Coastal & Marine Resources Centre
Ionad Acmhainní Cósta is Mara

Oregon State University

ERI Environmental Research Institute University College Cork

UCC Coláiste na hOllscoile Corcaigh, Éire University College Cork, Ireland

Report on Coastal Mapping and Informatics Trans-Atlantic Workshop 1: Potentials and Limitations of Coastal Web Atlases

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More information can be found on the Workshop web site:
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Table of Contents

Acronyms

CAMRA	The UK Coastal and Marine Resource Atlas
CMRC	Coastal and Marine Resources Centre
COTS	Commercial-Off-the-Shelf
CSW	Catalogue Services for the Web
CWA	Coastal Web Atlas
DBMS	Database Management System
DOI	Digital Object Identifier
FGDC	Federal Geospatial Data Consortium
geoRSS	Geographically Encoded Objects for RSS feeds
GIS	Geographic Information System
GML	Geographic Markup Language
ICZM	Integrated Coastal Zone Management
IMF	Internet Mapping Framework
IPR	Intellectual Property Rights
ISDE	Irish Spatial Data Exchange
ISO	International Standards Organisation
KO	De Kustatlas Online, Belgium
MIDA	The Marine Irish Digital Atlas
NCE	North Coast Explorer, Oregon
NGO	Non-Governmental Organisation
NSF	National Science Foundation
OCA	The Oregon Coastal Atlas
OGC	Open Geospatial Consortium
OS	Open Source
PSI	Public Sector Information
SDI	Spatial Data Infrastructure
UML	Unified Modeling Language
VIMS	Virginia Institute of Marine Science
VMT	VIMS Mapping Tools
W3C	World Wide Web Consortium
WFS	Web Feature Service
WMS	Web Map Service
XML	eXtensible Markup Language

Executive Summary

THE IMPORTANCE OF COASTAL WEB MAPPING

Governments, industry sectors, academic institutions and Non-Governmental Organizations (NGOs) have a tremendous stake in the development and management of geospatial data resources. Coastal mapping plays an important role in informing decision makers on issues such as national sovereignty, resource management, maritime safety and hazard assessment. Efforts to improve data accessibility are driven by legislation on topics such as **Environmental management, open access of public sector information** and **data standards and harmonisation**. The development of Geographic Information System (GIS) based web mapping products has improved the usability of GISs by non-specialists. This, combined with community needs, has resulted in the growth of a niche group of interactive coastal web atlases (CWAs) around the world, developed to address the needs of the coastal and marine community. The 2006 Green Paper on Future Maritime Policy in the European Union stated: "***a veritable Atlas of EU coastal waters… could serve as an instrument for spatial planning***" (European Commission 2006, p. 35), illustrating the increasing recognition of the potential of CWAs, even at an international level.

TRANS-ATLANTIC WORKSHOPS ON COASTAL MAPPING AND INFORMATICS

Funding was obtained through the U.S. National Science Foundation (NSF) and the Marine RTDI programme in Ireland to organize two trans-Atlantic workshops on coastal mapping and informatics. The first workshop, entitled "*Potentials and Limitations of Coastal Web Atlases*," was hosted by the Coastal and Marine Resources Centre (CMRC) at University College Cork in Ireland in July 2006. This workshop brought together key experts from Europe and North America to **examine state-of-the-art CWA developments**, **share lessons learned**, **determine future needs** in mapping and informatics for the coastal practitioner community and **identify potential opportunities** for collaboration.

COASTAL WEB ATLAS FEATURES

A coastal web atlas is ***a collection of digital maps and datasets with supplementary tables, illustrations and information that systematically illustrate the coast, oftentimes with cartographic and decision-support tools, and all of which are accessible via the Internet.*** Access to the various components can be provided in different ways. The typical CWA contains a number of general features, including: geospatial data and metadata; a map area for data display; a legend and/or layer list; tools to interact with the map and data; data attribute tables; topical information; powerful server and software technologies; and a well-rounded atlas design to meet atlas and user needs.

COASTAL WEB ATLAS CASE STUDIES

As part of the workshop, a number of representative coastal web atlas case studies from both sides of the Atlantic were presented by developers. This report provides an overview of the case studies, which highlight key aspects of CWA development and operations such as atlas purpose, institutional support, technology and functionality. Those included as case studies are: The UK Coastal and Marine Resource Atlas; De Kustatlas Online, Belgium; The Marine Irish Digital Atlas; The Oregon Coastal Atlas; North Coast Explorer, Oregon; and Mapping Tools for Coastal Management, Virginia.

Strengths, Weaknesses, Opportunities and Threats Analysis

During the workshop, four working groups were established to identify issues related to atlas **design**, **data**, **technology** and **institutional capacity**. Each working group focussed its discussion by carrying out a Strengths, Weaknesses, Opportunities and Threats (SWOT) Analysis. Examination of the various points which were raised by the four working groups led to the identification of a number of cross-cutting issues, listed in the table below.

STRENGTHS	WEAKNESSES
1. **Standards and specifications** are maturing and **gaining wide acceptance**. 2. International and national **regulations are driving the need** for data and encouraging their availability. 3. Academic institutions and research organisations can take advantage of **emerging technologies** to design innovative products. 4. Development of **web atlases can aid in collaboration** between institutions and sharing of methods.	1. **Metadata is often inadequate**, inaccurate or out of date. 2. **Data management is difficult** due to the large quantities of data, difficult-to-support formats and their appearance on multiple portals. 3. **Data access limitations**, licencing and desire to recoup costs are restrictive. 4. There are **limitations** in the ability to **display** certain data types and to perform **data analysis**.
THREATS	**OPPORTUNITIES**
1. The **Google Earth paradigm** challenges atlas developers to meet design expectations of users. 2. **Data policies and IPR** impair accessibility and re-use of data. 3. **Erratic funding** affects the ability to develop and maintain atlases and leads to staff turnover issues. 4. **Credibility**: Atlases may not meet actual user needs and expectations; data quality may be poor; changing technologies may be disruptive.	1. **Community building and collaboration** can leverage the expertise of atlas developers. 2. **E-Gov and SDI initiatives** are helping to increase interest in CWAs among policy makers and regulators. 3. Atlases enable **identification of data gaps** and provide the ability to **pull resources together** to fill gaps and improve data. 4. Use **emerging technologies**, including Open Source and OGC standards, to enhance data sharing, presentation and online analysis.

Considerations for Atlas Development

The design and usability of an atlas are keys to its success. An atlas should clearly communicate its purpose, be visually appealing, be kept as simple as possible, use efficient technology and management systems and have a flexible design to enable growth and change over time. Ultimately its success relies on the atlas users, so efforts should be made regularly to ensure that it meets the needs of those users. An output of the workshop was a list of considerations for atlas design and implementation on topics such as data content and display, metadata, atlas interface, atlas tools, technology, user feedback and support for maintenance and future developments.

Conclusions and Recommendations

The following table provides a summary of the report's conclusions and recommendations.

CONCLUSIONS	RECOMMENDATIONS
1. CWAs provide a range of data related services.	Methods for **providing additional CWA services** should continually be explored to better meet user needs.
2. CWAs in the United States and Europe are using similar technologies and standards.	**Collaboration** among American and European researchers should be actively supported in order to advance CWA design and implementation.
3. New legislation and policies are driving the production of quality coastal datasets and improved data availability.	**The CWA community must provide input to policy development** to help raise awareness of issues, including data accessibility. Methods for **effective outreach to decision makers** must be improved.
4. Data cost and intellectual property considerations can limit data availability in an atlas.	CWA developers and data managers should develop a collective approach to **inform policy makers of limitations** that **data cost, licensing and IPR issues** impose on users
5. Much data is still inaccessible or of variable quality.	Data owners should be encouraged to **devote resources to properly cataloguing their data** and improving data quality.
6. Consolidation of international standards and specifications is making development easier.	CWA **developers must be aware of the latest standards and specifications** and strive towards their implementation. **Data providers** should also be encouraged to **implement them**.
7. CWAs use cutting edge technology to develop effective web resources.	CWA developers should **keep informed of emerging technologies** and look for opportunities to implement them.
8. DBMSs are crucial for efficient content management.	**Efficient, flexible and easy to use spatial data management systems** need to be used for improved content management.
9. A common ontology for coastal and marine data is necessary.	The CWA community should **be informed about ontology developments** and consider implementing them.
10. Google Earth and other virtual globes revolutionised public expectations of geospatial data visualisation.	The CWA community needs to **evaluate the impact** of such viewers on their own initiatives and determine if there is the **potential to work with or incorporate elements** of virtual globes in next version CWAs.
11. Existing CWAs offer limited functionality for analysis and value added outputs.	CWAs should **offer a suite of analysis tools and value added outputs.** Developers should explore the utility of various technologies to help in development.
12. Existing atlases are sometimes too complicated for general audiences.	Development must be **responsive to user needs.** Developers should **consider designing multiple versions** to offer a range of services. **Regular user feedback** is crucial for atlas success.
13. The erratic nature of funding can compromise maintenance and ongoing CWA development.	Different **financial models need to be examined** to determine the best methods for continued CWA support, such as **sponsorship**, **subscriber-only areas** and **spin-off initiatives**.
14. Ongoing dissemination and publicity of CWAs is important to atlas success.	**Regular methods** should be explored for **effective outreach** such as **Email lists, publicity, events, brochures, giveaways** and **other innovative ideas** to increase awareness.
15. There is limited capacity to measure the impact of CWAs.	Better methods need to be developed in **how to measure impacts of CWAs** in the coastal community.
16. The emergence of CWAs has resulted in a growth of expertise in CWA design.	It is vital to **develop links** within the CWA community **to enhance collaboration, build on lessons learned and identify best practise.**

1. Introduction

Governments, industry sectors, academic institutions and Non-Governmental Organizations (NGOs) have a tremendous stake in the development and management of geospatial data resources. Good access to relevant geospatial data is particularly pertinent for planning in the coastal zone where, worldwide, 20% of humanity lives less than 25 km from the coast (Burke *et al*., 2000). Coastal mapping plays an important role in informing decision makers on issues such as national sovereignty, resource management, maritime safety and hazard assessment.

Diverse data of relevance to the coastal zone are held by a broad range of organisations and can often be difficult to access. Efforts to improve data accessibility are driven by legislation on topics such as:

- **Environmental management**, for example the US Coastal Zone Management Act and the EU Water Framework Directive (US Congress 2000; European Parliament 2000);
- **Open access of public sector information**, for example the US Freedom of Information Act and the EU Public Sector Information Directive (US Congress 2002; European Commission 2003);
- **Data standards and harmonisation**, for example the US National Spatial Data Infrastructure and the EU INSPIRE Directive (Clinton 1994; European Parliament 2007).

The Internet is a valuable tool for providing access to geospatial data, both for professionals and the general public. The development of Geographic Information System (GIS) based web mapping products has improved the usability of GISs by non-specialists. This, combined with community needs, has resulted in the growth of a niche group of interactive coastal web atlases (CWAs) around the world. These have been developed to address the needs of the coastal and marine community. CWAs cover an array of scales, ranging from the estuary level to entire national coastlines. The 2006 Green Paper on Future Maritime Policy in the European Union stated: "***a veritable Atlas of EU coastal waters… could serve as an instrument for spatial planning***" (European Commission 2006, p. 35), illustrating the increasing recognition of the potential of CWAs, even at an international level.

A coastal web atlas can be defined as: *a collection of digital maps and datasets with supplementary tables, illustrations and information that systematically illustrate the coast, oftentimes with cartographic and decision-support tools, and all of which are accessible via the Internet*.

CWAs deal with a variety of thematic priorities (e.g., oil spills or recreational uses) and can be tailored to address the needs of a particular user group (e.g., coastal managers or education). There a many benefits which CWAs can provide, including:

- **A portal** to coastal data and information from **diverse sources**;
- **Up to date** geospatial data which is frequently changing;
- A widely **accessible** coastal resource to a broad audience;
- A comprehensive and searchable **data catalogue**;
- Improved **efficiency** in finding data and information;
- An instrument for **spatial planning**;
- **Interactive tools and resources** which empower users to find their own answers;
- An **educational resource** which raises people's consciousness about coastal topics.

While significant capacity has been built in the field of web-based coastal mapping and informatics in the last decade, little has been done to take stock of the implications of these efforts or to identify best practice in terms of taking lessons learned into consideration. In order to address these issues, funding was obtained through the U.S. National Science Foundation (NSF) and the Marine RTDI programme in Ireland to organize two trans-Atlantic workshops on coastal mapping and informatics. These workshops aim to provide an opportunity to bring together key experts from Europe, the United States and Canada to examine state-of-the-art developments in web-based coastal mapping and informatics, future needs in mapping and informatics for the coastal practitioner community and potential opportunities for collaboration.

The first workshop, entitled "*Potentials and Limitations of Coastal Web Atlases*," was hosted by the Coastal and Marine Resources Centre (CMRC) at University College Cork in Ireland from July 24th to 28th, 2006. This workshop brought together over 40 participants from academia, government agencies and conservation organizations from Europe and North America to share technologies and lessons learned from the development of CWAs. A variety of aspects were examined, including institutional capacity, technology, atlas design and data issues. Key aims of this initial workshop were to:

- **Create and strengthen relationships** between experts in the field of marine and coastal mapping in North America and Europe;
- **Identify state-of-the-art approaches** to marine and coastal mapping and informatics;
- **Identify lessons learned** from participants' combined experiences;
- **Prepare guidelines** as a resource for developers and decision makers on CWA projects;
- Provide recommendations on the **development of a joint program of work** to funding bodies in Europe and North America, including the NSF, European Science Foundation and Natural Sciences and Engineering Council of Canada to provide international research experiences.
- Plan the **follow-up workshop**, entitled **"***Building a Common Approach to Managing and Disseminating Coastal Data, Maps and Information,"* to be held at Oregon State University in July 2007.

The purpose of this report is to summarise the findings from the Coastal Web Atlases Workshop and to provide recommendations for those wishing to develop CWAs of their own. It also aims to highlight significant issues that need to be addressed, both within the coastal mapping community as well as those with a stake in the management of data relevant to the coastal zone.

2. Coastal Web Atlas Features

Based on the definition of a coastal web atlas given in Section 1, an atlas contains a collection of maps with supplementary tables, illustrations and information which systematically illustrate the coast. Access to the various components can be provided in different ways. The typical CWA contains a number of general features, which can be contained in one or several web pages (Fig. 2.1). The key components that make up a CWA are described below. Case studies presented at the workshop are used to visualise these features. These case studies are described further in Section 3, as well as in Maelfait *et al*. 2006, DEFRA 2006, Haddad *et al*. 2006, Institute for Natural Resources 2005 and O'Dea *et al*. [in press].

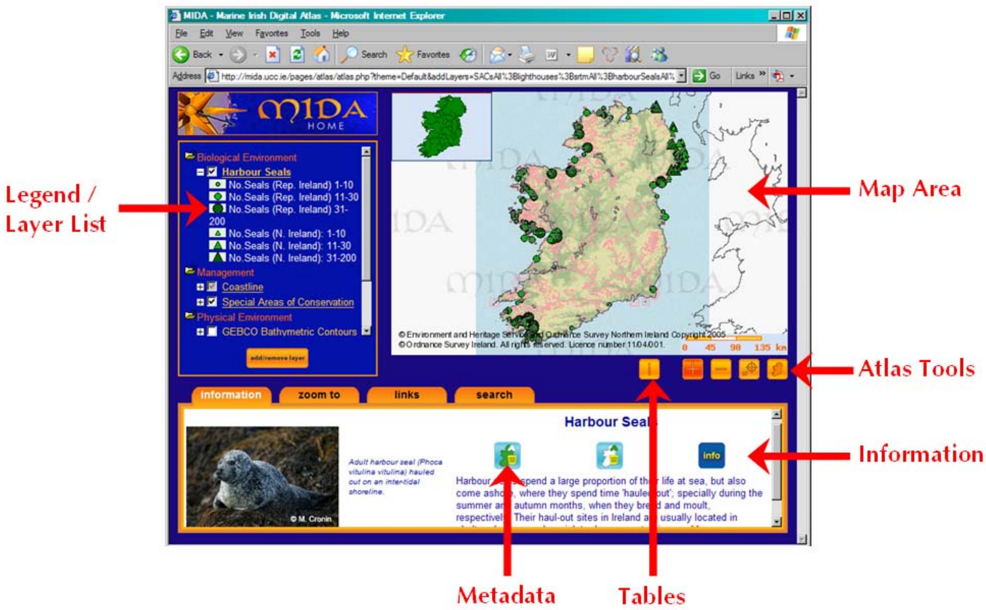


Fig. 2.1: *This image of the interactive map page of the Marine Irish Digital Atlas (MIDA) illustrates one example of providing access in a single web page to various CWA components.*

2.1. Map Area

The map area displays the geospatial data as either **static** map images or **interactive** maps where users can zoom in to areas of interest and query particular map features for more information. It may also contain:

- A small **overview map** of the entire geographic area;
- A **scale bar;**
- **Geographic coordinates**;
- An atlas **watermark**;
- **Copyright information** (Fig. 2.1 and 2.2).

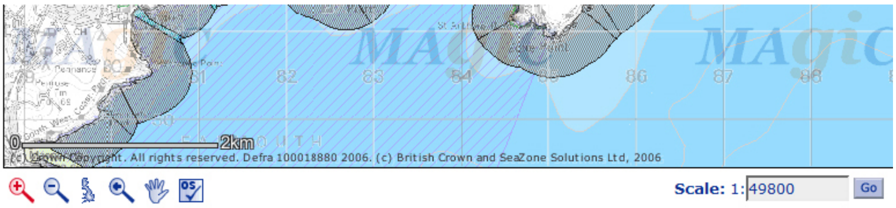


Fig. 2.2: This example from the Coastal and Marine Resource Atlas (CAMRA; part of the MAGIC web site) illustrates the use of a copyright statement, watermark and scalebar.

2.2. Data Display

The maps displayed in the map area are composed of **geospatial datasets** (point, line and area features, raster grids and/or images). The geospatial data can:

- Be from **one to many data owners**;
- Be **limited** or **infinite in the number** that can be viewed at one time;
- Viewable as **grouped themes** (Fig. 2.3);
- **User controlled** with the functionality to turn layers on and off;
- Displayed as **images or vectors**, depending on the system functionality;
- Be created from a wide **range of scales**, which may result in CWA designers to set **scale factor limits** to avoid misrepresentation of data when viewed at different scales.

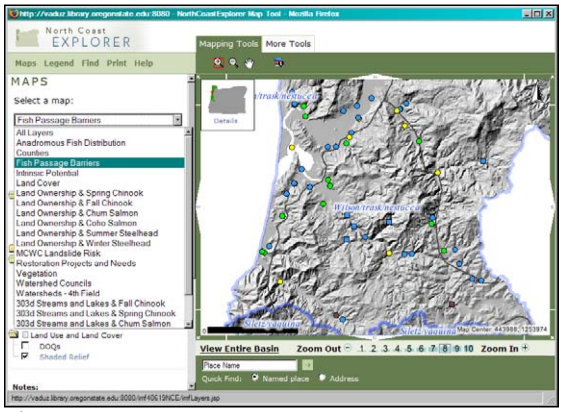


Fig. 2.3: Fish passage barriers are one of many themes to select in Oregon's North Coast Explorer. When selected, the dynamic layer list updates with the relevant thematic layers.

