origin, in particular in order to contribute to the preparation of Quality Status Reports for the maritime area or for regions or sub-regions thereof.

IMPACT (Impacts on the marine environment): Shall arrange for the collection of information on human activities, other than those leading to inputs of substances, and on their impact on the marine environment and shall evaluate this information with regard to the geographical distribution and temporal trends, in particular in order to contribute to the preparation of Quality Status Reports for the maritime area or for regions or sub-regions thereof. IMPACT shall also develop the concepts and tools relevant to its work for such an overall assessment of the quality statusof the marine environment.

SIME (Substances in the marine environment): Shall arrange for the monitoring or collection of information on concentrations and effects of substances in the marine environment and evaluate this information with regard to spatial differences and temporal trends, in particular in order to contribute to the preparation of Quality Status Reports for the maritime area or for regions or sub-regions thereof.

SEBA (Sea-based activities): Shall draw up draft programmes and measures for the prevention and elimination of pollution of the maritime area from offshore installations, dumping and dredging activities that are associated with dumping or have similar effects to the dumping of dredged material.

RAD (Radioactive substances): Shall draw up draft programmes and measures for the prevention and elimination of pollution of the maritime area as a result of anthropogenic inputs *of radioactive substances, including wastes; - including best available techniques for the reduction or elimination of inputs of radioactive substances to the maritime area.*

POINT (Point sources): Shall draw up draft programmes and measures for the prevention and elimination of pollution of the maritime area from land-based point sources.

NUT (Nutrients): Shall draw up draft programmes and measures for the prevention and elimination of pollution of the maritime area from anthropogenic inputs of nutrients.

DIFF (Diffuse sources): Shall draw up draft programmes and measures for the prevention and elimination of pollution of the maritime area from diffuse sources.

Assessment Coordination Group (ACG): Shall, on the basis of regional and sub-regional reports, coordinate the preparation and review of a Quality Status Report for the maritime area.

Principal subsidiary bodies of the Commissions: ASMO (Assessment and Monitoring Committee), and **PRAM** (Programmes and Measures Committee)

Actions taken to reduce discharges to the marine environment from offshore installations (Paris Commission; source: Annexes in 1992 report):

1978: Provisional target standard: 40 mg oil/l (see Table 2).
1992: TWG decided that:This standard is still appropriated for the oil content in discharges of produced water both for existing and new installations.
1980: *Decision on discharges resulting from exploration activities* (Annex 2).
1986: Agreement on a list of recommended species and effects to be determined when testing oil based muds (Annex 6).
1988: Decision on the use of oil-based muds (Annex 4).
1990: Adoption of guidelines regarding harmonisation of procedures of approval, evaluation and testing of offshore chemicals and drilling muds (Annex 7).
1992: TWG-agreement on chemicals/products which do not require further testing for offshore use/discharge (Annex 3).
1993: GOP will examine:

a) a new list of recommended species and effects to be determined when testing offshore chemicals and drilling muds.

b) the organisation of a new ring-test for sediment reworkers.

1995: INPUT (source: Report 1995):
PAH´s from rivers, atmosphere and dredging (Netherlands and Germany). Input of oil to the maritime area (Norway). Germany does not advocate the routine monitoring of oil pollution

Further Annexes in 1992 report: Possible technologies for treating produced water (1) Guidelines for sampling, analysis and calculation of oil in cuttings (5) Treatment techniques of produced water (8) Information on installations exeeding the target standard (9) Dutch oil and gas installations exeeding the target standard in 1990 (10) UK oil and gas installations exeeding the target standard in 1990 (11)

Table 2: Number of installations exeeding the 40 mg oil/l target standard

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
. Number of installations exeeding 40 mg/l	10	13	8	12	21	41	49	43	48	70
Quantity of hydrocarbons discharged by these installations (tonnes)	131	325	940	601	895	975	1266	836	1265	2701
Total number of installations in the convention area	NA	NA	127	141	149	160	156	181	187	191

NA: Not available

Actions taken to reduce discharges from refineries (Paris Commisssion):

1980: Guidelines for discharges from new refineries.
1982: Guidelines on sampling procedures for determination of hydrocarbon content in effluents (Annex 1) and principles to be followed in the infra-red method of analysis (Ann. 2).
1983: Line of action for all contracting parties:
- a) Review of discharges (identifying environmental harm).
- b) Reduction programmes for discharges of those refineries.
- c) Report to the Commission upon results.

1989: Adoption of recommendation 89/5:

New refineries:
- a) Separation of cooling waters.
- b) Collection of stormwaters.
- c) Effective treatment of wastewaters (5 mg/l oil in effluent).
- d) Total discharge not more than 3g oil per to. of crude oil processed.

Existing refineries:
- a) (by 1.1.1994).
- b) (by 1.1.1991).
- c) (by 1.1.1994).
- d) (by 1.1.1994).

1992: Agreement of the TWG on analysis and sampling methods.

The North Sea Conferences

The International Conferences on Protection of the North Sea - held on a ministerial level in 1984, 1987, 1990 and 1995, have dealt with the same issues and problems that are regularly discussed within the framework of the various marine conventions. Why then are these high-level meetings been held?

Following a number of reports in which concerns were expressed about the state of the environment in the Helgoland and German Bights and other coastal areas around the North Sea, the government of Germany invited all North Sea States to participate in special discussions about the marine environment of the North Sea in general and about the most affected areas in particular. Various factors influenced the form and timing of the meeting, but in general it can be stated that the German initiative was the result of a serious concern and a need to bring the North Sea issues and problems in a very concentrated way to the political/ministerial level.

In 1984, among others, a number of decisions were taken on oil pollution, transportation on chemicals in bulk, noxious products transported in packaged form. The Conference underlined the importance of a joint monitoring programme in the entire North Sea area and the increased protection of sensitive areas like the Wadden Sea. One important element of the second North Sea Conference in 1987 was the emphasis on the need to take an early preventive and precautionary approach to measures for the prevention of emissions and negative effects to the environment, even if absolute scientific evidence is not available. This approach has been expressed in the preambular part: **"Accepting that, in order to protect the North Sea from possibly damaging effects of the most dangerous substances, a precautionary approach is necessary which may require action to control inputs of such substances even before a causal link has been established by absolutely clear scientific evidence"**.

After two unsuccessful attempts at the second and third North Sea Conferences, in 1993 Germany succeeded in getting ist proposal adopted to designate the North Sea as a Special Area under MARPOL Annex 1 (Oil Pollution). It was furthermore agreed to take action within the IMO to designate the North Sea as a Special Area under the future Annex on air pollution. The need for a global standard for the sulphur content of fuel oil was pointed out (DE JONG, 1995).

References:

1. Jong de, Folkert (1995): 4th North Sea Conference, Esbjerg 8-9 June 1995. WSNL, 1995-2.
2. North Sea Quality Status Report (1993), North Sea Task Force, Oslo and Paris Commission, London, 1993
3. Oslo and Paris Commissions (1992): Monitoring and assessment. ISBN 0 946956 24 3.
4. Oslo and Paris Commissions (1992): Discharges of oil in the Convention area. ISBN 0 946956 27 8.
5. Oslo and Paris Commissions (1995): Decisions and recommendations of the Oslo and Paris Commissions 1992-1995. ISBN 0 946955 45 X.
6. Report to the Nordic Council's International Conference on the Pollution of the Seas, October 1989

Captions:

Table 1: Conventions for the Protection of the Marine Environment

Table 2: Number of installations exeeding the 40 mg oil/l target standard

Figure 1: Schematic way, how a marine convention is supposed to function (adopted from: Report to the Nordic Council's International Conference on the Pollution of the Seas, October 1989)

Figure 2: Sketch map of the geographical area covered by the Helsinki Convention, the Convention area. (adopted from: Report to the Nordic Council's International Conference on the Pollution of the Seas, October 1989)

Figure 3: Sketch map of the geographical area covered by the Paris Convention, the Convention area. (adopted from: Report to the Nordic Council's International Conference on the Pollution of the Seas, October 1989)

Figure 4: Working structure of the Oslo and Paris Commissions. (Terms of reference for the individual working groups in the following text).

Development of an environmental sensitivity index of coastal resource vulnerability in relation to hydrocarbon pollution

Karlo van Bernem, GKSS-Research-Centre, Max-Planck-Straße, D-21502 Geesthacht, Germany

As an example from Europe, I will present the "Thematic Mapping and Sensitivity Study of the German Wadden Sea" (4). Today this vulnerability study is part of the official German Oil Contingency Plan. With the development of this study we tried to find spatial and temporal differences of vulnerability in an area that is highly sensitive as a whole.

DICKS & WRIGHT (1989) summarized some fundamental aspects concerning "coastal sensitivity mapping". They emphasized the importance of environmental sensitivity as an valuable and useful concept in the control and management of industrial and urban development and in contingency planning. Foreknowledge of both, sensitivity and vulnerability of habitats is essential to environmental planning and protection and in counteracting and minimizing the impact of unplanned activities.

The Wadden Sea - a sensitive environment
A contiguous region of tidal flats, barrier islands, alluvial terrestrial zones and salt marshes, about 450 km long and up to 20 km wide, extends along the North Sea coast of Germany, the Netherlands and Denmark. This "Wadden Sea" is of enormous value as a cleansing site for the coastal water, as a nursery for young fishes, and as a feeding ground for nearly all palearctic species of wading birds and waterfowl. The proximity of important shipping routes and ports is a permanent threat, especially to the German part of the region, which became a national park in 1986. Large quantities of petroleum, which can be spread over wide areas by tides and winds, present not only the danger of temporary damage but rather of permanent harm, since oil bound to the sediment is released very slowly and can therefore repeatedly contaminate those parts of the tidal flats that have become free of the oil.

To develop a plan for employing mechanical devices or chemical methods to control contamination in the various zones of the region, information on the vulnerability of the systems is needed. The areas of the region and the seasons during which special protection is required should be identified, and the circumstances under which control measures and cleaning procedures should not be undertaken at all, due to the minor extent of the damage, must be defined. To do this the results of many years of field and laboratory experiments could be used. They showed that the short and long-term consequences of oil pollution in Wadden Sea areas clearly depend on the type of habitat affected - determined by both, abiotic and biotic parameters (interrelationships among toxicity, turbation, and persistence).

Plans for vulnerability or sensitivity indices were developed among others by GUNDLACH & HAYES (1978), where the following kinds of habitat are listed in increasing order of vulnerability.

1. Exposed rocky headlands
2. Erosive wave-cut platforms
3. Fine-grained sand beaches
4. Coarse-grained sand beaches
5. Exposed tidal flats
6. Mixed sand and gravel beaches
7. Gravel beaches
8. Sheltered rocky coasts
9. Sheltered tidal flats
10. Salt marshes and mangrove swamps

This kind of sensitivity concept is based mainly on geomorphological parameters. Furthermore it is designed for regions that are fundamentally different from the Wadden Sea coast - in geomorphology, sedimentology, biology, meteorology, and hydrography.

This situation and the necessity of including a greater number of ecological parameters made it essential to greatly modify this concept for the German North Sea coast. To do this, ecological, economic, and logistic pilot studies were carried out. The main activity of the ecological study was a cartographic survey of the entire German section of the Wadden Sea which accounts for about 60 percent of the total area of approximately 8,000 km^2 (Figure 1), the development of a comprehensive data base including an information system, and - as the essential topic of this paper - the development of an evaluation system of species and habitats with respect to their vulnerability by oil. These three parts should make it possible to obtain detailed data to determine vulnerability to oil in individual cases - on the one hand, and to summarize them, with the necessary degree of simplification, for use in contingency planning - on the other hand. It should also make information available on behalf of the national park authorities and to serve scientific purposes, i.e. in ecosystems research.

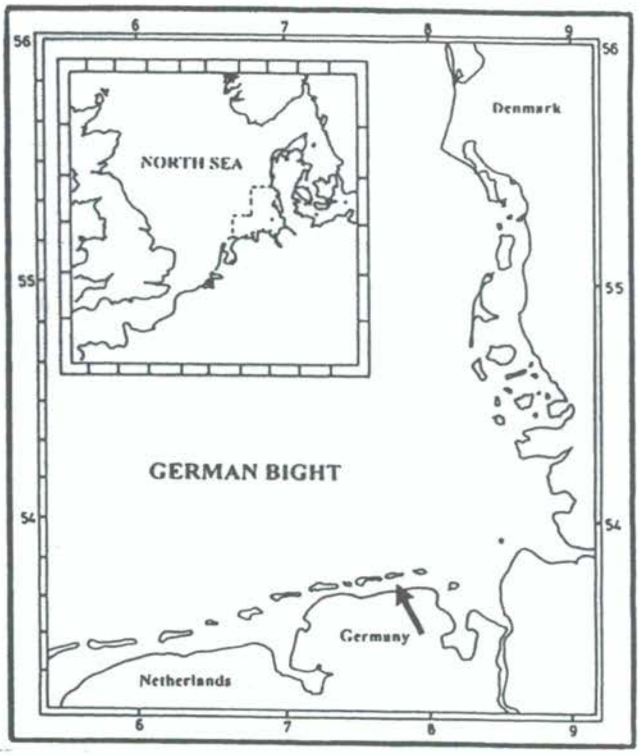


Figure 1: The Danish, German and part of the Dutch Wadden Sea. (The island of Spiekeroog is indicated by an arrow).

