

**European Union Demonstration Programme on Integrated
Management in Coastal Zones**

Thematic Study F

**Information required for
Integrated Coastal Zone Management**

by

J.P. Doody, C.F. Pamplin, C. Gilbert and L. Bridge

December 1998

Acknowledgements

Throughout the course of this study we have visited many of the Demonstration Programme projects and talked with a wide variety of other project leaders. We have also received considerable help from individuals representing local, national and international organisations who have given so freely of their time, views and experience. We would like to take this opportunity to thank all these people for their time and effort. We have found working on this study a stimulating and enjoyable, if occasionally tiring, experience. We have been asked on many occasions ‘How can the Demonstration Programme project network can be sustained?’ We do not know if this will be possible, but we would ask the EU to consider how the goodwill, knowledge and experience that are so evident in the Demonstration Programme ‘community’ can be harnessed for the future.

Authors

Dr J. Pat Doody
National Coastal Consultants
5 Green Lane
BRAMPTON
Huntingdon
Cambridgeshire
PE18 8RE, UK
Tel: +44 1480 457624
e-mail: pat.doody@btinternet.com

Dr Chris Pamplin
Xipress
5 Kings Court
NEWMARKET
Suffolk
CB8 7SG, UK
Tel: +44 1638 565800
e-mail: chris@jspubs.com

Mr Clive Gilbert
Acting Director
Coastal and Marine Observatory for the Channel and Southern North Sea
1 Waterloo Crescent
DOVER
Kent, UK
Tel: +44 1622 221569
e-mail: clive.gilbert@kent.gov.uk

Linda Bridge
European Liaison Officer, CoastLink
Kerkstraat 38
6668 AP Randwijk
The Netherlands
Tel: 00 31 488 491252
e-mail: linda@bart.nl

Table of Contents

Table of Contents	3
Executive Summary.....	6
Background	6
The problems.....	6
Findings and Conclusions at the Project level	6
Adopt a strategic view of information.....	6
Be led by the issues.....	7
Understand the true cost/benefit of information management tools.....	7
Develop local information exchange networks.....	7
The roles of a local information centre data providers and users.....	8
Actions to be taken at European level.....	8
Practice what you preach.....	8
Be more user led.....	9
Improve the availability of good-quality and affordable maps.....	9
Actions for the European Environment Agency.....	9
Become more accessible.....	9
Speed up ‘state of the coast’ reporting.....	10
Further develop and consolidate a Europe-wide strategic information exchange system.....	10
Become user led.....	11
Next steps.....	11
Timely dissemination is important.....	11
Make more use of satellite images.....	11
The output of the LaCoast study should be validated by the projects.....	11
Available and affordable map products are essential for effective ICZM.....	11
Free availability of publicly funded data products.....	11
Lessons for the European Environment Agency	11
The EEA must become more proactive.....	11
State of the coast report.....	12
Mechanism for finding out what data are available should be put in place.....	12
Indicators and decision support tools.....	12
Introduction.....	13
Integrated coastal zone management.....	13
Coastal management.....	13
Introduction.....	13
Competing interests.....	13
Sectoral exacerbation.....	14
The integrated approach.....	14
Defining integrated coastal zone management.....	15
The Demonstration Programme	15
Background to the Programme.....	15
Finding best practice.....	15
The thematic studies.....	16
The information thematic study.....	16
The objectives of the information theme.....	17
Definitions.....	17
Information, data, understanding.....	17
Coastal zone.....	17
The importance of information in ICZM.....	18
Methodology	19
Initial model of the processes leading to information need	19
The DPSIR causality model.....	19
The origin of information need within the DPSIR model.....	19

Data + Context = Information.....	19
Data selection	20
Questionnaire	20
Project visits	21
Approaches to organisations.....	21
Results.....	22
Awareness raising	22
Participation versus Consultation.....	24
The stock-take	25
Transparency	26
Artisan knowledge base.....	27
Resources.....	28
Education.....	29
Scientific research and the projects	29
Summary of the results of the project visits	31
Contacts with EEA Topic Centres and Partner Organisations.....	32
European-wide EU approaches to data provision	32
EEA: The Dobris Assessment	32
EEA: State of Europe’s Coast.....	32
EEA: Experts’ Corner	32
EEA: EIONET.....	33
EEA: ETC Catalogue of Data Sources	33
EEA: ETC Land Cover	33
EEA: CORINE	33
The Centre for Earth Observation	34
Other European research initiatives	35
Directorate Generals	35
European-wide non-EU approaches to data provision.....	35
International coastal NGOs	36
EUCC.....	36
Eurocoast.....	36
United Nations Environment Programme	36
The Council of Europe	36
UNESCO.....	37
Regional Seas Programmes	37
National approaches to data provision.....	37
France.....	38
Greece	38
United Kingdom	38
The Estuaries Review.....	38
The Coastal Directories Project	38
LOIS UK.....	39
Discussion	40
The implicit information strategy	40
Data attributes.....	41
Key data characteristics.....	41
Major subject types	41
Data availability and accessibility.....	42
Credibility.....	42
Data collection and collation	43
Context.....	43
Data aggregation	44
Scales of data provision	45
The national context.....	45
The supra-national context	45
The European context	46
Satellite data	46
Meeting the information need.....	46

Metadata	47
Dissemination	48
Participation	49
Research effort	50
Creating a sustainable ICZM strategy	50
The European Spatial Development Perspective	51
The European Environment Agency	51
State of Europe’s Coast.....	52
CORINE.....	52
Tools for management	52
Models and Decision Support Systems	52
Decision support systems	53
Geographical Information Systems	54
The importance of maps.....	54
Indicators.....	55
Conclusions	56
General principles	56
Lessons about ICZM	56
Research	57
Lessons for the EU	58
Lessons for the EEA	58
References	60
Appendices	61
Appendix 1: Defining the coastal zone	61
Appendix 2: The questionnaire	63
Appendix 3: Visits, meetings and conferences	67
Appendix 4: Key European Topic Centres	69
Appendix 5: National Focal Points	70
Appendix 6: Regional Seas Programmes and Conventions	71

Executive Summary

Background

There is a general consensus amongst those who have studied the impact of human activities in the coastal zone that more progress and greater effort towards integrated approaches to management are required if sustainable development is to be achieved without further serious degradation of the natural and cultural environments. As a contribution to the required dialogue, the information thematic study, undertaken by the European Environment Agency (EEA) as part of the EU Demonstration Programme on Integrated Management in Coastal Zones, aimed to establish ‘the role of information in integrated coastal zone management’. The results of the study include a synthesis of the experiences of many of the 35 Demonstration Programme projects, and look at the need for harmonised and timely data flow, and provision of information at all spatial scales, from international to national, regional and local levels.

The problems

This study concludes that the key on-going problem in relation to the nature of information required for coastal zone management lies not so much in the provision or the content of information itself, but in the way it is presented to those who formulate and implement policy and take management decisions. The application of science (including data models, collection and collation) must therefore involve more than just providing information on the state of the coastal environment, identifying indicators for assessing environmental change or developing mechanisms for monitoring and predicting the effect of policy and management options. Information must also inform the analysis of issues, help the user to ask the right questions and then provide signposts to where appropriate data can be found. This has important implications for all data providers, research workers and those attempting to define indicators and develop management tools.

In addition and surprisingly, it appears that the desirability of an integrated approach to management has yet to be accepted by all the players active in the coastal zone. The best way to persuade these players of the benefits of an integrated approach to management is for them to understand the advantages of a consensual approach compared with ‘going it alone’. The question is ‘How can such understanding be achieved?’ The following conclusions offer practical ideas for improving the level of understanding and provision of information to support integrated coastal zone management (ICZM).

Findings and Conclusions at the Project level

Adopt a strategic view of information.

Being essential in developing the ICZM process, information can form an integral part of a participatory approach, or be the basis for consultation. Whichever approach is adopted, and the Demonstration Programme has shown both to be effective, it is crucial to take a strategic view of information.

This strategy must be effective in raising awareness and building participation. It should also ensure that an appropriate context is established for decision making, such as a proper framework for benchmarking of progress towards quantitative/qualitative objectives or targets, preferably cross-sectoral. It should facilitate the building of a knowledge base and the monitoring and evaluation of the ICZM process itself. To be effective, the strategy should ensure participation at all stages and must also implement an agreed information exchange mechanism.

Conclusion

Help to recognise and demonstrate the value of a strategic view of information in developing the ICZM process.

Be led by the issues

This study has recognised the importance of the stock-take in the information strategy followed by the Projects. Whilst the stock-take is a natural process that is widely used it does carry a hidden danger. In most Projects some data were found more easily than others. It is important that this ease of availability is not allowed to influence the management process. Effective ICZM must be led by the issues and not by what data happen to fall easily to hand.

Conclusion

Be issue-led, not data-led

Understand the true cost/benefit of information management tools

This study has shown that whilst management tools (such as geographic information systems and decision support systems) have a valuable part to play in achieving ICZM, their successful use requires careful management in their own right. Such systems tend to be expensive in both financial and personnel terms and care must be taken to ensure that the technology does not become an end in itself.

It is important to recognise that information is just one element of successful management. An effective GIS providing quality information does not, in itself, ensure successful ICZM. Only with the knowledge necessary to understand the coastal zone and its problems can information be integrated into the management process.

Management tools are designed to manipulate data, or to move data from place to place. However, management tools cannot *understand* what they manipulate. Only *people* can gain that understanding. Therefore, decisions about whether to use a particular tool should always involve an analysis of how the tool will enhance understanding of the issue at hand, i.e. there should be full correspondence between the conceptual framework for assessment (from data to information) and the management tools.

Conclusion

Decide whether to use technical and other information management tools only after the true costs and benefits have been assessed against the information flow needs.

Develop local information exchange networks

Several of the Projects have developed or are currently setting up local or regional centres which seek to bridge the gap between the scientific and technical community and decision-makers in municipal and regional authorities, the private sector and in coastal communities (the public). These centres can range from a physical observatory to a virtual network on the Internet.

Each centre operates separately according to local political, social and economic requirements, forming the hub around which local ICZM decisions and management action are taken. The hub becomes a local information exchange network that provides continuity at the strategic level, agrees data protocols, helps with data validation and information dissemination and is a focus for expert opinion. The hub helps to maintain contact between the various players (managers, data providers and researchers) by being a communication backbone in a strategic metadata system.

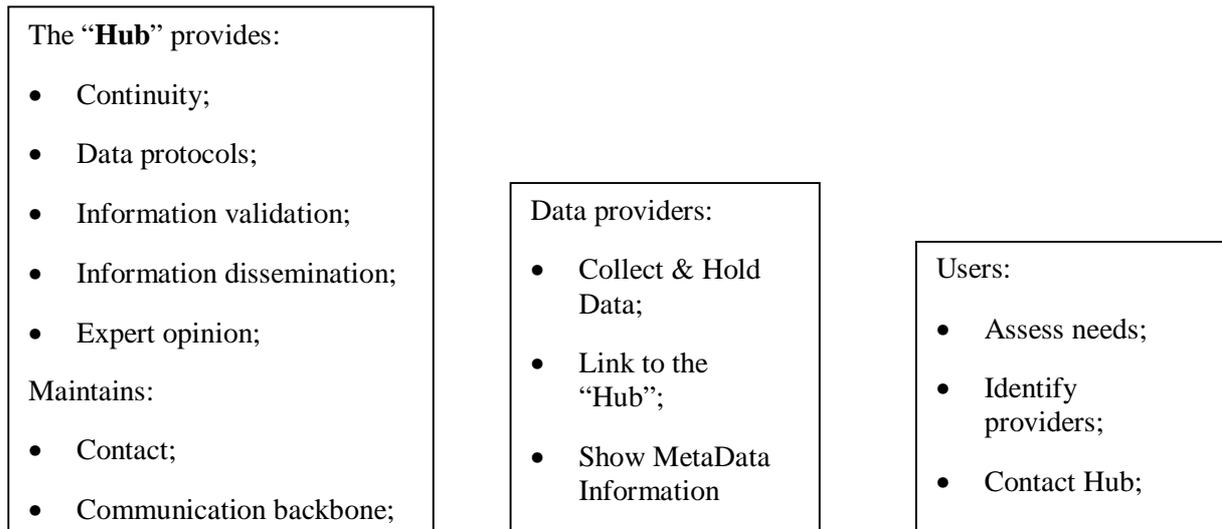
Political support and involvement are crucial to the sustainability of any ICZM strategy. By being able to provide high quality, timely information and advice through an information exchange network, the ICZM process may retain the political support necessary for its long-term survival. In particular by

setting up a relevant information and advice centre linked to a political process there is more likelihood that the necessary impetus derived from those initiating the process will be sustained in the long term.

Conclusion

Recognise the value of a strategic view of information in sustaining the ICZM process by establishing local ‘observatories’ that facilitate local information exchange according to the roles summarised in the figure below.

The roles of a local information centre data providers and users



Actions to be taken at European level

Practice what you preach

Too often a sectoral interest will commission research or draw together data for its own purposes without reference to other sectors. Inevitably this leads to incompatible data sets, duplication and overlap, and confusion among downstream users. One of the hypotheses suggested for testing by the Commission and borne out by the Demonstration Projects is that horizontal integration is a prerequisite for a healthy ICZM process. Yet it is not always clear that different Directorates within the Commission are working to a common agenda or are even aware of what each other are doing. Nevertheless, some measures are in place or in the pipeline to allow the anticipation and reduction of environmental impacts by the prior assessment of projects and policies has made some progress, encouraged by EU activity. Most Member States and some sectors have produced guidance and other support in the use of *Environmental Impact Assessments* (EIA), which is seen as an important influence on project planning. However, most of these assessments have only lead to limited adjustments to projects, often because they were executed at rather a late stage in project design. Although the Strategic Environmental Assessment Directive is still only under discussion - several member states (Belgium, Denmark, Finland, Italy, Netherlands and Spain) and the European Commission have developed procedures and initiatives for SEA.

Conclusion

Strengthen inter-directorate procedures and protocols to ensure that each directorate is working to an agreed agenda and in full knowledge of Commission-wide programmes and initiatives from the outset.

Be more user led

In many instances data collection effort (including research, survey and monitoring) fails to deliver adequate information flows to those concerned with management. Developing a local research agenda should help overcome this failing at the project level, but the problem is more acute at higher institutional levels.

It should be possible to promote a greater user focus in new coastal and marine research by requiring EC-funded research proposals, at all levels, to:

- show how potential users have been brought into the process of identifying research needs;
- include a clear statement of how the results will be applied to the problem and who will benefit;
- have a clear policy for disseminating knowledge gained to users, and assessing how effectively the results have been used.

Conclusion

The EC should promote the involvement of users in defining research needs, and engender a greater user focus in the outputs of such research.

The same principle applies to other areas, including the use of satellite data through the Centre for Earth Observation (CEO). The CEO data source is under-utilised by coastal zone managers because of the continuing technological focus on new satellites and image manipulation.

This study has identified a number of information needs that lend themselves to assessment by remote sensing. These needs can be met by simple techniques working on satellite images. Linking the LaCoast project and the European Environment Agency's (EEA) Image 2000 project will provide both a means of assessing change, and a more detailed baseline picture of the coastal zone.

Conclusion

The CEO should give greater emphasis to practical applications for the use of remotely sensed data.

Improve the availability of good-quality and affordable maps

The cost of basic maps is a common barrier to effective ICZM. For many of the Projects, essential maps were either out of date, inaccessible or very costly. The EU should investigate the options for publishing a Europe-wide series of map of the coastal and marine zone. With available satellite data it should be possible to create new maps with an agreed geo-referenced coastline. Alternatively, maps that are derived from publicly funded data collection and collation programmes should be made freely available, as they are in the USA.

Conclusion

The EU should make maps of Europe's coastal zone available at affordable prices.

Actions for the European Environment Agency

Become more accessible

This study found little awareness among the Projects of the EEA and its activities. Even when individuals were aware of potentially relevant EEA data, problems of validation and access were encountered. This study concludes that the projects funded by the EU in general, and the EEA in particular, must be more timely in reporting their results and more proactive in promoting their use.

Conclusion

The EEA should promote the use of studies it has funded by requiring more timely reporting and by increasing accessibility to their results.

Speed up ‘state of the coast’ reporting

This study has found a high level of interest in the development of a state of the coast report at the European level. Such a report is seen as an essential first step in assessing the coastal resource and the pressures influencing its development. The Projects, a number of national Government agencies and international institutions have undertaken similar reviews. A state of the coast report could be built upon these existing initiatives at local, national and international levels. There would be a cascade of reporting from the local to the European level.

To make these existing initiatives more appropriate to ICZM, they need to incorporate a comprehensive description of the hinterland and coastal areas as well as the marine environment including information derived from data bases such as those of the EEA. The Mediterranean coast report, prepared recently by the ETC M&CE, provides an initial model of the approach.

Given the interest at all levels in this approach, it should be possible for the EEA, through the ETC M&CE, to bring about a series of agreements that would allow the current local, national, regional seas and Europe-wide stock-taking exercises to be extended and consolidated. These would eventually form a series of linked reports leading ultimately to the State of Europe’s Coast and Seas Report (based on the various databases becoming available at the European level (Waterbase, Airbase, EUNIS (nature) etc.)

Conclusion

The ETC M&CE should be mandated to develop the process necessary to produce a State of Europe’s Coast and Seas Report through the coordination of existing information sources.

Further develop and consolidate a Europe-wide strategic information exchange system

This study has found that the complexity of the coastal zone precludes the development of prescriptive approaches to achieving ICZM. However, we suggest that by facilitating the exchange of information and understanding about the ICZM process amongst players at every level, it is possible to promote ICZM itself.

Building a strategic information exchange system is just as important at the European level as it is at the Project level. Existing institutional mechanisms, such as Regional Seas Programmes, should be combined with local information exchange networks to build the required system. The reporting cascade shown in figure 1 would form one element of the multiple information flows that would operate both up and down through the scales and across sectors.

The European strategic information exchange system should include protocols that allow existing initiatives, at all spatial scales and across all sectors, to be cohesive. It would also facilitate the identification and assimilation of contextual information at lower levels. The system would provide a series of signposts that point to where relevant data can be found, noticeboards that advertise what is available, gateways through which information is accessed, and pathways along which the information can be transferred.

This study identified a number of existing information exchange mechanisms that have some of the required attributes (for example, the DESIMA system being developed at the Joint Research Centre). These initiatives should form the starting point for the development of a dedicated Europe-wide coastal and marine information network within the frame work of the EEA EIONET network.

Recommendation

The EEA should set up a Europe-wide coastal and marine information exchange system. [The starting point for this should be within the framework of the existing EEA EIONET network.]

Become user led

The impaired linkage between the EEA and those at the Project level hinders the development of an appropriate user-focus in designing and implementing ICZM support tools. This problem was identified in work relating to satellite data, development of DSS and identification of indicators.

Recognising the importance of being user-led, the EEA should develop closer links with the local information exchange networks. This can be achieved through the strategic information exchange network built from the regional sea programmes the ETC M&CE and other EU institutions.

Recommendation

Link development of tools for ICZM more closely to the needs of users and tailor the results for ease of use and understanding.

Next steps

Taking all of the above into account the main recommendations for action at European levels are:

Timely dissemination is important

The results of EU-funded projects, such as CORINE, should be more timely in their publication. This will help to avoid costly data collection programmes producing results which users see as out of date.

Make more use of satellite images

Those concerned with the production, processing and dissemination of satellite data should make greater use of existing images and techniques as part of a process aimed at giving credibility to their use in identifying resource distribution and coastal change.

The output of the LaCoast study should be validated by the projects

The Demonstration Programme project teams should, as a matter of urgency, validate and assess the results of the LaCoast study. Based on the results of this evaluation a new project should be initiated to bring the results up to date.

Available and affordable map products are essential for effective ICZM

Any ICZM project requires affordable, up-to-date maps that are available at suitable scales. A standard and agreed outline of the coast of Europe, at various scales, would save considerable duplication of effort during the initial phases of projects.