2.3. Legend/Layer List

A **legend** defines the symbols and colours used to display map features. The **layer list** is generally provided to give the user control of the layers which are viewed in the map. The legend and layer list can:

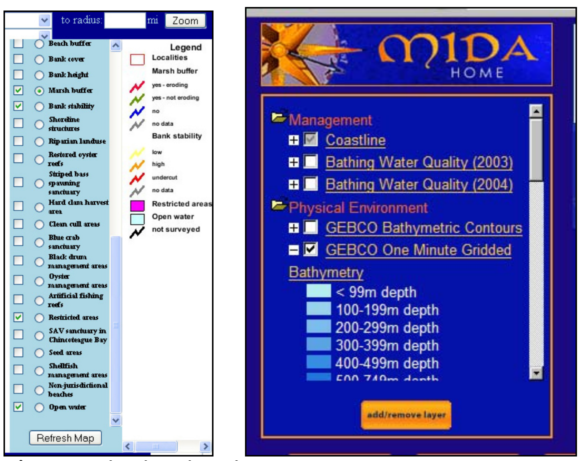


Fig. 2.4: (l) The Shoreline Manager's Assessment Kit from VIMS displays the layer list and legend separately in the same window. (r) The MIDA layer/legend list is combined. The layer names, which are listed in a hierarchical structure, also link to external information such as text, metadata and data download.

- Be **displayed separately** or **together** (Fig. 2.4);
- Be a **static, predetermined list** or **user-modified list**;
- Appear in the **same window** next to the map, or open in a **pop-up** window;
- Provide the **user control of the layers** that appear in the list, either by selecting data layers from a master list or by selecting a theme of grouped layers.

2.4. Atlas Tools

There are a broad range of tools which are possible to include in a CWA, depending on the atlas purpose. An atlas can:

- Simply allow a user to **zoom** to an area of interest or **identify** map features and see related attributes;
- Provide tools which enable users to **search for specific datasets** relevant to their interests (e.g. title, keyword, date, area, etc.);
- Enable the user to perform more **advanced queries** for **features within a dataset** itself (e.g. site name, value or range of values, etc.; Fig. 2.5(l));
- Offer tools to perform **spatial analysis** using data within the atlas and visualise the results in the map;
- Address specific needs to certain user groups (Fig. 2.5(r)).

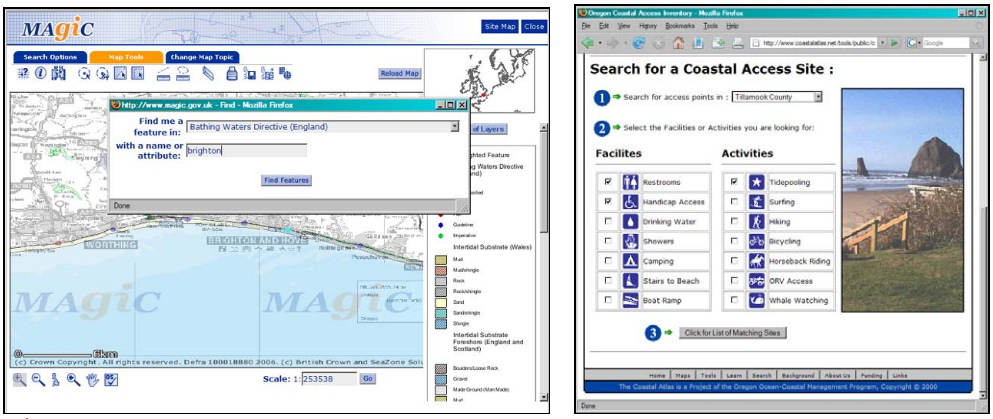


Fig. 2.5: *(l) The CAMRA allows users to search for specific feature attributes within a designated dataset; (r) The Oregon Coastal Atlas includes a resource that enables coastal visitors to find access points that meet their interests and needs.*

2.5. Attribute Tables

The information held in the attribute tables of geospatial data can be made available to atlas users. These tables provide additional information about map features to the user, including fields such as names, types and quantities. Attribute tables can:

- Generally be accessed by using an ***Identify* tool** and then selecting a point in the map;

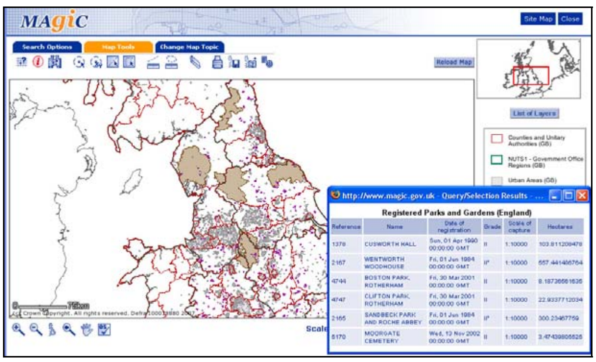


Fig. 2.6: *In the CAMRA, tables resulting from identifying or querying features appear in a separate pop-up window.*

- **Table results** can appear in a separate part of the map page or in a pop-up window (Fig. 2.6);
- Be accompanied by a **map highlighting the feature** selected;
- Appear for a **single feature** selected or for features in **multiple layers** located under the selected point or area.

2.6. Metadata

Metadata is a crucial component of a CWA, as they provide the **source information** for the various layers, such as ownership, the date and scale at which data were created. Metadata assures users of the **quality of the data** and enables more advanced atlas users to find data layers of relevance to their own work.
Metadata available in atlases can:

- Be displayed in a **standard format** or as the data owners provide them;
- Be of **variable quality**, depending on information provided by data owners;
- Consist simply of **basic metadata** information or offer **full details** about the datasets;
- Be presented in a **tiered system** showing varying metadata levels (Fig. 2.7);
- Be displayed as simple **web pages** or stored in a database and **dynamically displayed** in a template;
- Be **exportable** in a format that enables sharing with metadata databases and search engines.

Fig. 2.7: *Using a tiered metadata design, such as the MIDA's Abstract, Discovery and Full metadata levels, improves accessibility to information.*

2.7. Information/Extras

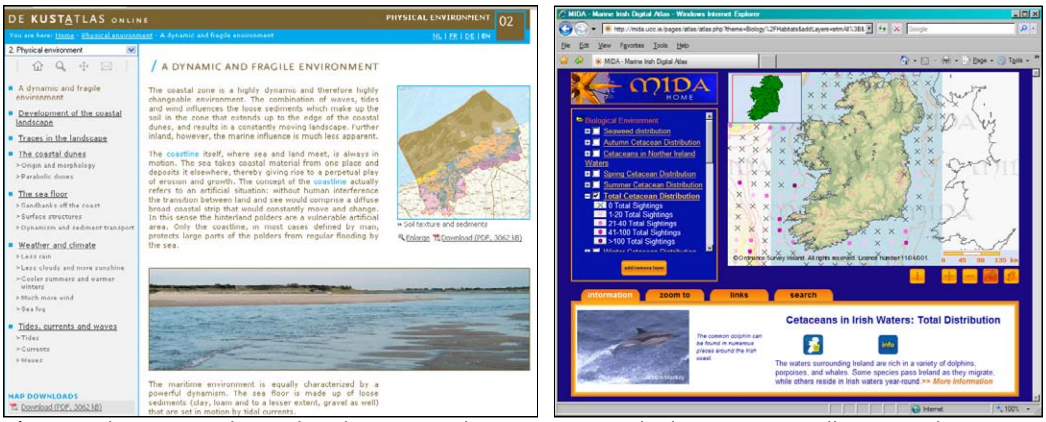


Fig. 2.8: *(l) De Kustatlas Online focuses on thematic topics which use maps to illustrate information, while making related geospatial data, charts and illustrations available; (r) The MIDA centres on an interactive map where users can view data by theme and access additional information on the topics (users can also access maps from the text pages via links).*

Additional relevant information adds value to the map display by helping to highlight specific **coastal topics** (Fig. 2.8). Information can include:

- General and detailed **descriptions of topics and issues** relevant to the atlas purpose, including photos and documents;
- **Links** to key web sites, organisations, and documents;
- **Resources** for specific user groups (e.g. coastal management, education, tourism, etc.).

2.8. Behind the Scenes

Powerful server and software technology are used to support the hosting of a CWA. **Atlas design** takes into account available financial and technical resources, audience needs and limitations, system architecture, web design and content management. Atlases can:

- Be hosted on one of several **operating systems** (e.g., Microsoft, UNIX/LINUX);
- Be based on a variety of **web servers** (e.g., Microsoft IIS, Apache);
- Be constructed using **proprietary software** for web GIS and database management system (e.g., ArcIMS and ArcSDE), or **Open Source software** (e.g., University of Minnesota MapServer and PostgreSQL);
- Employ **database management systems (DBMSs)** to manage their content and/or data (Fig. 2.9), or provide direct access to files;
- Be designed and **tested** to work in one or many types of **web browsers**.
- Be designed to **consider best available technology and network speeds** of users;
- Meet national or international **standards** (e.g., ISO 19115/19139 metadata standards, Open Geospatial Consortium (OGC) web mapping standards).

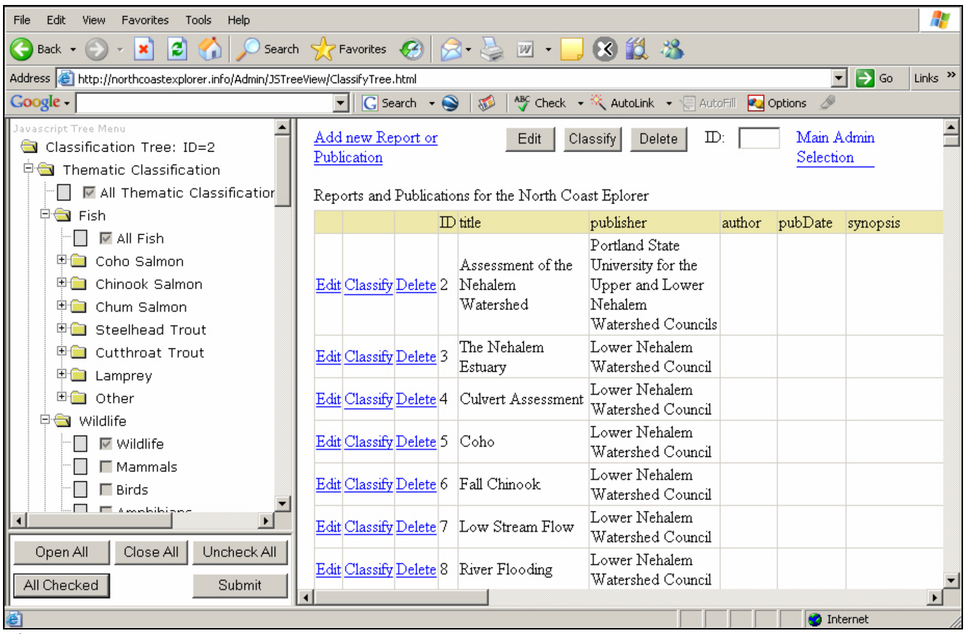


Fig. 2.9: *The North Coast Explorer uses a web-based content management system for adding and removing content records, as well as classifying content (i.e., topic, place, and content type).*

3. Coastal Web Atlas Case Studies

As part of the workshop, a number of coastal web atlas case studies from both sides of the Atlantic were presented by developers. The CWA case studies are summarised in the following tables, which highlight key aspects of CWA development and operations such as atlas purpose, institutional support, technology and functionality.

3.1. THE UK COASTAL AND MARINE RESOURCE ATLAS

Contact:
Kevin Colcomb
Counter Pollution and Response Branch
Maritime and Coastguard Agency
Bay 1/09, Spring Place
105 Commercial Road
Southampton SO15 1EG, UK
Email: kevin.colcomb@mcga.gov.uk
Web: http://www.mcga.gov.uk/

Alison Dickson (Technical Contact)
MAGIC Project Manager
Natural England
Government Buildings
Otley Road, Lawnswood
Leeds, LS16 5QT, UK
Email:
Alison.Dickson@naturalengland.org.uk

http://www.magic.gov.uk

ATLAS PURPOSE

- Provide a flexible resource for **national oil spill planning**, facilitating:
  - Seamless **multi agency, operational response**;
  - Audit and contingency **planning**, consistent with the UK **National Contingency Plan** (NCP);
  - **Clean-up management**;
  - **Damage assessment**, compensation, responsibilities;
- Provide **information on sensitive resources** of the UK coastline and its seas to all stakeholders.
- Assist in identification of **protection** and **clean-up priorities**.

DISTINGUISHING FEATURES

- A coastal and marine extension of the **MAGIC** (Multi Agency Geographic Information for the Countryside) website.
- Focussed on **oil spill planning**.

TARGET AUDIENCE

	General Public;	√	Commercial/Industry;
	Tourists;	√	Consultancies;
	Students;	√	Coastal/Environmental Managers;
	Researchers/Scientists;	√	Decision Makers;
	NGOs;		Other:
√	Government/Public Bodies;		

ATLAS SUPPORT (FINANCIAL/INSTITUTIONAL)

Partners and Funders:

- Maritime and Coastguard Agency;
- Scottish Executive;
- Dept. for Environment, Food and Rural Affairs;
- Department of Trade and Industry;
- English Nature;
- Scottish Natural Heritage;
- Joint Nature Conservation Committee;
- Kent County Council;
- Hampshire County Council;
- Essex County Council;
- Environment Agency, Anglian Region;
- Energy Institute.

ATLAS DESIGN AND USABILITY

Focus:
Textual content;
√ Map content;
Design:
√ Clear navigation and instruction;
Involved user feedback;
Access text from maps/maps from text;
√ Single/Multiple point(s) of access to map/data;
√ Guided navigation;
Map Page:
√ View limited/unlimited layers;
√ View data independently/by theme;
√ Combined/Separate legend & layer lists;
√ Links to internal/external pages.

Documentation:
√ Thematic text;
√ Metadata:
- Database/Flat files;
- Single/Multiple format(s);
Illustrations, images and charts;
√ Help page(s);
√ Tutorial;
Standards:
√ Metadata standards: ISO 19xxx;
OGC;
Other:

TECHNOLOGY USED

Mapping Software:
Open Source
√ Proprietary: ESRI ArcIMS;
Data Storage:
√ Locally: SQL Server with ArcSDE;
√ Distributed Network: SPIRE database (early 2007);

Database Management System:
Yes/No;
Other:

FUNCTIONALITY/TOOLS AVAILABLE

Level:
Basic;
Moderate;
√ Advanced;
Search Capability:
√ Search for data;
√ Search for attributes;
Search for thematic information;

Mapping Tools:
√ Zoom, recentre and full extent;
√ Identify features;
√ Layer list control;
View by theme;
√ Print/Export maps;
√ Query attributes;
√ Measure line and areas;
√ Download geospatial data.

Other:
- Marine data viewable in ED50 Mercator and GB National Grid.

DATA/CARTOGRAPHIC INFORMATION INCLUDED

Geographic Area: England, Scotland and Wales;
Number of Datasets: >100;
Topics:

√ Physical Environment;
√ Coastal Habitats;
Imagery;
√ Biology;
√ Management;
Human Impact;
√ Conservation;
√ Environmental Monitoring;
√ Infrastructure;
Industry;
Culture & Heritage;
√ Natural Resources;
√ Fisheries, Aquaculture & Agriculture;
Tourism & Recreation;
√ *Other:* Sensitivity.

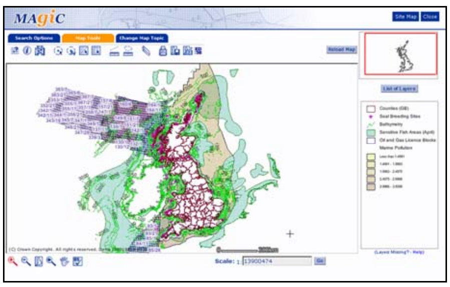
DATA ISSUES

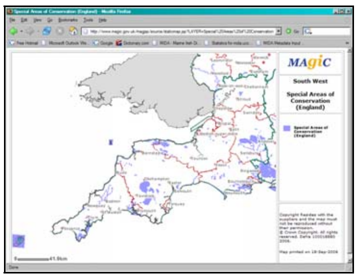
IPR/Cost:
√ Cost-prohibitive data (base/other);
√ Intellectual Property Rights (IPR);
√ Data use restrictions;
Accessibility:
√ Data sourcing and acquisition;
√ Poorly managed, inaccessible data;
Limited GIS-ready data;
√ Data duplication;
Distributed network not yet feasible;
Data retrieval speed;
Quality:
√ Variable/inconsistent data quality;
√ Inappropriate data scales;
√ Incomparable regional datasets;
√ Poor/non-existent metadata;
Management:
√ Data management plan development;
√ Balance of development and updates;
Regularity of data updates;
Manual upload of data to atlas;
Resources to source/acquire data;
Other:
• Over-reliance on personal knowledge for data information.

OTHER CHALLENGES

√ Funding for site maintenance;
√ Designing simple, intuitive and informative web interface;
√ Content balance of science and information;
Product promotion;
√ Design of efficient DBMS for content management;
Other:
• Marine topic new to countryside atlas MAGIC;
• Aligning to MAGIC procedures.

IMAGES





3.2. DE KUSTATLAS ONLINE, BELGIUM

Contact:
Kathy Belpaeme
Co-ordination Centre for Integrated Coastal Zone Management in Belgium
Ghent, BELGIUM
Email: Kathy.belpaeme@vliz.be
Tel: +32 (0)5934 21 47
Web: http://www.kustbeheer.be

http://www.kustatlas.be

ATLAS PURPOSE

- Facilitate **communication** and **awareness-raising**;
- Provide a **contact point** for coastal information;
- Help implement the **European Recommendation on Integrated Coastal Zone Management**;
- Integrate **planning** and **coastal policy**;
- Make **coastal indicators** visible as policy support instruments.

DISTINGUISHING FEATURES

- Initially **published as a book** (Belpaeme and Konings 2004), then developed as a CWA;
- **Designed simply** but effectively;
- **Uses Flash** instead of a web mapping system for its maps;
- Available in **four languages**.

TARGET AUDIENCE

√	General Public;	√	Commercial/Industry;
√	Tourists;	√	Consultancies;
√	Students;	√	Coastal/Environmental Managers;
√	Researchers/Scientists;	√	Decision Makers;
√	NGOs;		Other:
√	Government/Public Bodies;		

ATLAS SUPPORT (FINANCIAL/INSTITUTIONAL)

Funders:
- The Coordination Centre for ICZM (partnership);

Partners:
- The province of West-Flanders (coastal province);
- The Flemish Government: Nature and Coastal Defence Department;
- Flanders Marine Institute (VLIZ);
- Environmental Department, Federal Government (since 2005).