The abiotic factors recorded included the exact position and elevation of the "benthos stations", the length of time they remain under water, and the grain size and shear strength of the sediment. The biological factors included the diversity and biomass of macro- and meiofauna, the diversity and abundance of juvenile fishes, microphytobenthos and macrophytes, the importance of the areas as resting, molting, and nesting grounds for the avifauna, and it's significance as a habitat for mammals.

To deal with the interrelationships among biotic and abiotic factors, a list of ecologically relevant parameters for every benthic species was prepared. This "weighted evaluation" of the species is based on determinations of the species diversity and abundance, and sediment conditions at each "benthos station". Differences in the vulnerability of the ichthyofauna and avifauna in the various areas and of the salt marshes were similarly evaluated, both individually and with combined data for the various zones of the entire region. All of the characteristics recorded were assembled in the data processing system.

The evaluation
The entire numerical evaluation remains in a linear system. All groups - sediment, benthos, ichthyofauna and shrimp populations, avifauna, and saltmarshes - are assigned indices calculated from their own individual, numerically assigned values. These are smoothed by the formation of four classes with increasing vulnerability. For the period from the beginning of December until the end of March, only the vulnerability class "benthos-sediment" is considered. As soon as the juvenile fishes begin to arrive, and the nesting and resting seasons for several bird species begin, the appropriate class values are added, starting at the beginning of April. Thus, by the end of November, a sensitivity scale from 1 to 12 can be assigned (Figures 2 and 3). The vulnerability of the salt marsh is represented separately. To delimit the habitats, the individual values of the field stations were assigned to areas with borders set by a protocol, standardized for use by EDP and GIS. Figures 4 through 8 show examples of some of the conditions in the sheltered tidal flats between the island of Spiekeroog and the mainland.

Evaluation of individual categories.
Sediments (Figure 4). Sediment classes were defined according to the relative amount of particles less than 0,06 mm and the water content. In addition, light and dark sandflats were distinguished according to sediment inspection at the various stations and evaluation of aerial images. Thus class 1 referred to light sand flats, class 2 to dark sand flats, class 3 to tidal flats of sand and silt, and class 4 to mud flats. Various field studies served as a basis for this classification system (2,3,10).

Benthos (Figure 5). For evaluating the vulnerability of the species and communities to petroleum, giving consideration to aspects of their significance to the ecosystem, the following categories were established: (1) physiological sensitivity, (2) ecological sensitivity, (3) importance as food, (4) metabolic importance, (5) capability of dispersal, and (6) duration of reproductive period. Within these categories, every species was assigned a weighted value (wV) from 1 to 3, where 1 signified weak or minor, and 3 strong or high. An example is provided in the following evaluation of macrofauna:

Physiological sensitivity was judged according to the experience gained by many years of research in the field and laboratory (1,7,8). This scale includes the following levels:

1 - Species with little change in abundance after exposure to petroleum.
2 - Significant decline in abundance.
3 - Very great decline in abundance.

Ecological sensitivity can be determined by observing settlement patterns and food consumption:

1 - Endobenthic sand dwellers, substrate feeders, or predators.
2 - Sand flat dwellers that feed on the surface, nonfiltering inhabitants of mixed sand and mud flats, and residents of mud or sandy mud flats that are tolerant of oxygen dificits.
3 - Predators with tentacles, filter feeders, and species that live on the surface of mud flats.

According to BEUKEMA (1981), the average weight of the biomass in the Dutch Wadden Sea amounts to 26,6 g ash-free dry weight per m^2. Almost 99 percent of this, 26,2 g, was accounted for by only 14 species. Relying on the average weights of the dominant species in the biomass, the importance as food of the macrofauna species was estimated according to the following scale:

1 - Species with less than 0,1 g ash-free dry weight/m^2 that are rare prey species.
2 - Species with less than 0,1 g ash-free dry weight/m^2 that are frequently preyed upon by fishes or birds.
3 - Species with greater than 0,1 g ash-free dry weight/m^2.

Several species increase the oxygen supply in the sediment through their movements, while certain sediment and epistrate feeders have a controlling or destructive effect on populations. The following levels were used for the criterion metabolization of organic substances:

1 - Inhabitants of detritus-poor sand sediments or suspension feeding sessile species.
2 - Species active in bioturbation with feeding habits that scarcely contribute to the breakdown of organic substances.
3 - Substrate and epistrate feeders greatly active in bioturbation.

In recolonization of tidal flats, very mobile species and those with planktonic larval stages have an advantage. The following scale is used for evaluating the dispersal capability of species:

1 - Actively swimming species with a life history that includes a planktonic larval stage.
2 - Actively swimming species that develop in the benthos.
3 - Species with a limited locomotory capability without planktonic larval stages.

Duration of the reproductive period is an additional criterion to consider. Species that produce larval stages for long periods of time have an advantage in being able to rapidly resettle unpopulated areas, as reflected in the following scale:

1 - Reproduction throughout nearly the entire year.
2 - Reproduction for four to six month per year.
3 - Reproduction for one to three month per year.

To provide data on abundance comparable to those from other studies, absolute abundance values were evaluated on a five-level scale which was defined for each species using all values measured.

1	for	$x = N_{min}$	to	$\frac{1}{4}\,\bar{x}$
2	for	$x = \frac{1}{4}\,\bar{x}$	to	$\frac{3}{4}\,\bar{x}$
3	for	$x = \frac{3}{4}\,\bar{x}$	to	$\bar{x} + \frac{1}{4}\,\sigma$
4	for	$x = \bar{x} + \frac{1}{4}\,\sigma$	to	$\bar{x} + \sigma$
5	for	$x = \bar{x} + \sigma$	to	N_{max}

x = species abundance
$\bar{x}$ = mean value of all species abundances measured
σ = standard deviation
N_{min} = minimum and
N_{max} = maximum number of species abundance measured.

The arithmetic value for individual species was calculated using the following equation:

$$Index_{(A1)} = (\bar{x}\ wV_{s1} \cdot A_{s1}) / (\bar{x}\ wV_{max} \cdot A_{max})$$

$\bar{x}\ wV_{s1}$ = mean weighted value for species 1
A_{s1} = scaled abundance value for species 1
$\bar{x}\ wV_{max}$ = maximum mean weighted value
A_{max} = maximum scaled abundance value

The arithmetic value for a station is calculated by multiplying the sums of the species indices with the sediment class value (Cs) of this station:

$$\text{Station-Index} = \text{Index(A1)} + \text{Index(A2)} + \ldots + \text{Index(An)} \cdot Cs$$

The resulting Station-Indices were placed in four classes numbered with increasing sensitivity (Figures 2 and 3).

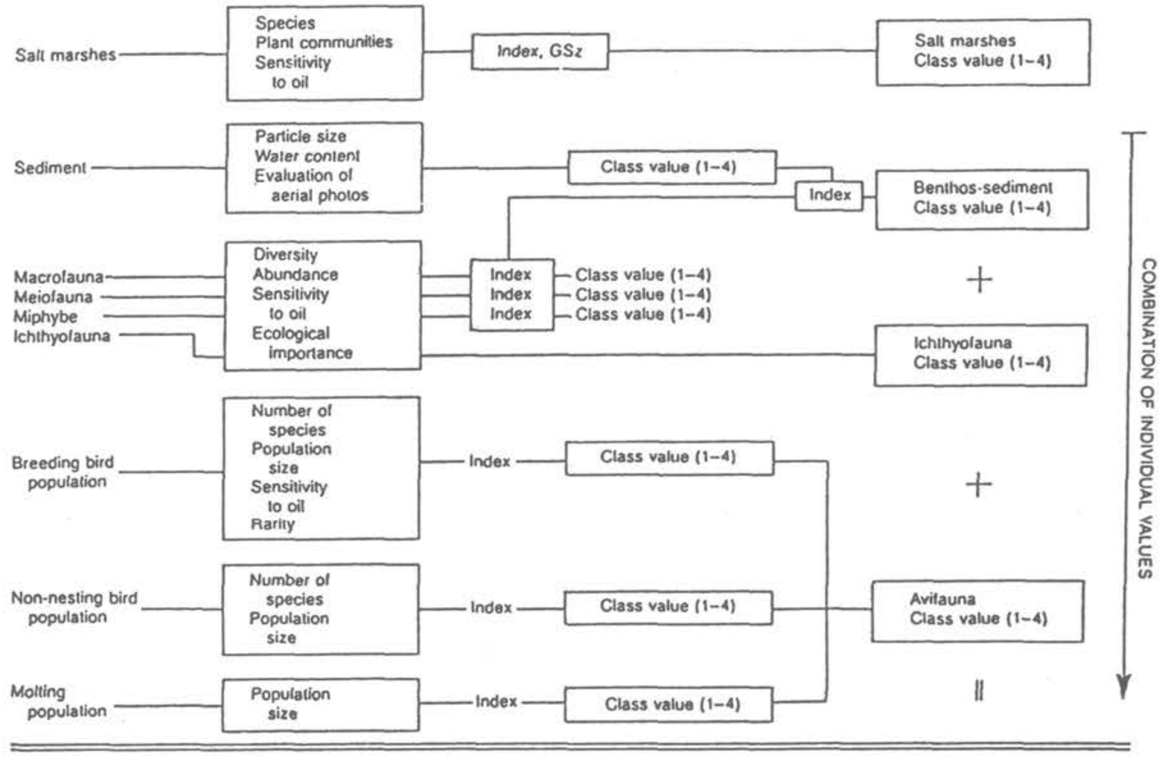


Figure 2: diagram of the degree of influence of all groups and their combinations. Period of validity: Benthos-sediment class value alone: November till March; sums of individual class values: April til November.

Ichthyofauna and shrimp populations (Figure 6), were evaluated as described above (Benthos) additionally using a weighted value for the commercial importance of distinct species. In place of stations, various transects used for the assessment of fish and shrimp stocks during high tide were employed (Figure 4).

Breeding bird populations. Of the about 27 species present, 13 proved especially vulnerable. A "minimum breeding pair" number is assigned only to these species. The distinction between "suspicion of breeding" and "proof of breeding" provided other qualitative differences. All three qualities were assigned weighted values according to a model similar to those used for the groups "benthos" and "ichthyofauna":

1 - Suspicion of breeding.
2 - Proof of breeding.
3 - Reaching or exceeding the minimum number of breeding pairs.

Non-breeding bird populations. The abundance of all 36 species that might occur can reach or exceed a predetermined minimum. Because the qualitative criterion "suspected" is discarded in this category, only two values remain:
2 - Proof of presence.
3 - Reaching or exceeding the minimum abundance.

The **molting population** was assigned a class value directly, without arithmetic calculations.

Relationships among the values influencing the "benthos-sediment" parameter

Categories	Species (examples)		
	Macrofauna Arenicola marina	Meiofauna Harpacticus spec.	Microphytobenthos Achnanthes spec.
Physiological sensitivity	2	3	1
Ecological sensitivity	1	3	1
Significance as a food	3	3	1
Saprobic importance	3	1	2
Capability for dispersion	2	1	3
Isolation	–	2	1
Duration of spawning period	3	3	1
Sum of assigned values	14	16	10

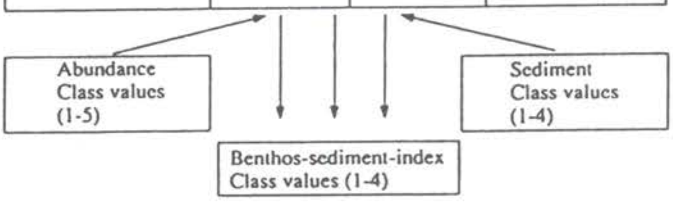


Figure 3: Relationships among the values influencing the "benthos-sediment" complex.

Summary of breeding, non-breeding, and molting groups.
Sea and shore birds have a greater radius of action than other organisms in the Wadden Sea because of their great mobility. The distribution and abundance of birds in this kind of habitat is not only determined by seasonal factors but also to a great degree by such environmental factors as weather, roughness of the sea, water level, and food supply. On the other hand there are certain periods of time, including the breeding and molting seasons, when there are especially strong bonds keeping the birds within a limited area. If this area is disturbed or destroyed, there is little chance for the bird to move to another place because of the lack of suitable habitats still unoccupied.

One difference between the calculations of the indices for the complex "benthos-sediment" and those for the "avifauna" was the definition of separate classes for breeding, non-breeding, and molting bird populations to take into consideration the various qualities of each group in weighing the aspects of species conservation. For the collective evaluation, the individual class values for each month were added, and the sums were assigned new class values ranging from 1 to 4 (Figures 2 and 7).

Marine mammals in the Wadden Sea are mainly represented by the common seal (*Phoca vitulina*). It's resting places must meet a number of conditions, so their locations can be determined exactly. Neither an arithmetic evaluation nor an arbitrary assignment to classes was carried out for this species. The animal´s presence and whether sites were used for resting or for reproduction during the various seasons were documented as a characteristic of the location (Figure 8).

