OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

ICS
International Centre for Science
and High Technology

International Environment Institute of the
Foundation for International Studies

Industrial Risk Assessment for Integrated Coastal Management.
A Training Course on Geographic Information Systems

25 November - 3 December 1996
Gozo, Malta

Final Report

International Environment Institute (IEI)
Foundation for International Studies
Old University Building
St Paul Street
Valletta VLT 07
MALTA
tel: + (356) 240741
fax: + (356) 230551
e-mail: iei@cis.um.edu.mt

International Centre for Science
and High Technology (ICS)
Via Grignano 9
P.O. Box 586
34014 Trieste
ITALY
tel: + (39) 40 224572
fax: + (39) 40 224575

Table of Contents

ICS
International Centre for Science and High Technology

International Environment Institute of the
Foundation for International Studies

Final Report

Title: Industrial Risk Assessment for Integrated Coastal Management. A Training Course on Geographic Information Systems

Dates: 25 November - 3 December 1996

Venue: Gozo, Malta

Convenors: Mr Louis F. Cassar, Executive Coordinator, International Environment Institute, Foundation for International Studies, University of Malta, Valletta, Malta.

Prof Enrico Feoli, Environment Programme, ICS-UNIDO, Trieste, Italy.

(a complete list of the training course organisers and secretariat can be found in Annex I)

Purpose

The Training Course was organised with the aim of improving the capacity of the management of the industry/environment interface in developing countries of the Mediterranean region, by introducing Geographical Information System (GIS) technology and Decision Support System (DSS) techniques. In particular, the Training Course was aimed at addressing problems related to Industrial Risk Analysis and Integrated Coastal Zone Management in Mediterranean developing countries *(see Annex II)*.

Topics and programme

The Training Course was opened by Prof Ugo Leone, ICS Project Leader, who outlined the aims of ICS and gave general information on the relevance of the Training Course topic.

Opening speeches were delivered by Prof Ugo Leone, Prof Patrick J Schembri, Chairman of the International Environment Institute of the Foundation for International Studies, and Mr Saviour Borg of the Ministry of Foreign Affairs and the Environment. The Workshop was inaugurated by the Hon. Parliamentary Secretary for Gozo, Dr Anton Refalo. Following the official inauguration session, the Workshop was addressed by Prof Enrico Feoli of ICS, Mr Anton Micallef of the Euro-Mediterranean Centre for Insular Coastal Dynamics and Mr Louis F Cassar of the International Environment Institute, who briefed the participants about the expected outcome of the Workshop, and also gave presentations on their respective institutions.

Following the opening and briefing sessions, the Training Course following the attached programme *(see Annex III for course programme, list of teaching faculty and abstracts of lectures)*. The programme dealt with a general evaluation methodology having a wide range of potential applications in the study of integrated coastal zone management, basically oriented to coastal development and the conservation of landscape environmental quality.

The Training Course was officially closed on 3 December 1996, by Mr Piergiorgio Stipa on behalf of ICS-UNIDO and Mr Louis F Cassar on behalf of the IEI-Foundation for International Studies. A certificate of attendance *(Annex IV)* was presented to each participant.

Participants

Twelve participants coming from ten Mediterranean countries attended the Workshop. The final list of participants is attached as *Annex V.*

Conclusions and recommendations

A questionnaire was distributed to all participants in order to obtain their comments on the Training Course *(a copy of the questionnaire is attached as Annex VI).*

The participants' comments on the lectures and practical exercises were generally positive, describing the course content as being interesting, useful, comprehensive and well-presented. It was suggested that more time should be devoted to the practical exercises, with shorter lectures. The importance of lectures examining detailed case studies, linking the theoretical and practical aspects, was stressed. It was felt that the lecture programme could have been improved by ensuring that the general introductory lectures on coastal uses and management were all delivered during the first few days, thereby freeing the remaining days for work of a more practical and applied nature. Suggested additional topics for future courses included Remote Sensing, mapping procedures and image processing.

The participants expressed an appreciation of the network of contacts established through participation in the Training Course, and wished to be informed of future activities in this field. A suggestion was made during the final discussion for such courses to be held also at the subregional level e.g. for the Maghreb countries.

Following high-level discussions between representatives of ICS, the IEI, ICoD and the Ministry for Foreign Affairs and the Environment, future cooperation has been proposed which includes the holding of further joint activities focussing on the area of GIS and Environmental Risks and Impacts.

Funding

The total budget for the Training Course amounted to a total of US$39,951 as in the attached financial statement *(see Annex VII)*.

Press release

Immediately after the end of the Training Course, a press release *(Annex VIII)* was sent to the main local newspapers.

Annex I - Organisation

Prof Ugo Leone
Project Leader
International Centre for Science
and High Technology
Via Grignano 9
34014 Trieste - **Italy**
fax: + (39) 40 224575
tel: + (39) 40 224572

Prof Salvino Busuttil
Director-General
Foundation for International Studies
Old University Building
St Paul Street
Valletta - **Malta**
fax: + (356) 240353
tel: + (356) 233218

Mr Saviour Borg
Director
Multilateral Affairs
Ministry of Foreign Affairs
and the Environment
Palazzo Parisio
Merchants Street
Valletta - **Malta**
fax: + (356) 237822
tel: + (356)245705

Mr Louis F Cassar
Executive Coordinator
International Environment Institute
Foundation for International Studies
Old University Building
St Paul Street
Valletta - **Malta**
fax: + (356) 230551
tel: + (356) 240741

Prof Enrico Feoli
Environmental Programme
International Centre for Science
and High Technology
Via Grignano 9
34014 Trieste - **Italy**
fax: + (39) 40 224575
tel: + (39) 40 224572

Mr Anton Micallef
Director
Euro-Mediterranean Centre
on Coastal Dynamics
Foundation for International Studies
Old University Building
St Paul Street
Valletta - **Malta**
fax: + (356) 230551
tel: + (356) 240746