ATLAS DESIGN AND USABILITY

Focus:
√ Textual content;
Map content;
Design:
√ Clear navigation and instruction;
Involved user feedback;
√ Access text from maps/maps from text;
√ Single/Multiple point(s) of access to map/data;
Guided navigation;
Map Page:
√ View limited/unlimited layers;
√ View data independently/by theme;
√ Combined/Separate legend & layer lists;
√ Links to internal/external pages;

Documentation:
√ Thematic text;
Metadata:
- Database/Flat files;
- Single/Multiple format(s);
Illustrations, images and charts;
Help page(s);
Tutorial;
Standards:
Metadata standards:
OGC;
Other:

TECHNOLOGY USED

Mapping Software:
Open Source
Proprietary
Data Storage:
√ Locally:
Distributed Network;

Database Management System:
No;
Other:
- PHP/HTML web content;
- Flash for interactive maps;
- Downloads available in pdf/xls/gis format.

FUNCTIONALITY/TOOLS AVAILABLE

Level:
√ Basic;
Moderate;
Advanced;
Search Capability:
Search for data;
Search for attributes;
Search for thematic information;

Mapping Tools:
√ Zoom, recentre and full extent;
Identify features;
Layer list control;
√ View by theme;
√ Print/Export maps;
Query attributes;
Measure line and areas;
√ Download geospatial data;

Other:
- Links to coastal indicators for each topic.

DATA/CARTOGRAPHIC INFORMATION INCLUDED

Geographic Area: Belgium
Number of Datasets: 33
Topics:

- √ Physical Environment;
- √ Coastal Habitats;
- √ Imagery;
- √ Biology;
- √ Management;
- √ Human Impact;
- Conservation;
- Environmental Monitoring;
- √ Infrastructure;
- √ Industry;
- √ Culture & Heritage;
- √ Natural Resources;
- √ Fisheries, Aquaculture & Agriculture;
- √ Tourism & Recreation;
- Other:

DATA ISSUES

IPR/Cost:

- Cost-prohibitive data (base/other);
- √ Intellectual Property Rights (IPR);
- √ Data use restrictions;

Accessibility:

- √ Data sourcing and acquisition;
- √ Poorly managed, inaccessible data;
- √ Limited GIS-ready data;
- Data duplication;
- Distributed network not yet feasible;
- Data retrieval speed;

Quality:

- √ Variable/inconsistent data quality;
- √ Inappropriate data scales;
- √ Incomparable regional datasets;
- Poor/non-existent metadata;

Management:

- Data management plan development;
- Balance of development and updates;
- √ Regularity of data updates;
- √ Manual upload of data to atlas;
- √ Resources to source/acquire data;

Other:

-

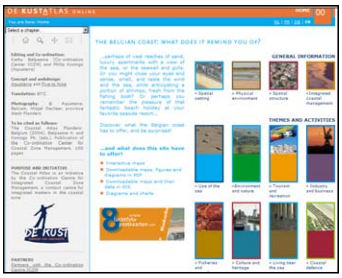
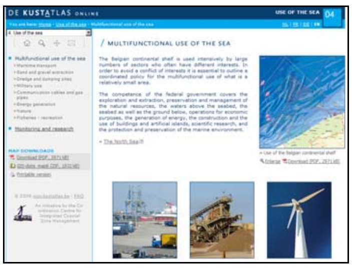
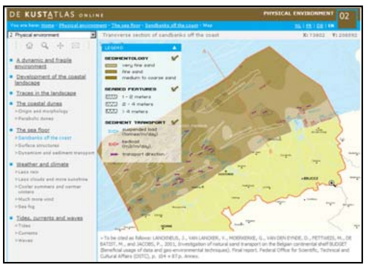
OTHER CHALLENGES

- √ Funding for site maintenance;
- Designing simple, intuitive and informative web interface;
- √ Content balance of science and information;
- √ Product promotion;
- Design of efficient DBMS for content management;

Other:

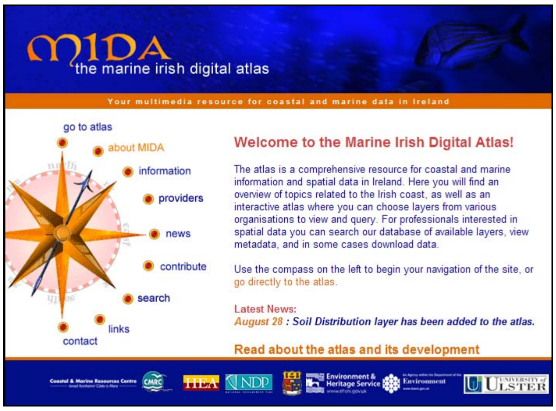
-

IMAGES

3.3. The Marine Irish Digital Atlas

Contact:
Liz O'Dea/ Valerie Cummins
Coastal and Marine Resources Centre
ERI, University College Cork
Haulbowline Naval Base,
Cobh, County Cork, IRELAND
Email: l.odea@ucc.ie; v.cummins@ucc.ie
Tel: +353 (0)21 4703100
Web: http://cmrc.ucc.ie/



http://mida.ucc.ie

Atlas Purpose

- Provide a **professional and public resource** for coastal and inshore marine areas for Ireland;
- Make available **maps, data and information** on coastal themes;
- Assist professionals in identifying **sources of data, information and expertise** on the marine environment;
- Offer **accessibility to GIS data** in the form of searchable metadata and a web GIS;
- Encourage a **greater appreciation** of Ireland's coastal regions.

Distinguishing Features

- **Island-wide**, covering the Republic and Northern Ireland;
- Uses **Open Source software**;
- Single main atlas page is sectioned into **panels** (map, layers and information);
- Includes spatial data from **over 30 organisations**.

Target Audience

√ General Public;
√ Tourists;
√ Students;
√ Researchers/Scientists;
√ NGOs;
√ Government/Public Bodies;
√ Commercial/Industry;
√ Consultancies;
√ Coastal/Environmental Managers;
√ Decision Makers;
Other:

Atlas Support (Financial/Institutional)

Partners:
- Coastal and Marine Resources Centre, University College Cork;
- Centre for Coastal and Marine Research, University of Ulster, Coleraine, N. Ireland;

Funders:
- Ireland's Higher Education Authority under the National Development Plan PRTLI III Programme (development funds).
- Environment and Heritage Service, Northern Ireland (Northern Ireland data and partnership);
- CMRC.

Atlas Design and Usability

Focus:
- Textual content;
- √ Map content;

Design:
- √ Clear navigation and instruction;
- √ Involved user feedback;
- √ Access text from maps/maps from text;
- √ Single/Multiple point(s) of access to map/data;
- Guided navigation;

Map Page:
- √ View limited/unlimited layers;
- √ View data independently/by theme;
- √ Combined/Separate legend & layer lists;
- √ Links to internal/external pages;

Documentation:
- √ Thematic text;
- √ Metadata:
  - Database/Flat files;
  - Single/Multiple format(s);
- √ Illustrations, images and charts;
- √ Help page(s);
- √ Tutorial;

Standards:
- √ Metadata standards: ISO 19xxx;
- OGC;

Other:
- Three tiers of metadata.

Technology Used

Mapping Software:
- √ Open Source;
- Proprietary:

Data Storage:
- √ Locally: Flat files;
- Distributed Network;

Database Management System:
- √ Yes/No: PostgreSQL;

Server Operating System:
- Red Hat Linux Apache Web Server;

Other:
- Apache Web Server;
- ArcGIS 9 used for data processing.

Functionality/Tools Available

Level:
- √ Basic;
- Moderate;
- Advanced;

Search Capability:
- √ Search for data;
- Search for attributes;
- Search for thematic information;

Mapping Tools:
- √ Zoom, recentre and full extent;
- √ Identify features;
- √ Layer list control;
- View by theme;
- Print/Export maps;
- Query attributes;
- Measure line and areas;
- √ Download geospatial data;

Other:
- Advanced metadata search;
- **MIDA InfoPort**: a comprehensive guide to information on coastal and marine themes and issues;
- PDF/Printable maps not possible due to data licensing issues.

DATA/CARTOGRAPHIC INFORMATION INCLUDED

Geographic Area: Republic of Ireland and Northern Ireland (UK)
Number of Datasets: >120
Topics:

√ Physical Environment;
√ Coastal Habitats;
√ Imagery;
√ Biology;
√ Management;
√ Human Impact;
√ Conservation;
√ Environmental Monitoring;
√ Infrastructure;
√ Industry;
√ Culture & Heritage;
√ Natural Resources;
√ Fisheries, Aquaculture & Agriculture;
√ Tourism & Recreation;
Other:

DATA ISSUES

IPR/Cost:
√ Cost-prohibitive data (base/other);
√ Intellectual Property Rights (IPR);
√ Data use restrictions;

Accessibility:
√ Data sourcing and acquisition;
√ Poorly managed, inaccessible data;
√ Limited GIS-ready data;
Data duplication;
√ Distributed network not yet feasible;
√ Data retrieval speed;

Quality:
√ Variable/inconsistent data quality;
√ Inappropriate data scales;
√ Incomparable regional datasets;
√ Poor/non-existent metadata;

Management:
√ Data management plan development;
√ Balance of development and updates;
√ Regularity of data updates;
√ Manual upload of data to atlas;
√ Resources to source/acquire data;

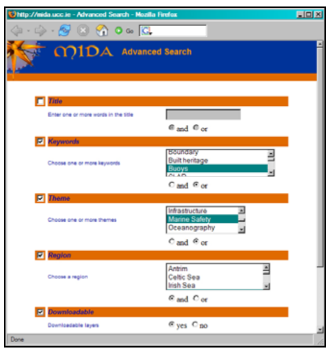
Other:
- Time required to source and acquire data;
- Lack of data catalogues;
- Memorandum of Understanding is agreed with each data contributor.

OTHER CHALLENGES

√ Funding for site maintenance;
√ Designing simple, intuitive and informative web interface;
√ Content balance of science and information;
√ Product promotion;
√ Design of efficient DBMS for content management;

Other:
- Designing the atlas interface to provide access to everything in a single window;
- Developing a flexible data model.

IMAGES



3.4. The Oregon Coastal Atlas

Dawn Wright
Department of Geosciences
104 Wilkinson Hall
Oregon State University
Corvallis, Oregon, USA
Email: dawn@dusk.geo.orst.edu
Web: http://dusk.geo.orst.edu/djl/

Tanya Haddad
Oregon Coastal Management Program
800 NE Oregon St. #18, Suite 1145
Portland, OR 97232, USA
Email: Tanya.Haddad@state.or.us
Tel: +1-971-673-0910
Web: http://www.oregon.gov/LCD/OCMP/

http://www.coastalatlas.net

Atlas Purpose

- Serve as a **coastal manager's web depot** for digital and traditional information, using:
  – **Interactive mapping**;
  – **Direct search & download** access to natural resource datasets;
  – Geo-spatial **analysis tools**;
- Present background information on different **coastal systems** (estuaries, sandy shores, rocky shores, ocean areas);
- Provide **decision-making resource** and streamline decision-making relating to the Oregon Coastal Zone.

Distinguishing Features

- Integrates data from a **distributed network**;
- Uses **both proprietary** and **Open Source** web mapping software;
- Provides **advanced interactive tools**;
- Designed for **coastal managers**.

Target Audience

General Public;
Tourists;
Students;
√ Researchers/Scientists;
√ NGOs;
√ Government/Public Bodies;
Commercial/Industry;
√ Consultancies;
√ Coastal/Environmental Managers;
√ Decision Makers;
√ Other:
• Includes public outreach sections.

Atlas Support (Financial/Institutional)

Partners:
- Oregon State University;
- Oregon Ocean-Coastal Management Program;
- Ecotrust;

Funders:
- NOAA;
- U.S. Geological Service/Federal Geospatial Data Centre (FGDC);
- National Science Foundation.

ATLAS DESIGN AND USABILITY

Focus:
- Textual content;
- √ Map content;

Design:
- √ Clear navigation and instruction;
- √ Involved user feedback;
- √ Access text from maps/maps from text;
- √ Single/Multiple point(s) of access to map/data;
- Guided navigation;

Map Page:
- √ View limited/unlimited layers;
- √ View data independently/by theme;
- √ Combined/Separate legend & layer lists;
- √ Links to internal/external pages;

Documentation:
- √ Thematic text;
- √ Metadata:
  - Database/Flat files;
  - Single/Multiple format(s);
- √ Illustrations, images and charts;
- √ Help page(s);
- √ Tutorial;

Standards:
- √ Metadata standards: FGDC;
- OGC;

Other:
- Glossary.

TECHNOLOGY USED

Mapping Software:
- √ Open Source: Minnesota MapServer;
- √ Proprietary: ArcIMS;

Data Storage:
- √ Locally: Flat files;
- √ Distributed Network;

Database Management System:
- √ Yes/No;

Server Operating System:
- Red Hat Linux, Windows 2000 SP3;

Other:
- 3 distributed servers managed by partners;
- M IIS 5.0, Apache Web Server 2.0;
- FGDC Isite Server.

FUNCTIONALITY/TOOLS AVAILABLE

Level:
- √ Basic;
- √ Moderate;
- Advanced;

Search Capability:
- √ Search for data;
- Search for attributes;
- √ Search for thematic information;

Mapping Tools:
- √ Zoom, recentre and full extent;
- √ Identify features;
- √ Layer list control;
- View by theme;
- √ Print/Export maps;
- Query attributes;
- Measure line and areas;
- √ Download geospatial data;

Other:
- Advanced metadata search;
- Learning section (coastal geographic settings, coastal topics, Atlas related technologies);
- "Make your own map";
- Coastal Access Tool;
- Direct technical assistance;
- Geospatial tools, including:
  - Hazards Management: Mitigate the Losses;
  - Watershed Assessment: Identify Potential Actions;
  - Protecting Ocean Areas: Visualize the Benefits;
- Advanced tools can be downloaded.

DATA/CARTOGRAPHIC INFORMATION INCLUDED

Geographic Area: Oregon Coastal Zone
Number of Datasets: >3300
Topics:

√ Physical Environment;
√ Coastal Habitats;
√ Imagery;
√ Biology;
√ Management;
√ Human Impact;
√ Conservation;
√ Environmental Monitoring;
√ Infrastructure;
Industry;
Culture & Heritage;
√ Natural Resources;
√ Fisheries, Aquaculture & Agriculture;
√ Tourism & Recreation;
Other:

DATA ISSUES

IPR/Cost:
√ Cost-prohibitive data (base/other);
√ Intellectual Property Rights (IPR);
Data use restrictions;

Accessibility:
Data sourcing and acquisition;
√ Poorly managed, inaccessible data;
Limited GIS-ready data;
Data duplication;
Distributed network not yet feasible;
Data retrieval speed;

Quality:
√ Variable/inconsistent data quality;
Inappropriate data scales;
Incomparable regional datasets;
Poor/non-existent metadata;

Management:
√ Data management plan development;
√ Balance of development and updates;
√ Regularity of data updates;
√ Manual upload of data to atlas;
√ Resources to source/acquire data;

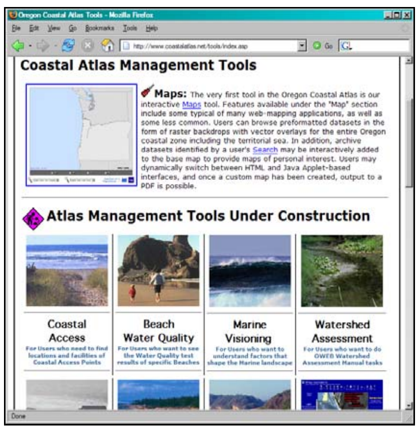
Other:

OTHER CHALLENGES

√ Funding for site maintenance;
√ Designing simple, intuitive and informative web interface;
√ Content balance of science and information;
√ Product promotion;
√ Design of efficient DBMS for content management;

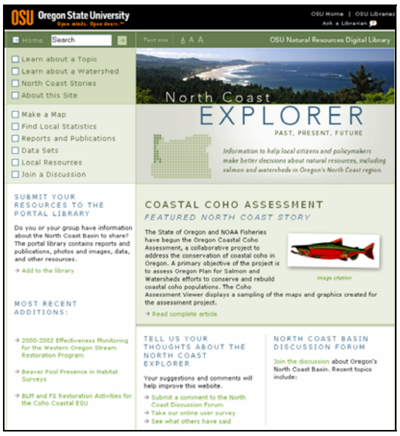
Other:
• Designing new tools for management needs;
• Developing improved searching.

IMAGES



3.5. North Coast Explorer, Oregon

Contact:
Renee Davis-Born and **Kuuipo Walsh**
Institute for Natural Resources,
Oregon State University
210 Strand Hall,
Corvallis, Oregon 97331, USA
Email: renee.davis-born@oregonstate.edu; kuuipo.walsh@oregonstate.edu
Web: http://inr.oregonstate.edu



http://www.northcoastexplorer.info

Atlas Purpose

- Provide information about Oregon **coastal watersheds** and the **species** inhabiting them;
- To **facilitate access to data and information** from a wide variety of sources **to citizens and decision-makers** actively involved in natural resource use, policy and planning;
- Provide a resource that **meets user information needs**, including:
  - Regional trends and current status of salmonids and other **native fish species**;
  - Regional trends and current status of **land use and stream habitats**;
  - Human caused **barriers to fish passage** and locations of currently **inaccessible habitat**;
  - Areas of greatest **intrinsic potential** for production of salmonids.

Distinguishing Features

- **Thematic atlas** targeting a specific audience;
- User controlled interface provides several **levels of functionality** and **multiple map and font sizes**;
- **Advanced searching** of all site content;
- Targets user needs: **data, tools and expertise**.

Target Audience

	General Public;		Commercial/Industry;
	Tourists;	√	Consultancies;
	Students;	√	Coastal/Environmental Managers;
√	Researchers/Scientists;	√	Decision Makers;
√	NGOs;		Other:
√	Government/Public Bodies;		•

Atlas Support (Financial/Institutional)

Partners:
- Institute for Natural Resources;
- Oregon State University Libraries;

Technical Support:
- InfoGraphics Lab, University of Oregon;
- Oregon Department of Fish and Wildlife;

Funders:
- Oregon Watershed Enhancement Board.

Atlas Design and Usability

Focus:
√ Textual content;
√ Map content;

Design:
√ Clear navigation and instruction;
√ Involved user feedback;
√ Access text from maps/maps from text;
√ Single/Multiple point(s) of access to map/data;
√ Guided navigation;

Map Page:
√ View limited/unlimited layers;
√ View data independently/by theme;
√ Combined/Separate legend & layer lists;
√ Links to internal/external pages;

Documentation:
√ Thematic text;
√ Metadata:
- Database/Flat files;
- Single/Multiple format(s);

√ Illustrations, images and charts;
√ Help page(s);
√ Tutorial;

Standards:
√ Metadata standards: FGDC;
OGC

Other:
- Glossary;
- User controlled interface;
- Multi-media stories to inform users.