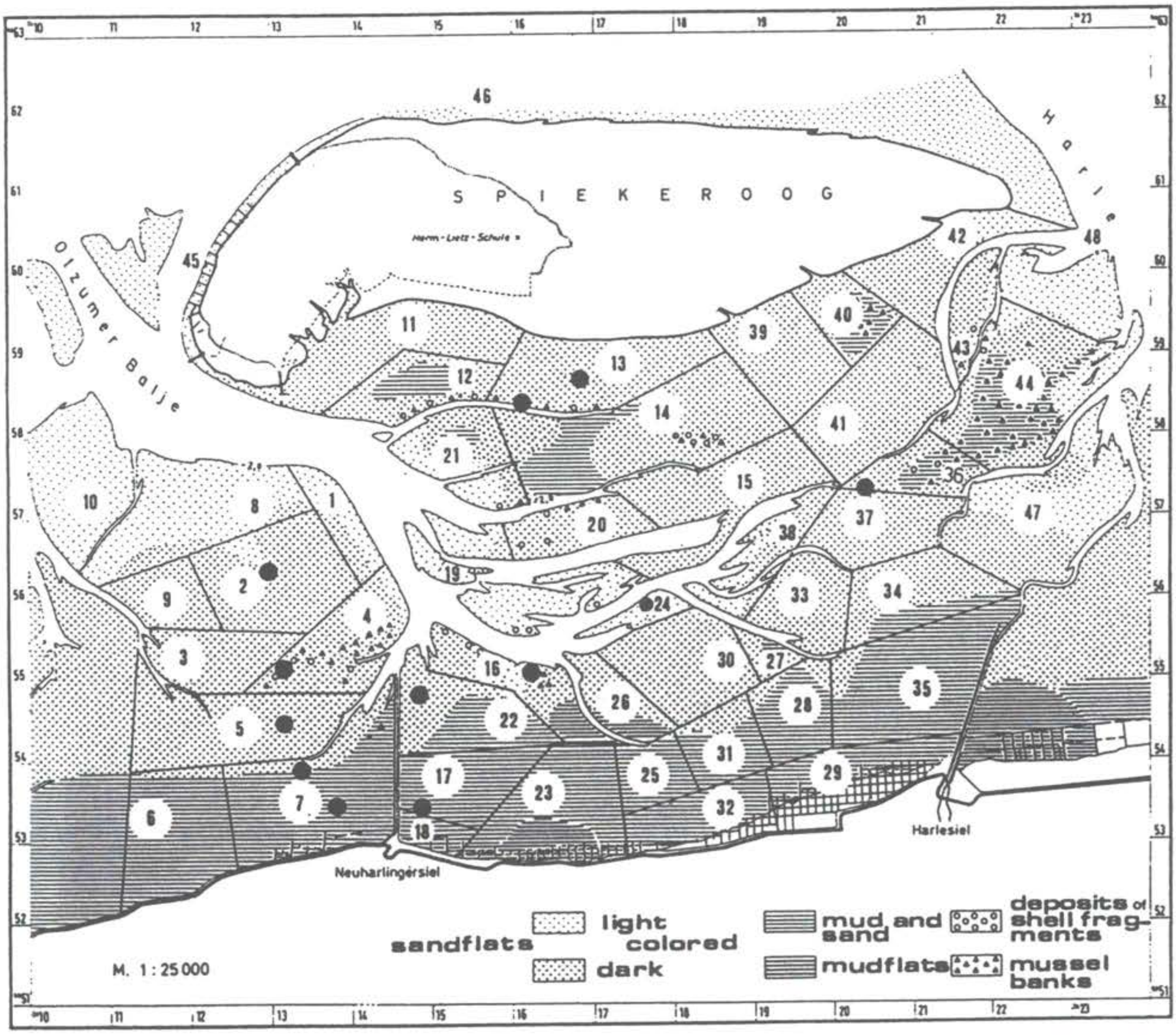


Figure 4: Distribution of sediment types and locations of sampling stations between Spiekeroog and the mainland (numbered circles indicate benthos-sediment stations, solid circles indicate fishery transects).

Salt marshes. Based on many years of research on the sensitivity of halophytes to petroleum (12), evaluation criteria for the individual species were developed like those for the category "benthos".

Area of contact: Weighted values were 1 = small, 2 = medium, and 3 = large.

Position of the regeneration organs: 1 = underground (geophytes), 2 = over 50 cm above the sediment, 3 = 10 to 50 cm above the sediment, 4 = 1 to 10 cm above the sediment, 5 = plants forming rosettes, and 6 = small (therophytes). Position of regenerative organs and location of new shoots after oil contamination were considered.

Physiological reaction: 1 = little, 2 = medium, 3 = strong, and 4 = very strong.

Regeneration: 1 = very rapid, 2 = rapid, 3 = medium, 4 = slow, and 5 = no regeneration.

Degree of endangerment: 1 = low, 2 = medium, and 3 = high. This is an evaluation of the exposure to harm in case of an accident. The main zone of endangerment is assumed to extend as far as the mid-tide level or a little beyond.

The points in the individual evaluation criteria are added and the sum is divided by the number of criteria (5). The quotient is assigned to one of eight classes corresponding to special indicator values. For areas subject to grazing by cattle, this species sensitivity index is increased by two points, because contamination is intensified in the absence of protective leaf cover. Thus, a scale from 1 to 10 is produced (14). To give proper emphasis to the population density distribution of each species, a community vulnerability index was employed (CVi), which is calculated according to the food value method of KLAPP (1971):

$$CVi = \frac{\text{distribution of one species . it's vulnerability value}}{\text{total settlement density}}$$

The value for oil sensitivity of the specific kind of plant association (CVi) calculated by this method is then placed in one of four classes scaled according to vulnerability.

General evaluation

The general evaluation in Figure 8 was made only for the eulittoral zone as an example. This combined the values for all classes from all areas or the resulting combined classes, except for those from the salt marsh. Thus, the sum can reach a maximum of 12 points. Because of the linear arrangement, all evaluations remain relative, and an enlargement of the research area results in a new arrangement of index values. By comparing Figures 5, 6 and 7 with 8, the contribution made to the total vulnerability index value by each of the groups, benthos, ichthyofauna, and avifauna, can be determined.

Conclusions

The methods developed provide for the first time the possibility of putting the necessary data from field investigations to use with very little supplemental effort. They also permit further refinements of the evaluation technique, the assignment of values to the basis data, and the determination of the interrelationships among the different data groups. It is possible to confirm the importance attached to the individual data and the influence of evaluation procedures on final conclusions. In this way, a comprehensive concept of plausibility can be developed with a view towards the practical needs of the user. To find the parameters that reflect differences in an environment that is generally highly sensitive ecologically, it was found necessary to rely on the largest set of data that could be assembled. A summary of all available general information has been provided for contingency planning to permit a quick reaction to oil spills. Temporal and spatial pecularities within the ecosystem can be considered using the specific information in the data base or provided by specialist consultants. Furthermore, the system can impart a detailed set of pertinent facts to scientists and governmental agencies.

This vulnerability study was specially prepared for the Wadden Sea with regard to its ecological characteristics and established research data. Concerning the demands of other countries I may conclude according to Dicks & Wright (1989): " We cannot advocate a uniform approach to map preparation. Like spills, the individual needs of a coastal area and its environment are unique, and the response and sensitivity maps benefit from tailoring to local demands. Nevertheless, our advice is to keep the maps simple, make sure they are designed for the user, and make it clear where expert guidance is needed".

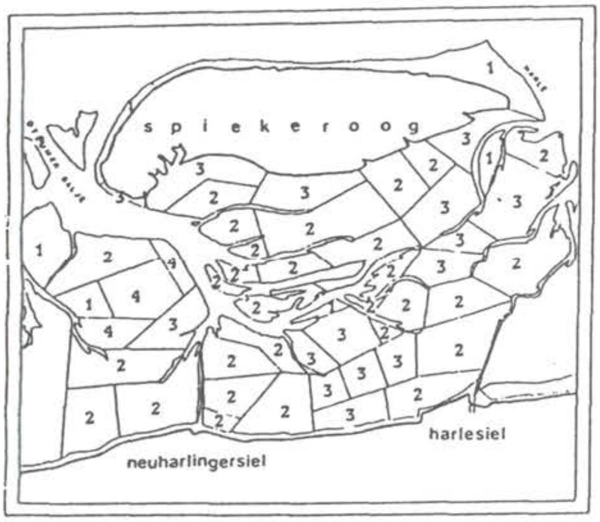


Figure 5. Distribution of the individual class values for benthos-sediment

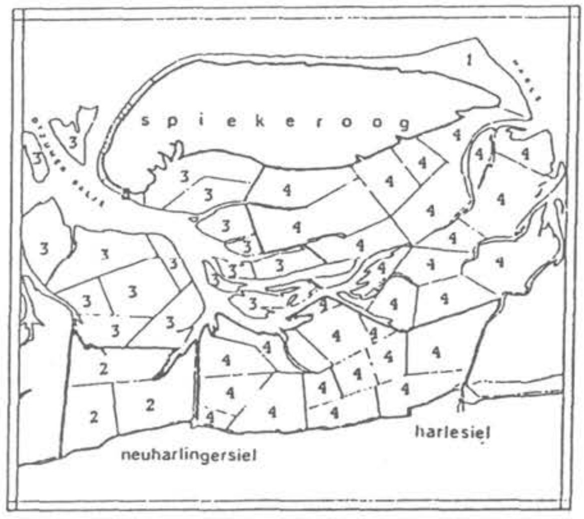


Figure 7. Distribution of the individual class values for avifauna

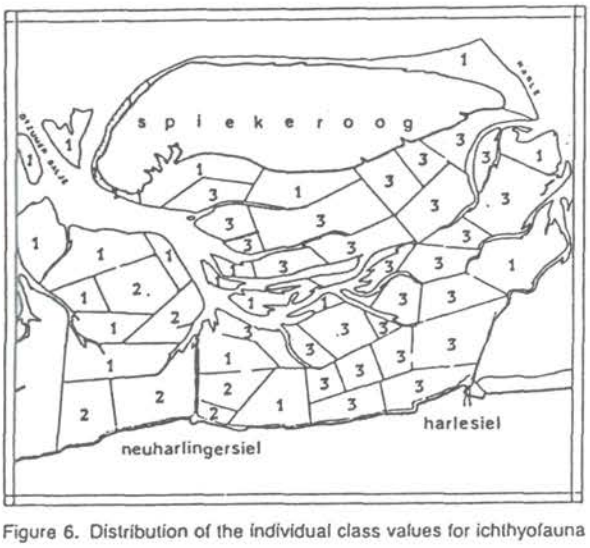


Figure 6. Distribution of the individual class values for ichthyofauna

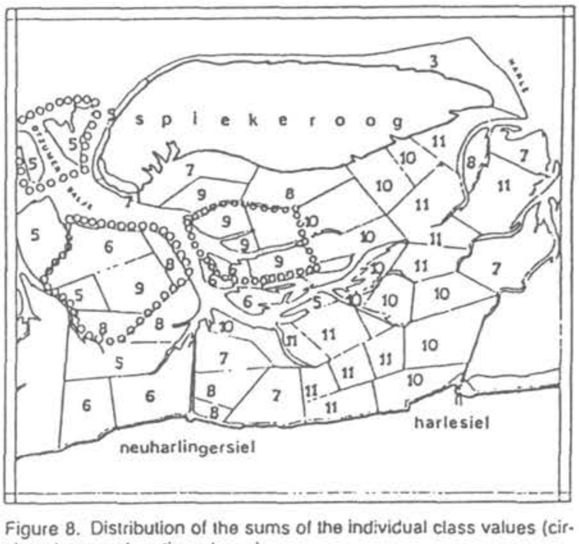


Figure 8. Distribution of the sums of the individual class values (circles show seal resting places)

References:

1. **Bernem van, K.H.** (1982): Effects of experimental crude oil contamination on abundance, mortality and resettlement of representative mud flat organisms in the mesohaline area of the Elbe estuary.- Netherlands Journal of Sea Research, 16: 538-546.

2. **Bernem van, K.H.** (1984): Behaviour of penetration and persistence of crude oil hydrocarbons in tidal flat sediments after artificial contamination. Senckenbergiana marit.; 16 (1/6): 13-30.

3. **Bernem van, K.H.** (1987): Field tests on the effects of oils and dispersants in tidal flats. UBA Texte 6/87: 65-74.

4. **Bernem van, K.H., J. Dörjes and A. Müller (1989):** Environmental oil sensitivity of the German North Sea Coast.- In: Proc. 1989 Oil Spill Conf., San Antonio, 239-245.

5. **Beukema, J.J.** (1981): Quantitative data on the benthos of the Wadden Sea proper. In: Invertebrates of the Wadden Sea, N. Dankers, H. Kühl, and W.J. Wolff, eds. Belkema, Rotterdam: 112-174.

6. **Dicks, B. & R. Wright** (1989): Coastal sensitivity mapping for oil spills. In: Ecological Impacts of the Oil Industry, B. Dicks, ed. 1989 Institute of Petroleum.

7. **Dörjes, J.** (1984): Experimental investigations about effects of crude oil and dispersed crude oil in tidal flats environments. (ed.), Senckenbergiana marit.; 16 (1/6): 271 pp.

8. **Farke, H. , D. Blome, N. Theobald, and K. Wonneberger** (1985): Field experiments with dispersed oil and a dispersant in an intertidal ecosystem: fate and biological effects. Proc. 1985 Oil Spill Conf., Washington, D.C.: 515-520.

9. **Gundlach, E.R. & M.O. Hayes** (1978): Vulnerability of coastal environments to oil spill impacts. Marine Technology Society, v12: 18-27.