Mr Piergiorgio Stipa
Associate Professional Officer
Earth, Environment and Marine Sciences and Technologies
International Centre for Science
and High Technology
Via Grignano 9
34014 Trieste - **Italy**
fax: + (39) 40 224575
tel: + (39) 40 224572

Ms Maria Bugeja
International Environment Institute
Foundation for International Studies
Old University Building
St Paul Street
Valletta - **Malta**
fax: + (356) 230551
tel: + (356) 240741

Ms Elisa de Roa
International Centre for Science
and High Technology
Via Grignano 9
34014 Trieste - **Italy**
fax: + (39) 40 224575
tel: + (39) 40 224572

Ms Lucienne Bugeja
Conference Unit
Foundation for International Studies
Old University Building
St Paul Street
Valletta - **Malta**
fax: + (356) 230551
tel: + (356) 234571

Ms Simone Vella
Conference Unit
Foundation for Intrnl. Studies
Old University Building
St Paul Street
Valletta - **Malta**
fax: + (356) 230551
tel: + (356) 234571

Annex II - Aide-memoire

13.11.96
EF/ps/esr
604/2.1.2.A

International Centre for Science and High Technology

International Environment Institute of the Foundation for International Studies

AIDE-MEMOIRE

Industrial Risk Assessment for Integrated Coastal Management. A Training Course on Geographic Information Systems

Gozo, Malta
25 November-3 December 1996

International Centre for Science and High Technology (ICS)
Via Grignano 9, P.O. Box 586, 34014 Trieste, Italy
Tel.: +39-40-224572 Fax: +39-40-224575

International Environment Institute of the
Foundation for International Studies
University of Malta, Old University Building,
St. Paul Street, VLT 07 Valletta, Malta,
Tel.: +356-240741 Fax: +356-230551

BACKGROUND AND JUSTIFICATION

Growing consensus for ICAM in the Mediterranean

The implementation of an Integrated Coastal Area Management (ICAM) can stimulate and guide the sustainable development of coastal areas: it can minimise the degradation of the natural system, provide a framework for the management of multi-sectoral activities and maintain options for future uses of resources, ultimately contributing to the protection and sustainable use of region's coastal resources.

The growing realisation of the relevance of coastal dynamics to the understanding of the health and well-being of the general Mediterranean environment, the need to further study and understand insular systems as a representative of the whole, has now been accepted by the scientific and policy-making communities. An initiative to focus attention on this area so as to promote the island sustainability is thus called for.

In modern industrial societies, human activities are interacting with the basic environmental systems in a way that the nature never experienced before. It is in this context that industrial ecology has evolved as a branch of ecology with the specific aim of analysing the interactions systematically. The best way to define industrial ecology is by way of analogy to traditional ecology. Within both industrial and natural ecosystems, each process or network of processes is viewed as an interrelated part of a larger whole. In other words, it has to be considered that manufacturing processes are not performed in isolation from their surroundings but are influenced by them and, in turn, have their own influence in the environment. This analogy forces to apply ecological concepts in the industrial context. Ecology has shown that sustainable ecosystems have cyclic processes rather than linear. On the contrary, many present-day industrial processes, being essentially dissipative, follow linear models, in which materials are degraded, dispersed and lost. Industry is under pressure to move away from this linear model towards cyclicity in order to achieve a sustainable development. Industrial ecology is intended to facilitate this by offering tools for managing the industrial development. Due to practical and economical reasons, it is impossible to achieve the complete cyclicity in short time. For this reason, it is necessary to develop tools useful for planning the industrial development. Among the possible tools the Computer Information Systems can be considered among those with the highest content of utility for the reason that they are able to provide in a fast and organized way at least some of the necessary information on which to base decisions. By the term CIS it is here meant any computer system composed by hardware and software able to integrate data bases, mathematical and logical models and graphical representation of the information both by abstract and geographic maps. Not all the CISs are designed to support decisions, many are just organized to analyze, understand and represent the information stored in data bases. Only if the CIS is oriented and used to support decisions it is called Decision Support System (DSS). Notwithstanding that in the specialized literature DSS is now viewed as a mathematical technique or a set of techniques for

optimizing something under some constraints, we consider DSS in its broad meaning as a special case of CIS and we call Mathematical Decisions Support Systems (MDSS) those based on mathematical tools. MDSS may or may not be part of DSS since decisions are generally done based also on information (meta-information or meta-knowledge) that are not codified and available for MDSS.

Decision Support System, a CIS that is able to integrate the following main subsystems:

- DataBase (DB), a system for collecting, storing and retrieving information.
- Data Analysis and Modelling System (DAMS), a system for analysing the data retrieved from DB and for producing models for explanation or simulation.

Geographic Information System (GIS), a system capable to integrate different georeferred information from DB, to give new data to DAMS and to display the results of DAMS on maps.

Mathematical Decision Support System (MDSS), a system capable to suggest the best solution among some alternatives keeping in mind specific objectives and specific constraints.

AIMS OF THE TRAINING COURSE

The main objective of the training course is to improve the capacity of the management of the industry/environment interface in developing countries of the Mediterranean region by introducing the geographical information system technology and in particular industrial risk assessment for integrated coastal management. The training course will be addressed to face problems related to environmental assessment for coastal management and/or related activities.

STRUCTURE OF THE TRAINING COURSE

This activity is intended as a training course, and it is planned for dissemination of information on the use of GIS An overview of integrated coastal area management will be given to the participants.

Several lectures will be given by specialists in GIS, DSS and CZM. Special practical training will be given to the participants by using adapted case studies.

PARTICIPATION

The training course will bring together technologists and researchers in contact with the industry. Participation is by invitation. A maximum of 15 participants will be admitted to the training course coming from Mediterranean countries. About ten lecturers will be invited to speak on specific topics.

EXPECTED OUTPUTS

The training course will be the occasion to reinforce and strengthen the network already established by ICS with the Mediterranean countries to deal with problems related to integrated coastal zone management and industrial risk assessment.