Technology Used

Mapping Software:
Open Source:
√ Proprietary: ArcIMS;

Data Storage:
√ Locally: Database;
Distributed Network;

Database Management System:
√ Yes/No: ASP.Net;

Other:
- Moxi Media Internet Mapping Framework front end (Java Server Page-based);
- Used Open Archives Initiative Protocol for Metadata Harvesting.

Functionality/Tools Available

Level:
√ Basic;
√ Moderate;
√ Advanced;

Search Capability:
√ Search for data;
Search for attributes;
√ Search for thematic information;

Mapping Tools:
√ Zoom, recentre and full extent;
√ Identify features;
√ Layer list control;
√ View by theme;
√ Print/Export maps;
Query attributes;
Measure line and areas;
√ Download geospatial data;

Other:
- Advanced search tool;
- Mapping tools:
  - Pre-made maps;
  - Mapping Tool Wizard for novice users;
  - Advanced Mapping Tool for those familiar with GIS mapping;
- Special tools for:
  - Interactive statistical report generation to create custom tables and graphs;
  - Submission to the Explorer Digital Library via ScholarsArchive@OSU;
  - Discussion Forum (used very little);
  - Administration.

DATA/CARTOGRAPHIC INFORMATION INCLUDED

Geographic Area: North Coast Basin, Oregon
Number of Datasets: 43
Topics:

√ Physical Environment;
√ Coastal Habitats;
Imagery;
√ Biology;
√ Management;
√ Human Impact;
Conservation;
√ Environmental Monitoring;

√ Infrastructure;
Industry;
Culture & Heritage;
√ Natural Resources;
Fisheries, Aquaculture & Agriculture;
Tourism & Recreation;
Other:
- Intrinsic potential;
- Fish passage barriers.

DATA ISSUES

IPR/Cost:
Cost-prohibitive data (base/other);
Intellectual Property Rights (IPR);
√ Data use restrictions;

Accessibility:
Data sourcing and acquisition;
√ Poorly managed, inaccessible data;
√ Limited GIS-ready data;
√ Data duplication;
√ Distributed network not yet feasible;
√ Data retrieval speed;

Quality:
√ Variable/inconsistent data quality;
√ Inappropriate data scales;
√ Incomparable regional datasets;
Poor/non-existent metadata;

Management:
√ Data management plan development;
Balance of development and updates;
√ Regularity of data updates;
√ Manual upload of data to atlas;
Resources to source/acquire data;

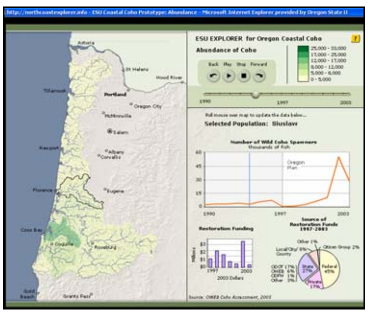
Other:
- Using Open Archives Harvesting.

OTHER CHALLENGES

√ Funding for site maintenance;
√ Designing simple, intuitive and informative web interface;
√ Content balance of science and information;
√ Product promotion;
√ Design of efficient DBMS for content management;

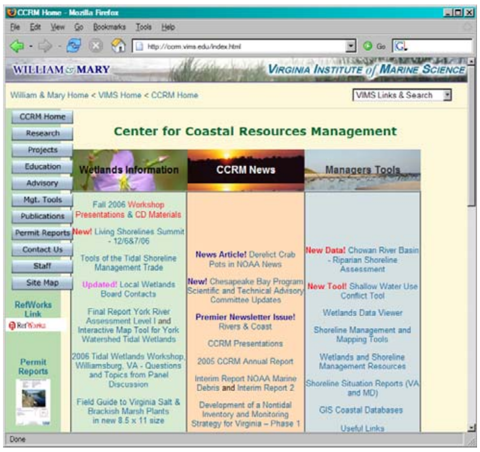
Other:
- Designing a product which combines power with ease of use.

IMAGES



3.6. Mapping Tools for Coastal Management, Virginia

Contact:
Marcia Berman
Center for Coastal Resources Management
Virginia Institute of Marine Science
College of William and Mary
Gloucester Point, Virginia, USA
Email: Marcia@vims.edu
Web: http://ccrm.vims.edu



http://ccrm.vims.edu

Atlas Purpose

- Report status in **trends in coastal resources**;
- **Make data available** to the management community;
- Provide resources to **enhance coastal management**;
- **Build awareness** of the general public.

Distinguishing Features

- **Several different web GISs** rather than one atlas;
- Different web sites are **tailored to specific needs**.

Target Audience

√ General Public;
Tourists;
Students;
√ Researchers/Scientists;
√ NGOs;
√ Government/Public Bodies;
Commercial/Industry;
√ Consultancies;
√ Coastal/Environmental Managers;
√ Decision Makers;
Other:

Atlas Support (Financial/Institutional)

Partners and Funders:

- State agencies:
  - Dept. of Environmental Quality;
  - Dept. of Health;
  - Marine Resources Commission;
- Federal agencies:
  - NOAA;
  - U.S. Environmental Protection Agency;
- In-house contributions.

ATLAS DESIGN AND USABILITY

Focus:
Textual content;
√ Map content;
Design:
Clear navigation and instruction;
Involved user feedback;
Access text from maps/maps from text;
√ Single/Multiple point(s) of access to map/data;
Guided navigation;
Map Page:
√ View limited/unlimited layers;
√ View data independently/by theme;
√ Combined/Separate legend & layer lists;
Links to internal/external pages;

Documentation:
Thematic text;
√ Metadata:
- Database/Flat files;
- Single/Multiple format(s);
Illustrations, images and charts;
√ Help page(s);
√ Tutorial;
Standards:
√ Metadata standards: FGDC;
OGC
Other:

TECHNOLOGY USED

Mapping Software:
Open Source
√ Proprietary: ESRI ArcIMS
Data Storage:
√ Locally: Sybase 12.5;
Distributed Network;

Database Management System:
Yes/No;
Other:
- Apache Web Server.

FUNCTIONALITY/TOOLS AVAILABLE

Level:
Basic;
√ Moderate;
Advanced;
Search Capability:
Search for data;
Search for attributes;
Search for thematic information;

Mapping Tools:
√ Zoom, recentre and full extent;
√ Identify features;
Layer list control;
View by theme;
√ Print/Export maps;
Query attributes;
√ Measure line and areas;
√ Download geospatial data;

Other:
- Coastal Management Tools:
  - Shoreline Manager's Assessment Kit (SMAK);
  - Oil Spill Cleanup And Response (OSCAR);
  - Blue Infrastructure (BI);
  - Wetlands Mitigation Targeting Tool;
  - Wetlands Data Viewer;
  - Chesapeake Bay Shoreline Inventory.

DATA/CARTOGRAPHIC INFORMATION INCLUDED

Geographic Area: Virginia
Number of Datasets: varies by site
Topics:

√ Physical Environment;
√ Coastal Habitats;
√ Imagery;
Biology;
√ Management;
√ Human Impact;
√ Conservation;
√ Environmental Monitoring;
√ Infrastructure;
√ Industry;
√ Culture & Heritage;
√ Natural Resources;
√ Fisheries, Aquaculture & Agriculture;
Tourism & Recreation;
Other:

DATA ISSUES

IPR/Cost:
√ Cost-prohibitive data (base/other);
Intellectual Property Rights (IPR);
√ Data use restrictions;

Accessibility:
Data sourcing and acquisition;
Poorly managed, inaccessible data;
√ Limited GIS-ready data;
√ Data duplication;
√ Distributed network not yet feasible;
Data retrieval speed;

Quality:
√ Variable/inconsistent data quality;
√ Inappropriate data scales;
√ Incomparable regional datasets;
√ Poor/non-existent metadata;

Management:
√ Data management plan development;
√ Balance of development and updates;
√ Regularity of data updates;
√ Manual upload of data to atlas;
Resources to source/acquire data;

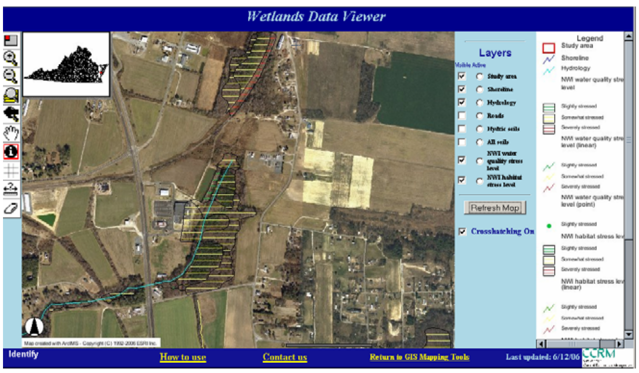
Other:
- Poor data overlays.

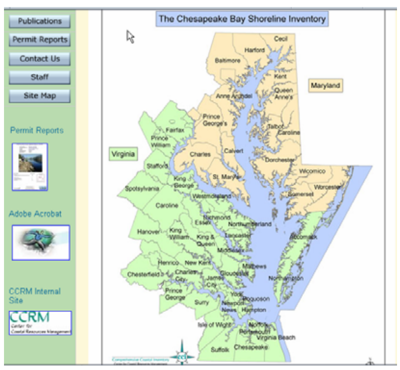
OTHER CHALLENGES

√ Funding for site maintenance;
√ Designing simple, intuitive and informative web interface;
√ Content balance of science and information;
√ Product promotion;
Design of efficient DBMS for content management;

Other:
- Limited funding/support for necessary data acquisition development (e.g., shoreline change/erosion, wetlands updates).

IMAGES





4. Strengths, Weaknesses, Opportunities and Threats Analysis

During the workshop, four working groups were established to identify issues related to atlas **design**, **data**, **technology** and **institutional capacity**. Each working group focussed its discussion by carrying out a Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis (Weihrich 1982). The results are presented below.

4.1. SWOT Analysis

The following tables provide the top five strengths, weaknesses, opportunities and threats for each theme which resulted from the discussions.

4.1.1. Atlas Design

ATLAS DESIGN	
STRENGTHS	**WEAKNESSES**
- **Intuitive structure** of web sites and map pages; - Inclusion of **contextual information** in order to better understand the data; - **Hierarchical** data organisation; - **Multiple user pathways** to retrieve maps and layers of interest; - **Tools** for data analysis and creating reports.	- The **cartography / design** challenge of displaying many layers; - **Inadequate database management system** (DBMS) for efficient management of information, metadata and data; - Inadequate **search functions** for data and content; - Failure to meet user needs where atlas developments are **technology-driven**; - **Lack of distributed systems** to enable data owners to share and manage their own data.
THREATS	**OPPORTUNITIES**
- **Funding** limitations (e.g., focus on technology rather than maintenance; staff turnover); - Keeping up with **design expectations** of users (e.g., Google Earth); - **User interpretation**: misunderstanding of how to use atlases or their components; - **Data policies, cost and IPR** issues impact atlas design in data quality and accessibility, and thus atlas functionality (e.g., spatial analysis using large scale data).	- **Open Source** technology; - **Enhanced DBMSs** to accompany Open Source web mapping technology to efficiently manage data, metadata and CWA content; - Improved **cartographic display** of large quantities of layers in coastal atlases; - Potential for sharing data through **distributed networks** (e.g., utilising Web Map Services and Web Feature Services); - Potential to develop **regional nodes** that tie in with larger atlases (e.g., national or statewide).

4.1.2. Atlas Technology

ATLAS TECHNOLOGY	
STRENGTHS	**WEAKNESSES**
- **Improving technology** for publishing maps on the web: choice between Open Source (OS) and commercial-off-the-shelf (COTS) products; - Maturing **standards and specifications** (e.g., OGC specifications, ISO metadata & W3C standards); - Progress in **network capacity & hardware** (e.g., processor speeds, storage capacity, monitor resolutions); - Contribution of **other technologies and tools** (e.g., XML, UML, content management systems) to web mapping development; - Advantages of **OS tools** (e.g., broad community support, access to source code, low cost; Lack of COTS levels of technical support is possible disadvantage).	- **Software support issues**: COTS software may offer more readily available commercial support, although OS software does not preclude this; - **Large datasets** can require significant disk space and are not always supported by web GIS software (e.g., raster data); - **Hardware becoming obsolete** (e.g., media obsolescence; backup software cannot deal with physical media; compatible drives no longer available); - **Inadequate metadata** may limit functionality (e.g., be incomplete, out of date and not match the data object; digital object identifiers (DOI) could be used to link data to metadata); - Web GIS is presently poor at dealing with **time series** and **3D/4D data**.
THREATS	**OPPORTUNITIES**
- Difficulty in coping with **high server loading** during peak use; - **Technology evolution** can be disruptive: need to balance the exploration of new technologies against maintaining a stable and functioning system; - The challenge of **keeping data current**; - **Lack of funding** and consequent personnel turnover; - **Partners who are weak** or unwilling to co-operate.	- **3D and 4D web GIS** riding on increased hardware and network capacity; - Simulation and **online spatial analysis**. - **Data mining**; - Widespread use of **geo-tagging** (e.g., geoRSS) to facilitate incorporation of many more items in web mapping systems; **Recommender systems** to supplement search queries; - Increased interest in CWA by policy makers and regulators as SDI initiatives become established leads to **funding potential** (e.g., EU Marine Green Paper).

4.1.3. Atlas-Related Data and Metadata

ATLAS-RELATED DATA AND METADATA	
STRENGTHS	**WEAKNESSES**
- **Growing awareness** and acceptance of standards;	- **Limited quantitative and analytic utility**: tools can sometimes produce

- **Regulation** is driving the need for data; - Provides **publicity** for data products; - **Reduced labour costs** for routine searches; - **Widely accessible** to a broad range of users.	suspect/alarming results; - **Data patchiness**; - Assessment of **data quality** is difficult on map presentations, original purpose and fitness for use can be hidden: 'pretty map syndrome'; - **Inadequate metadata**; - Existence of **multiple portals** to same data.
THREATS	**OPPORTUNITIES**
- **New competitive technologies** for improved data access (e.g., Google Earth); - **Intellectual property restrictions** limit data re-distribution; - Data viewed as **source of income**; - **Erratic funding** affects ability to develop and maintain atlas data as well as causes loss of skilled staff; - **Lack of incentives** for data providers.	- Focus on the delivery of **source data** and **value-added products**, not only interactive maps; - **Identification of data gaps** and need for data collection requirements; - **Community-building** and **harmonization** among atlas providers (e.g., ontologies); - Become the **definitive reference** for certain data, if it contains current, good quality data; - Use **new, emerging technologies** for data and metadata presentation/delivery.

4.1.4. Atlas-Related Institutional Capacity

ATLAS-RELATED INSTITUTIONAL CAPACITY	
STRENGTHS	**WEAKNESSES**
- **Academic CWA host institutions** have the ability to leverage additional research and education funds; - **Government CWA host agencies** may have **mandate** for CWA development; - Opportunities for **collaboration** with other institutes; - The permanent nature of government agencies ensures long-term **institutional support**; - Data and information requirements for the **Coastal and Marine sector** stimulate demands for CWA development.	- Volatile and **short term nature of funding** and all associated impacts (e.g., staff turnover; difficult to maintain atlases); - Vulnerability to **political trends** and changes in priorities; - **Data access limitations**, licensing, and desire to recoup costs; - Limited experience in **marketing** and building awareness; - Tendency towards **project control** limits the formation of partnerships for data sharing.
THREATS	**OPPORTUNITIES**
- Changing **policy drivers**; - Perception of **'too many' databases** and mapping applications; - Credibility is affected by **poor quality data and metadata**, poor models and decision	- **Collaboration**: availability expertise and experience in CWA community; - Movement to E-GOV and **knowledge-based economy** (e.g., geospatial data can underpin many government activities);

support software; - Over or **poor marketing** means user expectations not met; - **Challenges of collaboration**: partner doesn't deliver up to specifications.	- Delivering on **government policy** (e.g., implement ICZM mandate); - **Economic development**: open data licenses could lead to new products; - **Leveraging data acquisition** (e.g., opportunities to pool resources to obtain more or better datasets).

4.2. Synthesis: Identification of Cross-Cutting Issues

Analysis of the various points which were raised by the four working groups led to the identification of a number of cross-cutting issues. These issues are presented below, coupled with examples provided by the workshop participants.

4.2.1. Strengths of Existing Coastal Web Atlases

1. **Standards and specifications are maturing and gaining wide acceptance, e.g.:**
    - The MIDA adopted a profile of the ISO 19115 metadata standard. This has facilitated the creation of a distributed metadata exchange network (ISDE) with other environmental data supply agencies in Ireland who also use the ISO standard.
    - The OCA and the NCE use the FGDC metadata standard, which is the widely accepted American standard. The NCE used the Open Archives Initiative Protocol for Metadata Harvesting to acquire metadata held in other data repositories.
2. **International and national regulations are driving the need for data and encouraging their availability, e.g.:**
    - National Spatial Data Infrastructures (SDIs) in different countries set out policies and rules regarding data delivery; directives, such as that on the re-use of Public Sector Information (PSI) in Europe (European Commission 2003), drive requirements for governments to make certain data available.
3. **Academic institutions and research organisations can take advantage of emerging technologies to design innovative products, e.g.:**
    - The NCE, developed at Oregon State University, is using ASP.NET technology to drive the database. They have also put a Moxi Media Internet Mapping Framework (IMF) front end on the ArcIMS web GIS.
4. **Development of web atlases can aid in collaboration between institutions and sharing of methods, e.g.:**
    - Developers of the MIDA and the OCA have shared ideas on design and technology issues and web GIS development.
    - The CAMRA is part of the UK's MAGIC atlas, which is developed and supported by a partnership of 12 national and regional agencies.

4.2.2. Weaknesses of Existing Coastal Web Atlases

1. **Metadata is often inadequate, inaccurate or out of date, e.g.:**
    - The MIDA developers found that many digital datasets were delivered by their owners with non-existent or poor metadata. To address this, data owners are consulted in order to provide a complete set of minimum "Discovery" metadata for each dataset displayed in the atlas.

2. **Data management is difficult due to the large quantities of data, difficult-to-support formats and their appearance on multiple portals, e.g.:**
   - Both the OCA and the NCE use databases for data management, yet new records have to be added by hand. Streamlining of data management procedures is required.
   - The CAMRA atlas team has identified multiple datasets for the same kind of information.
3. **Data licencing, access limitations and desire to recoup costs are restrictive, e.g.:**
   - Both the MIDA and the CAMRA have had to overcome licensing issues and related costs for base data, which restricts the detail of data that can be published in the atlases.
   - Even when base data is free to display online, as in the US, developers must deal with this issue pertaining to a variety of high quality, proprietary data.
4. **There are limitations in the ability to display certain data types and to perform data analysis, e.g.:**
   - Most of the atlases presented are strong on map visualization but offer a limited number of tools. Some, however, provide a range of interactive coastal mapping tools, such as the toolset developed by the Virginia Institute of Marine Science (VIMS).