10. **Höpner, Th., K.H. van Bernem, W. Brüggemann, U. Kant, K. Kiesewetter, M. Michaelsen, G. Ramm, R. Suda & K. Wonneberger** (1987): Hydrocarbon biodegradation in oxic tidal flat sediments, role of epiphytobenthos and effects of dispersants. UBA Texte 6/87: 76-81.

11. **Klapp, E.** (1971): Wiesen und Weiden. 4th ed. Paul Parey, Berlin and Hamburg. 620 pp.

12. **Neugebohrn, L.** (1987): Pflanzenbestände im marin-terrestrischen Übergangsbereich (Einteilung der Arten und Gesellschaften des Deichvorlandes in Sensitivitätsklassen). WWA Niedersachsen, Stade.

Captions:

Figure 1: The Danish, German and part of the Dutch Wadden Sea. (The island of Spiekeroog is indicated by an arrow).

Figure 2: Diagram of the degree of influence of all groups and their combinations. Period of validity: Benthos-sediment class value alone: November till March; sums of individual class values: April till November.

Figure 3: Relationships among the values influencing the "benthos-sediment" complex.

Figure 4: Distribution of sediment types and locations of sampling stations between Spiekeroog and the mainland (numbered circles indicate benthos-sediment stations, solid circles indicate fishery transects).

Figure 5: Distribution of the individual class values for "benthos-sediment".

Figure 6: Distribution of the individual class values for "ichthyofauna".

Figure 7: Distribution of the individual class values for "avifauna".

Figure 8: Distribution of the sums of the individual class values (circles show seal resting places).

Local initiatives in support of Agenda 21 (sustainable development and local problems - environment and economy) - examples from Europe

Karlo van Bernem, GKSS-Research-Centre, Max-Planck-Straße, D-21502 Geesthacht, Germany

Chapter 17 of the agenda 21 is concerned with the protection of oceans and coastal areas and the sustainable use of their resources.

Key-words to characterise the fundamental sense of the agenda 21: Global partnership and cooperation - sustainability - biodiversity - economy.

The general definition of "sustainable development" has been introduced by the Brundtland Commission and states:

"Sustainable development is development that meets the needs of the present without comprising the ability of future generations to meet their own needs".

Prime Minister Gro Harlem Brundtland gives her vision on sustainability as follows:

"There are many dimensions to sustainability. First, it requires the elimination of poverty and deprivation. Second, it requires the conservation and enhancement of the resources base, which alone can ensure that the elimination of the poverty is permanent. Third, it requires a broadening of the concept of development so that it covers not only economic growth but also social and cultural development. Fourth, and most important, it requires the unification of economics and ecology in decision making at all levels".

Taking this as an introduction, I will at first shortly mention some scientific aspects, coming out of a workshop, held at the GKSS Research Centre in october 1995. - After that I´ll present two pragmatic examples from Germany, which were successful to some extent, but depict some of the nevertheless arising problems - as I think. - Last but not least I will present one other example as an attempt to implement the "Wise Use" of the environment in political and practical ways. This example deals with the highly sensitive North Sea Coast of Germany, the Netherlands and Denmark, The "Wadden Sea".

The aims of the workshop, above mentioned, were to explore, the relationships between sustainable development, biodiversity conservation and socio-economic pressures, trends, impacts an consequences, in the context of coastal zones. Furthermore to set up a research agenda and establish networks to address a range of high priority research questions for the next three decades. The workshop recognised different phases in the pollution/management cycle. The first phase typically involving rapid industrialization and high inputs and outputs, a second phase generating visible impacts and increased environmental awareness. The policy response results in an industry which becomes highly regulated and is forced to use best available technology for pollution control. Industrial point source pollution therefore, has been to some extent mitigated in the coastal environments of Western Europe, Canada and the USA.

The present problems and future impact on the coastal zone (third phase) will result from disproportionate and extensive physical changes and from diffuse pollution sources. Important trends are increased tourism, population movement into the coastal zone, increased transport pressure and changes in land use in the river basin drainage areas. Given the current trend of migration towards the coast and considering trend population growth rates, a population increase in the coastal zone of 15%, plus seasonal peaks of up to 100% may realistically be expected in the next 20 years. The population pressure will exert a "double-edged" and disproportional impact. On the one hand, the local regional/coastal economy will gain economic development benefits (increased income and employment). On the other hand, the development pressure will intensify land use competition and change, ecosystem loss and/or degradation (if carrying capacities are exceeded) and potential overload of the waste assimilation capacity in the coastal system. The currently planned investments for major harbours and their associated industrial development like Rotterdam, Hamburg and harbours along the Baltic in the "transition" economies typify this development pressure on a sensitive environmental system. A range of socio-economic sectors will increasingly compete for use of the coastal zone functions and services. These pressures on the environment are part of phase three of the pollution control/management cycle and require a drastic change in our approach to environmenal research and policy response.

Environmental research should move away from research centering on single substances (e.g. Cd, PCB´s etc.) and their damage/risk assessment and abatement costs, towards a more integrated assessment of coastal processes and systems. In addition environmental research should move away from the supply side (pure science driven) to the demand side (anticipated social needs) in order to achieve a better integration of research efforts with the present and future needs of policy and management. Increased collaboration between the natural sciences and socio-economics is a prerequisite for a better and more effective interface with/and information provision for policymakers. This collaboration and the development of Europe-wide management approaches can only be established through joint research. Three contrasting basin-wide areas were selected for combined and comparative natural sciences and socio-economic studies (EUROBASINS).

- A basin/estuary subject to pressure from the agriculture sector,
- an estuary subject to pressure from industry mainly and,
- a tourism dominated area.

At the basin levels these studies will focus on spatial planning and its impact on the estuaries and coastal areas. Within the different basins selected socio-economic scenarios of future change will be developed. Existing models will be evaluated in terms of their suitability to integrate with socio-economic models. Within the EUROBASINS study special attention will be paid to coastal habitat protection and restoration. These habitats are highly valued as sites for human habitation, recreation and many professional activities. In addition these habitats provide a wide range of goods and services including transport facilities, coastal protection and the capacity to deal with human waste. The present ongoing pressure and damage represents a very significant economic loss which needs to be quantified. Natural science alone cannot derive the policies necessary to conserve coastal habitats in order to achieve a more sustainable utilization of the coastal system. To conserve coastal areas the necessary policies have to be based on knowledge of the natural processes and an understanding of the socio-economic factors that contribute to their change. The studies will include a careful evaluation of the user functions and their economic variation under different use/management scenarios, a set of models plus a set of experiments that permit evaluation of habitat and biodiversity loss. New improved tools for rapid assessment of coastal biodiversity (e.g. parataxonomy) and for rapid assessment of the conditions of coastal habitats will be developed. This set of studies will form the basis on which to build habitat restoration (restoration ecology and ecoengineering). Criteria for restoration priorities will be jointly developed by natural and socio-economic scientists.

The EUROBASIN study will also require new methodologies in the field of indicators, monitoring and evaluation. Present monitoring techniques are expensive since they are heavily biased towards single chemicals. There is an urgent need for effect oriented and time-integrated monitoring. Modern techniques like remote sensing should be evaluated to determine whether from satellite imagery and knowledge of ground truth data a set of unit base loads for different economic activities and landscape use can be derived. Once these data are available, remote sensing can be used as a fast and efficient monitoring device. The "critical load concept" should be quantified and made applicable at the landscape level, taking into account the vulnerability of major resources (e.g. biodiversity, fish stocks, landscape amenity).

A risk assessment approach (actual and perceived) should be developed to evaluate natural and social system responses to different scenarios and management strategies. Since anticipated changes are taking place over long periods, current methodologies may not be adequate at the landscape level and will need to be supplemented by socio-economic indicators of sustainability. To implement this research programme through networking and funding, a coregroup of five laboratories/institutes was established. Two of them specializing in the socio-economic sciences and the other three in the natural sciences.

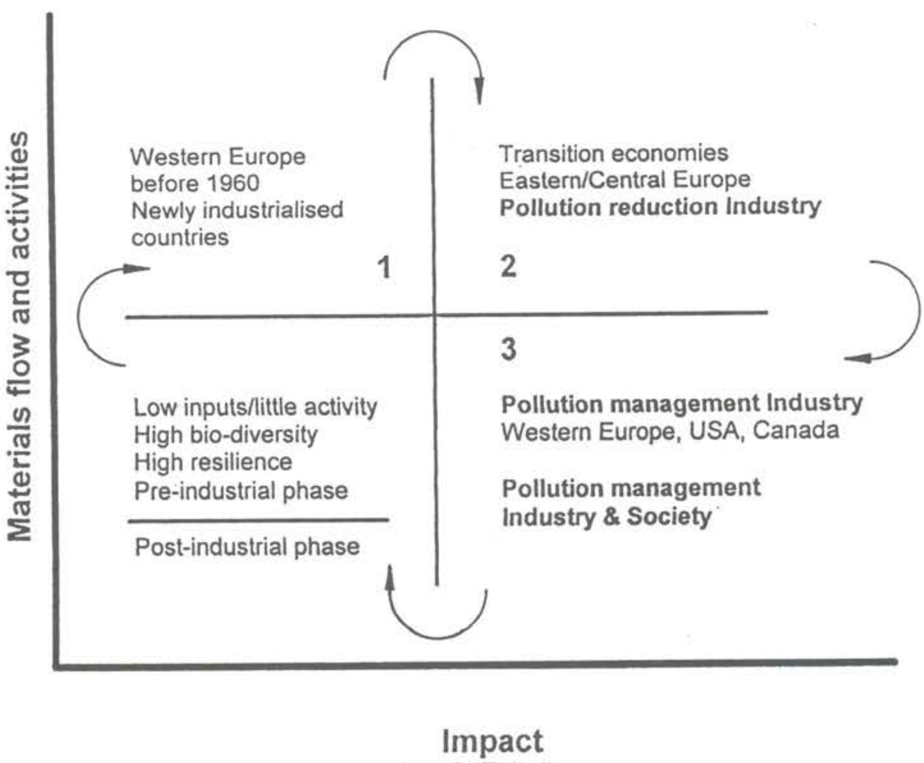


Figure 1 : The pollution cycle: Phases in pollution control and management interaction natural sciencec with the decision system (based on ideas of Stigliani). (Source: Salomons et al., 1995).

In the pre-industrial phase the excess materials and physical impacts are low. With the start of industrial expansion the excess flow of materials increases as well as physical disturbances (phase 1). The assimilative capacity of the system can however still cope. Once loading exceeds assimilative capacity we enter phase 2, where damage impacts affecting the general public becomes more visible also environmental awareness increases because basic economic needs have been met. Action is taken in the form of end-of-pipe solutions, subsequent actions include management in the form of new technology and phase 3 is entered. Phase 3 has to deal with the mitigation of the effects like remaining and hard to control diffuse sources, tourism and population pressure. Phase 3 requires more than any other phase strong research and policy cooperation between natural sciences and socio-economics, to control the rates of change and start the restoration efforts. Fast developing countries in Asia are in phase 1, "Transition" economies in Eastern/Central Europe are in phase 2, and countries in the EU and North America are entering phase 3 (SALOMONS et al., 1995).

After that, which will give us some stuff for discussion, let me shortly present the first of the pragmatic examples I promised. It meets directly the topics of this workshop and shows that a successful attempt can break down if there is not enough cooperation of the authorities and the economic parties envolved.

From 1988 to 1991 the federal government and the (old) coastal countries of Germany conducted a pilot-project concerning the oil disposal from ships. It became evident, that the sea captains were willing to undertake the reasonable unconveniences of oil disposal in the harbours, if they don´t have to pay anything. - Despite of MARPOL, it is very easy to dispose on the wide sea, if nowbody is looking, just with one finger on the button - .

In 1990, the last year of the pilot project, 160.000 t of oil containing water have been disposed in German harbours. - Since that year the countries "Schleswig-Holstein", "Hamburg" (step by step, up to a rest of a small amount) and "Bremen" (just in 1996) dropped out of the "cost free" disposal. The consequence was a plain decrease of the amount of oil disposed.

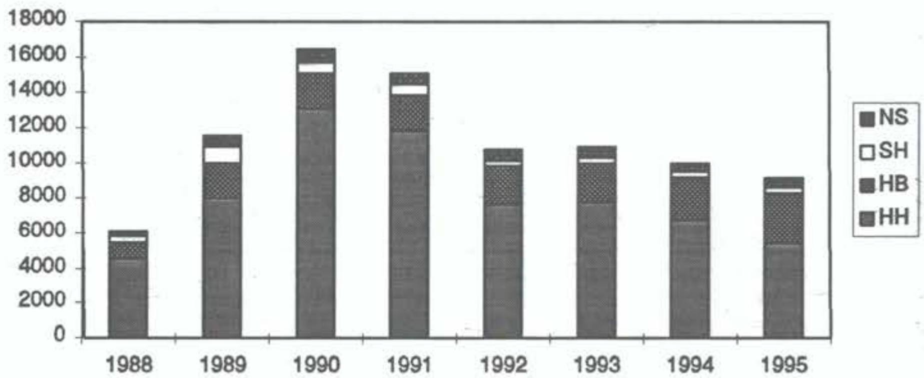


Figure 2: Disposal of oil residues from ships in German North Sea harbours of the countries Hamburg (HH), Bremen (HB), Schleswig-Holstein (SH) and Lower Saxony (NS) in m^3 from the years 1988-1995. (Source: Nieders. Umweltministerium).