The output of this activity will the training of the invited participants by transferring the acquired knowledge through the decision making process in their own countries. It is expected that through this activity the capacity building of the institutions from which the participants are coming will be improved.

PROGRAMME

The training course will deal with a general evaluation methodology with a wide range of potential applications in the studies of integrated coastal zone management, basically oriented to coastal development and conservation of landscape environmental quality. The innovative approach of this training course lays in the development of the basic use of GIS and DSS through practical demonstrations:

1) the integration of ecological factors with spatially-distributed data;
2) the use of spatial data analysis techniques to extract and map environmental indicators;
3) the formulation/solution of multi-objective decision processes for environment-compatible planning policies.

The key point of the method used is to develop GIS modelling and modelling techniques for industrial risk assessment and integrated coastal management. The implementation of existing methodologies for technological risk assessment and decision support systems allows to combine field observations with existing data on maps and with the results of image processing.

The GIS represents in this training course a critical tool for supporting numerical modelling of integrated coastal management processes.

Software tools

The GIS exercises have been designed to teach the basis of GIS concepts and methods, with respect to the IDRISI GIS for Windows system.

The entire set of exercises deal with processes relevant to coastal zone research and management like:

a) local and regional resource inventory and suitability analysis;
b) remote sensing and methods of image processing for coastal analysis;
c) modelling change in the coastal environment;
d) development planning, etc.

DOCUMENTATION

The documents available for the training course will be:

1) Aide-mémoire of the training course.
2) Programme and list of participants.
3) Lecture notes, bibliography and copies of manual of exercises (for internal use only).
4) A list of selected bibliography on DSS for industrial development.

LANGUAGE

The training course will be conducted in English and no translation facilities will be available. It is expected that the participants have a good command of English.

TIME AND VENUE

The training course will be held at the L-Imgarr Hotel, Mgarr Gozo, from 25 November to 3 December 1996.

FINANCIAL ADMINISTRATIVE ARRANGEMENTS FOR UNIDO-ICS FINANCED PARTICIPANTS

For those who will be invited by UNIDO-ICS to participate in the training course, round-trip air-economy transportation from the airport of departure will be arranged and prepaid tickets issued where necessary.

Room and board at the training course venue plus a daily allowance and terminal expenses will be provided upon arrival to Gozo. Reservation will be made for all participants at the L-Imgarr Hotel, Mgarr, Gozo (Tel.: +356-560455/7, Fax: +356-557589).

The participants will be required to bear the following costs:

All expenses in their home country incidental to travel abroad, including expenditures for passport, visa, and any other miscellaneous items. UNIDO-ICS will not assume responsibility for any of the following costs which may be incurred by the participant while attending the meeting:

(1) compensation for salary or related allowances during the period of the workshop;
(2) any costs incurred with respect to insurance, medical bills and hospitalization fees;
(3) compensation in the event of death, disability or illness;
(4) loss or damage to personal property of participants while attending the workshop.

VISA ARRANGEMENTS

Participants are requested to arrange for their visa as early as possible at the Maltese Embassy in their home country. In case of difficulties, please advise the contact person mentioned below.

CONTACT PERSON

For additional information, please contact Mr. L. Cassar. Further details about the training course and travel instructions will be provided upon request.

Mr. L. Cassar
Executive Coordinator
International Environment Institute
Foundation for International Studies
University of Malta
University Building
St. Paul Street, Valletta VLT07
Malta
Tel.: +356-240741
Fax: +356-230551

Annex III - Course programme, abstracts & training faculty

International Centre for Science and High Technology

International Environment Institute and
Euro-Mediterranean Centre on Coastal Dynamics of the
Foundation for International Studies, University of Malta
in collaboration with
Ministry of Foreign Affairs and the Environment

Industrial Risk Assessment for Integrated Coastal Management.
A Training Course on Geographic Information Systems

Gozo, Malta
25 November-3 December 1996

Programme

Monday 25 November

09:00-09:30	Open Ceremony
09:40-10.15	Presentation of ICS-UNIDO and IEI, etc. E. Feoli - Introduction to the course
10:15-11:00	A. Vallega - Conceptual basis to ICM
11:00-11:30	Coffee break
11:30-12:30	A. Vallega - Continued
12:30-14:00	Lunch
14:30-15:30	P.J. Schembri - Biogeography of the region
15:30-16:00	Coffee break
16:00-17:00	A. Micallef - Overview on integrated coastal area management
17:00-18:00	Open discussions

Tuesday 26 November

09:00-10:00	E. Feoli - Industrial Ecology
10:00-11:00	E. Feoli - Analysis and data integration
11:00-11:30	Coffee break
11:30-13:00	M. Gatt - Technical overview
13:30-14:30	Lunch
14:30-16:00	A. Fabbri - Geoindicators and environmental indicators
16:00-16:30	Coffee break
16:30-17:00	A. Fabbri - Continued
17:00-18:00	Open discussions

Wednesday 27

09:00-11:00	A. Fabbri - GIS modelling and modelling tools
11:00-11:30	Coffee break
11:30-12:30	A. Patrono - Case studies
12:30-14:00	Lunch
14:30-16:00	A. Patrono - Continued
16:00-16:30	Coffee break
16:30-18:00	Open discussions

Thursday 28

09:00-11:00	C. Galdies - Ecotoxicology
11:00-11:30	Coffee break
11:30-12:30	A. Patrono - Case studies
12:30-14:00	Lunch
14:30-15:30	A. Patrono - Continued
15:30-16:00	Coffee break
16:00 -18:00	Open discussions

Friday 29

09:00-11:00	**K. Fabbri** - Data integration by COSMOS
11:00-11:30	Coffee break
11:30-12:30	Open discussions
12:30-14:00	Lunch
14:30-15:30	**K. Fedra** - Technological risk assessment
15:30-16:00	Coffee break
16:00-17:00	**K. Fedra** - Continued
17:00-18:00	**K. Fedra** - Decision support systems