4.2.3. Threats to Coastal Web Atlases

1. **The Google Earth paradigm challenges atlas developers to meet design expectations of users, e.g.:**
   - Most of the atlases presented use ArcIMS, University of Minnesota MapServer or similar web mapping technologies. De Kustatlas Online, on the other hand, although lacking the levels of interactivity of other atlases, has attempted to make its interactive maps “Google-friendly”.
2. **Data policies and IPR impair accessibility and re-use of data, e.g.:**
   - The MIDA and the CAMRA are restricted in their use of base data and also their ability to allow download of third party data created using copyright base data.
   - The NCE is addressing issues of access to copyright protected materials and sensitive data.
3. **Erratic funding affects the ability to develop and maintain atlases and leads to staff turnover issues, e.g.:**
   - After the initial development phase, the MIDA is being maintained by funds from within CMRC.
4. **Credibility: Atlases may not meet actual user needs and expectations; data quality may be poor; changing technologies may be disruptive, e.g.:**
   - The CAMRA has encountered problems with inconsistent data records, poor data documentation, multiple copies of data, etc.
   - The quality of base maps in the MIDA (1:50,000 geotiffs) is limited by cost/IPR issues, therefore providing an inadequate base for certain user groups.

4.2.4. Opportunities for Improving Coastal Web Atlases

3. **Community building and collaboration can leverage the expertise of atlas developers, e.g.:**
   - This series of workshops is a practical response to this opportunity.

  - Networking with other groups who are working to improve data and metadata quality and accessibility, such as the Marine Metadata Interoperability Project, provides valuable opportunities for knowledge building and collaboration.

4. **E-Gov and SDI initiatives are helping to increase interest in CWAs among policy makers and regulators, e.g.:**
   - In Europe the forthcoming INSPIRE directive (European Union 2007) and the development of a European Maritime Policy (European Commission 2006) will drive activity in the development of tools for presenting and analysing coastal information.
   - In the US, the Coastal Zone Management Act (US Congress 2000) and the Executive Order to establish a National Spatial Data Infrastructure (Clinton 1994) are drivers for finding innovative methods to improve coastal data accessibility.
5. **Atlases enable identification of data gaps and provide the ability to pull resources together to improve datasets and fill gaps, e.g.:**
   - By incorporating information from a wide range of bodies, the CAMRA and MIDA have helped in highlighting data gaps and in documenting the quality of existing datasets.
6. **Use emerging technologies, including Open Source and OGC standards, to enhance data sharing, presentation and online analysis, e.g.:**
   - The NCE has used the Open Archives Initiative Protocol for metadata harvesting from distributed systems.
   - MIDA has used Catalogue Services for the Web (CSW) to share metadata as part of the ISDE. However, there is a need to go beyond these initial steps and share the data themselves.

5. Considerations for Atlas Development

Designing a coastal web atlas requires consideration of many factors which must be well thought-out before and during development, such as atlas design and usability, technology, data content and meeting user needs. The considerations described below are an output of the Workshop and are based on the collective experience of the participants. These are relevant for decision makers and technicians interested in developing a CWA service.

In brief, the design and usability of an atlas are keys to its success. An atlas should clearly communicate its purpose, be visually appealing, be kept as simple as possible, use efficient technology and management systems and have a flexible design to enable growth and change over time. Ultimately its success relies on the atlas users, so efforts should be made regularly to ensure that it meets the needs of those users.

5.1. Getting Started

It is imperative to invest sufficient time at the beginning of an atlas project to identify clear goals and to identify how best to achieve those goals. Critical questions to address are:

What is the purpose of the atlas?
- E.g., educational resource or tool for coastal managers?

Who is the atlas audience?
- E.g., general public or professionals?

What are their skills?
- E.g., basic web experience or GIS expertise?

What spatial data will it contain?
- E.g., 20 static layers or 200+ changing layers and expanding list?

Are there opportunities for data sharing?
- E.g., sharing data via a distributed system, all data stored locally or a combination?

What functionality is necessary?
- E.g., simple identify feature tool or more complex spatial analysis?

What additional information will be included?
- E.g., searchable metadata, topical descriptions, images, charts?

Which software should be used?
- E.g., off the shelf or Open Source software?

What operating system should be used?
- E.g., Microsoft or Linux server?

What technical and data standards should be met?
- E.g., Open Geospatial Consortium, metadata standards?

What resources are available for development?
- E.g., programmer, GIS specialist or science writer?

How should the web site and navigation be organised?
- E.g., focus on the interactive map or the text topics?

How will the content be managed?
- E.g., manual updates or a database management system?

How should data be searched?
- E.g. search metadata by various parameters, searchable data attribute tables?

How will the atlas be backed up?
- E.g., manual or automatic backup system?

Is the design scalable and flexible?
- E.g., ability to handle more layers and changing technology?

What institutional / financial support is available?
- E.g., single/multiple development grants or committed institutional funding?

How will the atlas be sustained and updated in the long term?
- E.g., grants for new development or annual sponsorship?

5.2. Implementation

Below are a number of points to consider in the design and implementation of an atlas and its components.

5.2.1. Atlas Interface

KEEP IT SIMPLE.

- The complexity of the atlas design should take into consideration the **variety of browsers and network speeds** of atlas users;
- Examine other systems to get design ideas and determine preferable **features**;
- Consider if the interactive map or the textual content should be the **focal point** of the atlas;
- Aim to make the site as **simple** as possible;
- **Minimise scrolling and pop-up windows** by containing page contents to a standard monitor size;
- Consider user **navigation** of the site and develop a web site flow chart to illustrate how the users will interact with the atlas interface and components;
- Design the atlas to be **flexible** in order to accommodate changes over time (e.g., increase in data quantity and topics, additional functionality);
- Think about designing **multiple atlas interfaces** to address different audiences which accommodate different **skill levels**; advanced map tools may not be necessary for some users and may complicate the interface;
- Consider providing **multiple means of access** to information, maps and data. Different users may find different paths useful (e.g., search and display individual datasets, or select a theme from a list).

5.2.2. Map Area

- Consider the size of the map area and the possibility of offering a **range of sizes** to fit different monitors (Fig. 5.1);
- Think about the size and location of the **overview map** and **scale bar**, as well as the potential for the user to turn them off;
- Determine how best to deal with **copyright** information (e.g., display copyright statement and/or watermark; Fig. 2.2);
- Identify how **geographic coordinates** should be displayed.

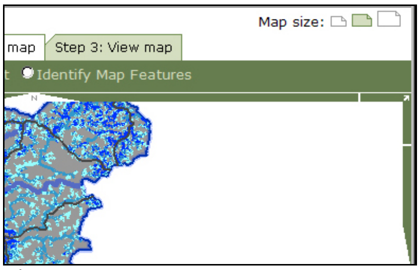


Fig. 5.1: *The North Coast Explorer provides users with a choice of map sizes to meet different monitor sizes of users.*

5.2.3. Data Content and Display

- Significant time should be invested in **determining what data** should be included;
- **Collecting and preparing data** is resource and time intensive;
- Some data owners may have **specific requirements** when displaying their data (e.g., symbology, restricted attributes, reduced resolution);
- Consider developing a **Memorandum of Understanding** for data suppliers to document agreed terms;
- **Cartographic issues** increase with the number of layers and may lead to misinterpretation or misrepresentation of data by the atlas user;

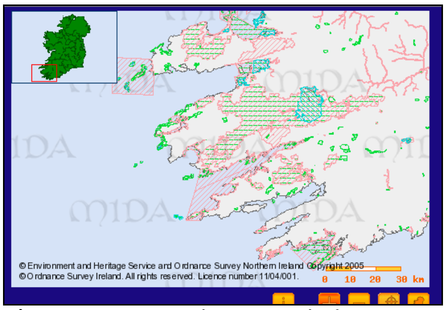


Fig. 5.2: *Cartographic example from MIDA, showing three protected area layers commonly displayed together, which often overlap. These polygons have semitransparent fill with lines aligned in different directions and are different colours as well.*

- When choosing **colours and fills**, consider what layers will most likely be viewed together to ensure clear interpretation by the user (Fig. 5.2);
- Always consider the **draw order** of the layers in order to avoid some layers hiding others which may be viewed together;
- Consider **limiting the number of layers** viewed at one time to minimise map overload;

AN ATLAS IS ONLY A SHELL IF IT CONTAINS INSUFFICIENT DATA.

- Awareness of the **different scales** of data displayed and their potential interpretation are important. Consider **setting scale factor limits** to reduce misinterpretation when layers of greatly different scales are viewed together;
- Consider **grouping layers by themes** to provide users with a quick alternative for viewing data.

5.2.4. Legend/Layer List

- It is worthwhile to **invest time examining different systems** to get ideas and determine legend/layer list features to use or avoid;
- Keep it as **simple** as possible;
- **Avoid** or minimise the use of **pop-up windows**;
- **Integrating the layer list and legend** can simplify the atlas by consolidating similar content; however also consider the option of having a **separate legend** for users wishing to print (Fig. 2.4);
- Enabling users to view **layers grouped by theme** provides quick access to data; however it is useful to also **include flexibility** that allows users to add/remove individual layers to the list;
- Consider including **links** from the layer list to supplemental information and/or metadata.

5.2.5. Atlas Tools

- Thought should be put into **what map tools are necessary** to meet the atlas purpose as well as users' skill levels.

- ➢ The **level of functionality** may influence the **software** chosen for the atlas (e.g., advanced mapping tools may be more easily supplied by a popular proprietary software);
- ➢ For more complicated tools, design them to use interactive forms to guide users through specific steps in the process (Fig. 5.3);
- ➢ A **flexible design** enables the addition of new functionality as needed;
- ➢ A **metadata search tool** which enables users to search for various qualities (e.g., title, keyword, date, area, etc.) is invaluable, particularly for professionals seeking data;
- ➢ If implementing a searchable metadata database, consider what **search elements** would be the most useful to users (e.g., name, keyword, theme, date, region, downloadable, etc.);
- ➢ Consider including **printing options** (e.g., printable page or PDF creator tool), however be careful of **data provider restrictions**;
- ➢ Where possible provide access to **downloadable geospatial data**, either from the data provider or the atlas itself.

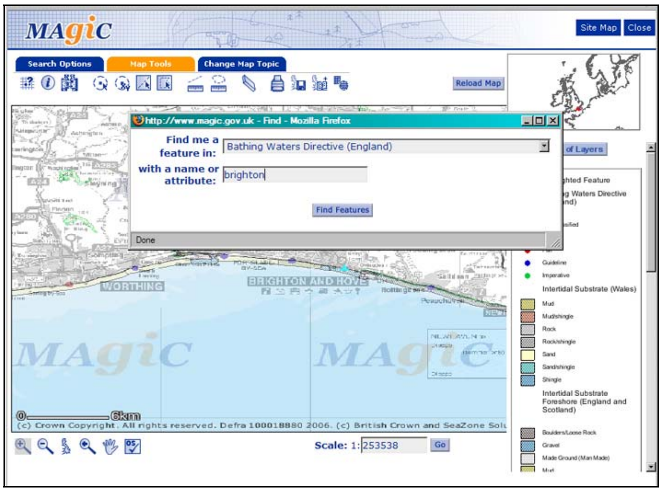


Fig. 5.3: *The UK Coastal and Marine Resource Atlas walks users through steps to query certain data attributes within specified datasets.*

5.2.6. Attribute Tables

- ➢ Add value to the atlas by making information held in the **attribute tables** available to the user.
- ➢ Consider **where to display** attribute tables (e.g., within the atlas interface or in a pop-up window);
- ➢ For each layer, consider **which fields** to make available to users (e.g., display full table or select most interesting or relevant fields);
- ➢ **Avoid** displaying **abbreviated or coded field names or attributes**.
- ➢ Consider translating abbreviations or providing links to other sources for descriptions to further explain table content and be informative to users (e.g., metadata, data dictionary);
- ➢ Consider displaying a **selected feature map** next to the table;
- ➢ Consider **labeling map features** of certain layers (e.g., counties, towns, etc);
- ➢ When a user selects a point in the map, determine if the selected features should be **returned for one or all layers** at that location.

5.2.7. Metadata

- Metadata is crucial to **data management** when bringing together data from a variety of sources;
- Metadata is **not always available** for geospatial data and it may require extra work, including discussion with data owners, to collect a minimum level of metadata for each dataset;
- Select a **metadata standard** (e.g., ISO, FGDC) that is/will soon be widely accepted;
- Be informed of current developments in **coastal and marine ontologies**, and implement them where possible.
- Develop a subset of **core metadata elements** which meet that standard and provide a minimum level to meet atlas needs (which is simpler than adopting full metadata);
- Providing access to **tiered levels of metadata** should be considered (e.g., Abstract, Discovery & Full; Fig. 2.7), in order to enable access for different levels of users;
- Consider storing metadata in a **database** in a format which allows for the potential to share the metadata with other servers. The metadata is then **easily searchable** and can be **displayed dynamically** in a template;
-
- Metadata should be **easily accessible** from the main atlas page when data is viewed;

METADATA IS CRUCIAL FOR DATA MANAGEMENT AND DATA SHARING.

5.2.8. Information/Extras

- Consider the **atlas audience** and their **information needs** when determining what textual information to include in the atlas (e.g. students looking for general information, professionals seeking downloadable data and links to key documents);
- Find ways to provide **easy and clear access to information** related to data layers (e.g., metadata, data downloads, and descriptive info);
- Using a **tab design** gives flexibility, enabling more functionality in the main atlas window (Fig. 5.4);
- **Provide links** between the interactive map and the text pages.

Fig. 5.4: *The use of tabs in the main map page of the MIDA, as seen in this example, provides easy access to information as well as additional functionality in a flexible and extendable way.*

5.2.9. Technology

- Resources should be invested to implement stable, reliable **hardware and backup systems**;
- A **cost-benefit analysis** should be performed that takes into consideration the cost of **web mapping and database software** (both proprietary and Open Source) as well as the programming and maintenance **resources** which are required;

- When choosing software, consider the various **built-in functionality** and what **customisation** will be necessary in the development;
- Be informed of developments related to the **Open Geospatial Consortium** and consider designing a system that meets their standards;
- Consider the **network speed** of the target user group and the host when designing the system;
- **Test the atlas** on different browsers and different platforms to minimize errors;
- Invest time in the development of a customised scalable **database management system** to efficiently manage atlas content (e.g., data layers, metadata, information), which will help to **save time** required to add and update data and information;
- Design the system to be **sustainable** and able to handle changing technology;
- Design the system to be **scalable** so that it can grow beyond current expectations.

5.2.10. User Feedback

- Acquiring regular **user feedback** is crucial for success;
- Feedback on a **demonstration atlas** midway through development can ensure the atlas design and data content is on the right track;
- **Implementing user suggestions** will ensure your atlas meets user needs, as well as help to provide focus for the next development steps;
- **Target different user groups**, including key data providers;
- Consider:
  - **Hands-on workshops** – personal discussion combined with surveys;
  - **Surveying** across user groups;
  - **Online feedback** (Fig. 5.5).

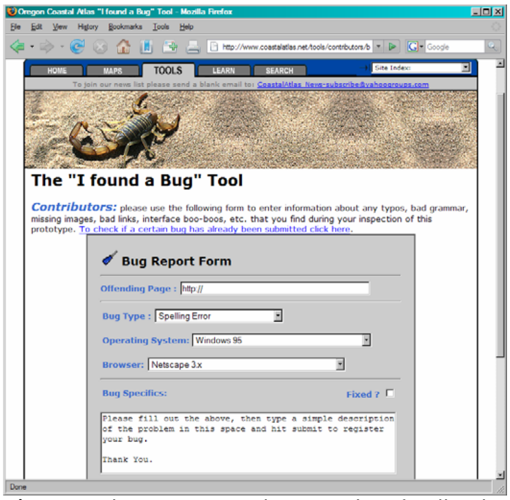


Fig. 5.5: *The OCA provides an online feedback form, entitled 'The"I Found a Bug" Tool.'*

5.2.11. Support and Future Development

The success of an atlas is not limited to the design of the system and its components. Other factors must also be taken into consideration to ensure atlas success:

- Be open to **collaboration**, for example, in sharing data via distributed systems or in sharing technology and ideas with other developers;
- **Funding** for atlas design, data and maintenance is a vital part of atlas success;
- Look beyond funding for initial atlas development and seek funding for **site maintenance and atlas extension**.
- **Disseminate and promote** the CWA through various resources to bring in new users and to remind past users that the atlas is up to date.

ALWAYS KEEP USERS IN MIND!

ADVANCED TECHNOLOGY DOES NOT NECESSARILY MEAN ATLAS SUCCESS.

HAPPY USERS DO.

6. Conclusions & Recommendations

1. **CWAs provide a range of data related services.** As a "one-stop shop" they give broad access to data from a wide variety of sources. Users save time which is usually necessary to source and acquire relevant data. The data and information CWAs contain educate and inform users about coastal topics. Users are empowered by the interactive nature of CWAs, which provide easy tools and resources that assist in finding answers.

   RECOMMENDATION**:** Methods for **providing additional CWA services** should continually be explored to better meet user needs, as web-based technologies continue to improve and data becomes more widely available. Consultation with the **user community** is important to ensure development maximizes added value.

2. **Workshop outcomes demonstrate that CWA developments in the United States and Europe are using similar technologies and standards.** The aims of developers on both sides of the Atlantic are similar, including exploring proprietary and Open Source software; international standards for data, metadata and technology; and looking towards a future of distributed networks to reduce data duplication.

   RECOMMENDATION**:** **Collaboration** among American and European researchers should be actively supported in order to **share knowledge and experience** to advance CWA design and implementation worldwide.

3. **New legislation and policies are driving the production of quality coastal datasets and improved data availability.** High quality spatial data underpins much of the policy implementation required by government. For example, LIDAR elevation data in coastal areas can be used to help identify coastal erosion and flooding risk. Freedom of Information legislation and coastal and marine policy for the European Union and the US are requiring government organisations to improve the visibility and accessibility of public sector information. CWAs are an effective way to help in the implementation of such legislation.

   RECOMMENDATION**:** **The CWA community must provide input to policy development** to help raise awareness of issues of relevance to coastal GIS communities, including the importance of data accessibility. Methods for **effective outreach to decision makers** must be improved in order to gain support from high levels.

4. **Data cost, licensing and intellectual property considerations can limit data availability in an atlas**. This is a universal challenge which varies by degree in each country. In certain countries (e.g., Ireland, United Kingdom) key base datasets reside with public bodies who must balance their commercial need for profit with their public duty to provide data. In such instances, licensing costs can limit the quantity or quality of base data provided in the atlas. Cost and IPR restrictions for research and commercial data must also be negotiated, which can be time intensive. In the US, government policy on Freedom of Information has been a driver for the development of data standards and data cataloguing by government agencies. The low cost and accessibility of data enables resources to be more wisely invested in research and development instead of limiting use to those who can afford the data.