Free availability of publicly funded data products

Those products, such as maps, that are derived from publicly funded data collection and collation programmes should be made freely available. This would bring Europe in line with the approach adopted by the USA.

Lessons for the European Environment Agency

The EEA must become more proactive

If the full potential of the EEA as a contextual data source is to be realised, it must become more proactive in promoting the results of its work at spatial scales below the European level.

State of the coast report

The EEA, through its Marine and Coastal Topic Centre, should co-ordinate the production of contextual information through a 'State of Europe's Coast Report' based on regional coasts and seas assessments.

Mechanism for finding out what data are available should be put in place

Metadata systems that facilitate the rapid location of relevant data are essential if ICZM is to be achieved. The EEA could play a crucial role in this by investigating the options for setting up the backbone for such a system at the European scale. Building this coastal data signposting system is not a trivial task, but is attainable over a 5-year frame. The EU should look at the Observatory approach pioneered by Cote d'Opale, Kent and Strymonikos as one possible model.

Indicators and decision support tools

Research into the development of indicators and DSS undertaken by the Topic Centre on Marine and Coastal Environments should be more clearly linked to the needs of users and the results tested through practical application.

Introduction

Integrated coastal zone management

Concern about Europe's coasts and seas is not new. Following his classic surveys of the British coast (Steers 1969a and 1973), Prof Alfred J Steers visited many European countries at the end of the 1960s. His report (Steers 1969b) gives an account of the state of the coast at that time and of his concerns for the future. 'I must confess that my travels have left me depressed. Many, many miles of coastline are now no longer in a natural condition. Tourism, especially in the Mediterranean, has made an enormous change in the last fifteen years'. He went on, 'There is only one really effective way of dealing with the use of the coast – an overall state plan carried out by people who understand the economic, urban, tourist, agricultural, conservation and other demands on the coast.'

Whilst, today, a 'state plan' for the coast may be considered neither feasible nor desirable, those responsible for policy formulation and management action must be aware of the wider context in which they work. Building more effective options for future action is dependent on a better *understanding* of the wide range of issues and problems that beset Europe's coast and seas. In this context the European Union Demonstration Programme on Integrated Management in Coastal Zones set out to show how a more sustainable approach to the use of the coast could be achieved.

Coastal management

Introduction

The history of human activity on the coastline has followed a similar pattern of intensification of use throughout much of Europe. Initially, coastal development was largely in harmony with coastal processes, modifying the habitats rather than destroying them. In some cases, such as the development of grazing marsh from enclosed saltmarsh in the north west or traditionally cultivated rice fields in the deltas of the Mediterranean, alternative habitats were created, which in the absence of intensive agricultural use developed their own nature conservation interest. As human populations increased and land use intensified, natural, man-modified or man-created habitats all came under pressure. Large-scale agriculture, afforestation and other intensive land uses created environments with little wildlife or landscape interest. The building of roads, railways, ports and harbours, industrial sites and tourist areas provided the final stage in the obliteration of many coastal areas.

The way in which human activity and the development of coastal systems are inter-linked can be illustrated in a historical context by reference to the deltas of Italy. Coastal deltas in Italy developed rapidly in late Roman times. This development continued into the 1700s with population increases, associated deforestation and agricultural development in the mountains (Cencini & Varani 1989). The new lands created from the deposition of deltaic sediment brought down from the eroding uplands were seen as an opportunity for coastal development, notably for tourism (Cencini *et al.* 1988). Damming the rivers, and mining aggregates from them, and from the beaches, reduced or eliminated the source of sediment, helping to create instability at the outer extremities of the system. Today, sea walls and other coastal defence structures complete the urbanisation of the coast in many areas around Italy's coastline (Cencini *et al.*, 1988).

Competing interests

Direct loss of habitat and reduction in species numbers and diversity, together with the degradation of many areas caused by changes in management practice, are important issues. Over-exploitation of both living and non-living resources, the nature of the long-term impact of past development on existing uses and the 'knock-on' effects of one activity on adjacent areas may also have implications for the commercial interests using the coast. Thus successful management is about *balancing* the competing environmental, economic and social demands made of the coast.

Some examples of the more important issues are:

- resource depletion (e.g. of fish stocks by over-fishing);
- landscape degradation and habitat loss (e.g. urbanisation for tourism);
- erosion of cultural diversity (e.g. through loss of traditional employment such as inshore fishing);
- inappropriate building in hazard zones (e.g. on soft coastal cliffs prone to erosion);
- building coastal defence structures (e.g. reducing sediment availability for ‘natural’ sea defences such as beaches);
- pollution from land-based industry and agriculture (e.g. eutrophication of coastal waters);
- increase in recreational activity.

The common feature of many of these issues is that there is either a spatial or temporal gap between the activity and its impact. Many of the effects are cumulative so that it is often not until a major and irreversible loss has occurred that the need for remedial action is recognised. This makes the determination of cause and effect difficult to unravel.

The enclosure of tidal land, for example, may cause a reduction in tidal volume in an estuary and lead to an increase in sediment deposition. This can cause ports to become inaccessible as the tidal channels become blocked. The time scale over which the estuary adjusts to the change can be 100 years or more; hence the consequences of actions taken by previous generations becoming apparent now (Doody 1992).

Sectoral exacerbation

As noted in the previous section, successful management of the coast must balance the competing environmental, economic and social demands made of the coast. Unfortunately policy and management responses to many of the problems on the coast have traditionally been from within the sector most affected by the issue or from organisations with a recognised regulatory or funding responsibility. Often little or no regard was given to the likely effects of one sector’s policy or management decision on other sectors. This situation has been made worse by the partitioning of planning and other regulatory mechanisms between the land and the sea.

For example, the headlong rush to develop tourism in the Mediterranean has caused not only physical degradation of the environment but also cultural changes that have adversely impacted on the local population. In some areas, such as the island of Majorca, the local population is arguing for greater control and even a stop to further tourist development. Another example is ‘solutions’ to coastal erosion. Throughout Europe hard engineering structures continue to be the most frequently adopted solution to coastal erosion, especially in low-lying estuarine or deltaic areas. Yet in many cases the erosion results from, or is exacerbated by, other human activities such as interrupting sediment movement along the coast, damming rivers and reducing the delivery of sediment to the coast.

The integrated approach

There is a general consensus amongst those who have studied the impact of human activities in the coastal zone that a more integrated approach to management is required if sustainable development is to be achieved without further serious degradation of the natural and cultural environment. This consensus has developed over many years as academic research has been applied to an understanding of the interactions between coastal processes and human activities. In this context it is not surprising that some of the more important academic publications are from geomorphologists (notably Bird 1984, Carter 1988 and Carter & Woodroffe 1994). The importance of understanding the dynamic nature of the coastline and the links between its component habitats and the role of human activity in changing its structure and function is central to their thinking.

At the same time those concerned more directly with coastal environmental issues have also recognised the need to develop more integrated approaches to management. This consensus is based on an increasing awareness of the detrimental impact that human action has had on the coastal (and marine) environment. Land loss, depletion of natural resources and degradation of landscapes and

wildlife habitats have led to recognition by organisations (such as the Council of Europe, the United Nations Environment Programme and NGOs) including the European Union for Coastal Conservation, of the need for a new approach to policy formulation and management. Evidence for this has been demonstrated in many seminars and conferences (see the European Coastal Conference (Bijvoet *et al.* 1991) and the World Coast Conference held in Holland in 1993) and through practical experience in many parts of the world (e.g. Organisation for Economic Cooperation and Development 1993a,b).

Defining integrated coastal zone management

‘Coastal management’, ‘integrated coastal management’ and ‘integrated coastal zone management’ are interchangeable terms that have come into common usage in recent years. At the present time, institutional and administrative frameworks in both Europe and North America are moving towards a common approach where the mechanism of integrated coastal zone management (ICZM) is being adopted. The ICZM approach rests on several key principles, of which (i) the need to integrate actions across competing sectors, and (ii) the importance of consensus building in the development and implementation of policy are the more important. Although the concepts may mean different things depending on the perspective of the observer, they all have one common feature: respect for the interrelated nature of the physical, biological and human components of the coastal zone. Thus one definition of ICZM, which stresses the importance of process to the development of policies and actions within the coastal zone, could be that it:

provides a mechanism for the integration of human activities, within a zone defined by natural processes, that facilitates the sustained use and exploitation of the resources without degrading the environment.

The Demonstration Programme

Background to the Programme

The European Union Demonstration Programme on Integrated Management in Coastal Zones was conceived as a joint activity between the relevant Directorate General (DG), in particular DG XI (Environment), DG XIV (Fisheries) and DG XVI (Regional Policy and Cohesion), with the support of DG XII (Research), JRC (Joint Research Centre) and the European Environment Agency (EEA). This collaborative arrangement was designed to ensure that the issues of coastal zone management would be evaluated from a truly integrated viewpoint.

The programme has at its heart the aim of showing how sustainable development can be achieved through co-operation and collaboration. Integration both across sectors (horizontal concertation) and at different levels of decision-making and policy formulation (vertical concertation) is a fundamental part of the programme.

Finding best practice

The Demonstration Programme was designed to test a number of hypotheses which, if validated, would be intrinsic to emerging best practice in ICZM throughout the European littoral. The hypotheses being tested are that:

- A sectoral approach to problem-solving is inimical to securing successful outcomes.
- There are significant barriers to the flow of information between the scientific and technical communities and decision-makers in local and regional authorities, and the private sector.
- The lack of horizontal and vertical concertation frustrates a consensual approach to coastal management.
- Monitoring and evaluation of coastal resources are rarely undertaken in any consistent or robust way.
- European Community policies and actions, and those of Member States, can be contradictory or competitive in the coastal zone.
- Outcomes are often less than optimal because of the paucity of genuine participation.

- Statutory and regulatory mechanisms are sometimes unhelpful to the integrated approach.

The thematic studies

The overall purpose of the Demonstration Programme is to identify what works in ICZM. The programme has three components:

1. 35 local Demonstration Projects that have been chosen to show different scales, problems and type of coastal experience;
2. six thematic studies to review what works and why; and
3. a wide-ranging debate¹ on the results of the Demonstration Programme and the conclusions to be drawn.

The thematic studies have been set up to review how integrated management can contribute to sustainable development along the coastline of Europe. The six themes are legislation, participation, technology, planning and management, policies of the EU and information. It is clear that the remits of the six themes overlap to some degree.²

The Demonstration Programme is based largely on the premise that many of the problems in the coastal zone result from the over riding influence of sectoral issues over more consensual approaches to decision-making. The justification for a particular action is often based on short-term economic evaluation, ignoring the knock-on effects on other interests. Achieving a more enlightened approach to management depends on integrating decision-making both across sectors and between the various levels of policy formulation. An important prerequisite to achieving this integration is the availability of relevant information. Information is needed not only to justify an integrated approach to management, but also to act as a sound basis for implementing policy, taking decisions and assessing their effectiveness.

The information thematic study

The European Environment Agency³ and DG XII, having recognised the important role that information plays in management, have financed the information thematic study. The information thematic study, which took place between January and November 1998, was aimed at establishing ‘the role of information in ICZM’. The results of the study include a synthesis of the experiences of many of the 35 Demonstration Programme projects, and look at the need for, and provision of, information at all spatial scales from international to national, regional and local levels.

Gaining an understanding of both the natural coastal and marine environments and the human activities that influence them is a clear objective of the Demonstration Programme. Using examples of existing practice the Programme intends to highlight both what works and why it works.

¹This debate began at the ‘Transnational Seminar on the European Spatial Development Perspective’ organised by the European Commission and held in Göteborg, Sweden on the 26–27th November 1998. It will continue over a 6-month period with the publication of a discussion document based on the results of the Programme in early 1999.

²See the Progress Report adopted 12/1/98 at <http://europa.eu.int/comm/dg11/iczm/intrep.htm>.

³The EEA, launched by the EU in 1993, has a mandate to orchestrate, crosscheck and put to strategic use information of relevance to the protection and improvement of Europe’s environment. The Agency is also required to ensure the supply of objective, reliable and comprehensive information at the European level. This information should enable Member States to take appropriate measures to protect the environment, to assess the efficacy of such measures and to inform the public about the state of the environment. Because of its wide-ranging remit the EEA has been closely involved in the ICZM Demonstration Programme.

The objectives of the information theme

The principal objectives of the information thematic study were:

- to determine the properties and characteristics of information in the coastal zone, and
- to evaluate the need for information and its use in the ICZM process.

In order to achieve these objectives a number of associated elements were analysed to determine:

- the extent to which existing methods of information provision meet the needs of the organisations concerned with management and/or policy formulation in the coastal zone;
- the opportunities for data exchange between sectoral interests and the ways in which exchange is achieved;
- the extent to which data collected at the local level can be aggregated into information at higher levels and how disaggregation of data collected for national or pan-European purposes may be made available at a lower level;
- options for new approaches, and validation of existing approaches, to the use of information technologies in accessing data and creating information;
- the extent to which electronic methods of data storage and retrieval can assist in meeting information needs; and
- the way knowledge accumulated through time is incorporated into the management process.

Definitions

Information, data, understanding

To avoid confusion and assist understanding the following definition was used to guide discussion, particularly within the Demonstration Programme projects.

Data is the raw material from which information is produced. Information is a collection of data relevant to a recipient at a given point in time. Information is data in context: it has meaning, relevance and purpose.

An important consequence of this definition is that we see information as one element of a hierarchy through which sustainable management of the coast *may* be achieved, thus:

$$\begin{aligned} \text{Data} + \text{Context} &= \text{Information} \\ \text{Information} + \text{Analysis} &= \text{Understanding} \\ \text{Understanding} + \text{Management} &= \text{Possibility of sustainable action} \end{aligned}$$

Information, when used to *nourish* the analytical process, can be transformed into an understanding of the issue in question. Crucially, it is the way in which this understanding is used that determines the efficacy of any management strategy. Throughout the study a distinction has been made between data, information and understanding.

Coastal zone

Defining the phrase *coastal zone*, and the nature of the interactions between the ‘natural’ coast and human activities, is important if we are to accurately identify information needs. (Appendix 1 provides a summary analysis of the various factors that define the coastal zone, stressing the importance of human activity in defining the limits of the zone for management purposes.) This report is based in large measure on the experiences of the Demonstration Programme projects. These projects occupy an enormous range of coastal environments. Therefore this report adopts a wide definition of the coast so that rivers and tidal inlets, the terrestrial coast, intertidal shores and the marine zone to the offshore limit of coastal processes are all considered to fall within the coastal zone.

The importance of information in ICZM

The importance of information in achieving effective ICZM is not a new insight. In 1991 at a conference in Cambridge, UK, Domingo Jimenez-Beltran, Executive Director of the EEA, stated that ‘information is at the root of choice’. We endorse the sentiment of this statement as it reflects the central role that information should play when formulating policy, taking decisions and undertaking management action. This is recognised again within Agenda 21, which encourages coastal States to ‘improve their capacity to collect, analyse, assess and use information...’, and that ‘Information for management purposes should receive priority...’.

There is little resistance to the idea that information is a vital part of the process of developing management strategies, policy options and taking decisions. The rest of this report looks at the role of information in achieving ICZM in Europe.

Methodology

The study was undertaken in a number of stages. At the outset we defined what is meant by *information* and how this differs from *data*. This definition was used to develop a model of information use in ICZM. This model was included in a questionnaire sent to all the projects. The responses to this questionnaire formed the basis for further analysis and visits to some of the projects. At the same time relevant organisations responsible for information provision or information exchange at European and national levels were contacted and appraised. A review was also undertaken of a range of tools deployed in developing policy or management action.

Initial model of the processes leading to information need

In order to inform the consultation process an initial model of the processes that lead to information need was created. In developing the model we recognised that the 35 projects cover a diverse range of geographical areas and problem domains. The model created assumes that, despite this diversity, information must play a central role in the development of a more integrated approach to management.

It was also considered unlikely that there would be a single formulaic approach to tackling the information issue. However, some common characteristics of effective information collection, collation and use do in fact exist.

The DPSIR causality model

The EEA uses a modification of the United Nations’ Pressure–State–Response model in their work at the European scale. The EEA’s DPSIR causality model shows **D**iving forces (e.g. industry and transport) producing **P**ressures on the environment (e.g. polluting emissions), which then degrade the **S**tate of the environment and have **I**mpacts on human health and eco-systems. **S**ociety **R**esponds with various policy measures, such as regulations, information and taxes, or management action which can be directed at any other part of the system.

The origin of information need within the DPSIR model

The DPSIR model was extended to show where information needs arise from the various elements in the model (see Figure 1). Information is needed to allow predictions to be made about the impact of policy changes; to identify key pressures in the system; if the state of the system is to be kept under surveillance and if the results of changes in the system are to be recognised and measured.

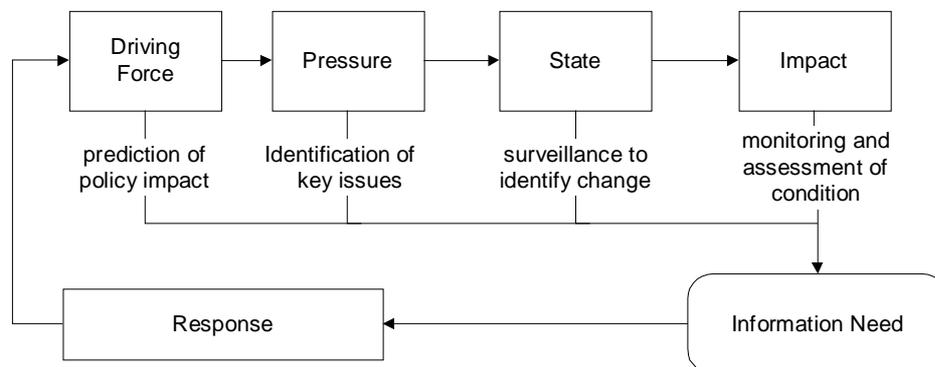


Figure 1 Information need in the context of the EEA causality model

Data + Context = Information

Having identified where information need originates it was important to understand how information can be obtained to fill the need. This process (illustrated in Figure 2) is seen as one in which an

analysis of the information need provides a context that allows the identification of relevant data. As stated previously, we see information as data in context. The final piece in the initial model was concerned with locating the relevant data.

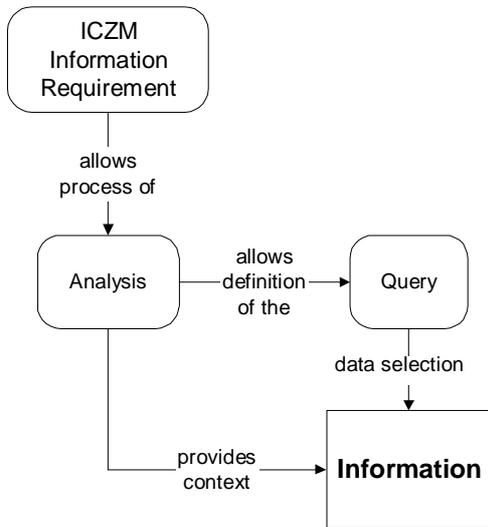


Figure 2 Information is created by selecting relevant data and placing it in context

Data selection

Having analysed the problem at hand and identified what data is relevant in that context, it is necessary to go out and get that data. The first step is to see if the relevant data exist. This requires knowledge of data availability: if you don't know that data exist you can't use them. If you know of the existence of suitable data then the next step is to assess their accessibility. If you don't know that data exist, or you know that data exist accessibility is a problem, your only way of obtaining suitable data is to undertake a data collection effort. Once you have data to hand you must make choices about the data quality, scale and currency (see Figure 3).