Saturday 30

08:30-10:30	**K. Fedra** - Case studies
10:30-11:00	Coffee break
11:00-12:00	**A. Role** - Recreation uses
12:00-13:30	Lunch
13:45-14-45	**L.F. Cassar** - Planning for conservation on the coastal zone
15:00-	Cultural tour (Includes also visits to some coastal sites)

Sunday 1

Free day

Monday 2

09:00-11:00	**K. Fabbri** - Socio-economic system
11:00-11:30	Coffee break
11:30-12:30	**K. Fabbri** - Continued
12:30-14:00	Lunch
14:30-15:30	**A. Patrono** - Case studies
15:30-16:00	Coffee break
16:00 -18:00	Open discussions

Tuesday 3

09:00-11:00	**K. Fabbri** - Policy analysis and decision making
11:00-11:30	Coffee break
11:30-12:30	**A. Patrono** - Case studies
12:30-14:00	Lunch
14:30-15:30	**A. Attard Montalto & M. Cassar** - Acquaculture in coastal areas
15:30-16:00	Coffee break
16:00-17:00	Open discussions and closure of the course

CONCEPTUAL BASIS TO INTEGRATED COASTAL MANAGEMENT

Adalberto Vallega
Department of urban, regional and landscape planning, POLIS, Università degli Studi di Genova

The presentation aims at presenting a spectrum of concepts relating to integrated coastal management which should be taken into account in order to plan and manage Geographic Information Systems (GIS) and other information tools.

On this subject the presentation covered (i) the concept of integrated coastal management according to international conventions and related materials (ii) the concepts of coastal system, coastal area and coastal use structure (iii) parameters concerned with ecosystem integrity (iv) jurisdictional frameworks (v) the coastal use structure (vi) conflicts between coastal uses, and (vii) decision-making systems.

These concepts were presented with reference to materials from both UN and technical literature. The Mediterranean was assumed as the core case study, and the approach was drawn from the book *Integrated coastal management. Fundamentals* (A. Vallega, in preparation).

BIOGEOGRAPHY OF THE MEDITERRANEAN REGION

Patrick J Schembri
Department of Biology, University of Malta

The session undertaken by Prof Schembri was conducted in the field, taking the form of an on-site lecture. The area selected was the Qawra/Dwejra region on the west coast of Gozo. This area is of particular interest by way of its geology, geomorphology and palaeontology, as well as the specialized habitats which occur in the region. The lecture highlighted the various environmental episodes which took place throughout the ages, giving practical examples through geomorphological and palaeontological evidence

---

AN OVERVIEW OF INTEGRATED COASTAL ZONE MANAGEMENT

Anton Micallef
EuroMediterranean Centre on Insular Coastal Dynamics, Foundation for International Studies, Malta

The marine environment is still regarded as an unlimited resource and a new frontier, still to be explored and exploited as an unlimited resource base. The truth is that we are still relatively unsure of the full scope of the marine environment as a natural resource base which can benefit mankind through a multitudinous range of uses; the challenge is to utilise it in a sustainable manner and to preserve the functional integrity of the land-sea interface.

It is because of this that the scope of coastal and marine development in particular need to be addressed not only with some alacrity, but also with great care and attention, because damage to the marine environment is also possible

from mismanagement. Integrated Coastal Zone Management (ICZM) thus needs to become a reality and to be practised in the shortest possible time span. A common approach to ICZM is particularly desirable because of the different values which are attributed to this resource in different parts of the world.

INDUSTRIAL ECOLOGY

Enrico Feoli
International Centre for Science and High Technology, UNIDO

The application of GIS and quantitative methods for analysis of industrial patterns was presented. The concept of industrial ecology and the interactions between industry and environmental systems were discussed. The use of specific tools, such as GIS and certain spatial pattern analysis methods (nearest-neighbour and spatial autocorrelation techniques), to assess the dynamics of industrial systems and to facilitate industrial planning and environmental control was presented.

ANALYSIS AND DATA INTEGRATION

Enrico Feoli
International Centre for Science and High Technology, UNIDO

The problems of data collection and organization for analysis and integration were presented. The concepts of technological space and environmental space were introduced. Different analysis methodologies were discussed: principal component analysis, canonical correlation analysis, etc. Finally, the importance of similarity indexes (e.g. Goodall's) was stressed.

TECHNICAL OVERVIEW OF GIS TECHNOLOGY

Matthew Gatt
Mapping Unit, Planning Directorate, Malta

This session aimed to give the participants from various backgrounds a brief overview of the development of GIS technologies over the past twenty years. The increasing application of GIS technology was discussed with reference to the following developments:

- The concepts and components of GIS
- An overview of spatial analysis capabilities
- Vector based systems and related developments
- The increasing importance of raster GIS and its integration with Remote Sensing
- The development of integrated database capabilities
- Key issues yet to be implemented in GIS
- Overview of local activities in relation to the above areas

---

GEOINDICATORS AND ENVIRONMENTAL INDICATORS

Andrea Fabbri
ERS, Geological Survey Division, International Institute for Aerospace Survey and Earth Sciences (ITC), Netherlands

This lecture analysed the use of environmental indicators in the geosciences and aimed to clarify the dilemmas associated with assigning values to natural resources. Definitions were provided for environmental impact, environmental indicators and indices, environmental impact assessment and the Delphi technique of constructing the indicator functions, as well as for operations such as scaling, weighting, aggregation and sensitivity analysis. The construction of indicator maps in order to generate thematic maps, using the concept of geo-environmental units and the techniques of spatial data analysis, was discussed. Geoindicators dealing with the coastal environment were described, namely coral chemistry and growth patterns, relative sea levels, shore line position and wetland extent, structure and hydrology. The lecture ended with a discussion of various practical problems concerning geoindicators, GIS and the decision-making process.

