Coastal Informatics:
Web Atlas Design and Implementation

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ABSTRACT

The Marine Irish Digital Atlas (MIDA) is an Internet resource built in a web GIS environment, where people interested in coastal and marine information for Ireland can visualize and identify pertinent geospatial datasets and determine where to acquire them. The atlas, which is being constantly maintained, currently displays more than 140 data layers from over 35 coastal and marine organizations both within Ireland and abroad. It also features an "InfoPort" which is a repository of text, imagery, links to spatial data sources and additional reference material for a wide range of coastal and marine topics. The MIDA team has been active in the creation of the International Coastal Atlas Network and the Atlas was chosen as one of the nodes for the Semantic Interoperability Demonstrator.

INTRODUCTION

Data and information regarding Ireland's coastal and marine environment are held by a broad range of organizations with both terrestrial and marine remits, including national government departments and agencies, local authorities, research and teaching institutions, industry, private consultants and non-governmental organizations. Only a limited number of these (such as the Environmental Protection Agency (EPA), the Marine Institute, the Geological Survey of Ireland (GSI) and the Ordnance Survey of Ireland (OSI)) provide ready access to their holdings (Dwyer *et al.* 2003). The time-consuming process of data sourcing and acquisition from these various data owners is

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complicated by the lack of data catalogues within many organizations, nonexistent or poor-quality metadata and variations in data quality (Bartlett 1999; McCormack 2003; O'Dea *et al.* 2004).

In order to address some of these issues and to improve the visibility of and access to coastal and marine related data and information, the Coastal & Marine Resources Centre (CMRC) at University College Cork developed the Marine Irish Digital Atlas (MIDA). The overall aim of the MIDA project was to collate island-wide coastal and marine spatial data and make it freely accessible over the Internet. The Atlas was intended as a resource for a broad audience and aimed to cater for anyone interested in coastal and marine matters on the Island of Ireland, encompassing the casual user searching for general information as well as the specialist that required particular data sets. This interactive, online tool, centered on a web GIS, was created with a number of specific objectives in mind:

- to develop a web site for presentation of geo-referenced coastal and marine datasets,
- to provide greater accessibility to data and information in the form of a web-enabled, customized GIS,
- to provide flexibility of use via a range of tools that allow users to select, overlay and compare geospatial layers,
- to allow users to search for and identify sources of data, information and expertise on the marine environment, and
- to encourage a greater appreciation of Ireland's coastal regions by incorporating educational and informational materials based on multi-media technology.

Development of the Atlas was funded by a grant from the Higher Education Authority of Ireland under the Program for Research in Third Level Institutions as part of the National Development Plan (2000-2006). Additional funding was provided by the Environment and Heritage Service of the Department of the Environment, Northern Ireland.

Since the MIDA was launched in 2006, the project has had multiple impacts and outcomes in areas as diverse as coastal governance in Ireland to technology development within the European Union (EU). In terms of international significance, the MIDA, together with the Oregon Coastal Atlas, served as a catalyst in the establishment of the International Coastal Atlas Network (ICAN). The partners involved in the development of the respective atlases organized and co-chaired the initial and subsequent ICAN workshops. The current operational version of the MIDA was launched at the first ICAN workshop held in Cork in July 2006 (O' Dea *et al*. 2007). Subsequently MIDA was chosen as one of the atlases for the Semantic Interoperability Demonstrator, which is presented in chapter 4. Ongoing enhancement and improvement of the Demonstrator keep MIDA at the forefront of technical development within ICAN.

This chapter presents the many aspects involved in the development of the MIDA including an assessment of the Atlas' impact to date. The following are discussed in detail:

- approaches to and challenges involved in spatial data and information collection, including data and metadata management issues,
- Atlas design and layout from both a user and developer perspective,
- Atlas usage, statistics and publicity,
- challenges in maintaining and enhancing the Atlas,
- a partnership for creating distributed systems between key data holders in Ireland and
- current Atlas developments in the context of ICAN.