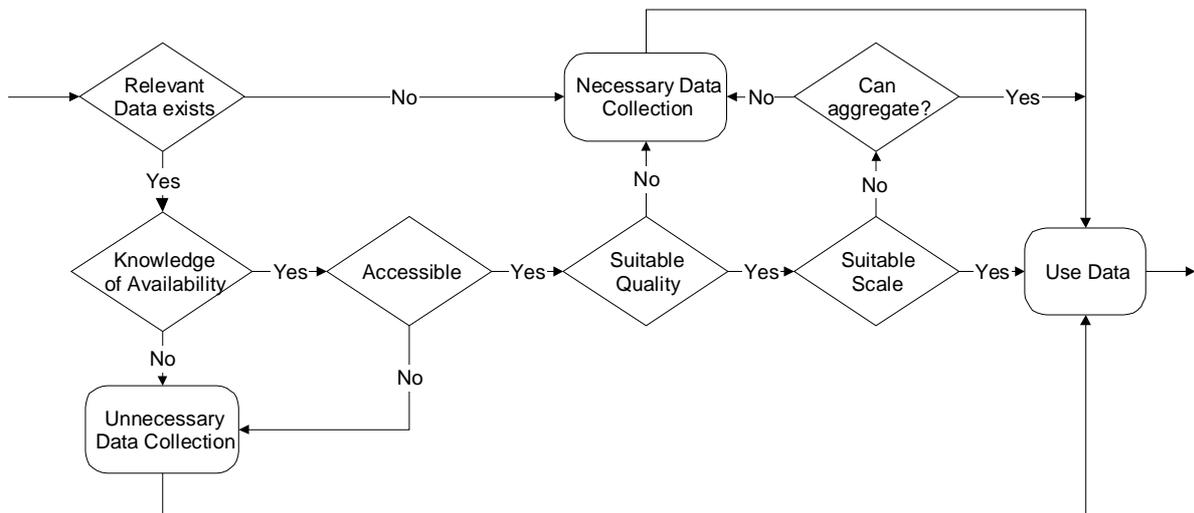


Figure 3 The process of data selection

Questionnaire

At the outset the thematic expert group agreed that each thematic team would circulate a questionnaire. It was hoped that this approach would help to maintain a level of consistency in the output of the six thematic studies. The information theme questionnaire is presented in appendix 2.

Project visits

An important element of each thematic team was visits to the Demonstration Programme projects. This study involved visits to 13 projects (see Appendix 3) and a further four visits through the CoastLink Partnership (in which two members of the theme F team are closely involved). During the course of the study a number of relevant conferences were also attended (these are also listed in Appendix 3).

Approaches to organisations

The EEA and its partner organisations potentially play a vital role in the provision of information within Europe. For this reason, the European Topic Centres (ETC), the Regional Seas Conventions and the National Focal Points (NFPs) were contacted. The information theme questionnaire was sent to 10 ETCs and the 17 NFPs of the EEA (see Appendix 4).

European Topic Centres

European Topic Centres are organisations, or groups of organisations, appointed by the EEA to execute specific tasks, in particular to provide thematic information. The most relevant centres to the Demonstration Programme are:

- Land Cover Topic Centre
- Marine and Coastal Environment Topic Centre
- Nature Conservation Topic Centre
- Catalogue of Data Sources
- Joint Research Centre

Visits were made to the Marine and Coastal Topic Centre partner organisations in Rome and the Coastal Zone Management Centre in The Hague.

National Focal Points

National Focal Points are responsible for national co-ordination of activities related to the EEA work programme.

National Reference Centres

The National Reference Centres were not targeted for this study. However, the UK's National Reference Centres for Nature Conservation, based at the Joint Nature Conservation Committee, was contacted.

Regional Seas Conventions

There are Regional Seas Conventions, also known as Action Programmes, covering all of the major European seas (see Appendix 6). Each has a mandate to assess and report on the quality of the marine and coastal environment in its specific region. In recognition of the important role these organisations play in improving the availability and access to information at a European scale, the ETC M&CE has organised meetings of an Inter-Regional Forum. The second such meeting, held in Rome in November 1997, was attended by a member of the information theme team.

Results

The following analysis looks at the way in which information has contributed to the ICZM process as developed by the projects. Although there is an overall logic to the way the projects have tackled the issue of data collection and information provision, a variety of approaches have been adopted. For some, data collection and collation are simply prerequisites to the analysis of the issues. Others see data collection and collation as a means of raising awareness. Yet others consider data collection and collation as integral to developing the management process.

To some extent the way in which information provision is viewed can be linked to the stage the project has reached, the people involved and the political environment within which decisions are taken. The following discussion reviews the different approaches and seeks to draw out any common lessons that may be learnt from the experiences of the projects. This includes information gleaned from the questionnaires, together with the results of the project visits and analysis of other documents produced by the projects.

Awareness raising

Most of the projects have been initiated by people who, having recognised that significant issues have arisen in the coastal zone, see the need for a more integrated approach to developing policy options or management strategies. These people often find themselves as lone voices that need to convince others that there is an issue to be addressed. It is important to recognise that despite the many problems which continue to arise, there remains an inadequate understanding of their significance by those who live in, work in or derive pleasure from the coastal zone. This lack of understanding can lead to the view that:

- the problem is too scientific and/or complicated;
- the problem is not relevant to me;
- I don't know how to get involved.

A specific sector may fail to understand, whether through ignorance or design, how their activities compromise the interests of others. This can result in their active opposition to any changes that may be more generally beneficial. This is made even more difficult when expert opinion seems equally divided between opposing parties. Under these circumstances the path of least resistance may dictate that people feel they should:

- leave it to the government or local authority to sort out; or
- rely on a technological solution.

The relationship between the coastal zone and its hinterland may be subtle but can nevertheless have a profound influence on local management. Take, for example, Italy's deltas, where the relationships between the land (and its management) and the sea are demonstrated by the delivery of sediment from river catchments to the deltas of the Italian coastline.

Understanding the way in which Italy's deltas have developed in response to human population levels (through cycles of erosion and accretion) might have helped to prevent some of the inappropriate development, and with it the need for costly coastal defence structures and the loss of some expensive infrastructure. There is a solid scientific basis underlying our understanding of the state of the Italian deltas. Despite this, it seems that this scientific understanding has had little or no influence on past or current policy on coastal development in the area.

The important point is that an understanding of the issues, and of the options for addressing them, is often not available to those who need to know. Even when understanding is available it may not

presented in a form that is appropriate to the intended recipient. Several of the Demonstration Programme projects illustrate these points.

EUICZM Project: Ricama

Members of the project team have a good understanding of the relationship between sheep grazing and afforestation in the uplands and the delivery of sediment to the coastal plain. However, although the knowledge is good and the information to back it up is adequate, the missing element is persuading those who have beach concessions and other interested parties of this link. This problem is bound up with the mistaken notion that coastal defence structures can secure protection. The need is for those who derive a living from beach recreation to understand that beaches are not stable and that without new supplies of sediment some will disappear. Defence structures may provide short-term benefit but can make the loss of beach material more rapid. How can this understanding be translated into a change in policy towards building groynes, for example? The key is that sediment availability and artificial beach nourishment (prevented by Italian law) provide a possible solution. At each of these levels it seems that the limiting factor is not a lack of understanding, but the failure to use the available understanding to effect a change in policy.

Lesson

It is important to understand the relationships between catchment management and coastal processes in areas where beach erosion is taking place, and to transfer this understanding to *everyone* who needs to know.

ICZM Project: Ricama

Italian law precludes beach nourishment with dredged ‘contaminated’ sediment as a means of building up natural defences. This is yet another barrier to better management and establishment of a ‘sustainable beach’.

Lesson

It is important to recognise difficulties with restrictive legislation affecting sectors for which it was not intended and to seek to influence a change in policy.

ICZM Project: Ricama

The Ricama project also highlights the need to raise awareness amongst all players. For example, it is important that there is a better understanding by some engineers of the significance of coastal processes. The fact that eminent scientists have promoted hard engineering solutions makes it more difficult for those who derive a living from beach concessions to accept that these structures could be adding to the problems of erosion.

Lesson

Ensure that those seeking to adopt hard engineering solutions to beach erosion understand both the positive and negative implications of this approach.

EUICZM Project: Latvia

The lack of appreciation of the importance of adopting a more integrated approach to management is felt most acutely in countries where there is a lack of experience, a lack of human resources or a tradition of cross-sectoral cooperation, such as in **Latvia**.

Lesson

ICZM is not only important in itself but, being an integrated process that promotes the exchange of information and experience, it also helps to raise awareness of the value of the process itself.

EUICZM Projects: **Isle of Wight** and the **Cyclades**

Even in areas where experience and expertise are not lacking, raising awareness amongst the sectors can still be a major requirement. It appears from the examples of the **Isle of Wight** and the **Cyclades** that this is the case, whether or not good quality information is available. For both of these projects the need to raise awareness of the value of adopting a more integrated approach across the sectors has been identified as a key issue. In the case of the Isle of Wight, the lack of information was not a constraint, though for the Cyclades this was an issue.

Lesson

The ICZM process itself is important in raising awareness of the need for more integrated forms of coastal management and vice versa.

EUICZM Projects: **Kent**, **Côte d’Opale**, **Epirus** and **Rade de Brest**

Although not strictly an information issue, many of the projects were driven by a need to accommodate developments resulting from European or national policies outside the influence of the local administration. Examples include transnational infrastructure (**Kent** and **Côte d’Opale** in relation to the Channel Tunnel), road developments (**Epirus**) and job losses brought about by changes to national policy (in **Rade de Brest**). Information about ‘external’ forces may help focus attention on the need to look more strategically at local issues. In **Kent**, the impact of the Channel Tunnel was used as a means of promoting a wider debate about other issues around the coast.

Lesson

Use information on national and international policies, which impinge on the local area, to identify and promote acceptance of the need for ICZM.

Participation versus Consultation

The way in which understanding is used determines the efficacy of any management strategy. Whilst to some extent the use of understanding is governed by the nature of the ICZM process, we have identified two basic models:

1. The participatory model, where all the stakeholders together determine information needs as part of the process of identifying issues and using the ICZM methodology. Participation plays a key role in the development of policy in the **Firth of Forth**, **Dorset** and **Magnesia** projects.
2. The regulatory model, where the players (regulators, usually planning authorities, developers and specialists who advise the regulators) prepare a plan for consultation. The plan, therefore, has a predetermined structure and embodies assumptions as to what issues are relevant. Consultation, such as it is, takes place amongst the regulators. In this model the wider public are restricted in their ability to input comment. An extreme case of this is **Palermo**, though the majority of the projects, driven by planning considerations, have a similar approach.

EUICZM Projects: Dorset and Rade de Brest

The **Dorset** project has used the members of its coastal forum to review existing information along sectoral lines and to produce a number of discussion documents. The understanding of the key issues was therefore ‘owned’ by the participating sectors. By comparison, **Rade de Brest** undertook a detailed stock-take using local specialists (and validated by international experts). The standing of these ‘experts’ in the eyes of the local politicians was important to the acceptance of the project’s conclusions.

Both approaches appear to have been successful. Their success and appropriateness seem to be related to the nature of the institutional responsibilities within the nations concerned. In the UK the planning process is becoming more open and the participation of the different sectors is an aid to decision-making. In France the strength of the political force is much more integral to the decision-making process.

Lesson

Seek to tailor participation of the different sectors to meet the socio-economic and political circumstances of the region.

EUICZM Projects: Down, Northern Ireland

With the return to normality in Northern Ireland, powers exercised previously by the UK Government in London are being returned to 26 district councils. Down District Council determined to draw up a plan for the future of Newcastle, a typical family-based holiday resort. The Council engaged consultants who drew up an imaginative proposal. But when it was put before the townspeople it was rejected out of hand because it was seen as a plan for tourists and not for those who lived there.

Lesson

Ensure the local community is fully involved from the start of the process and determine the balance of opinion on the basis of available information

The stock-take

It is common for projects to start with a ‘stock-take’ of existing data and information as part of the analysis of the coastal management issues. This happens not only at the project level but at other institutional levels where ‘state of the environment’ reports are prepared. Examples are the Dobris Assessment (Stanners & Bourdeau 1995) at the European level, the State of the Arctic Environment at the Regional Seas level (Nilsson 1997) and the Coastal Directories (UK) (Barne *et.al.* 1995-8) at a national level.

EUICZM Projects: **Rade de Brest** and **Strymonikos**

Both the **Rade de Brest** and **Strymonikos** projects set out at an early stage to gather knowledge about available data for the project area. This stock-take provided a comprehensive description of the area and its environment, as well as an analysis of the issue(s) to be addressed. In the case of the **Rade de Brest** these results have been validated scientifically (using international experts as well as local academics). Subsequent use of computer-based technology has helped with assimilation of the data and will also be used in the dissemination of the project's results. The whole process, including dissemination of the results to the many local players (including politicians) and sectors, has been very effective. However, the financial investment and the number of individuals involved in the process have been relatively high compared with other projects. The **Strymonikos** project as a whole is at an earlier stage of development, having just completed the initial review of information. This information will be made more widely available by publication of the results and has formed the basis for the establishment of an information centre.

Lesson

Think about a stock-take at an early stage in the ICZM process but be careful that data quality or availability does not predetermine the issues to be considered - issues should be prioritised according to their importance and not because of data availability.

EUICZM Projects: **Cyclades**, **Ria de Aveiro** and **Irish Dunes**

The **Cyclades** and **Irish Dunes** projects have been driven by and/or made use of universities in the collection of data and the provision of information for project development. The university may be seen as an 'honest broker' of impartial information or as a 'mediator', and hence can help create dialogue between competing sectors. However, the way the issue of an 'honest broker' is handled can be especially important. In the case of the Irish Dunes project, early approaches by the academics undertaking the project needed to be modified to obtain acceptance of their involvement. Compare also the experience of the **Rade de Brest** project, where the careful preparation of scientifically validated information provided a basis for discussion and agreement, with that of the **Ria de Aveiro** project, where some partners perceived the university, which was the main centre for data collection and collation, as distant academics. This resulted in it being difficult to obtain the necessary information required for the description and analysis phase of the project.

Lesson

Ensure that knowledge brokers, such as university academics and other scientists, are integrated into the information collection, collation and validation process.

EUICZM Projects: **Kent**

Using questionnaires and focus groups, **Kent** has drawn up a number of sustainability indicators for its coast and seas. Involving local authorities, interest groups, governmental agencies and universities from an early stage has facilitated access to data often held by such institutions but jealously guarded. One important proviso that should be noted is that each group participating in the process feels that its favourite issue is worthy of being monitored. The result is that some of the indicators measure issues that are relatively unimportant in the region.

Lesson

Involve actors on the coastal stage as early as possible when deciding which issues to monitor and evaluate, but beware the well organised and influential interest groups pushing their own agenda.

Transparency

Throughout the projects different approaches have been adopted to making available information accessible. Most projects have attempted to keep those contributing to the project, as well the wider public, informed about what is happening. They have used newsletters and other publicity to achieve this goal. A few have carefully considered and developed a policy for data exchange. The **Irish Dunes**

project serves as an example of providing information to the general public. The **Cornwall and Devon** and **Storstrøm County** projects illustrate different approaches to information provision, the former respecting the intellectual property rights of the data holders and the latter adopting a much more open policy.

EUICZM Project: **Irish Dunes**

Traditionally sand has been taken from the sand dunes and beaches to improve the adjacent acidic soils. Over time this has depleted the availability of beach sand and resulted in increased erosion. Academic studies (e.g. Carter 1991) have shown the cause and effect, but the local population has not accepted this. In this case an extensive education campaign was initiated using the mass media – i.e. providing information at all levels to encourage the acceptance of new understanding and new approaches. Web sites, the radio, television and newspapers are all used to ‘get the message across’.

Lesson

Use the media to inform the public and gain wider acceptance of changes to damaging traditional management practices.

EUICZM Project: **Cornwall and Devon**

The **Cornwall and Devon** project established a focus group (one of four) covering coastal information. This arose from recognising that establishing a dialogue between the various potential information providers would be more helpful than trying to identify all the information needs, and how these might be met, from the beginning. Trust and understanding between the local authorities (the project leaders) and other information providers and potential users were deemed essential to achieving effective data exchange. As a first stage in the process, agreement had to be reached that the potential providers were prepared to share their data. Once agreed, it was essential to understand and guarantee the intellectual property rights of the data providers.

Lesson

Reaching agreement between sectors on sharing data is the first stage in identifying data sources and achieving effective data exchange. Respect for the intellectual property rights of potential data providers is vital if data sharing schemes are to work.

EUICZM Project: **Storstrøm County**

In contrast to the approach of the Cornwall and Devon project, the **Storstrøm County** project has adopted a completely open approach to data provision, which has the advantage of encouraging participants to give data in the hope that they are likely to have access to much more than they provide. This has gone as far as publishing the locations of rare and endangered species, something that is anathema to many conservationists. **Storstrøm County** has also made a decision to enable all users to share information through adopting common protocols for information exchange. This has become an important part of their data strategy.

Lesson

Consideration should be given to adopting a fully open policy on access to data. Whilst this approach will often strike fear into the hearts of data custodians it often has more positive benefits than might at first seem likely.

Artisan knowledge base

Many of the projects are driven by, or use, scientific expertise to develop a better understanding of the policy and management issues. There can, therefore, be a tendency to overlook locally held empirical knowledge. The fact that this type of knowledge can be difficult to quantify in scientific terms does not diminish its value. Most of the projects recognise the importance of ensuring all the relevant sectors are represented in the development of the ICZM programme. This implicitly recognises the

value of artisanal input. Perhaps the most obvious and accepted form of local knowledge is that held by fisherfolk.

ICZM Project: **Dorset**

In **Dorset**, for example, a link between changes to the Common Fisheries Policy and landscape was identified. Allowing foreign vessels to fish closer inshore would probably result in further loss of local inshore vessels. These often represent a significant element in the beach landscape of small coastal towns and villages.

Lesson

Recognise the value of artisanal knowledge.

Resources

Financial resources *per se* do not appear to have been a particular limiting factor in providing information to the projects in general. Most projects have invested what their budgets allow and made use of other complementary resources where possible. This is especially the case where the projects are located within institutions (such as Local Authorities) that already have access to IT equipment, know how and suitable map-based data.

EUICZM Project: **Kavala, Irish Dunes and Storstrøm County**

Maps are a basic tool that all projects use. In many instances current maps of a suitable scale are not available and hence expenditure may be required to provide the necessary base-line information. In **Kavala** and for the **Irish Dunes** project acquisition of up-to-date maps of a suitable scale would required the Local Authorities to undertake their own mapping exercise. Difficulties of acquiring maps from military source also posed problems in Portugal and Greece. In **Storstrøm County** the cost of acquiring base maps, derived from publicly funded programmes, was high. Similarly all UK projects incur considerable charges for the use of maps licensed from the publicly financed Ordnance Survey.

Lesson

Under present purchase arrangements many up to date maps of a suitable scale and currency are costly to acquire. Efforts should be made to seek to influence a change in policy in relation to the use of data products (including maps) which are derivatives of publicly-funded data collection programmes.

EUICZM Project: **All Projects**

All of the projects have acquired and use some form of Geographical Information System (GIS)⁴. Quite sophisticated approaches using analytical GIS, such as ArcInfo or MapInfo, are used by several projects (**Rade de Brest** and **Bantry Bay**) where the complexity of the software requires dedicated personnel. Other projects have also developed quite sophisticated approaches to computer-based tools though at a lower cost because of collaboration between the team and other organisations already using the sophisticated technology (e.g. **Strymonikos**, through the Greek National Wetlands Centre). Finally, a more pragmatic approach has been adopted by projects such as **Dorset** which has used ‘off the shelf’ software and existing staff. Even here, though, specialist computer staff available within the Local Authority have given support.

Lesson

Use technological solutions suitable for the purpose and for which adequate financial and human resources are available.

⁴The Thematic Study on Technologies will provide more information on what these programmes can and can't do. For the purposes of this report it is important to know how the IT solutions have been applied.

EUCZM Projects: **Dorset, Firth of Forth and Devon and Cornwall**

In the UK, the voluntary approach to the development of ICZM has led to a more open and participatory form of data collection and collation. Through participation the cost of data acquisition has been greatly reduced as data is provided by collaborating organisations. This requires agreement at the outset that data will be freely shared between the partners. If this can be achieved then money to obtain new data to fill real gaps in coverage may be more easily found.