GIS MODELLING AND MODELLING TOOLS

Andrea Fabbri
ERS, Geological Survey Division, International Institute for Aerospace Survey and Earth Sciences (ITC), Netherlands

This lecture analysed the concepts of Geographic Information Systems (GIS) and of GIS modelling. Several models were discussed as examples, including USLE, DRASTIC and IDRISI's applications in coastal zone research and management. Various types of elementary and advance GIS tools were described and discussed, using ILWIS 2.0 for Windows. The Favourability Index Function, a general approach to spatial data analysis, was then presented. This enables the use of several data-driven and model-driven approaches to predictive modelling.

The following GIS models in IDRISI's Applications in Coastal Research and Management (UNITAR Vol. II, 1993) were introduced to deal with analytical functions, strategies, results and models:

- Local and Regional Resource Inventory *(shrimp fishing)*
- Remote Sensing Methods for Coastal Analysis *(Landsat TM to model bathymetry)*
- Modelling changes in Coastal Environments *(years of beach profiles to model past erosion and deposition)*
- General GIS Exercise *(data layers for aquaculture suitability study)*

CASE STUDIES IN GIS

Andrea Patrono
International Institute for Aerospace Survey and Earth Sciences (ITC), Netherlands

The participants carried out a series of exercises extracted and adapted from the UNITAR (United Nations Institute for Training and Research) workbook Applications in Coastal Zone Research and Management (Volume 3 of the series Explorations in Geographic Information Systems Technology). Photocopies of papers related or referred to during the theoretical and practical lectures were later to the participant for internal use.

In the course of presenting these case studies and assisting the participants during the practicals, several lectures were given, including:

- introduction to GIS for industrial siting and coastal management
- introduction to IDRISI with demonstration on screen using an LCD projector
- practical examples of GIS applications, including the introductory exercise

---

THE ROLE OF MARINE ECOTOXICOLOGY AS A COASTAL MANAGEMENT TOOL TO ASSESS INDUSTRIAL RISKS.

Charles Galdies
EuroMediterranean Centre on Insular Coastal Dynamics, Foundation for International Studies, Malta

Fundamental concepts of ecotoxicology and their practical applications were discussed in this lecture. The main differences between marine *pollution* and marine *contamination* were explained, and the objectives of ecotoxicological programmes, (i.e.) to identify whether the concentration of certain pollutants are "acceptable" and "water quality standards" are exceeded, was also discussed.

The main tasks of ecotoxicological programmes were defined as being three-fold:

1. to classify hazardous properties of a chemical or groups of chemicals
2. to provide environmental quality standards of toxic chemicals at potentially harmful concentrations, and
3. to evaluate biological monitoring procedures as diagnostic tests with a degree of predictive capability.

These tasks were discussed with respect to the various sources and types of pollution, the nature of toxic chemicals and the effects of major contaminants on complex ecosystems.

The objectives and methods of monitoring water quality were also explained in detail, with special emphasis on Biological Effects Monitoring techniques as qualitative analyses of ecological harm. Lethal and sublethal toxicological testing procedures were also discussed, and the lecture was concluded by relating the above information to a successful case-study on the environmental impact of tributyl-tin and the development of methods for the treatment of contaminants through biotechnological means. The results of this study were

discussed with respect to their ultimate application into a GIS-type decision-making process which would take into account scenarios of TBT contamination due to industrial activities along the coast.

DATA INTEGRATION BY COSMO

Karen Fabbri
Institute for Systems, Informatics and Safety (ISIS), European Commission Joint Research Centre (JRC), Ispra, Italy

COSMO (Coastal Zone Simulation Model) is an interactive demo for decision making in ICZM, developed by Resource Analysis (NL) for the 1993 World Coast Conference. The content of the model was briefly described and the participants were then asked to run the model on computer. COSMO simulates the impacts of a variety of development scenarios (displayed graphically) for a fictional coastal area called Catopia. Once impacts on water quality, employment, vulnerability, etc. are identified, multi criteria analysis (a pair-wise comparison using the Analytical Hierarchy Process, developed by Saaty, 1992) is performed on the set of alternatives.

TECHNOLOGICAL AND ENVIRONMENTAL RISK ASSESSMENT, ANALYSIS AND MANAGEMENT

Kurt Fedra
Environmental Software & Services GmbH, Advanced Computer Applications, Austria

Following definitions and classification of risk and risk management: the lecture introduced different approaches to risk estimation and assessment, concentrating on examples of environmental and technological risk. As detailed examples, the concepts of industrial safety review and facility emergency response, and finally hazards analysis and its relation to GIS were discussed. Examples of the assessment: of atmospheric and aquatic spills of hazardous materials were presented.

DECISION SUPPORT SYSTEMS: AN INTRODUCTION

Kurt Fedra
Environmental Software & Services GmbH, Advanced Computer Applications, Austria

The lecture covered definitions of decision support systems (DSS) and an analysis of decision-making processes with special emphasis on environmental planning and
management, a general DSS architecture, a range of DSS Paradigms, and a set of application examples. Information resources, the analytical functions required, and issues of the user interface for interactive DSS were discussed, with special emphasis on models and expert systems.

A GEOGRAPHIC INFORMATION SYSTEM FOR THE DIVING INDUSTRY IN THE MALTESE ISLANDS

Avertano Role
Geography Division, Mediterranean Institute, University of Malta

The outlook for the development of the diving industry in an island situation like Malta may be increasingly precarious if steps are not taken to establish the industry on a sound strategic plan. Scuba diving is a valuable form of ecotourist activity, playing a significant economic role within the Maltese tourist sector, and its long-term socio-environmental sustainability needs to be established. The drive towards sustainability of the industry must lie in investment in the natural resource i.e. the marine environment, through the security offered by a system of marine protected areas. Within this vision, the role of a geographic information system aimed at delivering information to decision-makers involved in the tourist diving sector is crucial.