DATA AND INFORMATION IN THE MIDA

Data and Information Collection

Regardless of the intended web GIS purpose, developers and spatial data managers often face similar difficulties when sourcing and acquiring data in addition to displaying them on the web. Challenges include variability in data quality, scale, data licensing and metadata (O'Dea *et al.* 2004; Department of Environment, Food and Rural Affairs 2002). When a web GIS contains spatial data from multiple data sources as opposed to from a single organization, these issues are compounded by differences in data management practices, including the existence of or differences in data catalogues and standard specifications. For the MIDA team, addressing the underlying data issues proved to be as challenging as the technological ones.

When the MIDA project started in 2002 a decision was taken to set up a centralized repository to hold all the spatial datasets to be displayed via the Atlas. This approach was taken as few organizations provided Internet access to their data holdings and those that did were not in a position to make their data available via distributed, standards-based, interoperable, web-sharing services.

In some countries, such as the United States, base datasets are easy and free/inexpensive to acquire. In Ireland licensing and significant data costs apply. The Ordnance Survey of Ireland (OSI), the Ordnance Survey of Northern Ireland (OSNI) and the United Kingdom Hydrographic Office (UKHO) are responsible for Ireland's terrestrial and marine base data, and all charge for the licensing of their data as well as for datasets derived from their base maps. Base data such as coastline, bathymetry, digital terrain models, hydrographic chart data, roads, rivers and imagery can often be the most expensive acquisition cost in a project (O'Dea *et al.* 2004). Access may also be difficult due to strategic and commercial factors that limit their availability (Bartlett 1999). The MIDA team encountered problems in regard to data cost and licensing restrictions therefore limiting the detail and amount of base data that was included in the Atlas. However, multi-annual licensing agreements at academic rates were reached with OSI, OSNI and SeaZone Solutions Ltd (distributors of UKHO data) for the base data used in the Atlas and this helped to contain data costs. An all-island raster map at 1:450,000 and coastal tiles at 1:50,000 were included. Cost prohibited the inclusion of a more extensive range of scales or the use of vector base data.

The broad spectrum of coastal data owners across Ireland made it challenging to find out who held what. Data acquisition involved personal knowledge, word of mouth and significant time investment. There were few resources in place to make data discovery easier (O'Dea *et al.* 2004). In some cases months were spent locating and sourcing important national or island-wide datasets for the MIDA. It was not uncommon to find that some desirable datasets, expected to exist in GIS-ready format, were not available, for example data layers pertaining to commercial, fishing and ferry ports. In such cases a decision was taken to generate the spatial datasets in-house using all available information such as published reports, web-sites and direct contact with relevant organizations. Having located datasets additional time passed before they could be included in the Atlas as issues such as the owner's data preparation time, the establishment of license agreements and the determination of licensing costs had to be resolved (O'Dea *et al.* 2004). In order to ensure clarity and avoid misunderstanding each data owner was offered the possibility of completing and signing a memorandum of understanding (MOU). The MOU specified the conditions under which the data owner supplied the data to the MIDA and also those that the CMRC adhered to in their use of the data. This MOU also helped to avoid any misunderstandings with regard to data use, when

the personnel, either in the owner's organization or in the MIDA team changed.

One early issue addressed by the MIDA team was that of the extent of coverage of the Atlas. Defining a coastal strip as a specific distance inland and offshore from the coast was seen as too prescriptive. However, datasets were only considered for inclusion if they included information pertinent to coastal and/or marine areas. Where a dataset also included information on inland areas (e.g., national monuments) the complete dataset was presented rather than clipped. In other cases datasets naturally fell on the coast (e.g., lighthouses). On the seaward side datasets extending to the British coast on the East and the continental shelf claim area to the west were included (e.g., sea-surface temperature). Moreover, only datasets with a national coverage (island wide, Republic or Northern Ireland) were prioritized. The inclusion of regional data was left as a future development. This means that there are few spatial gaps in coverage.

Data Organization and Sources

One of the initial project activities was the listing of all possible themes and layers that could potentially be included in the Atlas. The list was established through consultation and brainstorming efforts with experts and specialists from diverse areas of coastal and marine research to establish a comprehensive inventory. A hierarchical data classification structure evolved in the process of consultation to facilitate organization of the initial list. The data hierarchy was structured around four main categories: Management, Physical Environment, Biological Environment and Socio-Economic Activities, each emerging with several meaningful sub-categories in which similar entities were grouped to enable quick and easy navigation of data and information. Figure 1 shows the first category levels and all sub-categories for the Management category. The data structure has proven to be very robust and facilitates the addition of data layers as they become available without impacting on the overall classification so that the Atlas content can be easily expanded.