Lesson

Reduce the costs of data acquisition by agreeing to share data at an early stage in the ICZM process

EUCZM Project: **All Projects**

Many of the projects have considered how their activities might be funded beyond the end of the Demonstration Programme. **Rade de Brest** and **Strymonikos** have specific policies in place. In Brest, the 'Baie Contract', which all communes have signed up to, provides a long-term basis for development based on the original review of the state of the catchment and identification of policy options. In Strymonikos, the local community has agreed to finance an information centre that provides a facility for education as well as a focus for the provision of information and advice.

Lesson

The development of an information and advisory facility may generate political support for the continuation of the project and its objectives.

Education

For several projects, building understanding and consensus starts with the need to raise the awareness of the general public, including children. For this reason several projects (e.g. **Bantry Bay** and **Strymonikos**) are developing a community based approach to information dissemination. These examples suggest that information can be closely allied to educational needs. By doing this, it is possible to secure a longer-term interest and understanding of why achieving integrated coastal management is so important.

ICZM Project: **Storstrøm County**

The county has included within its information strategy a process whereby individuals can undertake simple surveys or monitor populations of scarce species. This public involvement generates support for more integrated forms of management and allows a more open approach to information provision. It also helps to protect natural populations through surveillance by a wider and more interested public.

Lesson

Consideration should be given to the potential benefits of a long-term investment in raising awareness in the general public through education.

Scientific research and the projects

Academic studies into the dynamics of coastal systems are legion, and 'data overload' is probably encountered more often than is a real lack of data. Such studies are a major resource for much of Europe and several of the projects have an academic focus (**Strymonikos**, **Cyclades**, **Irish Dunes** and **Bantry Bay**). Most of the rest are led by Local Authorities and make considerable use of the scientific community to produce and or validate data. However, academic research is not without problems. Research is often determined on the basis of academic requirements rather than the need to solve practical issues on the ground. And even if the research addresses a practical problem, there is often a problem in making the understanding gained available in a form that is accessible to those non-academics who would benefit from it. Therefore, it can be difficult to apply the results of research studies to policy formulation and practical management.

ICZM Project: Devon and Cornwall

One of the main focus groups in the **Devon and Cornwall** project is concerned with information. A local 'research agenda' is being developed by the projects in order to establish more clearly 'practical' requirements.

Lesson

Develop a local research agenda that brings potential users into the process of identifying research needs. This agenda should include a clear statement of how the results will be applied to the problem and who will benefit. It should also have a policy for disseminating to users the understanding gained from the research. And, of course, provision for these tasks should be part of the initial budget proposal.

Summary of the results of the project visits

A subjective summary of the result of the project consultation exercise is given in Table 1 below. In this table an indication of the extent to which the projects have developed their approach under each of the main headings is given.

Project name:	Awareness	Participation	Consultation	Transparency	Resources	Education	Comment lead agency etc	Funding
Norwegian coast	?			?		?	No info returned / RA development control	
Southern coast of Finland				?			LA, development control (property)	LIFE
Latvia				?			National	PHARE
Lithuania							No info returned / raising awareness	PHARE
Storstrøm							LA, plan NC important driving force	COASTLINK
Wadden Sea				?			No info returned / international co-operation	LIFE
Forth Estuary Forum							NC, Info part of participation process	LIFE
Belgian Coast (Flanders)							No info returned	TERRA CZM
Côte d'Opale							LA, > traffic driving force - Observatory	LIFE
Kent							LA, info collection by team - Observatory	COASTLINK
Isle of Wight							LA, co-ordination, plan of plans	LIFE
Dorset						?	LA, Info part of participation process	LIFE
Irish Dunes							Univ., awareness raising key issue	LIFE
Down, Northern Ireland							LA, awareness raising local population	COASTLINK
Bantry Bay				?			Univ., conflict resolution a key issue	LIFE
Devon and Cornwall				?			No info returned / LA, plan co-ordination	COASTLINK
Rade de Brest							LA, driving force job losses - Observatory	LIFE
Arcachon	?				?		No info returned	CONCERCOST
Vale do Lima							No info returned / regional transport key issue	CONCERCOST
Ria de Aveiro							No info returned / Univer.	LIFE
The Algarve							No info returned	TERRA CZM
The Algarve–Huelva							No info returned	COASTLINK
La Costera–Canal (Valencia)							No info returned / regional transport key issue	CONCERCOST
Ricama							RA, awareness raising key issue	LIFE
Napoli								POSIDONIA
Barcelona							LA, a development plan	POSIDONIA
Palermo								POSIDONIA
Taranto							No info returned	POSIDONIA
Athina								POSIDONIA
Ipiros							LA, regional transport key issue	COASTLINK
Cyclades				?			Univ., communication a key issue	LIFE
Magnesia							LA	LIFE
Strymonikos							Univ., good info. provision, info. centre	LIFE
Kavala							LA, co-ordination/raising awareness	TERRA CZM

NB: Devon and Cornwall are included as one project.

Key		Denotes that the element is of importance in the project
		Denotes that the element is of some importance in the project
		Denotes that the element is of little importance in the project
		No information
		Information is available but insufficient to make a judgement

LA	Local authority
RA	Regional authority
Univ	University
NC	Nature conservation

Table 1 Summary of the role of information

Contacts with EEA Topic Centres and Partner Organisations

The attempt to open dialogues with the ETCs and related organisations was not very fruitful. Whilst contact was made with most of the groups listed in Appendix 4, their responses were variable. Indeed, a few of the groups failed to respond at all. Other groups responded but indicated that they were able to do little. This reluctance was attributed to a variety of reasons, of which ‘time constraints’ was the most common. Other problems encountered included the inability of the recipients to receive attached documents through e-mail, which was generally due to software incompatibility. In one case an office move was in progress, while another common response was ‘We will comment soon’ (few did in fact reply subsequently).

What is clear from this experience is that the various contacts had little prior knowledge of the Demonstration Programme or failed to appreciate its significance to their activities. However, there was also a sense in some individuals and organisations that a conflict of interest arose, particularly when competing for available resources, when the organisation had a role as a partner with the EEA as well as their ‘normal’ responsibilities.

European-wide EU approaches to data provision

This section looks at data sources at the European level. The description is based on a trawl of the Internet, and on discussions with the projects and the agencies concerned. Where possible, comments from the projects are included under the appropriate heading.

EEA: The Dobris Assessment

One of the EEA’s tasks is to provide a state of the environment report. The Dobris assessment (Stanners & Bourdeau 1995) is a report on the state of the environment at the European scale. It was compiled in preparation for the Conference of Environment Ministers (1995 Sofia, Bulgaria). It contains information on a number of environmental parameters including: socio-economic developments; climate change; acidification; waste; biodiversity; and the marine and coastal environment. It looks at the pressures on each of these and the way in which human activities can lead to environmental problems. It provides a European-wide ‘stock-take’ of environmental issues and opportunities. A third report was presented in 1998 at the Ministerial Conference in Aarhus, Denmark.

EEA: State of Europe’s Coast

The ETC Marine and Coastal Environment has as one of its primary tasks the preparation of a ‘state of the coast’ report. The following description has been taken from the ETC Catalogue of Data Sources

‘The objective of promoting the compilation of a high quality dataset of basic variables relevant for characterising the state of the coastal and marine environment is to:

- ascertain the comparability of data and quality control procedures at European level
- facilitate the creation and maintenance of internationally accepted, unified quality control standards used in conjunction with sophisticated data management capabilities.

The ETC/MCE will undertake: a study on data management of the main organisations, including: quality check procedures, data treatment, storage, release and dissemination; an evaluation of data comparability; a Workshop to discuss the work progress.’

The Topic Centre has recently completed a draft of the ‘Mediterranean Sea: Environmental State and Pressures’ report that purports to provide a comprehensive review of the current information available mainly on the state of the marine environment (Izzo 1998).

EEA: Experts’ Corner

From time to time the EEA asks independent experts to summarise their views on topical or upcoming issues. These are designed to stimulate debate on issues and to facilitate the broader dissemination of

more recent environmental information that may provide useful inputs into the developing environmental agenda. Two recently published reports are *Public Access to Environmental Information* (1997) and *The State of Action to Protect the Environment in Europe* (1995).

EEA: EIONET

One of the aims of the EEA was to set up a European Environment Information and Observation Network (EIONET). The principal objective was to 'provide the EU and Member States with objective, reliable and comparable information on the environment that can be used directly and efficiently'. EIONET consists of national networks organised by the Agency to help it retrieve information and identify special issues. In effect it provides the means of communication between the partner organisations of the EEA. Through EIONET, the EEA seeks to use existing capacities of Member States and to co-operate with other bodies and international organisations. It hopes that this approach will build synergy and avoid duplicated effort.

EEA: ETC Catalogue of Data Sources

ETC/CDS was founded by the EEA to:

- harmonise concepts for registering and locating environmental information within Member States and the EEA;
- develop and promote tools to ensure collection and free access to environmental information on a European scale;
- gather metadata relevant to the European scale; and
- maintain and update a European Data Catalogue.

EEA: ETC Land Cover

The ETC on Land Cover is responsible for providing information on land cover and land use within Europe. The topic centre has been given responsibility for maintenance and dissemination of the results of the ongoing work of the CORINE Programme, which includes the production of a coastal erosion database and a land cover map of Europe. Information on these aspects of the programme, again obtained from the ETC/CDS, is shown below.

EEA: CORINE

The CORINE Programme (1985–90) had two aims:

- to verify the usefulness of a permanent information system on the state of the environment for EU environmental policy, to check the technical feasibility of creating such a system, and to identify the conditions required for its installation and functioning;
- to supply information useful for EU environmental policy on topics of priority concern.

The main objectives of CORINE were:

- to collect data on priority subjects;
- to co-ordinate related international or national activities; and
- to improve data consistency.

The themes of the CORINE Information System are:

Biotopes	Land cover	ERDF regions
Designated areas	Water pattern	Settlements
Emissions into the air	Bathing water quality	Socio-economic data
Water resources	Soil types	Air traffic
Coastal erosion	Climate	Nuclear power stations
Soil erosion risk	Slopes	
Important land resources	Administrative units	
Natural potential vegetation	Coasts and countries	

Two specific areas of study are relevant to the Demonstration Programme, namely the coastal erosion project and the land cover project. The CORINE Coastal Erosion project provides a comprehensive description of the characteristics of the coast and its evolution based on existing information and expert knowledge. The output from the CORINE Land Cover project is a land cover map of the EU. This is based on Landsat and SPOT satellite data, which have 30 metre and 20 metre ground resolution respectively. Existing information obtained from topographic maps and aerial photography have been used to verify the satellite data.

It is not possible to comment further on the results of the coastal erosion project as the report has only just become available. However, two of the projects attempted to use data from the Land Cover project with very different results. **Bantry Bay** uses the data to form a 'land-use' context for their own database. Attempts by the **Magnesia** project were much less successful because of problems in 'use of the application'. As specialist expertise was available to both projects, it is not clear why this difference should have occurred. Clearly, however, the output of the Land Cover project has not been made available in a form that is accessible to all.

The Centre for Earth Observation

The DG Joint Research Centre (JRC) and DG Science, Research and Development (DG 12) are responsible for a wide range of research activities. Included within these activities is the work of the Centre for Earth Observation (<http://www.ceo.org/>). The CEO is charged specifically with encouraging wider use of earth observation data throughout Europe. In this capacity, it has funded a number of projects aimed at demonstrating how remotely sensed data can be used. Amongst these, the LaCoast project is the most relevant to the Demonstration Programme.

LaCoast

LaCoast (**L**and cover changes in **C**oastal zones) is being undertaken by the Agriculture and Regional Information Systems (ARIS) unit and the Space Applications Institute (SAI) at the JRC in Italy. It was clearly defined from the beginning that it should contribute to the Demonstration Programme. The project covers the entire coastal zones of 10 European Member States. For the LaCoast project the coastal zone has been defined as a 10 km-wide strip of land bounded by the shoreline.

A quantitative estimation of land use and land cover changes that have occurred over a period of about 15 years is being performed. The work is based on two complete Land Cover databases (scale 1:100 000), and is centred on two base-years: 1975 and 1990. Classifications are achieved for 1975 using Landsat/MSS data, whilst the 1990 status is provided by the CORINE Land Cover database. Statistics and maps of changes are produced according to countries, communes limits and distance from the shoreline. This project provides quantitative estimates of land cover and land use change in the coastal zone, focusing in particular on those caused by human activities. Where changes are observed, an exercise to identify and interpret the factors responsible for change is undertaken.

The results so far obtained using the LaCoast methodology have provided data relevant to environmental status and policy formulation at national and European scales. So far, though, despite the potential value of the information at the regional and local scales, there is little evidence of its adoption. Indeed, only one project (**Bantry Bay**) was reasonably familiar with LaCoast and had tried (unsuccessfully) to obtain some of the more detailed data.

There appears to be a number of reasons for this lack of more local use. The results of the work are only just coming on stream. Concern has been expressed about the different quality of work at the validation stage of the project. However, it is hoped that this situation will be rectified over the next few months (and within the timeframe of the consultation period for the discussion document resulting from the programme) as information from LaCoast will be sent to the projects for validation. Perhaps most importantly, the management team for LaCoast is reluctant to promote wider use before it has sufficient resources available to answer queries for users.

Clearly, it is difficult to judge how effective the output of the LaCoast project might be to the ICZM process. However a preliminary view of some of the output suggests that LaCoast might have the potential to play an important role at three spatial scales:

1. in identifying major change at national levels;
2. in identifying hot spots of change that when combined with other information can show trends in development pressures; and
3. in showing the nature of human activity and hence the key issues requiring a change of policy and/or management action.

LaCoast may not be able to add anything significant to what is already known in many areas.

Although the results have not yet been fully validated at Member State level it seems likely that they will validate existing trends. In so doing they will reinforce known key issues in coastal management and may help persuade those less sympathetic to these needs of their importance. However, they do represent an information resource that is now considerably out of date. (More information on LaCoast can be found at <http://www.ais.sai.jrc.it/environment/lacoast>.)

Other European research initiatives

Another series of research programmes of potential relevance to the Demonstration Programme is the European Land Ocean Interactions Studies (ELOISE) programme that combines coastal zone research project funding of the European Commission. This is an initiative of the Environment and Climate and the MAST Programmes of DG12. They address topics relating to biological and ecological processes in, and human impacts on, coastal ecosystems, as well as the socio-economic development in coastal zones. Other projects of relevance to coastal zone management deal with physical coastal oceanographic processes (such as currents, waves, sedimentation) and coastal engineering.

ELOISE

There are currently 30 projects included within the programme. The research has four main objectives:

- to determine the role of coastal seas in land–ocean interaction at a global level;
- to determine the impact of human action at a regional and global scale on land–ocean interactions;
- to help formulate a strategic approach to ICM;
- methodology and instruments to implement ELOISE.

The majority of these research projects are concerned with marine issues, including monitoring of carbon cycles, pollution and eutrophication. As might be expected from a global research perspective, more specific research that might be applied at a local or local regional scale is limited. Coastal dune management and modelling of saltmarsh growth in relation to sea-level rise are the most relevant to ICZM. ELOISE has a web page at <http://europa.eu.int/comm/dg12/eliose/eliose-h.html>.

Directorate Generals

Many of the Directorate Generals (DGs) run scientific research programmes that provide, to some extent, results relevant to coastal systems. It is by no means clear, however, whether, for example, the results of work undertaken by DG XIV are fed routinely to DG XI or whether a scoping exercise by DG XII is discussed automatically with DG XVI.

The potential for contradiction, overlap and competition in the coastal zone has been recognised by the Commission in terms of policy development and implementation, and is addressed by one of the other thematic teams. There is no reason to suppose that similar problems do not occur in the research field, even with the ELOISE Programme in place.

European-wide non-EU approaches to data provision

It is often the case that the drive for changes to existing policy and management practice comes from pressure groups. Their concern often results from local knowledge of environmental loss or

independent research. It is becoming increasingly clear to these bodies that, in their battle to change attitudes and established practice or to influence policy, good information is as powerful a tool as any.

In the coastal field there are several organisations that have become established to help develop a more enlightened approach to coastal management. In addition, the more widely based NGOs and inter-governmental organisations, such as United Nations Environment Programme (UNEP), the International Union for the Conservation of Nature (IUCN) and the Council of Europe, have taken a specific interest in ICZM issues. Each of these organisations has been promoting the need for more integrated approaches to coastal management and as such have played a major part in raising awareness of the issue.

International coastal NGOs

The European Union for Coastal Conservation (EUCC) and Eurocoast have been established to promote better management of the coast at the European scale: EUCC from a wide conservation perspective and EUROCOAST in the context of more technical solutions to management problems. Each can provide a wealth of technical information and knowledge. The way in which this process is being developed is illustrated by reference to the EUCC, which is setting out to provide a European-wide information and advisory service based on the experience and expertise of its members.

EUCC

The EUCC is a voluntary conservation organisation committed to promoting the wise and sustainable use of Europe's coast, and to ensuring the maintenance of its biodiversity. It has set out to achieve this through the provision of information and advice based on the best available scientific data and expert knowledge. Over the last 3 years, EUCC has played a central role in the development of new European policy documents: the European Coastal Code, the European Coastal and Marine Ecological Network (ECMEN) and the action plan entitled *European Regions for a Safe and Clean Coast*. EUCC has given the highest priority to the communication of these documents and the implementation of the approaches contained therein. This effort has been targeted at the international, national and local levels.

Eurocoast

Eurocoast aims to bring together people from different sectors operating in the coastal zone and to provide a network for information exchange between scientists and managers throughout Europe. This network is based partly on biennial conferences, which form one strand of the information exchange process (see for example Taussik & Mitchell 1996).

United Nations Environment Programme

It is important to recognise that concern for coastal management is not new. For years, many organisations have been promoting more integrated approaches. The United Nations Environment Programme (UNEP) has taken a leading role in promoting management in a number of regional seas, notably the Mediterranean Action Plan (See MAP 1996). In this context, their data are incorporated in the ETC/MCE's report on *Mediterranean Sea: Environmental State and Pressures*, which is a joint venture with the co-ordinating unit of the Barcelona Convention (UNEP MAP). The MAP itself includes a compendium of information on the state of the Mediterranean coast and sea (MAP 1996).

The Council of Europe

In the past, the Council of Europe has also taken a lead in collecting data. Interest has focused on describing coastal areas in terms of their flora and fauna. Some of these reports on saltmarshes (Dijkema, ed. 1984), dunes and shoreline vegetation (Géhu, 1985) and marine benthos (Mitchell, 1987) still provide the only comprehensive European-wide view of the particular resource. In addition, the Council of Europe has promoted the concept of ICZM through the publication of volumes devoted to the subject, e.g. *Naturupa*, 46. (1984), and a special issue due out at the end of 1998.

UNESCO

The United Nations in the guise of UNESCO, through its Intergovernmental Oceanic Commission, sponsored the production of a practical guide on coastal management aimed to help build a coherent information system to assist decision-makers (UNESCO 1997).

Regional Seas Programmes

Programmes concerned with the protection of the marine environment have evolved in all the European regional seas. Although having different aims and coverage, reports have been prepared on the state of the environment for several regional seas.

A synthesis of existing information is provided in the Quality Status Reports (QSRs) produced by regional and international organisations, e.g. HELCOM, OSPAR (See QSR for the North Sea, Anon 1993) and the Barcelona Convention. Such QSRs contain sections on (GESAMP, 1994):

- Geography and scope of the assessment
- Human activities throughout the region
- Hydrography and climate
- Chemistry
- Biology.

ETC/MCE, which is responsible for organising the Inter-Regional Forum (see Costa 1997), provides contact points for and facilitates discussion of the development of common assessment tools and research needed to improve these assessments. As with the ELOISE research programme, much of the work is concerned with processes such as the biological effects of contaminants and transport models (including sediments, chemicals and carbon cycles).