PLANNING FOR CONSERVATION ON THE COASTAL ZONE

Louis F Cassar
International Environment Institute (IEI), Foundation for International Studies, Malta

This lecture session aimed to highlight the importance of the coastal zone, making particular emphasis on the application of an integrated approach to planning and management. Special reference was made to the Mediterranean region, while discussing: Integrated Coastal Area Management; the different elements involved in the planning process; the identification of environmental constraints; and, the various phases leading to the formulation of a management plan. Attention was given to the concept of involving key stakeholders at an early phase of the planning and management processes.

The lecture was followed by a field excursion to a number of sites in Gozo, of special interest to coastal area management. In spite of the inclement weather conditions, the entire group accompanied by those faculty members present at the time in Gozo, visited Ramla l-Hamra, San Blas and Dahlet Qorrot situated on the northeastern coast of the island. The purpose of the field excursion was to look at practical examples of land-use conflict in different coastal situations, that is, aeolian formations, limestone shore platforms, etc.

SOCIO-ECONOMIC SYSTEM

Karen Fabbri
Institute for Systems, Informatics and Safety (ISIS), European Commission Joint Research Centre (JRC), Ispra, Italy

This lecture discussed the Socio-Economic System and introduced participants to the basic concepts of environmental and ecological economics. Various existing methods and tools used for economic analysis, such as contingent valuation, hedonic pricing, supply and demand curves, etc., which are particularly useful for the economic valuation of coastal resources, were outlined.

POLICY ANALYSIS AND DECISION-MAKING

Karen Fabbri
Institute for Systems, Informatics and Safety (ISIS), European Commission Joint Research Centre (JRC), Ispra, Italy

During this lecture an overview of international policy for ICZM was provided. Some of the following milestones and organisations were reviewed: the Barcelona Convention, UNCED, the Genoa Declaration, the World Coast Conference, Agenda 21, the activities of IPCC (Intergovernmental Panel on Climate Change), the World Bank, etc. The second part of this lecture consisted of a coastal simulation game, in which participants were assigned specific roles and asked to simulate a meeting of a coastal council. Each participant had to define his/her objectives and attitudes towards a pre-defined set of management alternatives. The aim of this game was to promote awareness that ICZM decision-making is not a simple task as conflicts (environmental, economic, social, political, etc.) and uncertainty can not be eliminated but must be dealt with by compromise solutions such as trade-offs.

AQUACULTURE IN COASTAL AREAS

Michelle Cassar[1] & Antonella Attard Montalto[2]
[1]*International Environment Institute (IEI), Foundation for International Studies, Malta*
[2]*EuroMediterranean Centre on Insular Coastal Dynamics (ICoD), Foundation for International Studies, Malta*

Mediterranean Coastal Aquaculture

The aquaculture industry worldwide, and marine aquaculture in particular in the Mediterranean Sea, is a rapidly growing industry. Total Mediterranean production of marine aquaculture in 1995 was estimated at 36 000 tons, the main finfish species cultured being the Mediterranean seabass (*Dicentrarchus labrax*) and the Gilthead seabream (*Sparus aurata*). Impacts of coastal cage farms include the visual impact as well as a range of environmental effects caused by the waste outputs of nutrients and organic matter from the cages. The exposure to water currents in most coastal sites is sufficient to prevent serious effects on the water quality, such as eutrophication and algal blooms, but a degradation of the benthic ecology at these sites results from the increased sedimentation of waste material on the seabed. In the Mediterranean, cage farms sited over *Posidonia oceanica* seagrass meadows cause irreparable damage as regression of the seagrass meadow results in areas of bare degraded seabed. The careful selection of an appropriate farm site, based on parameters such as water depths and current velocities, is the most effective way of reducing a farm's environmental impact, through preventing the build up of wastes in the water column and on the seabed.

Remote Sensing and Geographical Information Systems in Aquaculture

Production sites for aquaculture need to satisfy fairly complex location criteria, and suitable areas should preferably be identified and designated in advance. The Spatial Optimizing Theory seeks to optimize production functions (those factors controlling economic activities at the planning stage rather than after launching the project. To enable location/site selection, a producer/planner

must know how individual production functions vary. Tools used for obtaining such data for spatial/location decisions are, amongst others, data collection, Remote Sensing and GIS. Remote Sensing allows an intensive survey of large areas by Satellite or Airborne sensors, and may be used to determine the following production functions either directly or by inference: water quality; water temperature; water quantity; soil type; shelter/exposure for cage culture; bathymetry. Inputs for Geographic Information Systems in Aquaculture include maps, tabular data, field surveys, digital archives, remotely sensed data and other GIS derived data. Outputs from GIS which can be used for aquaculture include textual reports, maps, tables and statistics, photographic products and data for other applications e.g.: GIS, databases, models. The benefits of GIS for aquaculture include the following: optimisation of location decisions, integration of several data types to give a coherent output; the maintenance/enhancement of fish production through ensuring good water quality and in adequate quantities for inland farms, and the identification of appropriate markets

Prof Adalberto Vallega
Universita degli Studi di Genova, POLIS
Dept of Urban, Regional and Landscape Planning
Stradone di S Agostino 37
Genova - **Italy**
tel: + (39) 10 209 5857 fax: + (39) 10 209 5907

Prof Patrick J Schembri
Department of Biology
University of Malta
Tal-Qroqq, Msida - **Malta**
tel: + (356) 3290 2789 fax: + (356) 312110

Mr Anton Micallef
Director, Euro-Mediterraean Centre on Insular Coastal Dynamics (ICoD)
Foundation for International Studies
Old University Building
St Paul Street
Valletta - **Malta**
tel: + (356) 240746 fax: + (356) 230551

Prof Enrico Feoli
Environmental Programme
International Centre for Science and High Technology
Via Grignano 9
34014 Trieste - **Italy**
tel: + (39) 40 224572 fax: + (39) 40 224575

Mr Matthew Gatt
Head, Mapping Unit
Planning Directorate
Floriana - **Malta**
tel: + (356) 240976 fax: + (356) 224846