   RECOMMENDATION**:** CWA developers and data managers should **inform policy makers of limitations** that **data cost, licensing and IPR issues** impose on CWA developers.

Policy makers concerned with **access to geospatial data** must be made aware of data needs and provide guidance on how to overcome data access obstacles. The CWA community needs to develop a collective approach on how best to address these issues.

5. **Much data is still inaccessible or of variable quality.** Organisations on both sides of the Atlantic are working to catalogue their geospatial data. Due to longstanding government policy, the US has developed a significant number of data catalogues. Europe is quickly catching up. Significant resources are required to catalogue historic data. Further resources are needed to ensure the quality of newly collected data and metadata.

   ***RECOMMENDATION*:** Data owners should be encouraged to **devote resources to properly cataloguing their data** and to improving data quality to enable future data sharing. Efforts should be made to inform them and encourage uptake of the **latest data documentation protocols.**

6. **Consolidation of international standards and specifications is making atlas development easier.** Open Source and Open Geospatial Consortium standards facilitate re-use of code and enhance data sharing, presentation and the development of advanced tools. Web Map Service (WMS) and Web Feature Service (WFS) protocols allow interoperability between distributed data servers. The ISO 19115/19139 metadata standards are now being adopted worldwide and will enhance exchange between geographic metadata catalogues. The FGDC standard in the US has been in place for a number of years and has proven to be useful in collaborative efforts, such as with the Oregon Coastal Atlas. National metadata standards, such as the FGDC, are now being aligned with the ISO standard. World Wide Web Consortium (W3C) standards facilitate development of GIS client interfaces.

   ***RECOMMENDATION*:** CWA **developers must be aware of the latest information** on the various **standards and specifications** and strive towards their implementation in their products. **Data providers should be encouraged to implement these standards** and be informed of the benefits that they can bring to their organisations.

7. **CWAs are using cutting edge technology to develop effective web resources.** A variety of technologies are being used to meet the demands of complex system design to produce atlases that provide access to a wide variety of content (e.g., geospatial data and metadata, text, documents, imagery). A number of software are being used in combination for data preparation, web mapping, database management and web services to find the most effective and efficient methods for CWA development. Both proprietary and Open Source software are being used. Many systems are moving towards becoming OGC compliant and implementing distributed networks.

   ***RECOMMENDATION*:** CWA developers should **keep informed of emerging technologies** and look for opportunities to implement them. Developers should find a **balance between improving technology and maintaining and updating existing systems**.

8. **Database management systems (DBMSs) are crucial for efficient content management.** Some existing CWAs use DBMSs to varying degrees to keep track of metadata, data and associated information. As spatial data volumes increase, their management and delivery become more difficult. CWAs can require a significant amount of time to manually add and update content. Users require fast response times, so it is imperative that CWA developments can keep pace with such requirements. Network capacity may need to be addressed in innovative ways. Digital Object Identifiers (DOI) may be of use in linking data to metadata.

Recommendation**: Efficient, flexible and easy to use spatial data management systems** need to be put in place for improved content management.

9. **A common ontology for coastal and marine data is necessary to enable exchange and integration of data.** Terminology used to describe similar data can vary between specialties or regions, which can complicate data searches and data integration.

   Recommendation**:** Those involved with CWAs and coastal and marine data should **be informed about coastal and marine ontology developments**. Opportunities to input into their development will contribute to ontology success. CWA developers should implement ontologies to enhance future efforts to **improve data discovery, sharing and integration**.

10. **The recent emergence of Google Earth and other virtual globes have revolutionised public expectations with respect to geospatial data visualisation**. The strong visual element and the ease of use of such viewers is setting a de-facto standard with respect to spatial data presentation.

    Recommendation**:** The CWA community needs to **evaluate the impact** of such viewers on their own initiatives and determine if there is the **potential to work with or incorporate elements** of virtual globes in next version CWAs.

11. **Existing CWAs offer limited functionality for analysis and value added outputs.** Many first generation CWAs offer visualization and simple interrogation of datasets. There is a need to add the ability for users to analyse data and generate value added products. Improvements are required in the software used, inadequate DBMS and the quality of available data.

    Recommendation**:** CWAs need to go beyond simple map visualisation and **offer a suite of analysis tools and value added outputs.** The next generation of CWAs need to extend beyond basic interactive map presentation systems. Developers should explore the utility of technologies such as XML, GML, geoRSS and content management systems to help in the development process.

12. **Existing atlases are generally designed to meet the basic needs of a broad range of users, but are sometimes too complicated for general audiences.** Some atlases focus on being accessible to a general audience while others target a specific user group, such as coastal managers. Users need robust, reliable systems that deliver data and information on time and in a format that meets their skill level and interest.

    Recommendation**:** It is imperative that atlas development is **responsive to the needs of the user community.** Developers should **consider designing multiple versions** which provide a range of services to make a system accessible to both the public and professionals. **Sometimes a simpler atlas is more effective** than one with a lot of functionality. It is important **not to oversell the ability** of atlases or to make unrealistic claims. It is also vital to balance the exploration and implementation of new approaches and technologies against maintaining a stable and functioning system. **Acquiring and acting on feedback** regularly from the user community **is crucial** for atlas success.

13. **The erratic nature of funding can compromise maintenance and ongoing CWA development**. In some cases CWAs are grant funded for initial development however

they risk going out of date due to the lack of resources for site maintenance beyond the initial development stage. This can undermine both user and data supplier confidence. In other cases atlases are funded indefinitely by an institution or network of partners. Funding is often tied to innovation and technology developments rather than user requirements and data delivery and updates. The uncertainty surrounding funding can also lead to loss of expertise and personnel from projects. After initial proof of concept projects, there is a need to fund atlases on a long-term basis in order to guarantee their stability.

***RECOMMENDATION*:** Different **financial models need to be examined** to determine the best methods for continued CWA support. Consideration should be given to **sponsorship** by key organisations; obtaining **multiple funding sources**; providing **subscriber only areas** for advanced functionality; or developing **spinoff initiatives**, such as the publication of a CWA in print media.

14. **Ongoing dissemination and publicity of CWAs is important to atlas success**. CWA publicity may be limited to landmark events such as launches or development of new tools. Outreach events increase the number of users.

***RECOMMENDATION*:** **Regular methods and creative options** should be explored for **effective outreach. Email lists** keep users informed of developments and reassure ongoing maintenance of a CWA. **Press publicity** and appearances at **events and conferences** increase exposure. Awareness can also be raised by **brochures and innovative giveaways** (e.g., postcards, calendars). **Maintaining momentum** is important to increasing the audience base. The CWA community needs to come up with **further innovative ideas**.

15. **There is limited capacity to measure the impact of CWAs in the coastal community.** Web statistic software enables site managers to study atlas usage by various means, such as the number of unique visitors, the number of pages visited and the files which are downloaded. However this information only tells part of the story. There are limited means to measure impacts that are difficult to quantify.

***RECOMMENDATION*:** Better methods need to be developed in **how to measure impacts of CWAs** in the coastal community, such as a cost-benefit analysis. For example, how to measure: the **convenience of quick access to data** which users would have previously had to acquire themselves; the benefits of **providing a holistic view** among the science community; and the value of **clearly communicating coastal issues** to the general public.

16. **The emergence of various CWAs has resulted in a concomitant growth of expertise in the area of online CWA design and presentation.** Continued collaboration within this community will help to build on existing knowledge and to meet the future needs of coastal communities.

***RECOMMENDATION*:** It is vital to take advantage of expertise and to **develop links** within the CWA community **to enhance collaboration, build on lessons learned and attempt to identify best practise.** The facilitation of further **workshops** will enable atlas developers to learn from each other. The establishment of an **International Coastal Atlas Network** needs to be explored to provide a group identity/brand. This network should offer support to the CWA development community worldwide and enable continued financial support for additional collaboration.

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Appendices

Appendix A: Programme for the Week

Day 1 – Monday 24th July (Project Partners)	
10:00	Meet in Lancaster Lodge lobby to walk to Council Room, UCC
10:30-11:00	**Roundtable Introductions of project partners and CMRC staff**
11:00-11:30	**Introduction to Coastal & Marine Resources Centre** (Valerie Cummins, Manager, CMRC)
11:30-11:45	Coffee
11:45-12:00	**Introduction to Project** (Dawn Wright, Oregon State University)
12:00-12:15	**Introduction to the week's agenda and arrangements** (Liz O'Dea, CMRC)
12:15-14:00	Lunch
14:00-15:30	**CMRC project and staff introductions and overviews, at CMRC**
15:30-16:00	**Informal preparation time**
16:00	Return to Cork (in Cork at 16:30)
20:00	CMRC-hosted dinner at Greene's Restaurant

Day 2 – Tuesday 25th July (Official Workshop) *Chair: Valerie Cummins*	
8:45	Meet CMRC escort in Lancaster Lodge lobby
9:00-9:30	Registration, Council Room, UCC Campus
9:30-9:50	**Introduction and Welcome** (Val Cummins, Manager, Coastal & Marine Resources Centre & Dawn Wright, Professor of Geography and Oceanography, Oregon State University)
9:50-10:20	**Case Study Presentation 1: UK Case Study: UK Coastal and Marine Resource Atlas** (Kevin Colcomb, Counter Pollution and Response Branch of the Maritime and Coastguard Agency, UK)
10:20–10:30	Questions and Discussion on Presentation 1
10:30-11:00	**Case Study Presentation 2: Belgian Case Study: De Kustatlas Online / the Coastal Atlas Online** (Kathy Belpaeme, Coordination Centre for Integrated Coastal Zone Management, Belgium)
11:00-11:10	Questions and Discussion on Presentation 2
11:10-11:40	Break – Coffee/Tea
11:40-12:10	Case Study Presentation 3: Irish Case Study: The Marine Irish Digital Atlas **(Ned Dwyer, CMRC, University College Cork, Ireland)**
12:10-12:20	Questions and Discussion on Presentation 3
12:20-12:50	**Case Study Presentation 4: Oregon Case Study 1: Oregon Coastal Atlas** (Dawn Wright, Oregon State University, USA)
12:50-13:00	Questions and Discussion on Presentation 4
13:00-14:00	Lunch (Staff Restaurant: hosted)
14:00-14:30	**Case Study Presentation 5: Oregon Case Study 2: North Coast Explorer** (Renee Davis-Born and Kuuipo Walsh, Oregon State University)
14:30-14:40	Questions and Discussion on Presentation 5
14:40-15:10	**Case Study Presentation 6: Virginia Case Study: Mapping Tools for Coastal Management in Virginia** (Marcia Berman, Virginia Institute of Marine Science)
15:10-15:20	Questions and Discussion on Presentation 6
15:20-15:40	Break – Coffee/Tea
15:40–16:30	**Coastal Atlas Showcase, Aula Maxima**
16:30-16:45	**Introduction to Issue-Specific Working Groups, Council Room** (Liz O'Dea, CMRC)
16:45–17:15	**Working Group Ice-breaker**
17:30–19:00	Official Launch of MIDA (in Aula Maxima, includes food and wine)

Day 3 – Wednesday 26th July (Official Workshop) *Chair: Dawn Wright*	
9:10	Meet CMRC escort in Lancaster Lodge lobby
9:30	Arrival at Council Room, UCC Campus
9:30-9:50	**Issue Based Presentation 1: Government Support for Coastal Atlases** (Tony Lavoi, NOAA Coastal Services Center)
9:50–10:00	Questions and Discussion on Presentation 1
10:00-10:20	**Issue Based Presentation 2: End Users of MIDA – A Government Perspective** (Trevor Harrison, Environment & Heritage Service, NI)
10:20-10:30	Questions and Discussion on Presentation 2
10:30-10:50	**Issue Based Presentation 3: Institutional Barriers to the Irish Spatial Data Exchange Project** (John Evans, Marine Institute)
10:50–11:00	Questions and Discussion on Presentation 3
11:00-11:30	Break – Coffee/Tea
11:30-11:50	**Issue Based Presentation 4: Scalability and Automation: Cyberinfrastructure for an Imperfect World** (Steve Miller, Scripps Institution of Oceanography)
11:50-12:00	Questions and Discussion on Presentation 4
12:00-12:20	**Issue Based Presentation 5: Atlas Design and Usability** (Liz O'Dea, CMRC, University College Cork)
12:20-12:30	Questions and Discussion on Presentation 5
12:30-12:50	**Issue Based Presentation 6: Coastal Atlas Tools** (Tanya Haddad & Paul Klarin, Oregon Ocean-Coastal Management Program)
12:50-13:00	Questions and Discussion on Presentation 6
13:00-14:00	Lunch (Staff Restaurant: hosted)
14:00–15:30	**Issue-Specific Discussions: Working Groups**
15:30-16:00	**Break – Coffee/Tea**
16:00-17:00	Presentations of Working Group Discussion Results
17:00-17:15	Concluding Remarks

Day 4 – Thursday 27th July (Project Partners)	
9:30	Arrival at Council Room, UCC Campus
9:30-11:30	**ArcMarine Data Model Discussion** – Marine Institute / CMRC / OSU projects to be discussed. Open to anyone interested.
11:00-11:30	Break – Coffee/Tea
11:30-13:00	**ArcMarine Data Model Discussion**
13:00-14:00	Lunch
14:00–23:00	**Depart from UCC Main Gate on Western Road for Field Trip to West Cork: Boat tour of Roaringwater Bay, dinner on Sherkin Island (guests welcome)**

Day 5 – Friday 28th July (Project Partners)	
9:10	Meet CMRC escort in Lancaster Lodge lobby
9:30	Arrival at MBA Room, UCC Campus
9:30-10:30	**Partner Meeting to Discuss Workshop Outputs//Write-ups from topic-oriented task groups/Conclusions/Future Plans**
10:30-11:15	Break – Coffee/Tea
11:15-12:00	**Partner Meeting to Discuss Workshop Outputs/Write-ups from topic-oriented task groups/Conclusions/Future Plans**
12:30-14:00	Lunch
14:00–17:30	**Informal trip to Kinsale (guests welcome)**

Appendix B: Abstracts

Day 1: Coastal Atlas Case Studies

Case Study 1: The UK Coastal and Marine Resource Atlas

Kevin Colcomb

Counter Pollution and Response Branch of the UK Maritime and Coastguard Agency
Southampton, UNITED KINGDOM

The Coastal and Marine Resource Atlas (*http://www.magic.gov.uk/*) was commissioned by a consortium of project collaborators from UK public bodies and industry, in recognition of the need to update the 1990 coastal sensitivity maps produced by the Nature Conservancy Council. The Atlas contains environmental and other resource datasets covering the Great Britain coastline and marine areas of the UK Continental Shelf. The Atlas is designed as a web based tool to access a wide range of information on coastal and marine resources. Critically, there is a sustainable mechanism in place by which the atlas will be maintained and updated, ensuring that it remains accurate and fit for purpose.

The atlas incorporates a series of 100 priority datasets describing important coastal and marine habitats and species, as well as physical geography and relevant infrastructure. This key information will meet the needs of operational staff involved in national coastal and marine contingency planning, pollution incident response and clean up. The atlas also provides a resource for a wider audience of environmental professionals and researchers.

The atlas was launched as a sub-topic on the UK Defra MAGIC website in November 2005. MAGIC is an ideal host for the atlas because it is already widely known and used by environmental professionals, has an expert data management team in place, and conforms to good practice in the management of geographical information.

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http://www.magic.gov.uk/
http://www.mcga.gov.uk/c4mca/mcga-home

Case Study 2: De Kustatlas Online/The Coastal Atlas Online: Discover what the Belgian coast has to offer, and be surprised!

Kathy Belpaeme

Co-ordination Centre for Integrated Coastal Zone Management in Belgium
Ghent, BELGIUM

The Co-ordination Centre for Integrated Coastal Zone Management was launched on 16th November 2005 (*http://www.kustatlas.be*). This site gives information on several themes and activities on the coast, such as environment and nature, tourism and recreation, industry and business, fisheries and agriculture, culture and heritage and coastal defence.

> Where are the nature reserves and wildlife areas on the coast and at sea?
> Where are the wooden and stone groins on our coast?
> What is the value of fish landings in Belgian harbours since 1950?
> Where are the maritime transport routes situated and do they come into conflict with the windmill parks?

You can find an answer on these questions and many more about the coast on *http://www.kustatlas.be*.

The site is unique! The flexibility and interactivity make it possible to produce maps, to export maps for use in presentations or publications, to consult data and GIS files and on the basis of this, to work with coastal data. Due to the relation with the sustainability indicators, the coastal data are put in the picture and a direct relation with coastal management is made possible.

The website is a result of the book 'The Coastal Atlas Flanders-Belgium'. This publication was a big success. The formula of an illustrative, but scientifically well-founded book has caught on well with many target groups. There was also much international interest. To meet the demand of students, scientists and governments for maps and data, the Co-ordination Centre decided to make a website. The website is fully available in four languages, so that our coast can also be discovered abroad.

Now that the book is no longer available in bookshops, the website will become more and more interesting for students, teachers, governments and coastal-lovers. The Coastal Atlas online is an initiative of the Co-ordination Centre for Integrated Coastal Zone Management. For more information: *Kathy.belpaeme@vliz.be*, +32 (0)5934 21 47, or *http://www.kustbeheer.be*.

http://www.kustatlas.be

Case Study 3: The Marine Irish Digital Atlas

Ned Dwyer

Coastal & Marine Resources Centre, University College Cork
Cork, IRELAND

The Marine Irish Digital Atlas (MIDA: *http://mida.ucc.ie/*) aims to become the most comprehensive online resource for spatial data and information regarding Ireland's coastal and inshore marine areas. The web-GIS that forms its core currently hosts over 100 data layers from more than 30 different organizations.

Users can interactively visualise and query these national and island-wide spatial datasets, search metadata to identify data owners, and view descriptive information, imagery and links in the MIDA InfoPort. This talk will present the context in which the atlas was developed and the experience of data and metadata collection, preparation and management. It will also look at atlas functionality and some of the technologies used in the implementation. Finally, MIDA's participation as a node in the Irish Spatial Data Exchange (ISDE) and atlas development plans will be presented.