It can be assumed, that in 1996 about 100.000 t of oil containing water will less be disposed in German harbours than it was done in 1990.

These quantities will be discharged into the North Sea to a greater extent. There is still only the country of "Lower Saxony", which still disposes about 6.000 t/year free.

One little success is left: Following the experiences of the "cost free" disposal, Germany submitted a "Manual on the Disposal of Ship's Waste" to the MEPC (Marine Environmental Protection Committee) that has been accepted.

The second pragmatic example concerns refinery effluents and emissions due to mineral oil (industry and consumption.

As mentioned before ("Source and extent of land-based oil pollution...") the restrictions to this source of land-based pollutants showed really good effects. The quantities of oil, discharged per million tonnes of crude oil processed declined significantly since 1981 (Table 2).

Table 1: Quantity of oil discharged (tonnes) per million tonnes of crude oil processed

Country	1981	1984	1987	1990
Belgium	23,0	21,2	1,6	0,7
France	13,0	10,9	5,7	2,8
Germany	1,2	1,2	0,7	(1) 7,4
Ireland	3,3	7,5	5,7	4,9
Netherlands	12,9	6,6	3,4	8,0
Norway	19,9	9,3	9,9	7,0
Portugal	55,5	NI	21,0	15,2
Spain	Ni	Ni	7,0	4,1
Sweden	2,2	1,3	2,1	1,5
United Kingdom	90,0	34,3	33,7	19,3

NI:No information;(1):1,9 when the 2 former East German refineries are excluded
(Source: OSPARCOM, 1992).

The special authorisation requirements, however, are still different in the European countries. The most rigid ones are found in Germany (Table 3)

Table 2: Regulations applying at national level (selected examples).

	France	Germany	Italy	Netherlands
Phenol	0.5/1.6	0.15	0.5	0.5 - 1
BOD	30/40	25	40	30
COD	120/150	80	160	100 - 200
Sulfide and mercaptans	-	0.6	- -	-
THC	5	2	5	5

(mg/l); (Source: OSPARCOM, 1992).

Concerning the Emissions from mineral oil in Western Germany, there was a clear decline during refinery production from the later seventies to the nineties (CO_2, THC, SO_2) - SO_2 from heating oil and diesel, plumbum and scavangers from gasoline, -

Table 3: Decline of emissions from mineral oil in Germany from 1975 (1980), set as 100%. to 1992 (1990,1991).

Decline of refinery emmissions:				
CO2	1980:	100%	1990:	59%
Hydrocarbons	1975:	100%	1991:	45%
SO2	1975:	100%	1992:	23%
Decline of heating oil and diesel fuel:				
SO2	1975:	100%	1992:	21%
Plumbum in gasoline:	1975:	100%	1992:	4.4%
Scavengers in fuel from inland production:				
	1975:	100%	1992:	< 1%

(Source: MWV, 1994).

The sulfur extraction from crude oil increased from about 0.5 tonnes in 1970 up to 2.7 tonnes per 1.000 tonnes crude oil in 1993 with growing effectiveness of the filtration processes.

From the heating gas used in refineries, fluid gas and gasolines, the sulfur extraction is nearly complete. The sulfur-content in diesel fuel has been decreased following the "Bundes-Immissionsschutzgesetz" (immission-control-law) from former 0.6 weight percent to the maximum of 0.2 weight percent. Hereby the total SO_2 emission from traffic decreased, in spite of the increasing use of diesel fuel within the last years. So the sulfur content of diesel fuel and heating oil in Germany is since years below the limit of the European control measures. (The same holds for the benzene-content, which is limited by the EU to 5 Vol. percent, while the content in Germany accounts to 2.1 Vol. percent).

Up to 1985 the decrease of the CO_2 Emission in Germany was achieved mainly by the efforts of the mineral oil industry. Only after this year the extraction of sulfur from the flue-gas of power plants, for example, following the above mentioned immission-control-law, played a decisive role.

After having presented these two practical examples, one of them being very successful, the other with a good start, but an unsure future, I will come to the last example: A conservation policy, based upon the "wise use concept".

This example concerns the highly sensitive coastline of Germany, Denmark and the Netherlands, the Wadden Sea.

The relatively high level of contamination in the Wadden Sea is caused by three main factors:

- A number of rivers, the catchment areas of which are highly industrialized and agronomised, flow into the Wadden Sea. The direct catchment area adds up to some 231.000 km^2. It extents to the south-east as far as the Chechien-Austrian border. Among the rivers are the Elbe and the Ijssel, a tributary of the Rhine. In addition, a substantial part of the Rhine waters enters the Wadden Sea via the North Sea through a coastal flow along the Dutch coast.

- The Wadden Sea is a system, which imports more sediments than it exports. The sediments originate almost completely from the North Sea and are carriers of heavy metals and other contaminants. Due to the net North Sea current, a substantial part of North Sea sediments - and consequently polluting substances - is deposited into the Wadden Sea.

- The Wadden Sea lies at the rim of north-west Europe. An important part of its contamination is caused by rain and dust which originate from the highly industrialized north-west and central European countries. Rivers are by far the largest carrier of polluting substances from the land to the Wadden Sea. The German rivers Elbe, Weser and Ems, together with the Dutch Ijsselmeer, discharge each year on average 60 km^3 of polluted water into the Wadden Sea. This discharge shows large yearly fluctuations as a result of differences in rain and snowfall in the catchment areas. That is why it is so difficult to determine whether or not the pollutant loads have decreased over the past years.

A conservation policy based on the "Wise Use Concept".
In the Montreux presentation the Ramsar definition of wise use, as accepted by the third meeting of contracting parties (Regina, Canada, 1987), was used as a starting point. According to the presentation the concept of "wise use" is not affected by administrative differences. It was stressed that the concept should be applied in conformity with agreed concepts and

guidelines in all three Wadden Sea countries. The Ramsar definition of "wise use" is as follows:

"The wise use of wetlands is their sustainable utilization for the benefit of humankind in a way compatible with the maintenance of the natural properties of the ecosystem." Sustainable utilization is defined as "human use of wetlands so that it may yield the greatest continuous benefit to present generations while maintaining it´s potential to meet the needs and aspirations of future generations."

In both the definitions of wise use and sustainable development, the maintenance of natural properties and potentials is called for.

"Natural properties" and "Potentials" not only mean potential yield but also species diversity, scenic beauty, scientific value and recreational value. This follows from the above definitions. These speak of "benefit" and "needs and aspirations of future generations". Clearly "benefit" and "aspirations" not only refer to economic yield. In this respect a distinction can be made between the situations in developing and developed countries as it is implicitly contained in the Brundtland description of sustainable development. According to the Brundtland Commission sustainable development contains two key concepts, being the concept of needs, by which in particular the needs of the world's poor is meant, and the concept of limitations, imposed by the state of technology. More specific for the Wadden Sea this distinction is reflected in the policies of the Wadden Sea countries: The prime function of the Wadden Sea is the nature function.

According to the definitions of wise use and sustainable development the natural potentials must be maintained. In practice the above may mean that the situation must be improved while otherwise irreversible changes may occur. Up till now the national and international Wadden Sea policies have primarily aimed at the conservation of the actual values of parts of the ecosystem (seals, birds). This is however no guarantee for maintaining the values and potentials of the whole ecosystem. There are many indications that the ecosystem is still deteriorating. There are even scientists who claim that the Wadden Sea ecosystem is heading into the direction of an irreversible collapse.

We can conclude from the statements given above that better guarantees for maintaining the natural properties of the Wadden Sea ecosystem can be provided by a policy based upon conservation and wise use.

Such a policy does not necessarily mean that by a more optimal management, both natural values and uses will increase. The focus will be on increasing natural values, which may imply that actual uses will have to be decreased. Society determines whether or not such a policy is developed and implemented. This depends on today's notion of benefit and of the aspirations of future generations (CWSS, 1992).

Elaboration of wise use conservation policy.
An outline for a common approach to the conservation of the Wadden Sea using the "wise use concept" as a starting point, is visualized by the flow diagram. The different elements of the diagram are briefly addressed in the following Figure 3.

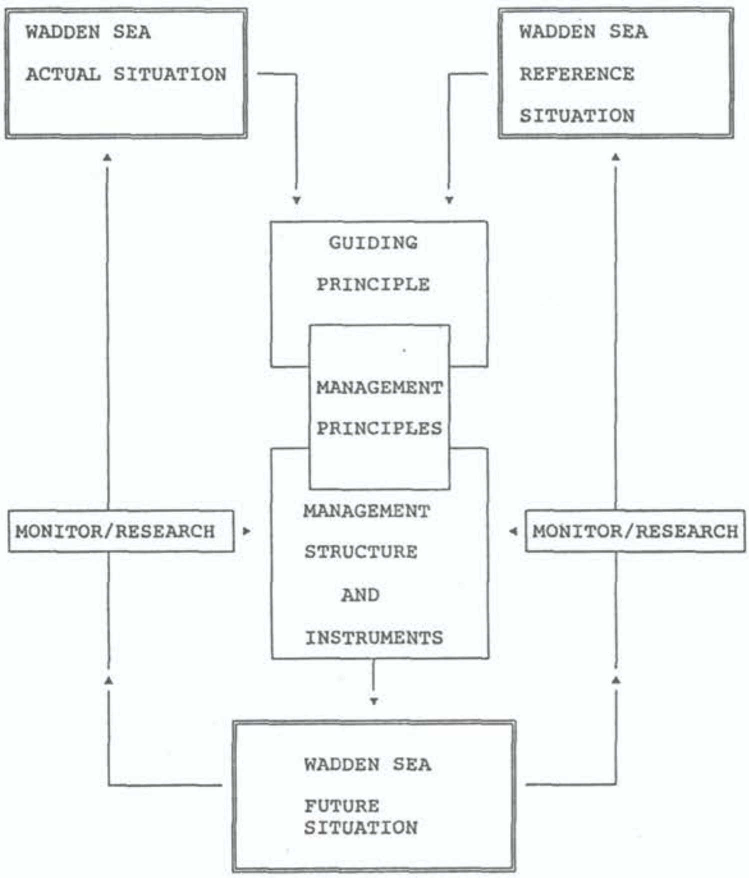


Figure 3: Approach to the conservation of the Wadden Sea using the "wise use concept" (see the following text, source: CWSS, 1992).

The Guiding Principle is the ultimate political goal for the Wadden Sea ecosystem. It determines the nature and direction of the policies to be implemented in order to reach the goal. In a policy based on wise use, the Guiding Principle should reflect the basic elements of the wise use concept, being maintenance of the natural potentials and sustainability of the ecosystem.

Essential elements in a wise use conservation policy are descriptions of the actual status and potential natural values of the ecosystem. The latter is called the Reference ecosystem. The actual status of the Wadden Sea as can be described in terms of uses, ecological values and threats, is relatively well known, although differences exist depending on the assessment of the situation. A comprehensive overview has been drafted in by a group of experts from the three Wadden Sea countries. The Reference Situation is a hypothetical ecosystem, composed from up-to-date scientific knowledge, which serves as a calibration instrument. By comparing the actual situation with the Reference it can be judged how far the actual situation is deviating from the Reference. Consequently political targets can be set in order to improve the actual situation into the direction of an ecosystem of which the quality is in accordance with the Guiding Principle.

Management Principles are the intermediates between politics and policy. Through Management Principles political responsibilities are transferred to policy and management. The box containing the Management Principles overlaps both the Guiding Principle box and the management box. This is because they can be regarded as being of a political and/or legal order and also are the basis of the construction of instruments for conservation management.

In a Management Structure the elements listed above are integrated. It also contains guidelines for the application of the elements in specific management plans.

The feedback in the flow-diagram is achieved through monitoring and research. Both instruments can provide information on effects of policy measures. They can also influence (through new insights) the reference that is presently in use and consequently the setting of new political targets (CWSS, 1992). At present a joint monitoring programme is in the process of implementation (KELLERMANN et a., 1994):

The concept for the Trilateral Monitoring and Assessment Program (TMAP)
As a transition zone between land and sea, the Wadden Sea is an open, highly variable sytem, which makes it difficult to assess its recent status and to judge if developments are mainly influenced by human activities or by natural events.

In order to improve this situation, a Trilateral expert Working Group (TWG) developed a general concept for an "Integrated Monitoring and Assessment Program on the Wadden Sea Ecosystem" in the period 1992-1993. The concept was developed based on four steps which gave a detailed and close connection between the general objectives of the monitoring program and the selection of the parameters to be monitored.