Prof Andrea Fabbri
Department of Earth Resources Survey, Geological Survey Division
International Institute for Aerospace Survey and Earth Sciences (ITC)
Hengelosestraat 99
P.O. Box 6
7500 AA Enschede - **Netherlands**
tel: + (31) 53 487 4282 fax: + (31) 53 48 74336

Dott Andrea Patrono
Department of Earth Sources Survey
International Institute for Aerospace Survey and Earth Sciences (ITC)
350 Boulevard 1945
P.O. Box 6
7500 AA Enschede - **Netherlands**
tel: + (31) 53 487 4282 fax: + (31) 53 48 74336

Mr Charles Galdies
Project Officer, Euro-Mediterranean Centre on Insular Coastal Dynamics (ICoD)
Foundation for International Studies
Old University Building
St Paul Street
Valletta - **Malta**
tel: + (356) 240746 fax: + (356) 230551

Ms Karen Fabbri
TA Sector - ISIS
Joint Research Centre (JRC)
Ispra (Va) - **Italy** 21020
tel: + (39) 332 785429 fax: + (39) 332 789394

Dr Kurt Fedra
Envir Software and Services
Advanced Computer Applications
BO 100 A/2352
Gumpoldskirchen - **Austria**
tel: + (43) 2252 633 050 fax: + (43) 2252 633 059

Mr Avertano Role
Geography Division, Mediterranean Institute
University of Malta
Tal-Qroqq, Msida - **Malta**
tel: + (356) 3290 2921 fax: + (356) 336450

Mr Louis F Cassar
Executive Coordinator, International Environment Institute (IEI)
Foundation for International Studies
Old University Building
St Paul Street
Valletta - **Malta**
tel: + (356) 240741 fax: + (356) 230551

Ms Antonella Attard Montalto
Project Officer, Euro-Mediterranean Centre on Insular Coastal Dynamics (ICoD)
Foundation for International Studies
Old University Building
St Paul Street
Valletta - **Malta**
tel: + (356) 240746 fax: + (356) 230551

Ms Michelle Cassar
Project Officer, International Environment Institute (IEI)
Foundation for International Studies
Old University Building
St Paul Street
Valletta - **Malta**
tel: + (356) 240741 fax: + (356) 230551

Annex IV - Certificate of attendance

International Environment Institute

and the

Euro-Mediterranean Centre on Insular Coastal Dynamics

of the

Foundation for International Studies, University of Malta

in collaboration with

Ministry of Foreign Affairs and the Environment, Government of Malta

This is to certify that

_____

has attended the course entitled

"Industrial Risk Assessment for Integrated Coastal Management A Training Course on Geographic Information Systems"

Gozo, Malta
25 November - 3 December, 1996

_____ _____

International Centre for Science and High Technology

International Environment Institute, Foundation for International Studies

Annex V - List of participants

Mr Ahmed ABDELREHIM
Geographic Information Systems Specialist
CEDARE
21/23 Giza Street
Nile Tower Bldg., 13th Floor
P.O. Box 52, Orman
Giza - **Egypt**
fax: + (202) 570 3242 tel: + (202) 570 3473

Ms Agathi ANASTASI
State General Laboratory
44, Komon Street
Nicosia 1451
Cyprus
fax: + (357) 2 316434 tel: + (357) 2 305061

Mr Mustapha CHAKIR
LASH, EMI, BP
765 Av Ibn Sina
Agdal
Rabat - **Morocco**
fax: + (212) 7 778853 tel: + (212) 7 670579

Ms Lamia CHAMAS
Ministry of Environment
B.P. 701091
Antelias - **Lebanon**
fax: + (961) 1521 037 tel: + (961) 1521 030
+ (961) 1521 038 + (961) 1521 031

Mr Charles GALDIES
Project Officer, ICOD
Foundation for International Studies
Old University Building
St Paul Street
Valletta - **Malta**
Fax: + (356) 230551 tel: + (356) 240746

Mr Matthew GATT
Head, Mapping Unit
Planning Directorate
Floriana - **Malta**
fax: + (356) 224846 tel: + (356) 240976

Mr Ahmed Otman MARSOKA
Technical Centre for Environment Protection
P.O. Box 83618
Tripoli - **Libya**
fax: + (218) 21 3338098 tel: + (218) 21 4445795

Ms Shirley MICALLEF
Environmental Biologist
Scientific Division
MUS, University of Malta
Msida - **Malta**
fax: + (356) 344879 tel: + (356) 343572
+ (356) 331734

Mrs Zamira RADA
Chemical Engineer
Institute of Chemical Technology
Blloku Vasil Shanto
Tirana - **Albania**
fax + (355) 422 3466 tel: + (355) 422 3466

Dr Nenad RAVLIC
Civil Engineering Institute of Croatia
Rijeka Department
Vukovarska 10a
51000 Rijeka
Croatia
fax: + (385) 51 330810 tel: + (385) 51 330744
+ (385) 51 330209

Dr Mohamed SARBAJI
Principal Engineer
Environmental Sciences and Research Laboratory
National Engineering School
Sfax - **Tunisia**
fax: + (216) 4 275 595 tel: + (216) 4 274 088

Mrs Abir ZENO
Ministry of State for Environmental Affairs
Damascus - **Syria**
fax: + (963) 11 4412577 tel: + (963) 11 4447608

Annex VI - Questionnaire

FEEDBACK FROM THE PARTICIPANTS TO THE TRAINING COURSE HELD IN GOZO, MALTA (23 NOV-3 DEC 1996):

INDUSTRIAL RISK ASSESSMENT FOR INTEGRATED COASTAL MANAGEMENT
A TRAINING COURSE ON GEOGRAPHIC INFORMATION SYSTEMS

You are kindly requested to fill out this pages, preferably day by day, and provide us with your comments (negative/positive/suggestions) on the contents and duration of each section of the Course.