MIDA is currently the only web GIS in Ireland to bring together spatial data from so many organisations, and it has been named a key part of marine infrastructure in Ireland. It is a successful cross-border effort, funded in the Republic of Ireland by the Higher Education Authority under the National Development Plan and in Northern Ireland by the Department of the Environment's Environment and Heritage Service.

http://mida.ucc.ie/

Atlas Credits:
Ned Dwyer[1], Liz O'Dea[1], Valerie Cummins[1], Juan Arévalo[1], Iban Ameztoy[1], Ciara Herron[2], Declan Dunne[1], Eamonn Ó Tuama[1], Dídac Perales[1], Kristell Coutell[1]
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Case Study 4: Infrastructure for data sharing, spatial analysis, resource decision-making, and societal impact: The Oregon Coastal Atlas

Dawn Wright

Davey Jones Locker marine GIS/seafloor mapping laboratory, Oregon State University, Corvallis, Oregon, USA

The Oregon Coastal Atlas, a collaboration of the Oregon Ocean-Coastal Management Program, Oregon State University and Ecotrust, is an interactive map, data, and metadata portal for coastal resources managers and scientists, with additional outreach sections for the general public. The portal enables users obtain data, but also to understand its original context, and to use it for solving a spatial problem via online tools. The design of the atlas draws from the reality that resource decision-making applications require much more than simple access to data. Resource managers commonly make decisions that involve modeling risk, assessing cumulative impacts and weighing proposed alterations to ecosystem functions and values. These decisions involve pulling together knowledge from disparate disciplines such as biology, geology, oceanography, hydrology, chemistry and engineering.

Practitioners within each one of these disciplines are often vested in the technologies that dominate the market within their particular field. This presents significant data integration difficulties for investigators involved in management decisions that are as inherently interdisciplinary as those in the coastal zone. The goal of our proposed effort is to address these problems by incorporating a variety of geospatial data and analysis tools within a common framework.

End-user training and direct technical assistance are incorporated into the development of the system, as are back-end system maintenance tools to ensure system longevity. In this way we seek to improve universal participation in coastal decision-making among communities by extending infrastructure to public offices that would otherwise face difficulties accessing these services and resources.

Keywords: web GIS, data access, information management, decision-making, coastal

http://www.coastalatlas.net/

Case Study 5: North Coast Explorer: Information to help local citizens and policymakers make better decisions about natural resources

Renee Davis-Born and Kuuipo Walsh

Institute for Natural Resources at Oregon State University
Corvallis, Oregon USA

The North Coast Explorer (*http://www.northcoastexplorer.info*) is an interactive website that provides citizens and policymakers with information about Oregon coastal watersheds and the species that inhabit them. The portal was created through a collaboration of the Institute for Natural Resources, OSU Libraries with the Oregon Watershed Enhancement Board in response to legislative direction to coordinate data and make natural resource information available to the public. The web portal facilitates access to data and information from a wide variety of sources to citizens and decision-makers actively involved in natural resource use, policy and planning. Through the portal, users can search for and download information, map spatial data, generate statistics about a particular area, and submit information to the portal library. The portal serves as a prototype for other interactive websites focusing on natural resources at the scale of water basins and for the Oregon Explorer, a statewide natural-resources digital library. The Oregon Explorer and its basin portals offer a single access point on the web to Oregon natural resources information, integrating information from many sources by creating a community of users and giving decision-support tools that allow users to analyze information of relevance to specific issues.

For more information contact:

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http://www.northcoastexplorer.info

Case Study 6: Mapping Tools for Coastal Management in Virginia

Marcia R. Berman

Center for Coastal Resources Management, Virginia Institute of Marine Science
Gloucester Point, Virginia, USA

The state of mapping tools for coastal management in Virginia is best described as "all over the map". This in part reflects a lack of collaborative effort between and among agencies of the Commonwealth and the academic community, as well as a definitive lag in recognizing the benefits of such applications. Thus far, no coordinated enterprise can call themselves a true "atlas", however, a review of current products and tools suggest that the development of a coastal atlas is certainly within reach.

The Center for Coastal Resources Management develops and maintains a digital shoreline inventory and a number of resource mapping applications. These products target local governments primarily, but have a state and regional focus as well. Collectively they encompass a growing electronic toolbox of resources developed to improve the local and regional planning capacity for decision-making. The toolbox potentially provides the foundation for future development of a coastal atlas.

The Virginia Shoreline Inventory includes maps, tables and GIS data about condition along tidal shoreline in Virginia. It is however, incomplete. Blue Infrastructure delineates essential aquatic resources within Virginia's coastal zone and uses the ArcIMS technology to reach the widest audience possible. OSCAR, the Oil Spill Clean-up and Response tool provides direction to individuals and agencies called to respond to oil spill clean-up needs. OSCAR is an outgrowth of the national initiative known as the Environmental Sensitivity Index Atlas developed by NOAA for oil spill response. These represent examples of tools developed to enhance management and planning within Virginia's coastal zone.

This paper will review these and other products in the CCRM toolbox and assess whether elements that comprise a coastal atlas are present. Critical components that are missing will be identified. Any current or proposed activities that will move progress forward toward a desired end will be highlighted.

For more information contact:

Marcia Berman
Center for Coastal Resources Management
Virginia Institute of Marine Science
College of William and Mary
Gloucester Point, Virginia USA
Marcia@vims.edu

Day 2: Coastal Atlas Issues

Government Support for Coastal Atlases

Tony LaVoi

Coastal Information and Application Services (CIAS) Division at the National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center
Charleston, South Carolina, USA

This presentation will focus on a series of federal efforts to coordinate and provide enhanced access to coastal and marine data within the United States. The presentation will cover the Federal Geographic Data Committee (FGDC) and the development of the National Spatial Data Infrastructure (NSDI), highlighting the role of ocean and coastal geospatial data within what to date has been a terrestrial focused effort. Information will be provided on both Geospatial One-Stop, a federal E-government project to improve the ability of the public and government to use geospatial information, and the National Ocean Service (NOS) Data Explorer, the primary Internet portal to obtain NOS spatial data. There will also be a discussion of the Interagency Working Group on Ocean and Coastal Mapping efforts to create an inventory of US ocean and coastal mapping programs. Lastly information will be provided on some recent activities within the Integrated Ocean Observing Systems (IOOS) community on data standards and transport systems.

For More Information contact:

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End Users of MIDA – A Government Perspective

Trevor Harrison

Natural Heritage Conservation Science, Environment and Heritage Service
Belfast, Northern Ireland, UK

Government agencies in Northern Ireland are responsible for the management and conservation of the coastal and marine environment; this obligation arises out of government's commitment to meet international agreements as well as European and national legislation. Sound environmental information is vital for sound management decisions regarding the marine and coastal environment; it is also important for monitoring the effects of these management decisions as well as reporting these results to stakeholders and the general public. This information is typically presented or required in a simplified summary format. This simplified summary information, however, must be based on sound, quality data; the procedures followed in producing the summary information must also be scientifically auditable.

Institutional Barriers to the Irish Spatial Data Exchange Project

John Evans

Marine Institute
Oranmore, Galway, IRELAND

The Irish Spatial Data Exchange (*http://www.isde.ie*) is a discovery meta-data service for spatially referenced data sets in Ireland. The Exchange was developed in partnership by the Marine Institute, the Geological Survey of Ireland, the Environmental Protection Agency and the Coastal and Marine Resources Centre at UCC using funds provided by the Information Society Fund. In this presentation John will give an overview of the Exchange and speak about the mainly non-technical institutional problems that arose during the Exchange's development.

Scalability and Automation: Cyberinfrastructure for an Imperfect World

Stephen Miller[1], Dru Clark[1] and John Helly[2]

[1]*Geological Data Center, Scripps Institution of Oceanography, University of California, San Diego*
[2] *San Diego Supercomputer Center, University of California, San Diego*
La Jolla, California, USA

Since the launching of the SIOExplorer online archive five years ago, the collection has grown to hold the data from 693 expeditions by the Scripps Institution of Oceanography (SIO), dating back to 1953. The bulk of the collection comes from multibeam swath mapping of the seafloor (300 expeditions), but the SIOExplorer Digital Library holds 102,000 objects from many diverse sensors, as well as documents and images. The collection is accessible with a Java CruiseViewer graphical interface over a global map, as well as from a webform or from Google.

While initially it appeared that the sheer volume of data from 300 multibeam expeditions would be the biggest obstacle, in practice it turns out that most of the problems derive from the complexity of the data. We have faced more than a few challenges in automating the building of the digital collections over a diverse set of scientific domains. During this span of 53 years there has been a continuing evolution of sensors, recording media, vessels, careers, naming conventions, and cumbersome mixtures of intermediate and final data products. In addition to the SIO Cruise Collection, the SIOExplorer Digital Library now includes federated collections for the historic SIO Photo Archives, the SIO Marine Geological Samples (dredged rocks and cores), the EarthRef Seamounts and an Educator's Collection of classroom resources for plate tectonics.

These efforts would have been impossible, or at least cost-prohibitive, without the help of the emerging field of Cyberinfrastructure. A metadata template file (mtf) synchronizes the arbitrary digital objects (ado's) with a structured approach to metadata. Scalability is insured by the structured mtf approach, allowing new classes of data to be added or entirely new collections to be built, without redesigning the digital library code. Data files have been automatically identified and metadata harvested with very little human intervention, using a set of prioritized based on directories and filenames.

We are now in the midst of a transition to a second generation mtf approach, which makes greater use of formal controlled vocabularies, thereby insuring even greater scalability. A recent award "Multi-Institution Testbed for Scalable Digital Archiving," is supporting the development of a related collection at the Woods Hole Oceanographic Institution (WHOI) which will provide online access to more than 5000 explorations of the seafloor, including Alvin submersible and Jason ROV data, along with WHOI cruises. A recent breakthrough has enabled federated searches across the SIOExplorer and the WHOI collections, as well as a collection of Arctic data at Oregon State University. Funding for the testbed is from the DIGARCH initiative, a joint program of NSF and the Library of Congress, NSF IIS 0455998.

http://SIOExplorer.ucsd.edu

Atlas Design and Usability

Liz O'Dea, Ned Dwyer and Valerie Cummins

Coastal & Marine Resources Centre, University College Cork
Cork, IRELAND

One of the key challenges of developing a coastal web atlas is its design and usability to meet both the owner's and users' needs. Depending on these needs, effective atlas design can be as simple as easy-to-navigate web pages with static maps, or as complex as providing interactive advanced GIS functionality. The interface should make access to data and information intuitive for the users, taking into consideration their technical skills, interests and reasons for using the atlas. Simultaneously it should deliver the data and information efficiently to meet the purpose of the atlas. Obtaining feedback from the target atlas audience throughout the development process is important to its success in order to ensure that both the owner's and users' needs are met.

Atlas design is not limited to the visible web interface. The design of the components behind the scenes is important for the stability and speed of the system. Time investment is needed to research hardware and software options (and their combinations) which are the most suitable. Consideration must also be given towards the development of a tailored database management system to ensure the efficient management of data (e.g. adding and updating data and metadata, data size and quantity) as well as supplemental information (e.g. related documents and tools).

This presentation will discuss these issues more in depth, focusing on the experience gained through the development of the Marine Irish Digital Atlas.

http://mida.ucc.ie/

The Tools of the Oregon Coastal Atlas

Tanya Haddad and Paul Klarin

Oregon Coastal Management Program
Portland, Oregon, USA

The Oregon Coastal Atlas (*http://www.coastalatlas.net*), a collaboration of the Oregon Coastal Management Program, Oregon State University and Ecotrust, is an interactive map, data, and metadata portal targeted at coastal managers, scientists, and the general public. The site was developed to meet long-standing needs in the state for improving information retrieval, visualization and interpretation for decision-making relating to the coastal zone. It has the ambitious goal of being a useful resource for the various audiences that make up the management constituency of the Oregon Coastal Zone. The site provides background information for different coastal systems, as well as the expected access to interactive mapping, online geospatial analysis tools, and direct download access to an array of natural resource data sets relating to coastal zone management. Therefore as a portal, the Oregon Coastal Atlas enables users to search and find data, but also to understand its original context, and put it to use via online tools in order to solve a spatial problem. We will describe in detail the various online tools of the atlas, some that are used for viewing data, some that are used for geospatial analysis; and tools for a diverse audience– some best suited for coastal planners and researchers, some for contributors to the atlas, and some for the general public.

http://www.coastalatlas.net

Atlas Credits:
Tanya Haddad 1, Dawn Wright 2 , Michele Dailey 2, Paul Klarin 4, John Marra 1,5, Randy Dana 1, David Revell 1,6
1 Oregon Ocean-Coastal Management Program, Department of Land Conservation and Development, 800 NE Oregon St # 18, Suite 1145, Portland, OR 97232; Corresponding author: tanya.haddad@state.or.us
2 Department of Geosciences, Oregon State University, Corvallis, OR 97331-5506
3 Ecotrust, Jean Vollum Natural Capital Center, Suite 200,
721 NW Ninth Avenue, Portland, OR 97209
4 Oregon Ocean-Coastal Management Program, Department of Land Conservation and Development, 635 Capitol St NE, Suite 150, Salem, OR 97301
5 now at NOAA Pacific Services Center, Honolulu, HI
6 now at Earth Sciences Department, University of California, Santa Cruz, CA.

Appendix C: Chair & Speaker Profiles

Kathy Belpaeme

Head of Co-ordination Centre for Integrated Coastal Zone Management in Belgium

Ghent, BELGIUM

Kathy.belpaeme@vliz.be

Work Experience

1996-1998: PhD researcher at the Free University of Brussels (topic: Genetic effects of marine pollutants on flatfish)
1998-2001: project coordinator for a European Coastal Zone Management project, named TERRA-Coastal Zone Management
2001-today: Head of the Co-ordination Centre for Integrated Coastal Zone Management in Belgium

Expertise as it Relates to Subject of Presentation

During 2004 Kathy Belpaeme was responsible for drawing up the Coastal Atlas for the Belgian coast. In 2005 she was responsible for supervising the establishment of the on-line version.

Professional Activities

As head of the Co-ordination Centre for Integrated Coastal Zone Management (ICZM), Kathy Belpaeme deals with a diversity of tasks implementing the European Recommendation on ICZM. The tasks are very diverse, ranging from local awareness raising, follow-up of European developments concerning the coast, implementing the EU ICZM Recommendation, to co-ordinating and advising coastal policy actions.

Marcia R. Berman

Director, Comprehensive Coastal Inventory Program
Center for Coastal Resources Management,
Virginia Institute of Marine Science

Gloucester Point, Virginia, USA

Marcia@vims.edu

Marcia Berman came to the Virginia Institute of Marine Science in 1989 to direct the newly legislated Comprehensive Coastal Inventory Program, a GIS and remote sensing program. The Coastal Inventory is charged with mapping conditions along the 16,100 km (10,000 miles) of tidal shoreline in Virginia. This effort has expanded to include the state of Maryland and parts of North Carolina.

Through additional grant and contract activities, Marcia has broadened the program to include the development of GIS based decision support tools to enhance coastal management at the local and regional planning levels within the Chesapeake Bay Watershed. In addition to her research interests in applied coastal science she has active research initiatives in the areas of shallow water use conflict, ecosystem risk assessment, and remotely sensed assessment techniques for wetland habitat valuation.

Marcia is a coastal geologist by training with a graduate degree in Oceanography from the School of Oceanography at Old Dominion University in Norfolk, Virginia. In her spare time she enjoys running, travel, and sailing.

Kevin Colcomb

Senior Scientific Officer
Counter Pollution and Response Branch
of the UK Maritime and Coastguard Agency

Southampton, UK

kevin.colcomb@mcga.gov.uk

Kevin graduated in Environmental Sciences from the University of East Anglia at Norwich in 1985, after which he worked at the UK Warren Spring Laboratory on a number of research projects in the field of maritime pollution. Those projects included the fate of oil at sea, the development of clean-up techniques for all types of shorelines and the application of dispersants to maritime oil spills.

In 1993 Kevin joined the Marine Pollution Control Unit, now Counter Pollution Branch of the MCA. His current responsibilities are primarily to ensure timely response to marine oil spills in UK waters, and to provide technical and scientific advice for dealing with marine pollution in general. He is also responsible for providing advice to local authorities on all aspects of marine and shoreline pollution through exercises and training courses. He is at present supervising several research projects aimed at improving the preparedness of UK agencies in responding to marine pollution incidents.

Kevin was involved in the last three significant UK oil spills, the ROSE BAY, the BRAER and the SEA EMPRESS incidents as well as the ERIKA and PRESTIGE spills. Current activities are centred around forging links with other statutory government bodies in the area of response to maritime incidents in line with the new National Contingency Plan. He is presently working with the UK environmental regulators, nature conservation bodies and fisheries departments in the areas of coastal protection, waste disposal and the setting up of standing environment groups on a regional basis throughout the UK.

Valerie Cummins

Director
Coastal & Marine Resources Centre,
University College Cork

Cork, IRELAND

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Valerie Cummins is the director of the Coastal and Marine Resources Centre. This involves the coordination of 22 research staff working in 20 EU and nationally funded research projects and commercial contracts. In addition to project management, Valerie has considerable expertise in issues pertaining to Integrated Coastal Zone Management (ICZM). She is actively engaged in research in these areas. For example, she is the co-ordinator of the EU Interreg IIIB Corepoint project. She chairs the Irish national coastal network, I-CoNet (part of the EU FP6 ENCORA project) and has successfully delivered a number of reviews on ICZM for government bodies. Her specific research interests include: participatory governance, capacity building for ICZM, the science and policy interface and sustainable development of coastal zones. Valerie is currently undertaking part time PhD studies on aspects of public participation in coastal zone management. In addition to research, she coordinates the delivery of the module 'ICZM – policy and practice' to UCC's Geography masters students. Valerie is also on the editorial panel of the international Marine Policy journal published by Elsevier and a member of the Marine Geography Commission of the International Geographic Union.

Renee Davis-Born

Policy Analyst and Project Manager
Institute for Natural Resources at Oregon State University

Corvallis, Oregon, USA

renee.davis-born@oregonstate.edu

Renee earned her Bachelor's degree in Environmental Science at Allegheny College, and went on to pursue a M.S. in Wildlife Science at OSU. Her background includes watershed assessment and monitoring, terrestrial ecology, and scientific writing.

Currently, Renee focuses her work on the application of science to inform decision-making, primarily through the development of digital libraries that focus on natural resources in Oregon's water basins.

Before joining the INR, Renee was Policy and Outreach Coordinator with the Partnership for Interdisciplinary Studies of Coastal Oceans, a university-based research consortium focused on coastal-ocean research and policy-relevant outreach.

Ned Dwyer

Remote Sensing Specialist
Coastal & Marine Resources Centre,
University College Cork

Cork, IRELAND

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Ned has a MSc and a PhD in Remote Sensing. He has worked for many years with both optical and radar satellite data for a range of applications including fire detection, rice mapping and natural disaster monitoring.

Since joining the CMRC in 2002 he has been working on development of the Marine Irish Digital Atlas - a web-enabled GIS for the presentation of data and information on the Irish coast. Activities have included project management, atlas design, dataset sourcing and preparation and development of educational and informational elements.

He also contributes to teaching in University College Cork's Department of Geography, at both undergraduate and postgraduate level, on remote sensing and GIS. Since December 2005, Ned is in receipt of a fellowship from the Environmental Protection Agency to work on aspects of climate change research related to the Global Climate Observing System (GCOS).