- Step 1: The monitoring concept took the Quality Status Report of the Wadden Sea (QSR 1993) as a starting point, in which all possible anthropogenic impacts on the Ecosystem were indicated.
- Step 2: The issues were evaluated and ranked into different priorities. Only the issues of concern for which problems already existed or could be anticipated were given the highest priority and were included in the future monitoring program.
- Step 3: In a furher step, hypotheses were formulated for each issue.
- **Step 4: In a last step, the monitoring parameter to proof the hypotheses were deduced.**

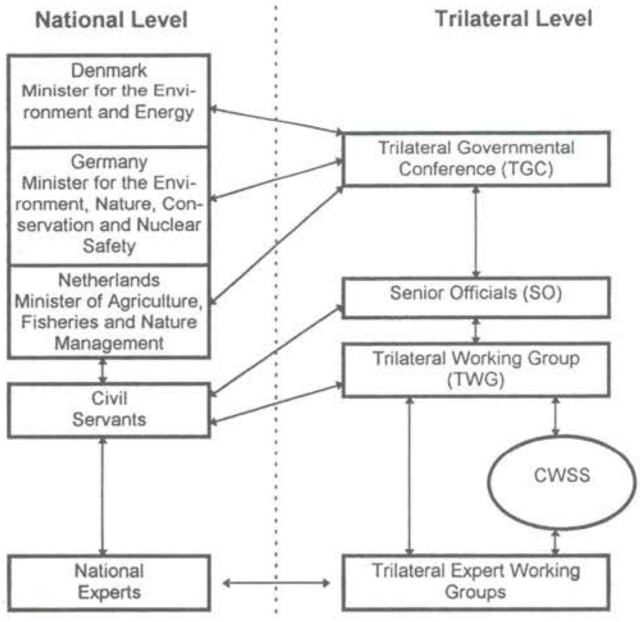


Figure 4: National and Trilateral organization of the **TMAP.**

The TMAP is embedded within the elements of the concerning trilateral policy and management (Figure 4 and 5).

The common structure of this trilateral policy consists since the sixth Governmental Conference in Esbjerg 1991 a Guiding Principle (...**to achieve, as far as possible, a natural and sustainable ecosystem in which natural processes proceed in an undisturbed way**) a number of Management principles and a set of common practice for human use.

At the Esbjerg and Leeuwarden Conferences the regulation of basically all major common uses and activities in the Wadden Sea was laid down in so-called **common objectives**.
For example:

- to prohibit further embankments and to minimize the loss of biotopes by sea defence measures.
- to close considerable parts of the Wadden Sea for mussel fishery.
- to establish zones covering the most sensitive areas where no recreational activities are allowed.

A prerequisite for common management is that the area under consideration has common borders. Thus **Common delimitation** has been fixed in Leeuwarden 1994.

Each of the habitats in the Wadden Sea needs a certain quality. This quality can be described by certain characteristic structures, the presence of certain organisms, the absence of disturbances and toxic effects and by the chemical condition of the habitat. For the common management six habitat types are distinguished:
The offshore zone, the beaches and dunes, the tidal area, the saltmarshes, the estuaries, the rural area.

For the first five of these habitats **Ecological Targets** were adopted with the objective to **increase the area which is natural, dynamic and undisturbed (DANKERS, 1994).**

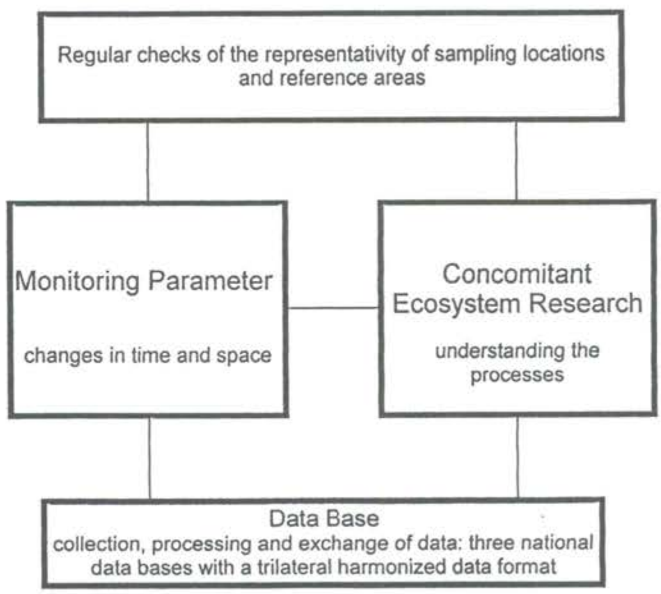


Figure 5: The parts of the TMAP.

How does the cooperation work?
Trilateral Governmental Wadden Sea Conferences (TGC) are held every three years with participation of the responsible ministers from the three countries: The minister of Agriculture, Nature Management and Fisheries (The Netherlands), the Federal Minister for the Environment, Nature Conservation and Nuclear Safety (Germany), the Minister for the Environment and Energy (Denmark).

These Conferences are the highest decision making body in the framework of the collaboration. At the conferences the ministers discuss progress regarding the implementation of the decisions of previous conferences and agree on further common measures and activities to protect the Wadden Sea. An important basis herefore is the assessment of the quality status.

Between these conferences senior civil servants meet to discuss the implementation of the decisions of the TGC´s. They solve problems on the technical level or determine what should be proposed to the next TGC. They adopt the budget and the program for the Common Wadden Sea Secretariat.

The trilateral Working Group (TWG) as a permanent group meets on average, four times a year. It is composed of civil servants of the responsible ministries as well as regional authorities. The TWG is commissioned with the overall implementation of the decisions of the Governmental Conferences and their preparation. The TWG can establish "ad hoc working groups" to execute special tasks. The TMAG is also operating under the responsibility of the TWG (Figure 4).
It seems clearly that such a management system is not directly applicable in very large ecosystems like for example the Great Barrier Reef, but I think the model of international cooperation and administration may be applied to selected parts of such a large ecosystem. Perhaps there is a possibility in South-East Asia to start an international cooperation within a smaller selected area which consists of emergent ecological characteristics and properties and to use such an area as a "demonstration site" for sustainable development and as a "crystallisation point" for further developments.

References:

1. CWSS (1992): Wise use and conservation of the of the Wadden Sea. Common Wadden Sea Secretariat, Virchowstr. 1, D 26382 Wilhelmshaven, Germany.

2. Dankers, N. & J. de Vlas (1994): Ecological targets in the Wadden Sea. Ophelia Suppl. 6: 69-77.

3. Kellermann, A., K. Laursen, R. Riethmüller, P. Sandbeck, R. Uyterlinde & B. van de Wetering (1994): Concepts for a Trilateral Integrated Monitoring Program in the Wadden Sea. Ophelia Suppl. 6: 57-68.

4. MWV (1994): Mineralöl und Umweltschutz. Mineralölwirtschaftsverband e.V., Steindamm 71, D 20099 Hamburg, Germany.

5. OSPARCOM (1992): Discharges of oil in the Convention area. Oslo and Paris Commission, ISBN 0 946956 27 8.

6. OSPARCOM (1995): Programmes and Measures - Decisions and Recommendations of the Oslo & Paris Commissions 1992-1995. Oslo and Paris Commissions, ISBN 0 946955 45 X.

7. Salomons, W., B. Bayne, C.H. Heip & K. Turner (eds.), (1995): Changing estuarine and coastal environments - sustainability and biodiversity in relation to economic aspects. EERO Workshop Report, GKSS-Research Centre, Max-Planck-Straße, D 21502 Geesthacht, Germany.

Captions:

Table 1: Quantity of oil discharged (tonnes) per million tonnes of crude oil processed

Table 2: Regulations applying at national level (selected examples).

Table 3: Decline of emissions from mineral oil in Germany from 1975 (1980), set as 100%. to 1992 (1990,1991).

Figure 1: The pollution cycle: Phases in pollution control and management interaction natural sciencec with the decision system (based on ideas of Stigliani). (Source: Salomons et al., 1995).

Figure 2: Disposal of oil residues from ships in German North Sea harbours of the countries Hamburg (HH), Bremen (HB), Schleswig-Holstein (SH) and Lower Saxony (NS) in m^3 from the years 1988-1995. (Source: Nieders. Umweltministerium).

Figure 3: Approach to the conservation of the Wadden Sea using the "wise use concept" (see the following text, source: CWSS, 1992).

Figure 4: National and Trilateral organization of the TMAP.

Figure 5: The parts of the TMAP.

Oil pollution from land-based sources and monitoring needs (Lecture)

Karlo van Bernem, GKSS-Research-Centre, Max-Planck-Straße, D-21502 Geesthacht, Germany

As a basis to discuss the problems of:

- parameters worth monitoring
- technological and analytical requirements
- common methods and standards
- intercalibration exercises
- development of a monitoring programme

a few examples from Europe are presented, concerning the following topics:

1. Point sources (control methods, using examples from the "Procedures and Decisions Manual" of PARCOM (1993) for platforms and refineries).

2. Diffuse sources (monitoring methods, using an investigation of hydrocarbons in the Elbe-River as example (THEOBALD et al., 1995).

3. A method to identify illegal oil pollution (THEOBALD, 1993).

4. An example concerning a most recent attempt of intercalibration exercises: QUASIMEME.

5. Bioassays, a short introduction to the topics of the department of Ecotoxicology at the Berlin University of Technology.

6. The introduction of the conclusions of an integrated marine environmental monitoring strategy (Annex I, ICES Cooperative Research Report No. 212, 1995).

1 Methods of sampling and analysis for implementing the provisional target standard for discharges from oil and gas production platforms (Figure 1).

At its eighth meeting (Madrid, 1986), the Paris Commission agreed to recommend to contracting parties that a standard of 40 mg/l for the average concentration of hydrocarbons in effluents discharged from platforms should be applied to all platforms constructed after 1. January 1988. The Commission adopted a revised sampling and analysis procedure for implementing the target standard and agreed that it should be reviewed by GOP (Group on Oil Pollution) in 1991.

Method of sampling:

1. For platforms discharging continuously, the standard shall be enforced by taking at least 16 samples per month, to be taken at pre-arranged intervals.

2. The sampling point shall be:

   (i) immediately downstream of the oily water separator, or separators if a number operate in parallel or series;
   (ii) from, or just downstream of, a turbulent region.

3. Care should be taken to ensure that the sample is of adequate size and is representative of the effluent.

Method of analysis:
The sample is acidified to a low pH and extracted with two volumes of carbon tetrachloride. The oil content is determined by comparison of the infra-red absorbances of the sample extract against known concentrations of the appropriate reference oil (stabilised crude from particular reservoir).

Method of calibration:
The series of standards required for calibration should be prepared by introducing a known weight or pipetting a known volume of the particular stabilised crude involved into a known volume extractant, and preparing further standards by successive dilution.

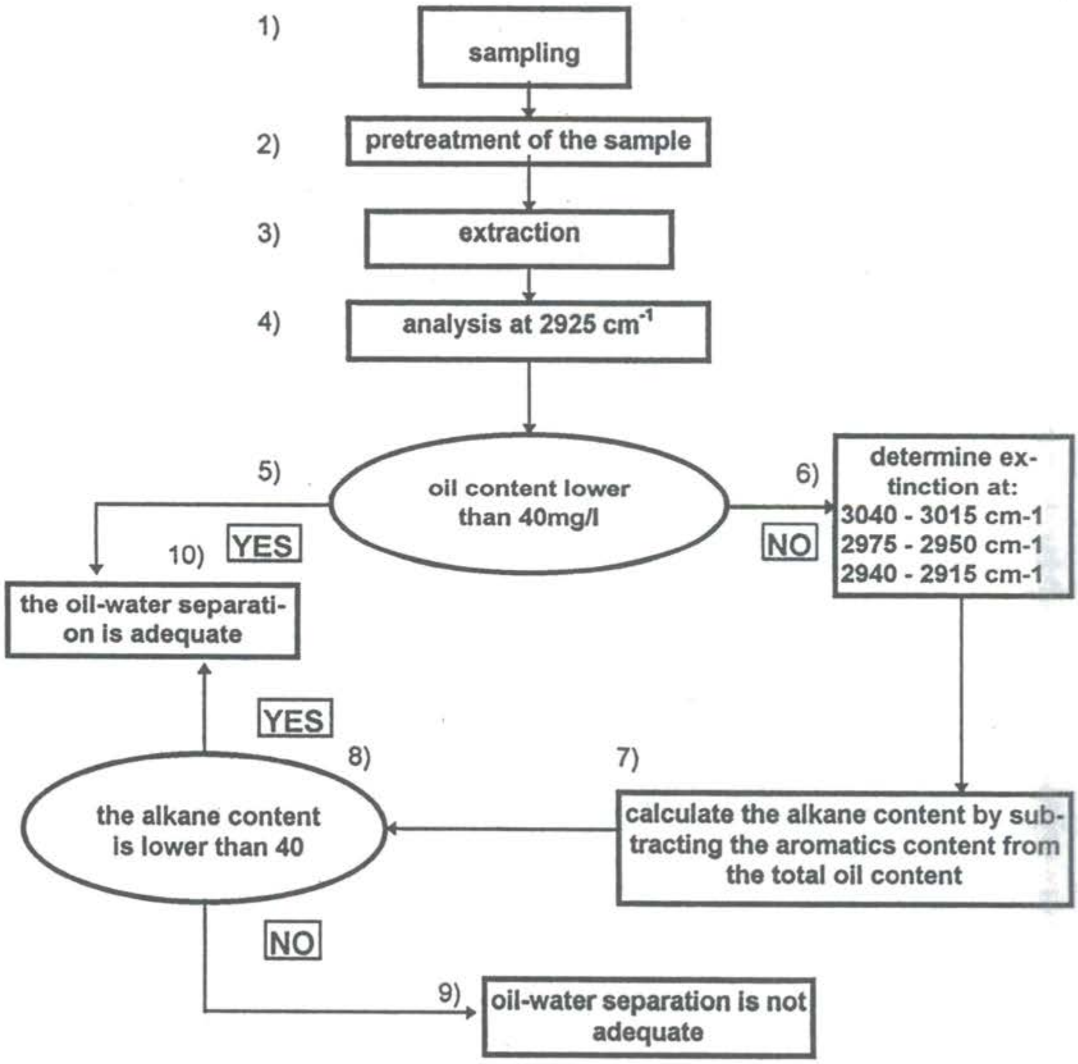


Figure 1: Sampling and analytical procedure for implementing the target standard for discharges from oil and gas production platforms (Source: PARCOM, 1993).