There are a number of other special interest groups which provide information at a regional sea scale. Examples from the Mediterranean include MedCoast, Medaset and MedWet. MedCoast seeks to raise awareness by promoting research, training and technical assistance in methods of coastal management in the Mediterranean and Black Seas. Medaset is a special interest group that is concerned primarily with the conservation of sea turtles in the Mediterranean. MedWet is concerned with the provision of inventories of wetlands in the Mediterranean region (Hecker & Tomàs 1995) which are published with the help of EU funding. MedWet works closely with Wetlands International (formerly the International Waterfowl and Wetlands Research Bureau) based in Holland.

At the regional seas scale, information provision revolves around conventions concerned with the quality of the seas, particularly in relation to pollution control and fisheries. At this spatial scale such reports provide a focus for political activity based on commitments relating to the various conventions. Because of this the reports continue to provide time series information on such issues as air and sea pollution, climatic variation, fishing activity, port and harbour developments, and shipping movements.

National approaches to data provision

Many Member States have, or are in the process of collecting, data on the nature and importance of their coastlines. Universities, governmental conservation organisations and non-governmental organisations all play a part in this data collection effort. Other local and often *ad hoc* data collection efforts are also being continually undertaken.

Access to the results of these efforts is often difficult to achieve, even for those working in the relevant sector. This barrier to access is often a product of the project-oriented nature of the collection effort, with many reports being published in small numbers to fulfil the originating project's needs. Even when results are published more widely, peer pressure dictates that, for academic studies at least, scientific journals are favoured, and therefore only a limited circulation is achieved.

Despite the lack of response from the National Focal Points, the following discussion looks at a number of examples of national data provision. The examples illustrate some of the approaches that have helped to make data more relevant to the needs of policy-makers and managers.

France

Sectoral approaches are usually the first to recognise the need for a wider information review on coasts. Describing the resource (such as habitat or landscape type) is often the first requirement in assessing the significance of individual sites or species concentrations. This means that resource maps have been generated for several habitats in Member States. France has always had a strong tradition in the provision of map-based information. For example, the Conservatoire du Littoral has worked to provide up-to-date maps of the main land uses at a scale of 1:50,000. Superimposed on these maps are nature conservation sites with data on the protection afforded each site.

Greece

The recent adoption of Natura 2000 has resulted in a number of national inventories of potential special areas of conservation. A typical example is that prepared by the Greek National Wetland Centre on behalf of the Greek Government (Dafis *et al.* 1996).

United Kingdom

The Estuaries Review

The conflict between the diverse sectoral interests active in the estuarine environment led to a perceived major loss of conservation interest in many estuaries in Great Britain. This caused the Nature Conservancy Council in the UK to undertake a review of the estuary resource (Davidson *et al.* 1991).

Partly as a result of this report, the successor conservation agencies embarked on a series of studies on the management needs of selected estuaries. For example, English Nature, with funding from the Department of the Environment, are completing a series of estuary management plans. The Countryside Council for Wales, Scottish Natural Heritage and a number of local planning authorities are also promoting integrated management at a number of individual sites.

The Coastal Directories Project

The Coastal Directories project began following a suggestion by the UK at the second meeting of the North Sea Task Force in 1989 that coastal habitats and species of conservation importance around the North Sea should be included in the Quality Status Report (QSR). The principal aim was to produce ‘a comprehensive description of the North Sea coastal margin, including its habitats, species and human activities, as an example to other North Sea states’ (North Sea Task Force 1993). This was published as *The Directory of the North Sea Coastal Margin* (Doody *et al.* 1993). The 16 volumes, covering 17 regions, collate existing information on the United Kingdom and Isle of Man coastal zone to provide national and regional overviews of the natural resources and human activities. A key feature of the Directories is the system of indexes to more detailed sources of information (Barne *et al.* 1995-8).

At the outset it was agreed that the work should involve a wide variety of individuals and organisations concerned with the conservation and use of the coastal margin. This was aimed at reflecting the complex nature of the habitats and species, and the wide-ranging influence of human activities. As the work evolved from the first meetings in 1990, the value of this approach was highlighted by the extent to which new approaches and data sources were identified. A large number of organisations agreed to participate, and the extent of the interest generated by the project is reflected in the number of financial contributions received.

One of the key lessons learnt from the UK approach has been that adopting a participatory approach in the data gathering process is as relevant and important at the national level as at more local scales. Participation promotes a better understanding and acceptance of management choices: a vital element in achieving greater integration of coastal management.

LOIS UK

The Land–Ocean Interaction Study (LOIS) is a 6 year multi-million pound project (1992–1998) funded by the UK’s Natural Environment Research Council involving more than 360 scientists from 11 institutes and 27 universities. It has collected a vast amount of data and is a major research investment aimed at improving the understanding of the way in which coastal systems interact. As its title implies, it was designed primarily to help elucidate the relationships that exist between the exchange, movement and storage of materials at the land–ocean boundary.

Some 300 papers have been submitted to academic journals, possibly half the number that will finally be published. Thus, as a research enterprise it is deemed to have been very successful. However, to date, the knowledge contained within the academic studies remains largely unknown outside the research establishment.

The specification for the project requires dissemination of its results. This has been interpreted as meaning that the field data and selected models should be distributed, on ten CD-ROMs, ‘to researchers and the user community’. It is not clear to what extent the ‘user community’ will be able to use these data as the CD-ROMs are still in preparation.

A preliminary review of the main findings of the study suggests that there are some important broad conclusions to be drawn from the work – Conclusions that are important to a more general understanding of the requirements for integrated management. For example, new insights to nutrient budgets show that 90% of the fluxes occur during only 5% of the time, i.e. ‘pulses’ are very important in delivering nutrient loads to the sea. This finding is important to any monitoring programme that is assessing the likely implications of changes in nutrient levels for eutrophication and other forms of pollution.

The work has also helped establish the validity of new technologies, such as remote sensing, in identifying saltmarsh vegetation patterns, thus providing a more cost-effective method of survey and monitoring. A better understanding of sediment budgets and their relationship to erosion in an estuarine system has also been established. This leads the way to interpreting land–sea-level change and the implications for flooding.

Discussion

In this discussion we look at how the Demonstration Programme projects tackled their own information needs. We seek to identify from this how the complexity of the coastal zone was overcome by the projects and to develop an approach that allows the lessons learnt to inform future fulfilment of information need.

The implicit information strategy

The majority of the projects denied having any strategy for information provision. Rather, they consider themselves to have been reliant on *ad hoc* approaches to data collection and information provision. However, it became clear that most of the projects understated the methodology behind the way in which they tackled the information issue, and their approaches were much more systematic than indicated in their responses to the questionnaire. Their approaches can be broadly characterised as:

- What do we need?
- What do we know?
- What do we not know?
- How can we find out?

An analysis of the questionnaire responses and information obtained through project visits and other discussions has shown that all projects adopted some form of structured approach to the development of a management strategy. From our analysis we can see that most projects have followed a similar nine-step approach.

Step 1: The stock-take

The projects determine the current state of the system with which they are concerned. The information required at this stage needs to provide a baseline for the current state of the coastal zone. Any stock-take also helps identify potential indicators for assessing and monitoring the efficacy of policy and management actions.

Step 2: Identification of objectives

The projects determine their objectives.

Step 3: Identification of issues

The projects determine what obstacles exist, if any, between where they are and where they want to be. This is where the information need for each issue is first defined.

Step 4: Analysis

The projects analyse the issues they have identified. This process allows the project teams to understand the issues and get a feel for what data will meet their information need.

Step 5: Data collection

Once the issue has been understood, it is possible to determine where the necessary data are located. Are they available to the project? If so, are they accessible? Are they at an appropriate scale? If the data are not already available, it may be necessary to undertake a data collection programme.

Step 6: Development of options

The projects use their insights into the problems, and the information they have gathered, to develop options for action.

Step 7: Agreement on actions

With a range of possible actions in place it is then necessary to gain agreement on which action(s) should be taken.

Step 8: Implementation

The chosen action(s) is then implemented.

Step 9: Monitoring of effectiveness of policy

Once an action has been implemented, it is necessary to monitor its effectiveness.

The information needed at the various stages of this approach has different characteristics. When conducting the stock-take contextual information is required. Once the management issues have been determined the issue-specific information needs can be identified. Yet more information needs arise from the requirement to rank possible responses and to monitor the effectiveness of the chosen action. Initiating an ICZM programme also requires knowledge about administrative structures, planning systems, relevant sectors, legal systems and local culture.

In effect, the need for information at each stage in the process is met in a variety of ways. These range from data collection by those who need specific types of information, collation of existing sources of information (data aggregation) or acquisition of information already processed by others.

To see how these various information needs can be met, it is important to understand some of the core attributes of the data from which the required information will be synthesised.

Data attributes

Key data characteristics

Considerable volumes of data are available on the nature of the coastal zone and the human activities taking place there. Indeed it could be argued that one of the difficulties of dealing with coastal data is its sheer volume and complexity. A further complication lies in the fact that data have both spatial and temporal components, which again have potential for very complex relationships in the coastal zone.

The spatial scales at which data are collected at the local project level are determined by the definition of the coastal zone. This can range from a relatively narrow zone along an open coast where there is relatively small catchment area (such as the **Isle of Wight**), to a much wider zone including a sedimentary plain and extending far inland to include the river basin (such as the **Wadden Sea**). Around Europe, the marine limits extend to at least the continental shelf in the west and include the whole area of the enclosed seas such as the Baltic, Mediterranean and Black Seas.

Most data also have a temporal scale. Changes in land levels resulting from the melting of the ice caps following the last glaciation are measured in thousands of years, and the changes in relative sea level in tens to hundreds of years. At the other end of the scale, tidal movement is measured according to monthly lunar and daily cycles, whilst the effects of storms may be felt over a few hours or even minutes when a particular threshold is exceeded.

Spatial data can tell us what is where and how much of it there is. It cannot tell us why it is there or how and why it is changing, nor can it provide a means of predicting its future state. Temporal data, on the other hand, provide a means of assessing change and answering questions, such as ‘why is change taking place?’ and ‘What is likely to happen in the future?’

Major subject types

In reviewing the status of a particular area there will be many characteristics that are potentially important. The following list represents a summary of the more important characteristics. It has been gleaned from reports and other documentation and is not intended to be exhaustive. It does, nevertheless, give a good indication of the range of topics that may need to be considered.

Geology and physical environment:

Geology
Wind and waves
Tidal regime

Sediment transport
Sea-level change, erosion and flooding
Coastal landforms

Terrestrial coastal habitats:

Sea cliffs
Sand dunes
Vegetated shingle structures and shorelines
Coastal wet grasslands
Saltmarsh

Marine and estuarine environments:

Estuaries, fjords and deltas etc.
Tides and tidal regime
Coastal lagoons
The sea-bed
The water column

Rare and important species:

Terrestrial plants and animals
Migrant waterfowl
Seabirds
Seals
Fish
Cetaceans
Sea-bed species

Archaeology and human history:

Important locations
Historical human activities

Coastal/marine protected sites:

Internationally designated sites
Nationally designated sites
Other protected sites

Land use and infrastructure:

Land use management
Infrastructure
Schools, shops, banks & administrative centres
Coastal defence
Agriculture

Human activities:

Land-based discharges
Land-based quarrying & infilling
Leisure and tourism
Hunting
Fisheries
Aquaculture
Shipping
Marine aggregate extraction and dredging
Oil and gas development
Oil spills
Water quality
Wind farms
Communication networks
Military use

Coastal management:

Demography
Land ownership
Cultural values
Planning (including legislation)

Data availability and accessibility

Having considered the range of subjects for which data may be needed there are three attributes any data must have if they are to be converted to information appropriate for the current need.

- **Availability:** knowledge is required about what data exist;
- **Accessibility:** when relevant data are available it is essential to know how to gain access to them. The costs of acquisition and details of any institutional barriers to information exchange need to be understood. The data must also be in a form that can be used by the technologies available to the recipient;
- **Appropriateness:** when data are available and accessible, the recipient must have a good understanding of the nature, quality and currency of the data, so that data can be used appropriately.

Credibility

The mechanism used to gather the data identified as necessary is also important. The mechanisms chosen by the projects took several forms:

- university and other scientific organisation;
- employed consultant; or
- use of project's own resources, or those of a partner.

Each approach has strengths and weaknesses. University or other academic institutions and specialist consultants may already own relevant data or may have ready access to them. They may also be able to provide a degree of validation of the data, helping to secure acceptance of the data by the partners. These more academic approaches may also provide timely information, though at a cost. Locally, however, there may be suspicion that the data may not be impartial. This can be particularly acute where there is a conservation focus to the perceived problem. In this context it may also be felt that local knowledge is not being taken into account.

A more participatory approach will help identify data sources and may facilitate access to them. This approach may reduce costs and help promote ownership of the issues and management options resulting from the dialogue. The participatory approach can, however, be quite time-consuming. Several of the projects recognised that prior to undertaking any review of data sources it was important to get agreement that the various sectors were prepared to share their data (e.g. **Storstrøm** and **Devon and Cornwall**).

Resolution of the credibility dilemma probably lies in the management of the project itself. If it is adequately scoped, the methodology specified and the outputs agreed by the user groups (including academic institutions) then who actually gathers the information becomes of secondary importance.

Data collection and collation

Data may be collected at many spatial scales. At the local scale spatial data describing vegetation and land cover may be derived from intensive mapping techniques. These data may form the basis for planning decisions by local authorities or for zoning use and determining management action in a nature reserve. Surveillance, monitoring and repeat surveys may be employed to measure, for example, traffic congestion or effluent discharge levels. At this scale, the collection and collation effort are usually tailored directly to the needs of those commissioning the work. The project-oriented view of data collection and collation dominates existing practice.

Because of the project-oriented nature of local data collection and collation efforts, data are usually collected with little consideration of their potential to meet future information needs. Similarly, collation schemes tend to be devised for the purpose in hand, which results in barriers to future use of the data by others. One way of tackling this is through harmonisation of data collection and collation protocols, perhaps enforced at the funding stage.

The situation is rather different when data are collected by institutions with a remit to work at higher spatial scales. Here the problem of data compatibility is less of an issue as the data are normally collected using a single methodology. Examples of this approach include national resource surveys of land use and vegetation, monitoring and surveillance for compliance with legislation and collection of statistics on population levels or fishing catches. Whatever the methodology some of the information derived from these sources may have particular relevance to the more local situation.

The extent to which others can use a data set depends not only on whether common survey or other data collection methods are employed, but also on the nature and accessibility of the data. At a local scale, identifying the availability of data, or at least being able to identify what data sets exist to meet the information need, may appear to be relatively straightforward. However, even where an open dialogue between the players prevents problems related to knowledge of data availability, problems caused by data incompatibility and relevance, confidentiality or cost may still arise.

Context

It is important to recognise that decisions taken at one geographical scale may be affected by, or impinge on, activities taking place at higher spatial scales. Many projects expressed little interest in data relating to more strategic issues until specifically asked. For many of these issues (sea-level change, mineral extraction, pollutant emissions, etc.) it is not until local data are aggregated to a larger scale that it becomes possible to see their relevance in a wider context.

For example, knowing the combined contribution of pollutants from the catchment of the **Rade de Brest** represents a first stage in assessing the impact and remedial action necessary to improve the

quality of the waters in the Bay, increase shellfish production and thereby enhance opportunities for employment.

Throughout this thematic study the response of the projects has demonstrated how little use is made of data derived from national or international data sources. For example, the data holding of the EEA is a resource that could be very useful as a source of contextual data. Whilst some denied any knowledge of the EEA, most projects were aware of the Agency yet few recognised its potential for data provision. This seems to apply whether the project is concerned with international port development (**Barcelona**) or a single estuary (the **Firth of Forth**), or encompasses several administrative units (**Rade de Brest** and **Devon and Cornwall**), is representative of island groupings (**Cyclades**) or extends across national borders (**Wadden Sea**).

Since the EEA and its partners have not set out to reach players at the local level, this lack of awareness is perhaps not surprising, although the problem is compounded by the perception amongst the projects that they have little need for contextual information. However, the EEA's remit includes a responsibility to disseminate information widely within the EU. It should therefore promote the use of contextual data at all spatial scales.

The results of the Coastal Directories approach in the UK provides local and regional decision-makers with information on the nature of the resource, its use and the extent to which it has changed as a result of historical and more recent human intervention. The Coastal Directories are, in effect, a 'state of the UK's coast' report that provides a contact list and reference source. Because the group 'steering' the project drew representatives from many of the UK sectors concerned with coastal and marine management, it also provided the first stage in the development of a national information exchange mechanism.

Data aggregation

One way of obtaining relevant contextual information is to aggregate data collected at different spatial and temporal scales. Several of the projects have a relatively wide catchment over which they are seeking to integrate management. The **Wadden Sea**, for example, covers three Member States, whilst the **CoastLink** projects all span a boundary between two nations.

It may be necessary to aggregate data in order to provide a picture spanning the whole of the project area. This may be particularly relevant where whole catchments are needed to address management issues, as in the case of **Rade de Brest**.

Before any data aggregation takes place, some form of harmonisation of data protocols is required. The **Wadden Sea** project includes the development of a harmonised programme of data collection and collation that includes common assessment criteria and a trilateral data handling system for the Dutch–German–Danish Wadden Sea (Life project DEMOWAD. Final report June 1998). Four outputs from the project are:

1. a manual with common monitoring guidelines and data management systems;
2. an implementation plan;
3. a package of monitoring parameters; and
4. harmonised digital Wadden Sea maps.

The first three of these support the lessons from other projects: before any data are collected, or monitoring programmes begun, agreement is required between the sectors (in this case between adjacent Member States) on the information needed. The value of a common base map is a lesson that is also shared with other projects.

Scales of data provision

The national context

Data are often collected by national agencies for use in policy formulation and enforcement. However, the original data may be useful at more local levels. The relevance of the data usually depends on the scale at which data can be made available. Some examples of the type of data that may be available from these sources are:

- statistics on the state of the environment and the pressures to which it is subjected, e.g. location and status of habitats and species in relation to maintaining biodiversity; fish spawning and feeding grounds, fishing effort and catches;
- levels of pollution in rivers and seas;
- oil pollution monitoring and surveillance;
- surveys of migratory species and production of distribution maps;
- national field surveys;
- collation of local data into national statistics; and
- monitoring of human activities.

The availability and accessibility of these data are not always readily appreciated at more local levels. However, the contextual information derived from these sources is a valuable resource at any level. The fact that data are seldom used at the local level indicates that their relevance is generally not appreciated. Projects are often too tightly focused on their local problems to recognise, or even seek out, contextual information.

Despite this lack of use, contextual information can provide local projects with:

- baseline information;
- pointers to key driving forces;
- potential ‘hot spots’ for adverse change;
- relative importance of impact (by comparison with wider geographical areas);
- options for management and new policy initiatives; and
- a mechanism for monitoring change.

The need to fulfil statutory obligations is a strong motivating force behind programmes of data collection. However, as much of the existing legislation relates to the land, data on the state of the sea is less frequently gathered. This shortcoming is offset by the development of a number of institutional mechanisms developed to help protect the environment of the seas around Europe. At the regional level, coastal and marine observatories such as those in **Kent** and the **Cote d’Opale** are attempting to draw together sub-tidal information often for the first time.

The supra-national context

The institutions responsible for administering Regional Seas Conventions and the like have a major role to play in the provision of contextual data, often in the form of state of the environment reports. Subjects in these reports are mostly concerned with marine issues such as:

- salinity;
- tides and tidal range;
- pollution;
- movement of ships and cargoes;
- fishing effort and catches; and
- impacts on marine life.