In order to focus data collection efforts a priority was assigned to each dataset listed. The data were allocated priorities of 1, 2 or 3. The priority 1 list contained a balance of datasets that were most sought after by professionals and highly desired by general users, including high and low water marks, territorial limits, protected areas, and bathymetry. Focus was placed on datasets with complete coverage of the Island of Ireland. Priorities 2 and 3 contained datasets of somewhat more specialist interest (e.g., seabed sediment types, seabird observations, shipping routes). During data collection most effort focused on sourcing priority 1 data. However, lower priority datasets were gathered and incorporated in the Atlas when readily available or easy to access.

Appendix A lists the datasets currently included in the Atlas organized under the four main data hierarchy categories. A dataset in the MIDA can contain several individual data layers, which hold different information belonging to the overall set. For example the rainfall dataset has thirteen

Figure 1. The hierarchical data classification structure for the MIDA, illustrating some subcategories and specific data layers for the Management category

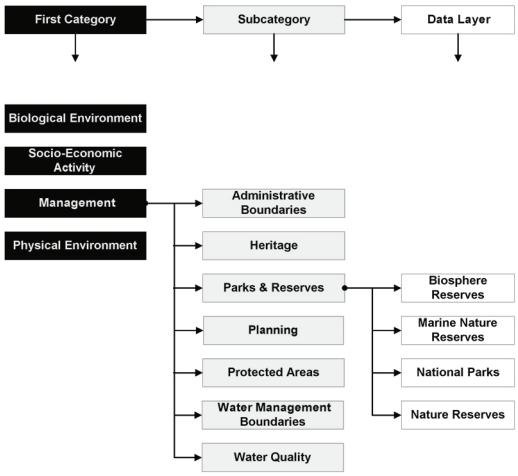
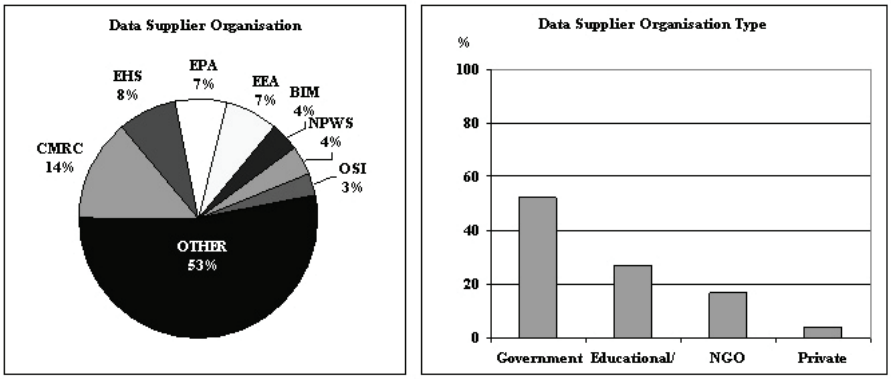


Figure 2. (a) The primary data supplier organizations (n=7) according to percentage of data layers provided to the Atlas. All those that contributed less than 3% of datasets are grouped as other (n=28). (b) Sectors to which data supply organizations (n=35) belong.



separate layers representing mean monthly and mean annual rainfall. Over 140 data layers from thirty five different organizations were gathered as of June 2009.

Figure 2 (a) shows that although 47% of the data layers came from seven organizations, the rest originated in the remaining 28 organizations. This broad distribution of data illustrates the many sectoral interests in the coastal and marine space and underlines the need for tools such as the MIDA, which can improve discovery and accessibility of spatial data.

Although data layers in the MIDA came from numerous organizations (Figure 2 (a)) many of these can be grouped as government organizations. Figure 2 (b) shows that over half of the MIDA data layers were from such organizations, a further 27% were supplied by educational institutions, followed by 17% from non-governmental organizations, while only 4% of data layers originated in the private sector. The MIDA collated and integrated many publicly available datasets from government organizations, which is encouraged through the EU Directive on the Re-use of Public Sector Information (European Union, 2003). Therefore it indirectly facilitates implementation of this Directive for public coastal and marine data in Ireland.