Procedure to correct the oil content for the aromatic hydrocarbons in order to comply with the term of "free hydrocarbon droplets" (blocks in Figure 1 are numbered from 1 to 10).

Block 1: All samples are taken according to PARCOM's procedures. If the oil content is expected to be below 40 mg/l then proceed to block 3;

Block 2: All samples are pretreated according to PARCOM's procedures. Consequence: the lighter hydrocarbons, including a part of the aromatics, are purged out of the sample by nitrogen;

Block 3:

- Carbon tetrachloride should be replaced by 1,1,2 trichloro - 1,2,2 trifluoroethane as extraction liquid.
- The amplitude, 5 cm, and the number of strokes, 100-150/min, should be specified for the shaking machine. The shaking time should be decreased from one hour to 30 minutes.
- Polar substances should be removed by a florosil pretreatment.

Block 4: Infrared analysis at 2925 cm^{-1}; the oil content determination should be carried out with a curve, calibrated with n-hexadecane ($C_{16}H_{34}$).

Block 5: If the sample has not been pretreated (see Block 1) and the oil content is higher than 40 ppm, a new sample must be taken and then go to Block 2.

Block 6: Whenever this is not the case, the extract should be analysed at three intervals:

- 3040 - 3015 cm^{-1} (for the aromatics: CH-stretch vibration)
- 2975 - 2950 cm^{-1} (for the aliphatics: CH_3-stretch vibration)
- 2940 - 2915 cm^{-1} (for the aliphatics: CH_2-stretch vibration)

Block 7: The method of subtracting is dependent on the nationally adopted standard procedure for the determination of oil content based on three wavelength.

Block 8: When the alkane content is lower than 40 mg/l, then the oil-water separation is working adequately; if not, the oil-water separation is not adequate.

1.1 Guidelines for discharges from new refineries

1. Oil concentrations in the effluents

- The "reference value" for the oil concentration in the process and other polluted waste streams should be 5 mg/l;
- clean cooling water should be separated from other waste streams and monitored. Possibilities for treating this stream should be available to cover of it becoming contaminated. Airfin cooling and/or recirculation cooling systems are preferable to once-through cooling systems in order to have a very small cooling water effluent;
- the "reference value" should be defined as the arithmetic mean of a statistically significant number of samples per annum;
- the "reference value" should be determined by a method of analysis based on the infra-red technique.

2. <u>Amount of oil in relation to capacity of the refinery</u>

- the total amount of oil to be discharged should be less than 3 g per tonne of refining capacity.

Guidelines on sampling procedures for effluents from refineries and reception facilities for determination of hydrocarbon content.

1. Sampling location

The sampling point should be located where the greatest degree of turbulence occurs. If possible the Reynolds number should be in the region of 20.000 or higher. If this is not possible it is recommended to create turbulent conditions, for instance by means of baffles. The sample should be taken from the central portion of the flow below the surface.

2. Sample containers

The sample container and the stopper should be made of material which will not contaminate or absorb material from the sample, preferably of glass.

3. Automatic samplers

- the length of the pipe between the sampling point and the container must be as short as possible;
- special caution should be taken to avoid loss of material in strainers and pipes;
- the automatic sampler should be capable of providing as many representative mixed samples per day as required.

4. Sample quantity

The sample quantity should preferably be about 1 litre or more. In general, one sample should not be split for different analyses.

5. Preservation of sample

Precautions must be taken in order to avoid any losses of material (by evaporation and biodegradation) between sampling and analysis (e.g. cooling and/or acidifying).

Principles to be followed in the Infra-Red method of analysis

1. Florisil column whenever interference by polar compounds is expected

2. Carbon tetrachloride (CCl_4) as solvent (safety precautions!) Freon 113 as alternative

3. Wavelengths:
   2925 cm -1 linked with a "real" standard solution taken from the surface waters around the treatment unit
   2925 and 2960 cm -1 linked with a synthetic standard solution 2925, 2960 and 3030 cm -1 linked with a synthetic standard solution

These methods are considered to be reference methods. Other methods may be used if they are calibrated against one of these methods. Countries reporting national data to the Commission should indicate the wavelength and the reference standard used

2. Input of hydrocarbons into the North Sea by the river Elbe (see: "Source and extent of land-based oil pollution...")

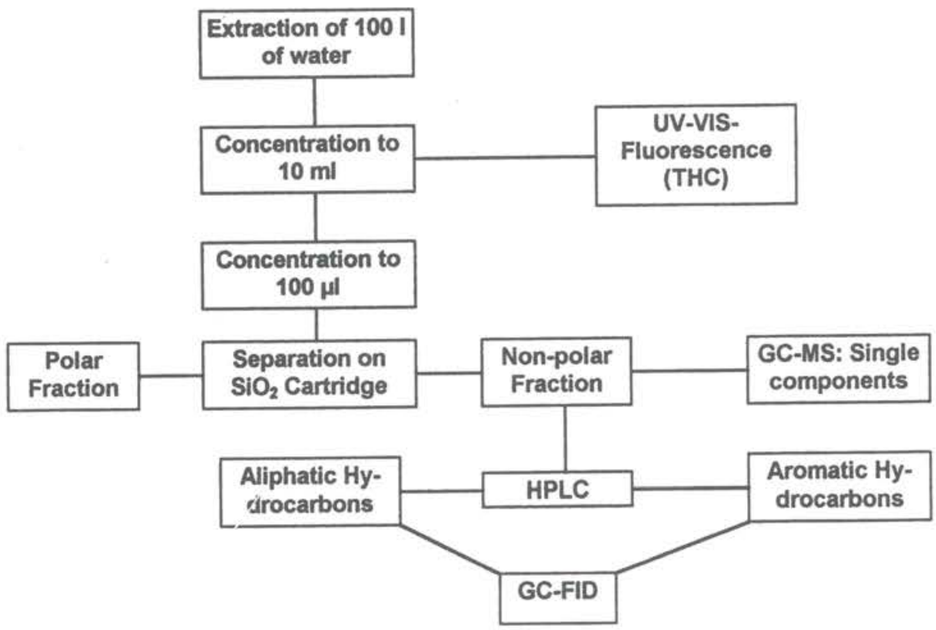


Figure 2: Scheme of the analytical procedures (explanations see following text). (Source: THEOBALD et al., 1995).

Methods

As a composite parameter for the "Total Hydrocarbon Concentration" (THC) the fluorescence of a pentane extract of an unfiltered water sample was used. Although this method does not yield real concentration values, it is often used in international monitoring programs (IGOSS method, IOC 1984) as it results in an easily reproducible value. The figure would indicate the real concentration if the composition of the hydrocarbons in the water corresponded to that of the calibration oil. As this is generally not the case, the measurement represents a relative value only and mostly corresponds to a maximum possible concentration. Therefore in addition to the THC determination, the composition of the water extract was investigated by GC and GC - MS and about 50 selected aliphatic and aromatic hydrocarbons were determined quantitatively. The scheme of the analytic procedure is depicted in Figure 2.

100 litres of unfiltered water (5 m depth) were extracted with one litre of pentane immediately after sampling. The extraction was carried out directly in the sampling glas bowl. Before extraction a solution of deuterated internal standards (3 n-alkanes, 10 PAH´s) was added to the water sample. The dried extract (Na_2SO_4) was concentrated at a rotary evaporator and adjusted to 10 ml. A dilution of this solution was used for the THC determination by fluorescence spectroscopy (Ex: 310 nm, Em: 360 nm). Topped Ecofisk crude oil was used as a calibration oil. THC is expressed in Ecofisk crude oil equivalents.

After this measurement the 10 ml hexane extract was concentrated in a rotary evaporator to ca. 1 ml and under a stream of N_2 down to 100 μl. This solution was separated on a prepacked SiO_2 cartridge (3 ml) into a hydrocarbon fraction (3 ml 10% CH_2Cl_2 in hexane) and a polar fraction (5 ml 50% CH_2Cl_2 -isopropanol).

The hydrocarbon fraction was concentrated to 250 μl, 2 μl thereof were investigated by GC-MS. For GC-MS analysis a Hewlett-Packard 5971A was used. Analysis was performed in selected ion mode (SIM), for quantification the internal standard method was used.

After GC-MS analysis the solution was evaporated - under a stream of nitrogen - to a volume of 100 μl. This extract was separated on a SiO_2 column by HPLC into an aliphatic and an aromatic fraction. These were analysed by GC with FID for the sum of aliphatic and aromatic hydrocarbons; for quantification the internal standard method was used.

Because of the recent confusion over the concept of "legally defensible methods" for oil spill studies, often believed to be limited to the analysis of specific polynuclear aromatic hydrocarbons by GC-MS. Katryn Burns, for example restates the need for a hierarchical scheme of methods to be used in environmental assessment studies. She illustrates the success of using several complementary methods in tandem with examples from the results of the Bahia las Minas (Galeta) Oil Spill Study, and presents further evidence for reasons why methods must continue to be developed for an expanded range of polar oxidation products (BURNS, 1993).

3. A method to identify illegal oil pollution

It is very seldom, that an illegal oil pollution on sea has been observed directly, so that the polluter can be identified. With the help of a modern "analytical scheme", developed at the BSH (Federal Bureau for navigation and hydrogaphy) it is possible to get first results within 2-3 hours and the final result within 4-5 hours.

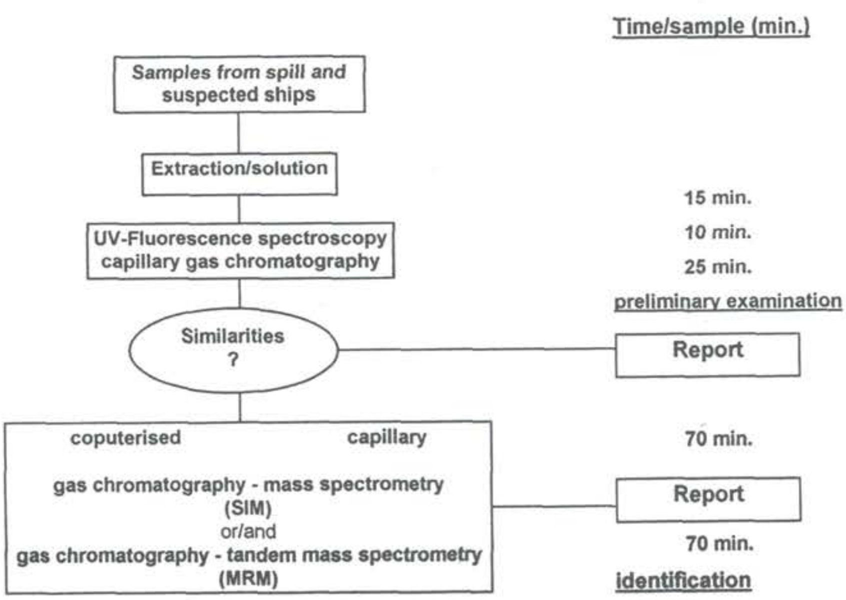


Figure 3: **Modern, computerised analytical methods can cope with the complexity of mineral** oil: several hundred specific components can be detected separately within a very short time and independently used for comparison (explanations in the following text). (Source: THEOBALD, 1993)

Because each oil presents a specific mixture, an identification can only take place by comparing the sample from the pollution with samples from the polluter under suspicion.

The analytical scheme contents three techniques, applied one after the other, : UV-fluorescence spectroscopy (UV-F), Capillar Gas chromatography (GC) and GC-MS.

The first two techniques are regarded as a pre-analysis. The UV-F method allows to define the sequence for the following analysis of the samples. If there are no detectable similarities, comparing the reaults of GC and UVF-analysis, the examination (checkup) can be finished at this point. If they exist, the samples with the clearest similarities are checked up further using GC-MS>

The very fast (10 min) and sensitive UV-F method (detection limit: ca. 0,2 μg/ml) is not very efficient to detect differences. A rough classification of the type of oil is possible, based on the synchronised fluorescence spectra. The intensity of these spectra gives information about the amount of oil in the sample. (Important for the following GC-MS to choose the necessary concentrations). With special columns and a temperature-programme, the time for GC needs just 30 min. Despite of the short time, GC is a very efficient screening method and gives an overview on the overall compound of the oil including a distinct classification: Gasoline, diesel, heavy heating oil, lubricant, crude oil. The detection of singular types of oil, coming for example out of mixtures from bilge-water is also possible.

The combination of GC-MS further allows a much better resolution of the singular compounds. the components are clearly identified by their masses and thus can be quantified very easily. GC-MS analysis means therefore a multidetector GC, with each mass-chromatogram being much better resoluted than the summarizing GC with FID-Detection.

By that way about 500 components of the oils can be defined. Additionally to this, high specifity disturbances like contamination and degradation processes, can be detected and excluded; specific additives or detergents can be recognized and eventually be used as supplementory features.

Steroides and pentacyclic triterpenes (used also as maturity-indicators during oil exploration), prooved to be very useful for the identification. (ideal to characterise crude-and product oils with a high boiling range).