Some of these issues may have a specific value to local management, providing additional sources of information (many of the projects professed to having little information on the marine environment), as well as a further spatial context within which to judge the significance of specific concerns. Reports

such as the Quality Status Report for the North Sea contain much useful information but were often not known to the Demonstration Programme projects (e.g. **Dorset**). Often, there is also a lack of integration of coastal data within the reports themselves, despite habitats, species and human impacts being identified as priority areas for research. Even when these issues have been included, as for example in the comprehensive review of the coastal margin of the North Sea (Doody *et al.* 1993), the report was presented as a peripheral contribution to the Quality Status Report rather than as part of the statement itself. Nevertheless, as **Kent** has shown in developing its indicators of sustainable coastal and marine use, such reports can be invaluable sources of information at the regional scale.

The European context

With the establishment of the EEA, which has the remit to provide data and information, internally consistent European-wide data are being provided. Much of this has to be derived from existing data, which is derived at more local levels and aggregated to provide European wide statistics and state of the environment reports such as the Dobris Assessment.

Some data are collected at the European scale. A good example of this is the worldwide bird ringing studies that have helped to elucidate the paths of migrating birds. Common methods for ringing, capturing and recording birds have been used to provide comparable information throughout Europe and beyond.

Satellite data

The Centre for Earth Observation (CEO) is responsible for that element of European-funded work related to the use of satellite data, which has the potential to be highly relevant to the Demonstration Programme. Presentations at the meetings of the Demonstration Project Leaders of the LaCoast study suggest that this may be particularly relevant. However, the results are only just coming on stream and again there has been little or no direct contact with the ICZM projects. As a result, it is difficult to assess the overall contribution of satellite data at this scale.

The CEO is also responsible for promoting the use of general satellite data. Land-based resource surveys, including those for coastal habitats, can be time-consuming and expensive. Satellites provide a possible alternative, allowing for greater and more frequent coverage and more consistency. They also have the potential to be more cost-effective. There are a number of examples of good quality and reliable information being obtained from satellite data, e.g. mangrove degradation due to pollution in India, which shows changes in both extent and quality of the vegetation. Another example from Egypt showed how Landsat images coupled with a GIS were used to analyse a wide variety of environmental data, including the status of coral reefs, and to provide the basis for developing a coastal zone management plan. In Tromso County, satellites have been used to monitor fish farms and pollution. The results have been calibrated at a scale of 5–8 metre resolution. (See the Proceedings of the 27th International Conference on Remote Sensing, 8–12 June 1998, Tromso, Norway.)

There is little evidence to suggest that information derived from satellites is used to any great extent by the coastal community in general, or by the projects in particular. The notable exception was the **Rade de Brest** project, which used such images to help define the catchment area for their project. Part of the problem lies in the nature of the coast, which does not lend itself to remote sensing. It is often long and narrow and even where flat expanses of habitat exist, these are often highly dynamic. At the same time the scale of resolution appears to be too large to provide meaningful information upon which decisions can be taken, at least at a local level. There also seems to be a distinct lack of knowledge about the existence and availability of relevant satellite data.

Meeting the information need

The type of information needed to allow successful ICZM is, of course, intimately linked to the nature of the coastal zone itself. The nature of the coastal zone is a product of the complex interaction between such factors as the ecology, social structure, physical environment and historical importance of the area in question. Clearly, complexity is one of the key characteristics of the coastal zone.

Perhaps because ICZM is a holistic approach to management, there is a tendency for managers and policy makers to see information in the same way. This ‘formulaic’ view of information provision sees all information pertaining to the coastal zone as, essentially, pre-existing. In this view it seems possible that a review of current information holdings will identify any gaps in information. This view also suggests that it should be possible to identify information needs outside of any specific problem domain. This is not the case.

The definition we adopted at the outset places information in a hierarchy in which information can be seen as data in context. A key consequence of this definition is that information can not exist in isolation. This means that there is no ‘formulaic’ or prescriptive approach to identifying information need.

Consider sea level rise. A rising sea level may have a number of causes. Changes in sea level *per se* (eustacy) are the result of global forces associated with the atmospheric temperature. Regardless of any anthropogenic cause, the consequences of the current rise of 1–2mm per year (as estimated by the Houghton 1990) for the coast are the same. In areas where the land level is stable or sinking (isostacy) there will be an inundation of the coast. Where the land is rising at a rate greater than the rise in sea level then there will be an overall drop in sea level on the coast. Tide-gauge records measure this relative change.

From day-to-day, the height of the tide at a specific point on the coast is influenced by the lunar cycle, the position of amphidromic points and local weather conditions. Eustacy and isostacy do not influence the daily variation in tides.

Higher mean sea levels increase the overall height of tides and under storm conditions the extreme high tide may be increased by a factor bigger than the sea level change itself. The height of the land is not only influenced by natural change but also by human activities. Hence a city built on alluvial sediment may sink under its own weight.

Knowledge of the relative rate of sea level change is important to formulating policy for a wide range of human activities in the coastal zone. Risk of inundation by the sea, flooding, erosion and damage from storms, salt-water intrusion and narrowing of the ‘protective’ foreshore are just a few of the issues.

However, these results are not dependent on sea-level change alone. Inundation by the sea is also influenced by topography. Rainfall, discharge rates of rivers and the state of the tide all contribute to the incidence and severity of flooding. Erosion rates depend on the strength of the feature being affected by the erosive force. Seawater intrusion is also effected by the hydrology of the aquifer. The maintenance of the beach depends on the availability of sediment, which is influenced by sediment supply. This in turn is affected by activities in the hinterland including land management (e.g. deforestation), aggregate extraction or the erection of artificial coast protection features.

The key point is that for the ‘single’ issue of sea-level change there is a very large number of inter-linked subjects, all with their own inherent spatial and temporal scales. It is the desire to integrate coastal zone management, the desire not to deal with sea-level change in isolation, that prohibits the use of a prescriptive approach to identifying information need.

However, a well-scoped ICZM project can identify particular issues, and thereby elicit information needs. Within the context of the issue it becomes easier to identify the attributes of the data that will meet the information need. It is the identification of the need that facilitates the acquisition of information to fulfil that need.

Metadata

Having identified the information need, and thereby recognised what data are needed, the process of tracking down actual data begins. The single most useful tool in this data location task is metadata. Metadata is simply information about what data are available, where they are kept and the custodians.

A metadata system can be seen as a sign-posting mechanism that allows the user to find out where suitable data might exist.

During the course of the study a number of metadata systems have been encountered. The development of an effective metadata system is fundamental to the development of any information exchange capability.

DESIMA

DESIMA (**DE**cision **SUP**port for **I**ntegrated coastal zone **MA**nagement) is being undertaken by the Marine Environment Unit of the Space Application Institute within the JRC (supported by the CEO). The objective is to develop an information system to support integrated decision making in coastal areas by providing access to data from a variety of sources, including both in-situ and remotely sensed data.

This system allows the owner of a dataset to hold and update it locally but at the same time give users 'online' access. On-demand data processing is included within the package allowing, delivery to meet the users' needs.

Biodiversity Information Service

The Joint Nature Conservation Committee in the UK is establishing a Biodiversity Information Service. This service sets out to provide a system for information exchange in relation to biodiversity status in the UK. At the same time it is designed as a mechanism for reporting on biodiversity to Government. Whilst it is not concerned exclusively with coastal biodiversity, it does provide an illustration of a possible model at the national level.

Biodiversity Conservation Information Service

At an international level the Biodiversity Conservation Information Service (BCIS) aims to provide 'better data for better decisions' through a consortium of several hundred national and international conservation organisations. A metadata database includes information on the data held by the member organisations. This includes an expert network system which provides rapid access to biodiversity expertise whenever it is needed (World Conservation Monitoring Centre, Cambridge, UK or IUCN the World Conservation Union, Switzerland).

European-Wide Service Exchange

The European-Wide Service Exchange is a development of the CEO, and part of its overall remit to improve the use of Earth observation information derived from satellite data. It attempts to encourage wider use of satellite data through the provision of an Internet-based interface between the providers of Earth observation data and potential users. It offers an extensive Earth observation library and free Internet space for advertising of Earth observation products and services. (EWSE can be found on the Internet at <http://ewse.ceo.org>.)

Other systems

The European Space Agency (ESA) has also developed a cataloguing system (Earth Remote Sensing and Services) for identifying satellite data through the Internet. The service includes an inventory of remote sensed images. (ERSS can be found on the Internet at <http://earthnet.esrin.esa.it>.)

Dissemination

The key to raising awareness and ensuring that data are used appropriately in the decision-making process is to ensure that understanding is disseminated adequately and effectively. Simply distributing information, or the data upon which it is based, is unlikely to ensure the transfer of understanding to those who need to know. A strategy for dissemination of the understanding gained from the operation of a project should be developed as part of the ICZM programme.

In this context it is important to recognise that the information flow is not just from scientists and other specialists to those who make and implement policy. There are many other necessary paths for knowledge transfer. The different sectors and the local community must understand the issues and accept the need for changes to management practice. At the same time those responsible for implementing new management strategies must recognise the role that local knowledge can play in understanding and analysing the issues. This is particularly important where there are strong cultural ties within and between communities and sectors.

The application of science (including data collection and collation) must therefore involve more than just providing data on the state of the coastal environment or identifying indicators for assessing environmental change or tools for monitoring the effect of policy and management options. It must also inform the analysis of issues, help the user to ask the right questions and then provide signposts to where appropriate data can be found.

An integrated approach to management has yet to be accepted by all the sectors involved in developing policy and/or managing the coastal zone. No doubt many sectors will only adopt a more integrated approach if they come to appreciate that the advantages of consensual approaches will outweigh those gained by 'going it alone'. Fundamental to gaining this appreciation is helping the players to understand both the way coastal systems function and how the processes influence the ability of the coast to sustain human uses. The question is 'How can such understanding be achieved?'

The approach adopted by the LOIS research programme illustrates the problem of not considering how the result of a research effort will be disseminated. Simply distributing the data is not helpful. The recipient of the data may not be aware of the nature, quality or value of the data. The needs of the scientists involved in the LOIS project are very different from those of managers and policy-makers on the ground. What is good for one is often unintelligible to the other. The onus is squarely on the researchers to deploy the *understanding* they have gained in doing the work, rather than distributing vast chunks of data. Data distributed in this way will come with no context: it will be noise rather than information.

The projects have used a wide variety of methods for disseminating the understanding they have gained through the execution of their roles. Newsletters, pamphlets, information centres and local media have all been employed to raise awareness, as have local fora, seminars and involvement in the local political process.

Participation

Assuming that sufficient care is taken with the data collection process, whether the resultant knowledge base is accepted may depend on whether a *participatory* or *consultative* approach was used. A participatory approach implies that the identification, collection and collation of relevant data are shared responsibilities across the sectors. The consultative approach involves use of 'information brokers' who are not necessarily involved in the ICZM process directly. If this approach is adopted it is imperative that the sectors are brought on side at an early stage and help to identify information needs as well as sources.

Several of the projects, including **La Costera-Canal** (Valencia, Spain), have successfully used the consultative approach. Based in Gandia, the project has managed to bring together over 30 municipalities, industrial and agricultural sector representatives, research organisations and other local interests, by the simple expedient of asking their opinion and advice at an early stage. Thus, locked in and with a vested interest in further participation, the participants are enthusiastic supporters of the project. External high-quality science can also help to give the information validity, but it is important that the source and results are made transparent. This approach is quite prescriptive and can be expensive.

There are advantages in adopting the participatory approach. These are not only in generating a sense of ownership of the information, but also in potentially reducing costs. Having established some common perception of the resource within the area, and the human activities that impinge upon it, the next stage in the process is to analyse the issues. Again, if this is a participatory process there will be

greater ownership of the conclusions, and where conflicts arise more likelihood of resolution through discussion.

Research effort

The ICZM process has been strengthened where scientific methods have been allied to local needs and knowledge. Unfortunately such an alliance is not common. Within many of the projects there is more often a disparity between research effort applied and the needs of local policy formulation and decision-taking. Research scientists usually have their own agenda that is dictated by the academic requirements of national (or sometimes international) funding bodies. The local area is often seen as being no more than an outdoor laboratory that can be discarded once the research is complete.

A river entering the Amvrakikos Gulf in western Greece has been canalised so that the rich delta soils can be used for farming. Sediment that was once spread across the delta is now deposited in greater concentrations in the lagoon, smothering benthos and destroying fish nurseries. Scientists have opined that a 5-year study of the fluvial regime, together with a study of sub-sea biotopes, is needed to understand what is happening. Local experience and specialist knowledge suggest, however, that long before the results are available irreparable damage will have occurred.

The solution to the problem is a political and social one, as the reinstatement of old channels is one of the requirements for reversing the adverse environmental impacts. This is not, therefore, simply a scientific problem, and irrefutable scientific data will not necessarily win the argument. Creating a local research agenda with the active involvement of scientists and information users *and local farmers and fishermen* may help overcome these misconceptions and help to establish, amongst other things:

- links between scientific study and the real needs of managers;
- common data collection protocols allied to information sharing;
- the identification of real as opposed to perceived data gaps;
- integration with local artisanal knowledge; and
- better access to the results.

Creating a sustainable ICZM strategy

For any coastal management strategy to continue to be effective a wide variety of information and expert opinion will be needed. The project's knowledge base will need to be updated, and monitoring and surveillance will be required in the often rapidly changing coastal environment. In many areas local political influence and support will be crucial to the maintenance (sustainability) of an agreed approach. Many factors impinge on any decision-making process, and good decisions will always require good information. There exists, therefore, an opportunity for the projects to ensure their long-term survival by developing into information exchange centres.

The pioneering Observatoire de l'Environnement Littoral et Marin in the **Côte d'Opale** provides an interface between the scientific and technical communities and decision-makers in local and regional authorities. Its sister initiative across the Strait of Dover in **Kent**, the Coastal and Marine Observatory for the Channel and Southern North Sea, acts in both an advisory capacity and as a centre for promoting, supporting and taking action to address issues identified by the user community.

In contrast to this approach, the recently opened coastal centre in the **Isle of Wight** aims primarily to educate the public about coastal and marine issues and help in the interpretation of the varying coastal landforms and habitats visitors can see on the island. An information centre at **Strymonikos** on mainland Greece has, with local political support, provided an education facility as well as a centre for the potential provision of information and advice across the region. A similar facility is being planned by the **Kavala** project. The planning department of the **Storstrøm County** project in Denmark provides a means of implementing protocols for planning decisions, and a virtual observatory has been

created in the Greek **Cyclades**, where access to the islands is difficult and no single island provides an obvious focus for a physical entity.

Each of these approaches relies on a combination of good information and availability of expert opinion for the provision of advice. The **CoastLink** network is specifically exploring the possibility of developing a network of observatories to carry forward the work of the Demonstration Programme.

The European Spatial Development Perspective

Data are gathered for two broad reasons:

1. to inform a decision (an action, a policy or a strategy) about a particular issue; or
2. to provide general contextual information.

For example, an application to dredge shingle off the coast of Dungeness in **Kent** requires specific data about the benthic flora and fauna in the immediate vicinity if damage to the biological interest is to be assessed. Making sense of that data requires context such as the nature of the sea bottom communities in the eastern Channel. Necessarily these investigations are undertaken at different scales. The important issue is that they are both carried out and can be related to each other.

In practice, this is rarely achieved because the different authorities involved have different standards for acceptable data collection. An information need can, therefore, result in the gathering of data that does not always fulfil that need.

Financial and administrative realities tend to dictate that data collection, collation and provision stop at administrative boundaries. But coastal problems and solutions do not respect administrative boundaries and until now this artificial restriction has not been overcome. Evolving new approaches to data collection that cross these boundaries and deal with 'coastal cells' based on geomorphological units, river basins or estuaries are providing new insights into the way the systems operate and the types of information needed to make decisions.

At lower spatial scales, contradictions tend to arise as more and more decisions are taken according to abstract, subjective, socio-economic or cultural criteria. Despite this, planning and management in administrative bodies is usually dependent on spatial data only – i.e. things that can be located, measured and put onto a map. However, it is clear from our study that it is the specifics of the information need that determine the scale of the data that will meet the need.

In this context the European Spatial Development Perspective represents an important stage in promoting a cross-sectoral approach to planning. This regional approach to strategic management will be strengthened by the production of a typology map of Europe's coasts and seas overlain with the main human influences. This will help link approaches to coastal management across Europe, whilst at the same time respecting the very different political and social conditions in which policy decisions and management take place. The Demonstration Programme projects suggest that the local/regional scale, as determined by physical attributes such as catchment areas, may be a suitable unit around which to base future strategic management decisions.

The European Environment Agency

The EEA has an important role to play in providing information for policy formulation at a European level. This includes a wide-ranging data collection and collation role. As such, the EEA has the potential to play a major role in the provision of contextual data to support ICZM. At the European scale, the European Topic Centre on the Marine and Coastal Environment has a mandate to produce reports on the state of Europe's coast. Despite the potential importance of this work, and the stated aim that 'in the context of the Demonstration Programme the Topic Centre will develop several activities related to the programme', there is little evidence from the projects that any relationship has been established. Indeed it is remarkable how few of the projects were aware of the work of the EEA.

State of Europe's Coast

The EEA Topic Centre for the Marine and Coastal Environments has as one of its primary tasks the preparation of a "State of the Coast" report. The main objective is to promote the compilation of high quality information characterising the state of the coastal and marine environment in Europe. So far the work has concentrated on procedures for information validation although the Topic Centre has recently completed a draft report on the Mediterranean for consultation the "Mediterranean Sea: Environmental State and Pressures". This provides a comprehensive review of the current information available, though mainly on the state of the marine environment (Izzo 1998).

CORINE

Other studies under the CORINE Programme include the production of a coastal erosion database and a land cover map of Europe. The former is directly relevant to the development of coastal policy and decision-making, and the latter contains a coastal element. Again, there is little evidence from the Demonstration Programme that either of these have been used by the projects. In the case of the coastal erosion database, despite the work being carried out between 1987 and 1990, the results have only just been made available. The study appears to have a number of inconsistencies when comparisons are made between the nature of the classified coast and the situation on the ground. With the land cover map of Europe, potential users found it difficult to access because of the 'unfriendly' user interface.

Both of the CORINE studies would have benefited from earlier contact with potential users, in relation to both validating the results and identifying user requirements.

Tools for management

Throughout the study very few of the projects referred to their use of such tools as models and decision support systems. The notable exception was the universal use of computer technology in general and GIS in particular. This is in sharp contrast to the EEA and other science-based organisations that use and develop a plethora of such tools. The following discussion looks at the role of some of these tools.

Models and Decision Support Systems

Models are abstractions of the real world and are, therefore, imperfect. They embody a single perspective on the studied system by ignoring those aspects considered irrelevant and simplifying those that remain. Models are of use when they can be applied to real situations. Thus a model of a tidal regime or offshore wave environment, which allows prediction of the movement of oil, spills or limits of areas potentially at risk from flooding are valued.

Models derived from research studies may help our understanding of how systems work but it is important to recognise that what is relevant in one area may not be so in another. The LOIS project in the UK looked at land-ocean interactions across the east coast of England. In this area a large river and estuarine system provided the research area with fluxes of sediment between the land and sea, and this was one of the major subjects studied. Clearly this work will not have the same relevance in an essentially open, rocky coast where there is little sediment movement. This is not, however, an argument for a similar study to be undertaken on every type of coast zone.

The ultimate goal of many of the models is to provide mechanisms whereby the manager can create simulations, based on the underlying models, of the consequences of an action given an initial starting position. In this context the models may include methods for interpreting the results of the simulation. These systems can be used to assess the implications of impacts such as those associated with a sea level rise. Here one parameter (e.g. relative sea level rise) can be matched against another (e.g. land elevation or population) and some simple scenarios developed. How much land and property is threatened and what are the likely socio-economic impacts? Different rates of sea level rise may be matched with the incidence of storms to provide a series of predictions against which effectiveness of remedial action (e.g. coast protection measures or flood warning systems) can be measured.

Decision support systems

Academics and research scientists have developed many of the decision support systems that we have identified. These systems generally embody very complex models. The drive for an integrated approach to coastal zone management gives rise to a spiral of complexity as models from different sectors are bolted together to create ever more complex models. An example of this is the RamCo system being developed by the Coastal Zone Management Centre in The Hague, Holland.