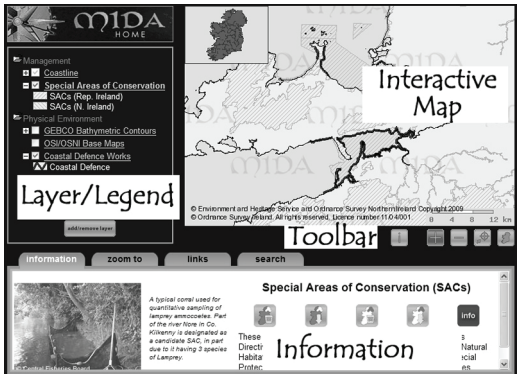
The seemingly large contribution of the CMRC to datasets in the MIDA is due to the fact that a significant number of datasets were constructed from other publicly available sources as directly usable GIS-ready spatial datasets did not exist (e.g., marinas, sailing clubs, saltmarshes). The private sector has a low representation among the data providers to the Atlas. This may be due to the commercial sensitivity of certain data and for less sensitive data companies market them directly. However, the MIDA offers a potential shop-window to private organizations to publicize their data holdings. The MIDA team hopes to develop a referrer capability for such organizations in the future.

THE MIDA LOOK AND FEEL

The Atlas Interface

The core of the MIDA is a web-based mapping system. The main page, illustrated in Figure 3, consists of three key areas: the map and toolbar, the layer/legend area and the information area. Users control what they see in the map by loading and displaying one or more layers. The layer/legend area lists those data layers that are currently loaded

Figure 3. The main atlas page of the Marine Irish Digital Atlas illustrates the map and toolbar, layer/ legend area and the information area



in the map, according to the four major categories mentioned previously. A tick-box is used to show or conceal the loaded layer in the map area while an expansion button allows control over the display of the individual layer's legend. Clicking on the "add/remove layer" button activates a pop-up window, which provides access to the full list of layers. One or more layers may be chosen to be added to or removed from the map. All layers loaded are automatically displayed in the map. Tools to navigate and query the layers within the map area include zoom-in, zoom-out, zoom to full extent, re-centre and feature query. These tools can be selected from the toolbar available underneath the map.

It is not appropriate to view together layers generated at very different scales without the possibility of misinterpretation by the user. Therefore, scale factor limits are associated with each layer in the Atlas display, so that when a user zooms in on an area, certain layers are turned off if the data are being viewed at a scale inappropriate to the level of detail in the layer (von Meyer *et al.,* 1999). The data owner who supplies each dataset specifies which of its attributes can be viewed. The attribute table opens in an external window when the user clicks on a specific feature after selecting the feature query tool from the toolbar. The attributes for the features in all layers directly below the point clicked are displayed. This was deemed to be more user- friendly than having to activate a specific layer in order to view its attributes. In some cases, the feature attributes contain a link to live data feeds (e.g., marine data buoys, webcams).

One of the innovative areas of the MIDA is the information area (see Figure 3) that provides access to additional functionality. From the "search" tab a basic and advanced search facility allows users to search for specific layers based on combinations of title, keyword, theme, region, downloadable dataset and a defined geographical area. The "links" tab provides a list of links to specific areas of the site. The "zoom to" tab allows users focus on a specific marine or terrestrial region or a specific subject theme (e.g., marine safety) by loading only those layers having a keyword associated with that region or theme. The "information" tab provides access to thematic information, metadata and the digital spatial data itself in cases where the data is freely downloadable.

Thematic Information

A brief description of the thematic content and a relevant photograph or image is provided for each data layer via the information tab. Currently 62 of the spatial layers are linked to specific additional thematic information in the MIDA InfoPort, which can be accessed directly from the information tab or via the Information link on the main Atlas page. The InfoPort is a repository of text, imagery, links to spatial data sources and additional reference material for a wide range of topics under the four main sections of the data hierarchy. In this regard the MIDA follows the approach of traditional, printed atlases, which provide descriptive information in addition to thematic maps. Each section has a brief description of the thematic areas addressed in the specific topic information pages within that sub-section.