If the similarities are big enough, with high probability the pollutor has been detected. 38% of offshore oil poluters could be clearly identified by this method. Intercalibration exercises with six institutions envolved, showed a very good reliability, the mistake lying by about 10 percent. (THEOBALD, 1993).

4. QUASIMEME, Intercalibration exercises

The intercalibration results presented above, were very good because a reliable standard could be applicated. In the analysis of samples with an unknown mixture of contaminants, mistakes of about 50 percent or more, are not unusual.

There have been several programmes of OSPAR to intercalibrate the analysis concerning oil pollution in the North Sea with changing results. A new programme, initiated by the European Union, showed a very successful development: The "Quality Assurance of Information for Marine Environmental Monitoring in Europe" - "QUASIMEME".

I will here just present a short example with respect to PAH's, that are, as we already know, ubiquitous in the environment and occur as a result both of natural processes such as forest fires, and of anthropogenic inputs from fossil fuel combustion and industrial sources. A core group of PAH's has now been listed as mandatory determinants in sediments under the "Joint Assessment and Monitoring Programme of the Oslo and Paris Commissions". Previous intercomparison exercises organised by the "International Council of the Sea" (ICES), Marine Chemistry Working Group, have shown a serious lack of comparability between PAH concentrations measured both in different laboratories, and using both techniques in common use (based upon Gas- and Liquid chromatography (LAW & NICHOLSON, 1995). The current QUASIMEME-programme seeks to built upon this experience and to identify areas of weakness within the present methodologies which contribute to the present lack of comparability. The ultimate aims are to demonstate that comparability can be achieved by use of appropriate methodology, and eventually to establish a continuous laboratory testing scheme coupled with a training programme 9LAW & KLUNGSOYR, 1995).

The conclusions from a first exercise with the aim of checking the accuracy of instrument calibration procedures show:

1. Seven of 25 laboratories participating in the exercise were capable of producing good data for PAH in standard solutions.

2. A number of individual laboratories need to pay attention to aspects of their performance.

3. The single factor most limiting laboratories performance seemed to be an inability to check data adequately prior to submission and to report it accurately, and much more attention and care needs to be given to this area. A data check list may be of assistance.

5. **Bioassays, a short introduction into the topics of the department of Ecotoxicology at the Berlin University of Technology.**

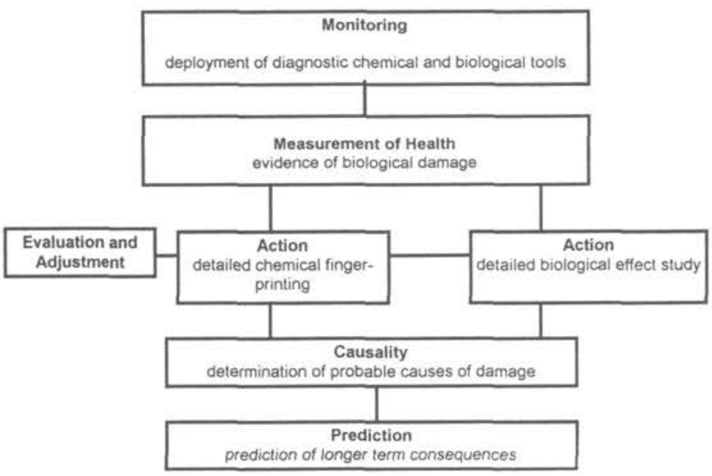
The following biotest-techniques with issues concerning specific hydrocarbon pollution are recommended for monitoring programmes in the ACME Report, 1995:

Method	Organisms	Issues	Biological significance
Bulky DNA adduct formation	Fish, Bivalvia	PAH's synth. organics amino triazine Pesticides	Genotoxic effects
Neoplastic and pre-neoplastic liver histopathology	Fish	PAH's synth. organics Pesticides	Pathological changes associated with exposure to genotoxic and non-genotoxic carcinogens
EROD or P-450 1A1 induction	Fish	Induction of enzymes which detoxify planar organic cont. i.e. PAH's planar PCB's dioxins	Possible predictor of pathology through mechanistic links. Sensitive indicator of exposure

The department for Aquatic Ecotoxicology at the Institute for Ecological Research and Technology - Berlin University of Technology (Director: Prof. Dr. P.D. Hansen) collects and evaluates data on aquatic environmental disasters and reference areas. Due to the scale of ecotoxicological effects, there is a real need for the valuation of extensive chemical and physical analytical data from various monitoring programmes. In order to secure the functioning and stability of waters and sediments or to actually re-establish these qualities, concrete ecological knowledge about the interactions of functions and structures of ecosystems, as well as nutrient cycles and energy fluxes in their temporal succession is needed.

As a conventional tool to satisfy legislative requirements, reporducible test data are easily obtained using bioassays. The standardisation and normalization of procedures based on DIN (German Institute for Standardization), participation in intercalibration exercises (EEC, ISO, DIN, ICES) and finally the application of the procedures in monitoring programmes are an important part of the ecotoxicological work in this department. For the interpretation and the application of the data in the field situation-line monitoring systems (biosensors for early warning) with whole cell sensors and immunotrapping devices which are more representative of the on-site field situation. Protective measures are of primary concern, i.e. recognition of a threshold value which may not be exceeded in order to avoid possible damage and expensive restoration measures. With respect to the assessment of ecosystem health and the development of tools and approaches the recent topics are:

- Sediment-Toxicology (freshwater and marine). "Interaction between sediments and orgnisms: The possible genotoxic and immuno-suppressive potential of metals".
- Effects Monitoring (freshwater and marine). Detoxification processes (MFO - mixed function oxy-genases) and DNA damage (Genotoxicity); immuno-suppression (Phagocytosis). "Parallel monitoring of mixed functional oxygenase (MFO) induction and DNA damage in marine organisms".
- Miniaturized bioassays (microplate techniques) and flow-through (on-line) monitoring Systems. Cost efficient screening methods (toxicity, genotoxipotential, mutagenicity) in the field (sediments).
- Biosensors (freshwater and marine). Whole cell sensors and Immuno-sensors - Biosensors for Enviornmental Monitoring (Immuno-absorbent analyte-trapping devices).
- Present Area of Research (EEC project): Development of on-stream biosensors for **pesticide detection - construction of immobilised microbial electrodes.**



Figures 4: An intergrated marine environmental monitoring strategy based on the need for closer integration of chemical and biological monitoring techniques. (Source: ACME, 1995).

6. Conclusions of an integrated marine environmental monitoring strategy (ACME, 1995).

In Annex 1 of the above mentioned ICES Report an integrated marine enviornmental monitoring strategy based on the need for closer integration of chemical and biological monitoring techniques is introduced. The conclusions and recommendations are as follows (Figure 4).

- A marine monitoring strategy that fully integrates it's chemical and biological components is proposed in order to allow an overall awareness of environmental quality in relation to issues of concern.
- For preliminary screening in areas where problems are not suspected, the use of diagnostic chemical and biological methods for the health status of individual sentinel or bioassay organisms should be the first line of approach. The detection of significant adverse biological effects would then trigger detailed biological and chemical investigations whose purpose would be to establish the severity of any impacts in the ecosystem, and the chemical causes of those impacts.
- This strategy does not preclude the need to use chemical monitoring techniques for assessing temporal trends in certain areas in relation to input controls, and for safegaurding the human food chain.
- The use of a selection of biological techniques directed at issues of concerns is advocated. (A list of techniques is presented in the report that were chosen from the wide range that have been tried and tested in the IOC and ICES series of workshops and elsewhere).
- The suite of techniques should cover a range of levels of biological organization and representative species of natural communities.
- There should be evaluation of the effectiveness of the monitoring strategy at all levels of measurement and necessary adjustment in order either to redefine the objectives or else modify the methods used.
- This proposed integrated enviornmental monitoring strategy is deemed to be the most appropriate way forward given the current state of knowledge.

References:

1. ACME (1995): Report of the ICES Advisory Committee on the Marine Environemtn, ICES Coop. Res. Rep., 212: 84-96, ISSN 1017-6195.
2. Burns, K. (1993): Analytical methods used in oil spill studies. Mar. Poll. Bull., Vol. 26, No.2: 68-72.
3. International Oceanographic Commission (1984): Manual for monitoring oil and dissolved/dispersed petroleum hydrocarbons in marine waters and on beaches. OC/UNESCO, Paris, Manuals and Guides 13.
4. Law, R.J. & M.D. Nicholson (1995): Report on the results of the ICES/IOC/OSPARCOM intercomparison programme on the analysis of chlorobiphenyls in marine media - step 2, and the intercomparison programme on the analysis of PAHs in marine media - stage 1. ICES Coop. Res. Rep., 207 : 52 - 104.
5. Law, R.J. & J. Klungsör (1995): Polycyclic aromatic hydrocarbons (PAH) in standard solutions. QUASIMEME Buleetin 3: 10 - 11.
6. PARCOM (1993): Procedures and Decisions Manual C3/94-E.
7. Theobald, N. (1993): Umweltsündern auf der Spur. Chemische Industrie 2/93: 33 - 34.
8. Theobald, N., Rave, A. & K. Jerzychi-Brandes (1995): Input of hydrocarbons into the North Sea by the river Elbe. Fresenius J Anal Chem (1995) 353: 83 - 87.

PUBLICATIONS OF THE RCU/EAS TECHNICAL REPORT SERIES

EAS 1 UNEP: Training Manual on assessment of the quantity and type of land-based pollutant discharges into the marine and coastal environment. RCU/EAS Technical Reports Series No. 1 UNEP, Bangkok, 1993. (65 pages) **(out of stock)**

EAS 2 L.M. Chou (ed.): Implications of expected climate changes in the East Asian Seas Region: an overview. RCU/EAS Technical Reports Series No. 2 UNEP, Bangkok, 1994. (196 pages). Also published as UNEP Regional Seas Reports and Studies No. 160. **(out of stock)**

EAS 3 UNEP: Proceedings of the UNEP Workshop on biological effects of pollutants. RCU/EAS Technical Reports Series No. 3 UNEP, Bangkok, 1994. (67 pages) **(out of stock)**

EAS 4 R. Kenchington and K.L. Ch'ng (eds.): Staff training materials for the management of marine protected areas. RCU/EAS Technical Reports Series No. 4 UNEP, Bangkok, 1994. (545 pages) **(in stock)**

EAS 5 Dr. Lawrence C.C. Koe & Dr. M.A. Aziz: Regional Programme of Action on Land-Based Activities Affecting Coastal and Marine Areas in the East Asian Seas. RCU/EAS Technical Reports Series No. 5 UNEP, Bangkok, 1995. (117 pages) **(in stock)**

EAS 6 Miguel D. Fortes: Seagrasses of East Asia: Environmental and Management Perspectives. RCU/EAS Technical Reports Series No. 6 UNEP, Bangkok, 1995. (79 pages) **(in stock)**

EAS 7 L.M. Chou: Proceedings of the Workshop on Soft-Bottom Benthic Communities as Indicators of Pollutant-Induced Changes in The Marine Environment. RCU/EAS Technical Reports Series No. 7 UNEP, Bangkok, 1995. (83 pages) **(in stock)**

EAS 8 Trevor J. Ward: Proceedings of the Workshop on Eutrophication in Tropical marine Systems - The Impacts and Management of Nutrient Pollution. RCU/EAS Technical Reports Series No. 8 UNEP, Bangkok, 1996. (137 pages) **(in stock)**

EAS 9 Report of the Training Workshop on Land-based Oil Discharges to Coastal Waters: Ecological Consequences and Management Aspects. RCU/EAS Technical Reports Series No. 9 UNEP, Bangkok, 1996. (220 pages) **(in stock)**

EAS 10 Proceedings of the Second ASEAMS Scientific Symposium (ASEAMS). RCU/EAS Technical Reports Series No. 10 UNEP, Bangkok, 1996. (120 pages) **(in stock)**

EAS 11 East Asian Seas Regional Report on the Issues and Activities Associated with Coral Reefs and Related Ecosystems. RCU/EAS Technical Reports Series No. 11. UNEP, Bangkok, 1996. (68 pages) **(in stock)**

EAS 12 Integrated Coastal Zone Management Training Manual (EAS-34). RCU/EAS Technical Reports Series No. 12. UNEP, Bangkok, 1996. (382 pages) **(in stock)**

Report of the Workshop on the Biology and Conservation of Small Cetaceans and Dugongs of Southeast Asia, Dumaguete, 27 - 30 June 1995. (101 pages) **(in stock)**

Report of the Workshop on the Application of Methodologies for Valuation of Environmental and Natural Resources with Particular Reference to Oceans and Coastal Areas, Denpasar, Bali, Indonesia 27 November - 1 December 1995. (112 pages) **(in stock)**

Report of the International Coral Reef Initiative (ICRI) Regional Workshop for the East Asian Seas, Denpasar, Bali, Indonesia 18 - 22 March 1996. (92 pages) **(in stock)**

UNEP

Issued and printed by:

East Asian Seas Action Plan
United Nations Environment Programme

Additional copies of this and other publications issued by the East Asian Seas Action Plan of UNEP can be obtained from:

Regional Coordinating Unit for East Asian Seas Action Plan
United Nations Environment Programme
United Nations Building, 10th Floor
Rajdamnern Avenue
Bangkok 10200
THAILAND

EAS/RCU Direct lines: Tel: (66-2) 281 2428
Facsimile: (66-2) 267 8008