RamCo

RamCo is 'a generic decision support system for the rapid assessment phase of sustainable coastal zone management'. It is a product that aims to 'assist decision makers to address semi-structured problems by allowing them to access and use data and analytical models'. Models can range, for example, from the theoretical models used to provide a means for the analysis to those that aim to predict the outcome of certain events based on information derived from previous experience.

The product is a models-based system. By setting numerical inputs to the dozens of models covering land use, water management, the economy, sustainable development and nature protection, simulations of development through time can be created. Those with sufficient time to gain an appreciation of both the way in which RamCo works, and more importantly the assumptions that underlie the models on which it relies will doubtless applaud the product.

However, the complexity of the underlying models is such that it presents a real barrier to busy managers and policy makers. The fact that this and other models may be designed for use by specialists to help **them** provide a means of providing more objective and comparable advice may be seen as a justification for the approach. However if this is the case it should be made explicit from the start.

There is often also a desire amongst academics and scientists to explore and integrate into their work the very latest advances in computer technology. This understandable desire is rooted in the need for such workers to attract funding through their development of leading-edge systems. In addition while it is often the management community that perceives the need for mechanisms to provide better information through which to improve the decision-making processes, those charged with the task of creating computer-based models and decision support systems are often drawn from the academic and scientific communities. These two communities have different needs and aspirations, and it is often the case that they do not communicate well.

As a result all too frequently the academic or research scientist creates very large, multi-variant models which provide closer and closer approximations of the real world. The nature of management is such that for a model to be of any practical value it must be simple to use and available when needed. Because these models are often prepared as academic exercises without discussion or contact with the potential user they are often highly theoretical and difficult to understand: a problem compounded by their use of language, notations and structures alien to policy and decision-makers.

SimCoast

SimCoast is a rule-based expert system for integrated coastal planning and policy using 'fuzzy logic' that is being developed by the Plymouth Marine Laboratory in the UK for DG VIII. This system is promoted on its ability to deal with highly complex issues on the coast and to tailor these to specific geographical locations.

The age-old importance of distinguishing between accuracy and precision arises. A report on a demonstration of the system concluded, 'there is a 93% chance of tar balls being found on beaches in the event of oil licences being granted off the China Sea'. This appears to be a rather obvious result that begs the question as to whether such systems make decision making easier and more cost effective than traditional approaches.

Evidence from the Demonstration Programme projects suggests that these type of systems whilst technically elegant, are too complex. They are inaccessible to those in the management arena seeking

better information on which to base their decisions. The only example of such a system being used was 'ADAGE' being developed as an environmental decision support tool by a consortium of the JRC, Aerspatial and others. The **Rade de Brest** project is involved with ADAGE, which is designed to help show how particular scenarios of land use change and management can have positive or negative effects. ADAGE acknowledges that its role is to influence decision-makers as much as it is to offer decision support functions.

The acid test for any DSS lies in its ability to provide a more objective way for policy makers or managers to reach a common understanding of the issues, and the likely outcome of a particular decision. The greater the need for such models to be interpreted by expert users, the more costly they become and the less likely they will be linked to the real needs of the user.

There is merit in seeing models as a way for managers and decision-makers to gain better knowledge and understanding of management and policy options. But to meet these needs models intended for wider dissemination must be based on practical, not theoretical, examples that can be applied to real situations.

Other systems

Cybestuaries is an example of another type of ICZM decision support system though in this case it does have a more practical approach. This 'Life' project uses case studies and examples of good practice to guide the user through the ICZM process. More details about this project and the associated CD-ROM can be obtained by emailing cybestuaries.sund@dial.pipeex.com.

Geographical Information Systems

The Demonstration Programme projects have, without exception, employed some form of computer technology in the development of the project. In the majority of cases this has involved the use of some form of GIS. The rationale behind the use of computer systems, to allow spatial data to be managed and explored graphically, is very powerful. The reality of such systems up to now appears to be that they are expensive to install, complex to use and only really empower the few who are able to extract information from them. The situation is changing as decisions are made to adopt more generally available and less costly information technologies.

All the projects visited have employed some form of GIS and, as far as could be ascertained, all largely lived up to expectations. However, informal comment has suggested that there are examples to back up the contention that GIS can be fine – at a price: but is that price worth paying? For some projects (e.g. **Dorset**) an early decision to use simple 'off the shelf' hardware and software packages appears to have paid off. Many of the projects have used more complex technological solutions. Some of these first identified their data handling needs and then choose a technology to suit those needs. Where sophisticated technologies have been acquired and successfully deployed they have been adequately staffed with specialist personnel (e.g. **Rade de Brest, Storstrøm, Strymonikos**).

Tempting as it might be to deploy highly technological solutions for the collation, storage, analysis and dissemination of data, it is important to recognise that this can be costly. It is important to consider the real needs for data provision and tailor technology to meet these needs. The EEA also uses GIS to distribute information. The expertise needed to support the relatively sophisticated software is not always available to potential users and this provides a barrier to information use.

An equally important consideration for the policy maker and manager is the extent to which an attractive user interface design may mask inherent flaws in the decision-making capability of the model or DSS. Decision-makers must always understand the limitations on any tool used in developing policy options or making management decisions. The designers and promoters of these tools must be equally honest in explaining what a particular system can and can't do.

The importance of maps

Maps are one of the commonest and most readily accessible forms of processed data. Potentially, they provide a presentation method that combines a vast amount of data in a succinct visual form. The

availability of base maps that are affordable, current and presented at an adequate scale is a common need for all projects. Problems encountered by the projects ranged from maps being out of date (**Irish Dunes**), available but costly (**Storstrøm County** and **Kavala**) or unavailable because of copyright or military considerations (**Ria de Aveiro**).

A European spatial metadata system, which will provide information on maps and spatial data, is under construction through a partnership with members drawn from Holland, Portugal, France and Spain. The organisations involved each have a responsibility at the national scale to provide information about the availability of spatial data. In the UK, for example, the Ordnance Survey runs the Spatial Information Enquiry Service (SINES) and in Portugal the Centre Nacional Informacao Geografica coordinates a National System of Geographic Information (SNIG).

Indicators

Many players attach some importance to the use of environmental indicators. The EEA, in response to the politicians need for a simple measure of the effectiveness of policy, have charged the ETC MCE with developing indicators of coastal characteristics at the European level. This focus on indicators has resulted in the preparation of a number of reports such as *A framework on integrated models and indicators for European integrated coastal management* (Draft February 1998) and *Indicators at a European level for coastal zone characterisation and management* (Draft June 1997).

Since the publication of the report on *Environmental Indicators and Green Accounting by the Commission* in June 1996 based on (COM(94) 670 final) several studies have been initiated. Amongst these the generic 'Environmental Pressure Indices Project' being undertaken under the auspices of EUROSTAT (the Statistical office of the European Communities) TAU, Spain and E*M*A*I*L*, Leiden, Holland has set out to provide details on 60 'pressure indicators' for Europe. This has identified 27 proposed indicators for the marine environment and the coastal zone. (For more details see the Internet at <http://www.telcom.es/tau/sheets.htm>). which amongst other things is designed to 'help in the difficult process of data collection.'

Taken together, these represent significant moves in attempting to meet the political demand for simple indicators as **tools** for assessing the efficacy of policy formulation and implementation. However, there is little evidence so far of the use of this approach by the projects. This appears to be partly because they do not know of its existence and are unaware of its relevance to the analysis of their problems. However this does not mean that they did not recognise the value of such an approach. Indeed several of the projects requested help with this element of their activity (Project Leaders Workshop, Lisbon June 1998). In addition, projects such as the **Kent CoastLink** project are specifically looking at developing indicators.

CoastLink

CoastLink, Kent is part of the TERRA funded network of six Demonstration Programme projects. Kent had developed a suite of 69 sustainability indicators for the county. One of its contributions to the CoastLink partnership has been to draw up a number of indicators for sustainable coasts and seas based on its own coastline and inshore waters. In collaboration with the **Epirus** project an attempt was made to identify certain generic indicators which could be applied to any coastline in Europe. The experience of local and regional authorities is that indicators can be a galvanising force for local politicians and coastal communities.

Conclusions

General principles

Information is data in context

Information is one element of a hierarchy through which sustainable management of the coast *may* be achieved, thus:

$$\begin{aligned} \text{Data} + \text{Context} &= \text{Information} \\ \text{Information} + \text{Analysis} &= \text{Understanding} \\ \text{Understanding} + \text{Management} &= \text{Possibility of sustainable action} \end{aligned}$$

Information is a prerequisite to understanding

Information, when used to *nourish* the analytical process, can be transformed into an understanding of the issue in question. Crucially, it is the way in which this understanding is used that determines the efficacy of any management strategy.

Disseminate understanding, not data

Using data dissemination to influence players in ICZM is far less effective than distributing understanding. A manager who receives some form of understanding of a problem is empowered to seek out relevant data. Managers who receive data out of context are no wiser about how to deal with their management problems.

The coast is too complex for prescriptive approaches to meeting information needs

This study has reinforced the view that the complexity of the coastal zone results in a wide range of information needs. The number, scale and nature of data sets that go to meeting these needs are legion. It is not financially, or logically, justifiable to simply collect ‘potentially useful data’ in isolation.

Lessons about ICZM

Information raises awareness

Information is vital in taking a proactive approach to awareness raising. Undertaken at an early stage, awareness raising helps to gather support for the ICZM effort. Those responsible for promoting ICZM must disseminate the understanding gained from the process both within the decision-making bodies and to the wider public.

Information helps build participation

Information is not only a key to problem-solving, it also provides a way of facilitating participation and thereby ownership of coastal management problems, issues and solutions. Use data collection and collation as a means of nourishing the participatory process.

Agree common protocols for information exchange

The way in which existing data are shared is of crucial importance. Data converted to information provide a better knowledge base, the capacity for understanding, and the potential for an improved approach to policy formulation and decision-making. Establish an agreement to share data at the outset

of a project. Agree common protocols for information exchange that respect the intellectual property rights of partners.

Build a strategic knowledge base

Take stock of the resources within the area and the human impacts on these resources. Then establish a dialogue between the sectors to help reach an understanding of what can and cannot be done. Although the value of the stock-take can be overstated, it is the starting point of choice for almost all the projects. The 'knowledge base' that results from a stock-take plays a major role at other levels of policy formulation and management.

Create a local research agenda

Whatever the current relationship between local scientists, managers and politicians, there is an increasing recognition amongst many of them that there is benefit in undertaking more applied research.

Establish an information exchange network.

Establish a facility, supported by local and regional groups, for the supply of relevant, reliable and timely information and advice.

Understand the importance of context

It is important to recognise and understand the wider context within which management decisions are taken. Use aggregated data or other contextual data sources to help identify strategic issues and management options.

Use 'state of the coast' reports to provide contextual data

Collation reports, such as the Coastal Directories series in the UK and the QSR prepared at the regional seas level, contribute to sustainable coastal and marine policy by providing the context in which local approaches to integrated management operate.

Monitoring and evaluation is an integral part of ICZM

Every stretch of coast, irrespective of its length, should be monitored and evaluated as to whether it is moving towards a more or less sustainable state, and at what speed. A set of sustainability indicators for coasts and seas, such as that being developed by the CoastLink network, should be recommended to all local and regional authorities.

Be issue led, not data led

Care should be taken to ensure that data quality or availability does not predetermine the issues to be considered. Issues should be prioritised according to their importance, and not because of data availability.

Research

Research proposals should be more user focused

Research proposals should show how potential users have been brought into the process of identifying research needs. They should include a clear statement of how the results will be applied to the problem under study and who will benefit. Any new research proposals should have a clear policy for disseminating the understanding gained to users, and provision for this should be made within the budget proposals.

Local and regional authorities must become more involved in specifying coastal and marine research

Over 90% of decisions taken about the European littoral are taken by local authorities. Yet rarely are local authorities involved in developing applied coastal and marine research. Where they exist, groups such as the National Coasts and Estuaries Advisory Group (of local authorities) in the UK, should be brought into the research programme development agenda at Member State and DG level at an early stage.

Dissemination of results should be part of project specification

More thought should be given to the method by which the understanding gained from a project is disseminated. Ideally the project specification should address this issue and an earlier dialogue with potential users is often very helpful.

Lessons for the EU

Timely dissemination is important

The results of EU-funded projects, such as CORINE, should be more timely in their publication. This will help to avoid costly data collection programmes producing results which users see as out of date.

Make more use of satellite images

Those concerned with the production, processing and dissemination of satellite data should make greater use of existing images and techniques as part of a process aimed at giving credibility to their use in identifying resource distribution and coastal change.

The output of the LaCoast study should be validated by the projects

The Demonstration Programme project teams should, as a matter of urgency, validate and assess the results of the LaCoast study. Based on the results of this evaluation a new project should be initiated to bring the results up to date.

Available and affordable map products are essential for effective ICZM

Any ICZM project requires affordable, up-to-date maps that are available at suitable scales. A standard and agreed outline of the coast of Europe, at various scales, would save considerable duplication of effort during the initial phases of projects.

Free availability of publicly funded data products

Those products, such as maps, that are derived from publicly funded data collection and collation programmes should be made freely available. This would bring Europe in line with the approach adopted by the USA.

Lessons for the EEA

The EEA must become more proactive

If the full potential of the EEA as a contextual data source is to be realised, it must become more proactive in promoting the results of its work at spatial scales below the European level.

State of the coast report

The EEA, through its Marine and Coastal Topic Centre, should co-ordinate the production of contextual information through a ‘State of Europe’s Coast Report’ based on regional coasts and seas assessments.

Mechanism for finding out what data are available should be put in place

Metadata systems that facilitate the rapid location of relevant data are essential if ICZM is to be achieved. The EEA could play a crucial role in this by investigating the options for setting up the backbone for such a system at the European scale. Building this coastal data signposting system is not a trivial task, but is attainable over a 5-year frame. The EU should look at the Observatory approach pioneered by Cote d’Opale, Kent and Strymonikos as one possible model.

Indicators and decision support tools

Research into the development of indicators and DSS undertaken by the Topic Centre on Marine and Coastal Environments should be more clearly linked to the needs of users and the results tested through practical application.

References

- Anon 1993. *The North Sea Quality Status Report*. Olson & Olson, Denmark
- Barne, J.H., Robson, C.F., Kaznowska, S.S., Doody, J.P., Davidson, N.C., & Buck, A.L., eds. 1995-8. *Coasts and seas of the United Kingdom*. Regions 1 - 17 (16 Volumes) Peterborough, Joint Nature Conservation Committee. (Coastal Directories Series.)
- Bijvoet, L.C.M.C., Strating, K.M. & Roos, H. 1991. *European Coastal Conference, proceedings, Scheveningen (The Hague)*, The Netherlands, 19-21 November 1991, EUCC, Leiden.
- Bird, E.C.F. 1984. *Coasts - an introduction to coastal geomorphology*. 3rd Edition, Basil Blackwell.
- Carter, R.W.G. 1988. *Coastal Environments*. Academic Press.
- Carter, B., 1991. *Shifting sands - A study of the coast of Northern Ireland from Magilligan to Larne*. Department of the Environment, Countryside and Wildlife Research Series No. 2. HMSO Belfast.
- Carter, R.W.G. & Woodroffe, C.D. (Eds.) 1994. *Coastal Evolution*. Cambridge University Press, Cambridge.
- Cencini, C. & Varani, L. 1989. Degradation of coastal dune systems through anthropogenic action. In *Coastlines of Italy*. Ed. Paolo Fabri. American Society of Civil Engineers, New York, 55-69.
- Cencini, C., Marchi, M., Torresani, S. & Varani, L. 1988. The impact of tourism on Italian deltic coastlands: four case studies. *Ocean & Shoreline Management*, 11, 353-374.
- Costa, M.D. 1997. Inter-regional Forum. Report of the 2nd Meeting, Rome, 6-7 November 1997. ENEA, Italy
- Dijkema, K.S. (ed.) 1984. *Salt marshes in Europe*. European Committee for the Conservation of Nature and Natural Resources, Council of Europe, Strasbourg.
- Dafis, S., Papastergiadou, E., Georghiou, K., Babalonas, D., Georgiadis, T., Papageorghiou, M., Lazaridou, T & Tsiaoussi, V. (eds.) 1996. *Directive 92/43/EEC - The Greek "Habitat" Project. Natura 2000: an overview*. Life Contract B4-3200/94/756, Commission of the European Communities DGXI, The Goulandris Natural History Museum - Greek Biotope/Wetland Centre. 917 pages.
- Doody, J.P. 1992. The conservation of British saltmarshes. In *Saltmarshes: morphodynamics, conservation and engineering significance*. eds. J.R.L. Allen & K. Pye, 80-114. Cambridge, Cambridge University Press.
- Doody, J.P., Johnson, C., & Smith, B. 1993. *Directory of the North Sea coastal margin*. Peterborough, Joint Nature Conservation Committee
- Géhu, J.M. 1985. *European dune and shoreline vegetation*. Nature and Environment series No. 32, Council of Europe, Strasbourg.
- GESAMP 1994. *Guidelines for marine environmental assessments*. IMO/FAO/UNESCO-IOC/WMO/WHO/IAEA/UN/UNEP Reports and Studies No. 54, 40 pages.
- Hecker, N. & Tomàs, Vives P. 1995. The status of wetland inventories in the Mediterranean Region. MedWet Publications/TWRB Publication 38. 146 pages.
- Houghton et al 1990. *Climate change: the IPCC Scientific Assessment*. Cambridge University Press, Cambridge. Intergovernmental Panel on Climate Change (IPCC).
- Izzo, G., (Co-ordinator) 1998. *Mediterranean Sea: Environmental State and Pressures*. ETC Marine and Coastal Environments, under contract to the European Environment Agency.
- MAP. 1996. *The state of the marine and coastal environment in the Mediterranean Region*. MAP Technical Report Series no. 100.
- Mitchell, R. 1987. *Conservation of marine benthic biocenoses in the North Sea and the Baltic*. Council of Europe, Strasbourg.
- Nilsson, A. 1997. *Arctic Pollution Issues: A state of the Arctic environment report*. Arctic Assessment and Monitoring Programme, Oslo.
- OECD 1993a. *Coastal Zone Management. Integrated policies*, OECD, Paris
- OECD 1993b. *Coastal Zone Management. Selected case studies*, OECD, Paris
- Stanners, D. & Bourdeau P. 1995. *Europe's Environment - The Dobbris Assessment*. European Environment Agency, Copenhagen.
- Steers, J.A. 1969a. *The coastline of England and Wales*. 2nd ed. Cambridge. At the University Press.
- Steers, J.A. 1969b. *Protection of coastal areas*. European Information Centre for Nature Conservation, Strasbourg.
- Steers, J.A. 1973. *The Coastline of Scotland*. Cambridge: Cambridge University Press.
- Taussik, J. & Mitchell, J. 1996. *Partnership in coastal zone management*. Samara Publishing, Cardigan.
- UNESCO 1997. *Methodological Guide to integrated coastal zone management*.
- Anon 1993. *World Coast 2000: Preparing to meet the coastal challenges of the 21st century*. Noordwijk, The Netherlands, 5th November 1993.

Appendices

Appendix 1: Defining the coastal zone

Defining *coastal zone*, and the nature of the interactions between the ‘natural’ coast and human activities, is just as important if we are to accurately identify information needs.

Fluvial processes occur over a massive geographical range. Rain falling on river basins carries sediment and other material derived from the land to the sea. In this sense, the coastal zone can include the rivers and tidal inlets, the terrestrial coast, intertidal shores and the marine zone to the offshore limit of coastal processes.

Geomorphological processes form the basis for the development of coastal landscapes. These may operate over a wide geographical area and provide the link between the land and the sea. Together these can form the basis for the definition of a ‘natural’ coastal zone (Figure 1).