This information will be used for a final evaluation of the Training Course and future discussions. You are free to sign your form or not.

Monday 25 November

Opening ceremony

Introduction to the Course (E. Feoli)

Conceptual basis to ICM (A. Vallega)

Field trip (P.J. Schembri)

Overview on integrated coastal area management (A. Micallef)

General comments on day 1

Tuesday 26 November

Geoindicators and environmental indicators (E. Fabbri)

Technical overview (M. Gatt)

Open Discussion

Industrial ecology (E. Feoli)

General comments on day 2

Wednesday 27 November

Analysis and data integration (E. Feoli)

GIS modeling and modeling tools (A. Fabbri)

Introduction to IDRISI and introductory exercise (A. Patrono)

General comments on day 3

Thursday 28 November

Ecotoxicology (C. Galdies)

Data analysis (E. Feoli)

Case studies (A. Patrono)

General comments on day 4

Friday 29 November

Data integration by COSMOS (K. Fabbri)

Technological risk assessment (K. Fedra)

Decision support systems (K. Fedra)

General comments on day 5

Saturday 30 November

Case studies (K. Fedra)

Recreation use (A. Role)

Planning for conservation of the coastal zone (L. F. Cassar)

Field trip (L.F. Cassar)

General comments on day 6

Monday 2 December

Socio-economic system (K. Fabbri)

Case sudies (A. Patrono)

Open discussion

General comments on day 7

Tuesday 3 December

Policy analysis and decision making (K. Fabbri)

Case sudies (A. Patrono)

Aquaculture in coastal areas (A. Attard Montalto & M. Cassar)

Open discussion

General comments on day 8

Closure of the Course (suggestions on follow up actions)

Annex VII - Financial Statement

Training Course on Geographic Information Systems
Industrial Risk Assessment for Integrated Coastal Management
25 November - 3 December 1996

Financial Statement	LM	USD
Subsistence Allowance to Participants	664.00	1,992
Terminals	243.00	729
Travel	2,417.00	7,251
Hotel Accommodation	5,283.00	15,849
Transport	581.00	1,743
Miscellaneous items (Visas/DHL Service, etc)	1,629.00	4,887
Administration fee:	2,500.00	7,500
** Promotion & Hospitality		-
** Stationery for the conference		-
** Handling charges		-
** Staff Remuneration & Overtime		-
** Communications (Postage, Tel & faxes)		-
** Preparatory meetings		-
** Bank & Account charges		-
	13,317.00	39,951

Contract No : 96/199 - Project No TF/GLO/96/105

Louis F Cassar
Executive Co-ordinator IEI

Charles Massa
Director Resources

17/4/97

Annex VIII - Press Release

4/12/96

Industrial Risk Assessment for Integrated Coastal Management
A Training Course on Geographic Information Systems

Gozo, Malta, 25 November - 3 December 1996

A 9-day Training Course on Geographic Information Systems in relation to Industrial Risk Assessment for Integrated Coastal Management was inaugurated in Gozo on Monday 25 November, by the Parliamentary Secretary for Gozo.

This training course was the second such event to be held within a span of one year, following collaboration between the International Centre for Science and High Technology (ICS) of the United Nations Industrial Development Organization (UNIDO) and the International Environment Institute (IEI) and the Euro-Mediterranean Centre on Insular Coastal Dynamics of the Foundation for International Studies, on a similar Workshop in October 1995. This year's Training Course ran from 25 November to 3 December, and participants included representatives from 8 Mediterranean developing countries (Morocco, Tunisia, Libya, Egypt, Lebanon, Syria, Albania, Croatia), as well as Cyprus and Malta.

The Training Course opened with inauguration speeches by the Hon. Dr Anton Refalo, Parliamentary Secretary for Gozo, Mr Saviour Borg, Director of Multilateral Affairs at the Ministry of Foreign Affairs and Environment, Professor Ugo Leone, ICS Managing Director, and Professor Patrick J Schembri, IEI Chairman. Presentations were then given by Professor Enrico Feoli (Environment Programme, ICS), Mr Louis F Cassar (Director, IEI), and Mr Anton Micallef (Director, ICoD), outlining the aims and activities of their respective institutions.

The objective of the Training Course was to develop the management capacity of Mediterranean countries in the increasingly important area of Geographical Information System Technology (GIS), with particular reference to the management of coastal areas. The implementation of GIS, together with decision support systems, contributes towards providing integrated and practical solutions to the complex interaction of the various economic benefits and environmental constraints that accompany the industrial development of a country's coast. Furthermore, participants were exposed to techniques on how to perform data analysis and risk assessment in coastal areas by computer assisted techniques.

Participation in this Training Course was expected to reinforce and strengthen the existing network set up between ICS and Mediterranean states, and to highlight the problems encountered in the areas of industrial risk assessment and integrated coastal area management. Besides the high-tech approach applied during the course, which was developed as a result of the on-going cooperation between ICS and the researchers of the International Institute for

Aerospace Survey and Earth Sciences (ITC, Netherlands) and of the Environmental Software and Survey (ESS, Austria), of particular importance was the high level of collaboration between specialists from various countries, including Malta, who delivered lectures on various aspects of coastal zone management and on the implementation of GIS and related computer programmes, as well as practical training on appropriate computer software and case studies to illustrate the concepts and methods of coastal GIS.

Talks were also held between the Foundation for International Studies, the Government of Malta and Professor Ugo Leone, on behalf of ICS, on the possibility of setting up a joint ICS/Malta Training and Research Centre based in Malta. The proposed future cooperation on this joint project would enhance the existing good relations between Malta and ICS in the areas of environmental research and protection. Moreover, the possibility of strengthening cooperation with the participants' countries, in the area of industrial risk assessment was also highlighted during the final conclusions.

The Training Course was closed by Mr Piergiorgio Stipa on behalf of ICS-UNIDO and Mr Louis F Cassar on behalf of IEI-Foundation for International Studies on the 3 December 1996.