John Evans

Information Services and Development Manager
Marine Institute

Oranmore, Galway, IRELAND

john.evans@marine.ie

John Evans is Information Services and Development Manager with the Marine Institute. John is responsible for teams working in data management, software development and IT Operations. One of his responsibilities is to advise the directors of the Institute on IT strategy. Most recently this has focused on the development of the knowledge management section of the National Research and Innovation Strategy for the Marine Sector 2007-2013.

Together with his management team, John directs and manages the delivery of various IT programmes, prepares IT and Information Service related budgets, and manages & directs external IT suppliers.

Tanya Haddad

Coastal Atlas Administrator
Oregon Coastal Management Program

Portland, Oregon, USA

Tanya.Haddad@state.or.us

Tanya has an MEM degree in Coastal Environmental Management from Duke University. She has worked at the OCMP since fall 1998, the first 2 years as a NOAA Coastal Management Fellow working on the Dynamic Estuary Management Information System (DEMIS), and subsquently on Dawn's NSF grant to construct the Oregon Coastal Atlas. She currently maintains and updates the Atlas and is always looking at ways to improve it.

Trevor Harrison

Natural Heritage Conservation Science, Environment and Heritage Service

Belfast, Northern Ireland, UK

Trevor.Harrison@doeni.gov.uk

Trevor Harrison works for the Environment and Heritage Service, an agency within the Department of the Environment in Northern Ireland. Aquatic Sciences is a relatively new initiative within the Conservation Science Functional Unit and Trevor is employed as a marine biologist within this unit. Trevor is involved in surveying and monitoring marine habitats and species within Northern Ireland to assist in the identification and designation of conservation areas as well as to monitor the condition of existing marine conservation areas. Prior to moving to EHS, Trevor worked as an estuarine ecologist for the South African Council for Scientific and Industrial Research.

Paul Klarin

Policy Specialist
Oregon Coastal Management Program

Salem, Oregon, USA

Paul.Klarin@state.or.us

Paul has worked in a variety of capacities as administrator, permit and regulatory review and planner for the past 16 + years. A program description can be found at *http://www.oregon.gov/LCD/OCMP/about_us.shtml*.

He has a BA from U.C. Santa Barbara in public administration and political science, and a MSc from University of Washington, College of Oceans and Fisheries, School of Marine Affairs.

Tony LaVoi

Chief of Coastal Information and
Application Services (CIAS) Division,
National Oceanic and Atmospheric Administration (NOAA)
Coastal Services Center

Charleston, South Carolina, USA

Tony.Lavoi@noaa.gov

Tony LaVoi is the Chief of the Coastal Information and Application Services (CIAS) Division at the National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center in Charleston, South Carolina. The Coastal Services Center was established in 1995 with a mission to support the environmental, social, and economic well being of the coast by linking people, information, and technology. The Center assists its primary customers, the United State's coastal resource managers, by providing access to information, technology, and training.

The CIAS division focuses its efforts on geospatial standards and interoperability, software application and database development, Internet programming and visualization, and network and desktop IT support.

Tony also serves as the NOAA representative to the Federal Geographic Data Committee (FGDC), the Geospatial One-Stop Board of Directors, and the Ocean.US Data Management and Communications Steering Team. He chairs both the NOAA GIS Committee and the Marine and Coastal Spatial Data Subcommittee of the FGDC, and leads the development of the National Ocean Service Data Explorer GIS data portal.

Tony is a graduate of the University of Wisconsin School of Engineering, is married, and has two children, Elise (8) and MacDougall (5).

Stephen Miller

Head of the Geological Data Center
Scripps Institution of Oceanography

La Jolla, California, USA

spmiller@ucsd.edu

Stephen Miller is the Head of the Geological Data Center at the Scripps Institution of Oceanography. The Geological Data Center is responsible for the online archiving of nearly 800 seagoing SIO expeditions since the 1950's. A recent award from the Library of Congress and NSF supports the extension of the SIOExplorer approach to Woods Hole cruises, Alvin dives and ROV expeditions. The digital library technology for these projects, developed in collaboration with the San Diego Supercomputer Center, also supports a long-term contract for the IODP Site Survey Data Bank, facilitating the review of data for proposals as they evolve from ideas to expeditions, serving the needs of 1000 investigators from 40 countries.

Miller's seagoing career began in high school with a lead-line survey for the Sea Lab II aquanaut habitat in La Jolla Canyon. While an undergraduate at UCSD (Physics) he continued to work with Dr. Spiess and the Deep Tow group at SIO. After graduate school at MIT (Geophysics) he returned to SIO for 7 years of exploration of the deep sea floor, followed by 13 years at UCSB. He has participated in 30 oceanographic expeditions, including Alvin submersible dives to 3000 meters near the Galapagos, and several cruises to Easter Island. He has sailed six (but not seven) seas.

The years 1993-2000 were spent in the private sector. Projects included: leading a software development group for multibeam seafloor mapping and visualization at Sea Beam Instruments (Boston); global fiberoptic cable system design at SAIC (Newport, RI); and regional fiberoptic cable design, permitting and installation with Global Photon (San Diego). For further information, see:

Geological Data Center (*http://gdc.ucsd.edu:8080/gdc_home*)
SIOExplorer Collections (*http://SIOExplorer.ucsd.edu*)
SIO-WHOI Project (*http://gdc.ucsd.edu:8080/digarch*)
Site Survey Data Bank (*http://ssdb.iodp.org/*)

Liz O'Dea

GIS Specialist and Manager of the Marine Irish Digital Atlas
Coastal & Marine Resources Centre,
University College Cork

Cork, IRELAND

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Liz has been working in GIS since 1996. She has a BA in environmental science from Willamette University, and a MSc in Geography from Oregon State University. She has mapped mountain tops, seabed and the space between. Four years working at Mt. Hood National Forest in Oregon gave her a strong knowledge base in GIS, which she then used to explore the world of web GIS at Oregon State University during her Master's research. There she developed a sea floor web GIS for the Virtual Research Vessel, as well as the Tahoma Virtual Atlas - a tool for a Seattle-area high school to incorporate community mapping into their science education.

Liz has worked at the CMRC since 2002, when she was hired to co-coordinate the creation of the Marine Irish Digital Atlas (MIDA). During that time she has overseen web design, atlas design and web GIS implementation, as well as being involved in other related issues (e.g. data and metadata acquisition and processing, database development, Open Source). She is now the manager of the MIDA project.

Among her other activities, Liz guest lectures in UCC's GIS courses and is a member of the Executive Committee for the Irish Organisation for Geographic Information (IRLOGI).

Kuuipo Walsh

GIS Analyst
Institute for Natural Resources (INR),
Oregon State University

Corvallis, Oregon USA

kuuipo.walsh@oregonstate.edu

Kuuipo Walsh received her Master of Science degree in Marine Resource Management from Oregon State University in 2002. She is currently a GIS Analyst for the Institute for Natural Resources (INR).

Kuuipo's research interests include marine and coastal geographic information systems, particularly spatial analysis, metadata and Web GIS.

Kuuipo served as a technical project assistant for the Umpqua Basin Explorer, North Coast Explorer and the Willamette Basin Explorer. Before joining INR, Kuuipo was a Data/Metadata Librarian in Dawn Wright's Seafloor Mapping Marine and Coastal GIS Laboratory. Kuuipo is a founding member of the Oregon Chapter of the Society for Conservation GIS.

Dawn Wright

Professor of Geography and Oceanography
and Director of the Davey Jones Locker
Marine GIS/seafloor Mapping Laboratory,
Oregon State University

Corvallis, Oregon USA

dawn@dusk.geo.orst.edu

Dawn’s research interests include geographic information science, benthic terrain and habitat characterization, tectonics of mid-ocean ridges, and the processing and interpretation of high-resolution bathymetry and underwater videography/photography.

Dawn has completed oceanographic fieldwork in some of the most geologically-active regions of the planet, including the East Pacific Rise, the Mid-Atlantic Ridge, the Juan de Fuca Ridge, the Tonga Trench, and volcanoes under the Japan Sea and the Indian Ocean. She has dived three times in the deep submergence vehicle "Alvin" and twice in the "Pisces V." She serves on the editorial boards of the "International Journal of Geographical Information Science," "Transactions in GIS," and "Geospatial Solutions," as well as on the National Academy of Sciences' Committee on Geophysical and Environmental Data.

Her most recent books include "Undersea with GIS" (published by ESRI Press, 2002), "Marine and Coastal Geographical Information Systems" (with Darius Bartlett, Taylor & Francis, 2000), and "Place Matters: Geospatial Tools for Marine Science, Conservation, and Management in the Pacific Northwest" (with Astrid Scholz, Oregon State University Press, 2005).

Appendix D: Participants List

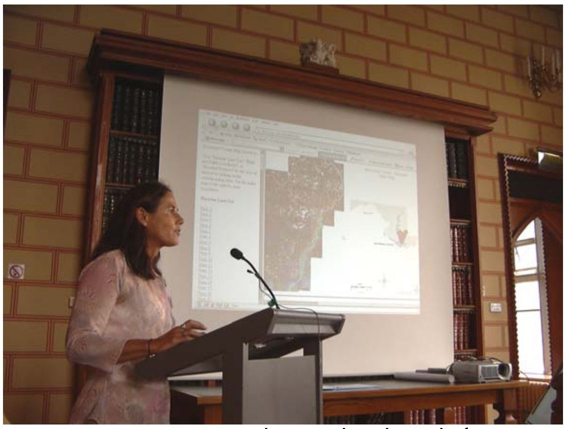
The following is a list of participants who attended the formal workshop on July 25th and 26th.

NAME	ORGANISATION	COUNTRY	E-MAIL
Iban Ameztoy	Coastal & Marine Resources Centre, University College Cork	Ireland	i.ameztoy@ucc.ie
Juan Arevalo	Coastal & Marine Resources Centre, University College Cork	Ireland	j.arevalo@ucc.ie
Kathy Belpaeme	Coordination Centre for Integrated Coastal Zone Management of Belgium	Belgium	Kathy.Belpaeme@vliz.be
Marcia Berman	Virginia Institute of Marine Science	USA	marcia@sweethall.wetlan.vims.edu
Joe Breen	Environment & Heritage Service	Northern Ireland	joe.breen@doeni.gov.uk
Carlo Brondi	Coastal & Marine Resources Centre, University College Cork	Ireland	carlobrondi@gmail.com
Dru Clark	Scripps Institution of Oceanography, University of California, San Diego	USA	dclark@ucsd.edu
Kevin Colcomb	Maritime and Coastguard Agency	England	kevin.colcomb@mcga.gov.uk
Niamh Connolly	European Science Foundation	France	nconnolly@esf.org
Valerie Cummins	Coastal & Marine Resources Centre, University College Cork	Ireland	v.cummins@ucc.ie
Michele Dailey	Geosciences Dept., Oregon State University	USA	dailemic@geo.oregonstate.edu
Renee Davis-Born	Inst. for Natural Resources, Oregon State University	USA	renee.davis-born@oregonstate.edu
Declan Dunne	Coastal & Marine Resources Centre, University College Cork	Ireland	d.dunne@ucc.ie
Ned Dwyer	Coastal & Marine Resources Centre, University College Cork	Ireland	n.dwyer@ucc.ie
Mehdi Essid	Laboratoire des Sciences de l'Information et des Systèmes (LSIS) - University Paul Cézanne	France	
John Evans	Marine Institute	Ireland	john.evans@marine.ie
Jeremy Gault	Coastal & Marine Resources Centre, University College Cork	Ireland	j.gault@ucc.ie

Tanya Haddad	Oregon Ocean-Coastal Management Program	USA	Tanya.Haddad@state.or.us
Joanne Hanna	Environment & Heritage Service	Northern Ireland	Joanne.Hanna@doeni.gov.uk
Trevor Harrison	Environment & Heritage Service	Northern Ireland	Trevor.Harrison@doeni.gov.uk
John Helly	San Diego Supercomputer Center	USA	jhelly@ucsd.edu
Ciara Herron	Centre for Coastal & Marine Research, University of Ulster, Coleraine	Northern Ireland	c.herron@ulster.ac.uk
Alejandro Iglesias-Campos	European Environment Agency Topic Centre on Terrestrial Environment	Spain	alejandro.iglesias@uab.es
Paul Klarin	Oregon Ocean-Coastal Management Program	USA	Paul.Klarin@state.or.us
Yassine Lassoued	Coastal & Marine Resources Centre, University College Cork	Ireland	y.lassoued@ucc.ie
Tony LaVoi	NOAA Coastal Services Center	USA	tony.lavoi@noaa.gov
Roy Lowry	British Oceanographic Data Centre	England	rkl@bodc.ac.uk
Steve Miller	Scripps Institution of Oceanography, University of California, San Diego	USA	spmiller@ucsd.edu
Caroline Nolan	Strangford Lough Management Committee	Northern Ireland	Caroline.Nolan@strangfordlough.org
Julia Nunn	CEDaR, the Centre for Environmental Data & Recording, Ulster Museum	Northern Ireland	Julia.Nunn@magni.org.uk
Liz O'Dea	Coastal & Marine Resources Centre, University College Cork	Ireland	l.odea@ucc.ie
Noel Ó Murchu	Department of Communications, Marine and Natural Resources	Ireland	noel.omurchu@dcmnr.gov.ie
Geoffrey O'Sullivan	Marine Institute	Ireland	geoffrey.osullivan@marine.ie
Éamonn Ó Tuama	Coastal & Marine Resources Centre, University College Cork	Ireland	e.otuama@ucc.ie
Josu Ramirez	Coastal & Marine Resources Centre, University College Cork	Ireland	j.ramirez@ucc.ie
Koen Verbruggen	Geological Survey Ireland	Ireland	koen.verbruggen@gsi.ie
Kuuipo Walsh	Inst. for Natural Resources, Oregon State University	USA	kuuipo.walsh@oregonstate.edu
Dawn Wright	Geosciences Dept., Oregon State University	USA	dawn@dusk.geo.orst.edu
Jim Wright	Memorial University Newfoundland	Canada	jim.wright@mun.ca

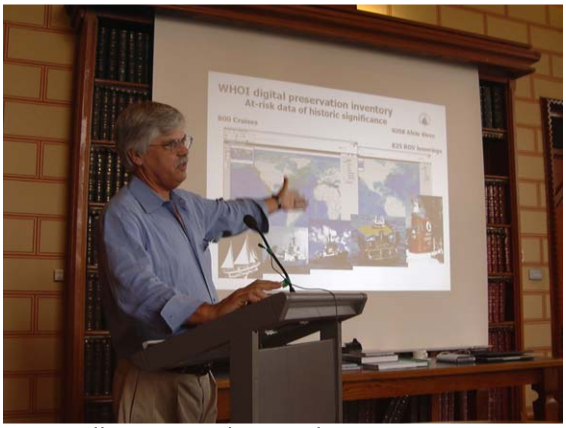
Appendix E: Photos

Dawn Wright opened the workshop.



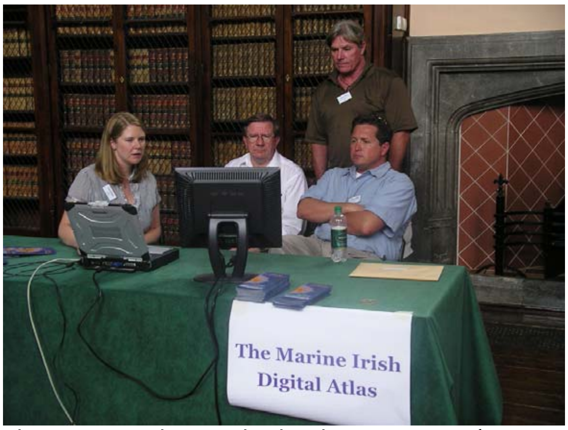
Marcia Berman presented coastal web tools from VIMS.

The UK Coastal and Marine Resources Atlas demonstration, from left: Iban Ameztoy, Julia Nunn, Trevor Harrison, Alejandro Iglesias-Campos, Kevin Colcomb and Roy Lowry.



Steve Miller presented SIOExplorer.

De Kustatlas Online demonstration, from left: Noel Ó Murchu, Kathy Belpaeme, Renee Davis-Born, Iban Ameztoy, Ciara Herron and MA students.



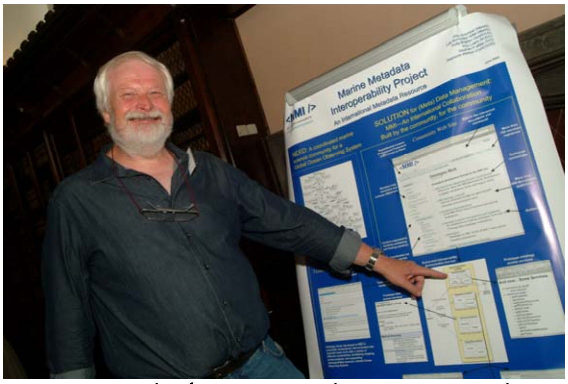
The Marine Irish Digital Atlas demonstration, from left: Liz O'Dea, Jim Wright, John Helly and Tony LaVoi.

Oregon's North Coast Explorer demonstration, from left: Kuuipo Walsh, Josu Ramirez, Éamonn Ó Tuama, Carlo Brondi and Declan Dunne.

At the MIDA launch, from left: Marcia Berman, Prof. Wrixon, President, UCC, Joe Breen, Liz O'Dea, Valerie Cummins, Dawn Wright and Jim Wright.

Geoffrey O'Sullivan, Gavin Burnell (UCC), Éamonn Ó Tuama and Niamh Connolly (ESF) at the MIDA launch.

The MIDA team at the launch, from left: Iban Ameztoy, Ciara Herron, Carlo Brondi, Valerie Cummins, Ned Dwyer, Liz O'Dea, Declan Dunne and Juan Arevalo.

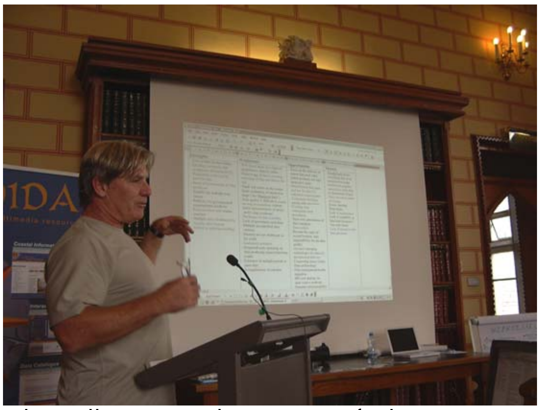


Roy Lowry and information on the Marine Metadata Interoperability Project.

Tanya Haddad, Renee Davis-Born and Michele Dailey at the MIDA launch.


Steve and Connie Miller with Dru Clark.


Kathy Belpaeme and Alejandro Iglesias-Campos.


John Helly presents the Data WG findings.


Tony LaVoi and Dawn Wright.


Institutional Capacity Working Group.


John Helly, Steve Miller, John Evans and Koen Verbruggen.


The Quad, University College Cork.