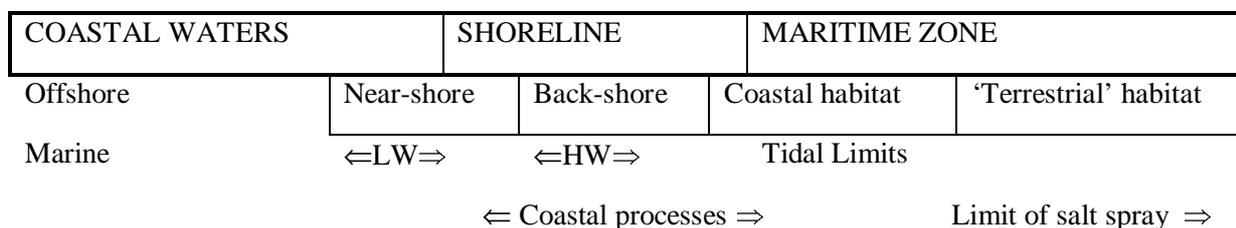


Figure 1 Definition of the ‘coastal zone’ (after Bird 1984)

Biological and physical characteristics combine to form a complex entity, the principal components of which are shown in Figure 2. Some species (notably Diadromous fish such as the salmon, *Salmo salar*) may travel from their feeding areas in the open ocean to spawn upstream in rivers. At the same time the zone is constantly changing. The zone therefore may have wide spatial limits and a highly dynamic temporal component.

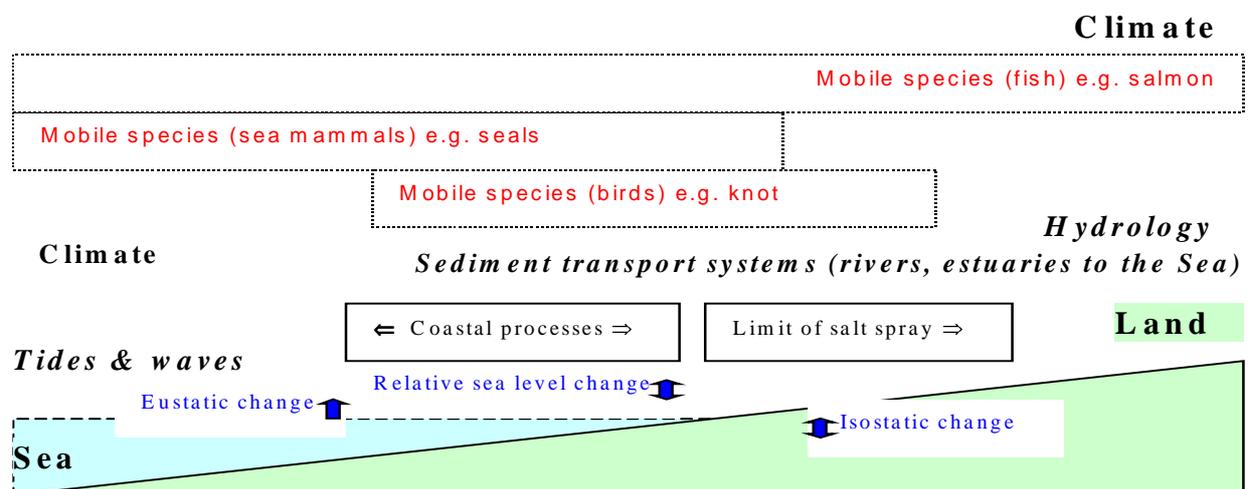


Figure 2 Principal components of the “natural” dynamic coast

Human influences are equally if not more wide-ranging. When these are superimposed on the ‘natural coast’ the potential scale and complexity of the interactions and hence the information requirements needed to understand what is happening are immense (Figure 3).

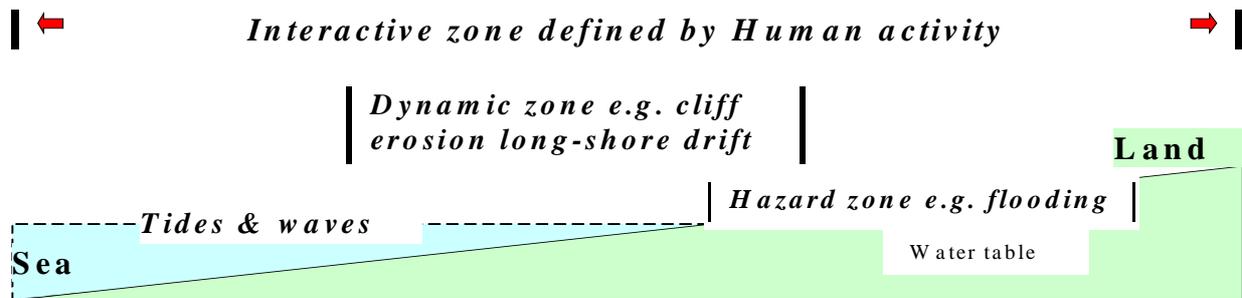


Figure 3 Zones for coastal management

Thus the zone is defined by a combination of natural features and human activities, which may interact across the whole zone and within individual components of the zone. Recognition of this interaction is the first stage in understanding the importance of an integrated approach to management and the wide-ranging nature and scale of information needs.

Appendix 2: The questionnaire

This appendix reproduces the text of the questionnaire used in this study.

Introduction

As you will know, as part of the EU Demonstration Programme on Integrated Management of Coastal Zones, six thematic studies have been initiated: this documentation relates to the information theme.

We have prepared this documentation to provide you with a preliminary indication of the questions that we feel are important to an assessment of the use of information in delivering appropriate management in the coastal zone. It is intended to be a guide to the issues that we will be considering, and has been sent to all Demonstration Programme Projects.

Definition

Given that we are now in the information age, there remains a surprising level of ambiguity in the way people use the words ‘data’ and ‘information’. For the purpose of this study, we have prepared the following definition of how we view the distinction between the two concepts:

Data is the raw material from which information is produced. Information is a collection of data relevant to a recipient at a given point in time. Information is data in context: it has meaning, relevance and purpose.

The information theme

The principal role of the information thematic study is to review:

- the properties and characteristics of information in the coastal zone;
- the need for information, and its use in, the ICZM process.

Further, more detailed, analysis will be undertaken to determine:

- the extent to which existing methods of information provision meet the needs of the organisations concerned with management and/or policy formulation in the coastal zone;
- the opportunities for data exchange between sectoral interests and the ways in which exchange is achieved;
- the extent to which data collected at local level can be aggregated at higher levels and how disaggregation of data collected for national or pan-European purposes may be made available at more local levels;
- options for new approaches, and validation of existing approaches to, the use of information technologies in accessing data and creating information;
- the extent to which electronic methods of data storage and retrieval can assist in meeting information needs.

Preliminary model of information creation

On page 2 you will find a summary of the relationship between information need and policy formulation set in the context of the causality model used by the European Environment Agency in Copenhagen. We are using this preliminary model of information creation as a succinct expression of the relationships we see between pressures, impacts and responses in the coastal zone. We have also supplied two annexes in which we provide examples, at various scales, of types of data used in the coastal zone and the nature and scale of its use and provision. Please don't be concerned if the material is difficult to follow. We will be able to expand on it later.

What we need from you

Initially, we need to gather the views and opinion, together with some facts and figures, from each of the Demonstration Projects about their current situation with respect to data and information. We have prepared a response guidance sheet (page 3) to help you formulate your submission to us. Please let us have your views by the end of April 1998.

Thank you.

Dr Pat Doody, Brampton, UK

Model of information creation

Information need in context

The European Environment Agency's causality model provides a framework in which to place information needs (Figure 1). We have extended the EEA model to show how the need for information flows from the need to predict, survey, monitor and assess in the coastal zone. It is clear from figure 1 that appropriate responses are dependent on meeting information needs.

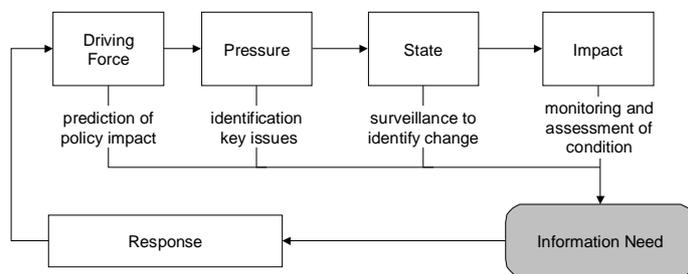


Figure 1 Information need in the context of the EEA causality model

With information need placed in context, we next consider how information need drives the information creation process.

Model of information creation

It follows from our definition of 'information' that both data (the raw material) and context are required before information (the product) is created. We model this simple position in figure 2. Whenever we need information to address an issue we must first analyse the issue to allow a determination of what data will, in the context of the issue, provide the information needed to respond in an appropriate fashion.

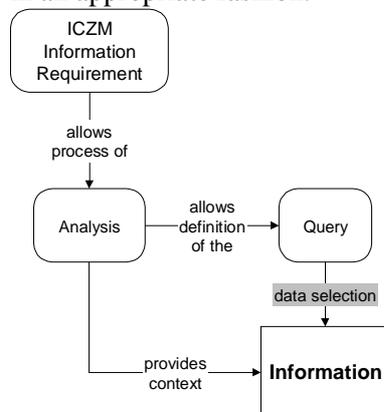


Figure 2 Information is created by selecting relevant data and placing it in context

Data selection

The complexity in information creation comes from the **process** of data selection. This is modelled in figure 3. In selecting data we first need to consider whether relevant data already exists. If they do not then we undertake necessary data collection.

However, just because relevant data does exist, it doesn't follow that we will know of their existence. Equally, even if we know that relevant data exists we may not be able to access them. In either case we may undertake unnecessary data collection. Once we have access to relevant data that we know about, we can assess their quality.

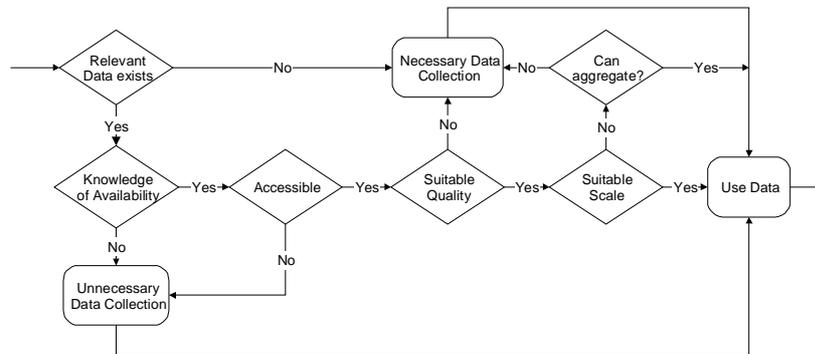


Figure 3 The process of data selection

We need to consider whether the existing data match our need in terms of their quantity, spatial and temporal resolution and their currency. If they fail any of these tests then we must undertake necessary data collection. If they meet all quality criteria we can finally consider if they match the spatial scale of our problem. If they do then we can use the existing data. If they do not then we can consider if the data can be aggregated in some way.

We have presented one model of data flow. Do you have a formal model of data flow in place, and if so who designed it and has it been endorsed by policy makers, or do you work on an ad-hoc basis?

Response Guidance Sheet

Ultimately, we need to understand what types of information you use, and how you use them, in your work on the coastal zone. At this stage, however, we need to gain a factual picture of the way in which you use information. As a follow up, for those projects we visit, we will look more closely at the **processes** you go through to assess information needs and access data to meet the need.

Data availability

We need to gain an understanding of the data that are available to you. You might refer to the appendices for example of data types at various scales. The following questions are an indication of the type of question that may help you to formulate your response:

- What types of data do you hold, if any?
- Do you collect data, and if so what kinds?
- What are the gaps in the data available to you?
- Do you think there may be relevant data sources you are not aware of?
- Overall, do you find that relevant data exist to meet your needs?
- How accessible is relevant data?
- Is available data of a suitable quality for your needs?
- Is available data at a suitable scale, and if not are they susceptible to aggregation?

Use of information

As well as considering data availability, we are interested in your use of data. The following questions are an indication of the type of question that may help you to formulate your response:

- Do you have a system for sharing data and with whom?
- Do you use any sources, which come from a different scale of operation?
- Do you feed data into any projects, which operate at a different spatial scale?
- Do you have a policy on data use, and if so is it a formal or informal policy?
- Do you consider the use and dissemination of data on the coastal and marine environment important to management?
- Is the information effectively used for decision making? If yes, in what form (reports, indicators, indices etc); if not, why?
- Have you heard about the EEA and its ETC/MC? If yes, how do you see its role in the context of ICZM?
- Do you think there is a need to model your data and information needs or do you simply make use of what you have?

Facts and figures

It will be of help to us if we know something of your budget in relation to data. The following are specific questions we would like you to answer:

- What do you spend on acquiring data (per annum)?
- What do you spend on maintaining data (per annum)?
- What type of computer hardware do you have?
- What type of computer software do you use?
- What did your IT system cost to initially set up?
- What is the maintenance cost of your IT system (per annum)?

Please send your response, by the end of April 1998, to:

Dr Pat Doody, National Coastal Consultants, 5 Green Lane, Brampton, Huntingdon, Cambs., PE18 8RE, UK

Note: This series of questions has been sent out to all Demonstration Programme projects. Visits will be made to a selection of projects during 1998 when more specific issues will be addressed. Visits will be determined partly by the response to this request for information.

Appendix 3: Visits, meetings and conferences

Dates: from - to	Location:	Action:
02-02-98	London	Thematic experts meeting (PD)
04-02-98 - 05-02-98	Copenhagen	Meeting EEA (PD, CG, CP & LB)
16-02-98	The Hague	Preliminary meeting ETC/MCE partner RIKZ (PD)
24-02-98 - 29-02-98	Cracow, Poland	Pan-European Biological & Landscape Diversity Strategy Conference, Central & Eastern Europe
06-03-98	Norwich	Meeting HMSO publishers (PD & CP)
24-03-98 - 26-03-98	Norwich	Final meeting and seminar LOIS project (PD & CP)
01-04-98 - 03-04-98	Brussels	Project leaders workshops (CG & LB?)
28-04-98	London	Thematic experts meeting (PD)
28-04-98	Brussels	Support workshop and Coastlink meeting (CG & LB)
13-05-98 - 15-05-98	Paris / Côte d'Opale	Project visit with seminar on "Conservation policies & integrated management on North Atlantic shores"
20-05-98	London	Theme F team meeting
25-05-98 - 28-05-98	Rade de Brest	Project visit (PD & LB - AM recommendation)
23-05-98 - 29-05-98	Genoa	Conference on Education & Training in ICZM, (CG)
05-06-98 - 12-06-98	Tromso / Norway	Conference on "Information for Sustainability", Symposium on remote sensing in the environment.
14-06-98 - 16-06-98	Oslo	North sea ecosystem workshop (unable to attend due to strike action)
05-06-98 - 12-06-98	Lisbon / Aveiro	Thematic experts & Project leaders meetings (CG & LB) and project visit.
17-06-98 - 21-06-98	Down / Newcastle	Project visit and "Coastlink" steering group (CG & LB)
08-07-98 - 12-07-98	Rome / Abbruzzo	Thematic experts seminar. Visit to ETC/MCE & RICAMA Project (PD)
15-07-98	Palermo	Project visit (CG)
30-07-98 - 31-07-98	Dorset	Project visit (PD)
		END July Interim Report to AB
10-08-98 - 13-08-98	Copenhagen / Storstrom	Interim meeting EEA , Project visit (PD & CP).
24-08-98 - 02-09-98		Holiday
31-08-98 - 03-09-98	British Columbia	Coastal Zone Canada '98, "Community based ICZM, sharing experience & building the knowledge" (CG)
16-09-98 - 18-09-98	Barcelona	Thematic experts meeting & project visit (PD)
22-09-98 - 26-09-98	Sefton, UK	Life project conference on sand dunes (PD)
12-10-98 - 15-10-98	Cyclades / Strymonicos / Kavala	Project visits (Athens) and at Thessaloniki & Kavala (PD)
12-10-98 - 18-10-98	Epirus	Coastlink workshop (CG/LB)
25-10-98 - 28-10-98	Göteborg	Thematic Experts meeting and ESDP/ICZM forum (PD)
04-11-98 November	The Hague	Visit to ETC partner (PD/CP)

09-11-98 - 11-11-98	Ispra, Italy	Remote sensing seminar CEO (PD)a
19-11-98 - 20-11-98	Devon / Cornwall	Project visits (PD) Plymouth Marine Laboratory (LOIS & SIMCOAST) (PD)
15-12-98		Final report to EEA
22-01-99	Brussels	Final meeting Thematic Experts
10-02-99 - 13-02-99	Noordwijkerhout	InfoCoast Conference, Holland (PD/CG/LB)
End March 1999		Final discussion document available for consultation
June 1999	Brussels	EU ICZM Demonstration Programme seminar (Provisional)

PD: Pat Doody, CG: Clive Gilbert, CP: Chris Pamplin, LB: Linda Bridge

Appendix 4: Key European Topic Centres

European Topic Centre	Responsible Organisation
Catalogue of Data Sources	Niedersächsisches Umweltministerium, Hannover, Germany
Land Cover	Environmental Satellite Data Centre, Kiruna, Sweden
Marine and Coastal Environment http://estaxp.santateresa.enea.it/www/etc/etc.html	ENEA – Centro Ricerche Ambiente Marino S.Teresa, La Spezia, Italy
Project partners	Coastal Zone Management Centre, The Hague, Holland
	Institute of Marine research, P.B. 1870 Nordnes, N-5024 Bergen, Norway
	Ifremer, B.P. 330, F-83507 La Seyne sur Mer Cedex, France
	National Centre of Marine Research, Agios Kosmas, 166 04 Hellenikon, Athens, Greece
	Norwegian Institute for Water Research, P.O. Box 173 KJELSAS, N-0411 Oslo, Norway
Nature Conservation	Muséum National d'Histoire Naturelle, Paris, France
JRC	

Appendix 5: National Focal Points

The Web page for the NFPs can be found at URL <http://www.eionet.eu.int/node/nfp/nfp-at.html> where **nfp-at** refers to the specific country as indicated below.

Country	Responsible organisation
Austria at	Umweltbundesamt UBA
Belgium be	Cellule Interrégionale de l'Environnement / Intergewestelijke Cel voor Leefmilieu IRCEL/CELINE
Denmark dk	Danmarks Miljøundersøgelser DMU
Finland fi	Suomen ympäristökeskus SYKE / Finlands miljöcentral FMC
France fr	Institut Français de l'Environnement IFEN
Germany de	Umweltbundesamt UBA
Greece gr	Ministry of Environment, Physical Planning and Public Works
Iceland is	Ministry for the Environment
Ireland ie	Environmental Protection Agency, Headquarters EPA
Italy it	SINA, Ministero dell' Ambiente SINA
Netherlands nl	RIVM, Rijksinstituut voor Volksgezondheid en Milieu RIVM
Norway no	Statens forurensningstilsyn SFT
Portugal pt	Ministério do Ambiente, Direcção-Geral do Ambiente SINAIA
Spain es	Dirección General de Calidad y Evaluación Ambiental
Sweden se	Naturvårdsverket
United Kingdom gb	Environmental Protection Statistics Division

Appendix 6: Regional Seas Programmes and Conventions

Regional Seas Convention	Address
Oslo & Paris Commission (OSPARCOM) http://www.osparcom.org/	Executive Secretary, New Court, 48 Carey Street, London, WC2A 2JQ
Helsinki Commission (HELCOM) http://www.helcom.fi	Environmental Secretary, Katajanokanlaituri 6, FIN- 00160, FIN-Helsinki, Finland
United Nations Environmental Mediterranean Action Plan Programme (UNEP MAP see MAP 1996)	First Officer, Vas. Konstantinou 48, P.O. Box 18019, 11610 Athens, Greece
Arctic Monitoring Assessment Programme (AMAP)	Stromsveien 96, P.O. Box 8100 Dep, 0032 Oslo, Norway
Black Sea Environmental Programme (BSEP)	Dolmabahçe Sarayı, 2 nd Hareket Kosku, 80680 Besiktas, Istanbul, Turkey