As shown in Figure 4 each information page has five tabs providing access to:

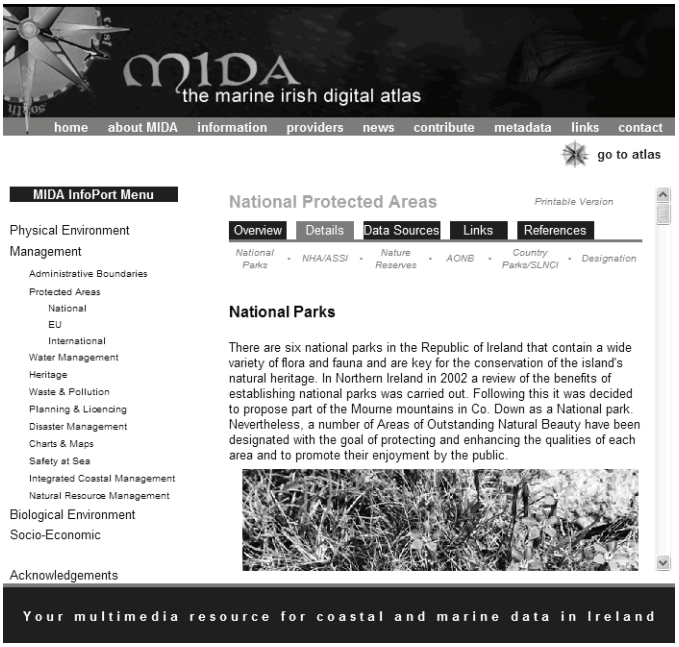
- Overview – This is a short introduction to the specific thematic topic.
- Details – This section presents the key aspects of the topic, organized under a number of headings to which the user can navigate. Images, tables and links to map views of relevant layers within the MIDA web GIS are provided.
- Data Sources – These are links to spatial data resources that are pertinent to the thematic topic. The spatial data may be in the MIDA itself or available via external websites.
- Links – These provide access to additional information and allow users explore a topic in more depth.
- References – This is a list of the documents and sources consulted in compiling the information page.

Each page is reviewed by an expert in the thematic area to ensure that the key information is complete and correct. The material is written so as to be accessible to and understandable by a wide audience whilst also being of relevance to specialists and professionals.

Metadata Display

In many web GIS applications metadata presentation is less than ideal. Long and extensive records, using the implemented standard's hierarchy, element names, technical terminology and structure are displayed. For users with limited familiarity with metadata, this can be incomprehensible and off-putting. Indeed, it can be difficult for users to find the basic information required on the dataset. For the purpose of the MIDA it was decided that metadata should be presented in a user-friendly and easy to follow manner. XSLT style sheets were used to display the XML encoded discovery metadata as HTML. Elements which are obliga-

Figure 4. Via the InfoPort users can access thematic information, images, links to spatial data sources and additional reference material for a wide range of coastal and marine topics



tory in the implementation of the ISO metadata standard but deemed to be of little interest to the general user (e.g., metadata language, character encoding) are not displayed although they are available in the XML. Moreover a tiered approach to viewing the metadata was adopted in order to enhance usability. Three tiers or levels of metadata may thus be viewed in the MIDA:

- **Abstract Metadata:** This is a succinct description of each dataset. It is the first level that users see when they choose to view the metadata for a particular layer. Five elements (title, abstract, geographical extent, owner, publication date) are simply extracted from the Discovery Metadata database and displayed. There is a link to the complete Discovery Metadata if users wish to view more information.
- **Discovery Metadata:** This contains all the metadata elements defined in the customised ISO profile for each dataset. It forms the main catalogue of the Atlas and may be queried. Appendix B lists and defines the elements that form the Discovery Metadata. If the user wishes to see more information, a link to Full Metadata is available.
- **Full Metadata:** This may be provided by the data owner who contributes the dataset. The format, detail and quality of the metadata are the data owner's responsibility and it is displayed as supplied. Full metadata is available for 82 of the over 140 data layers.

FACILITATING DIFFERENT USER-GROUPS

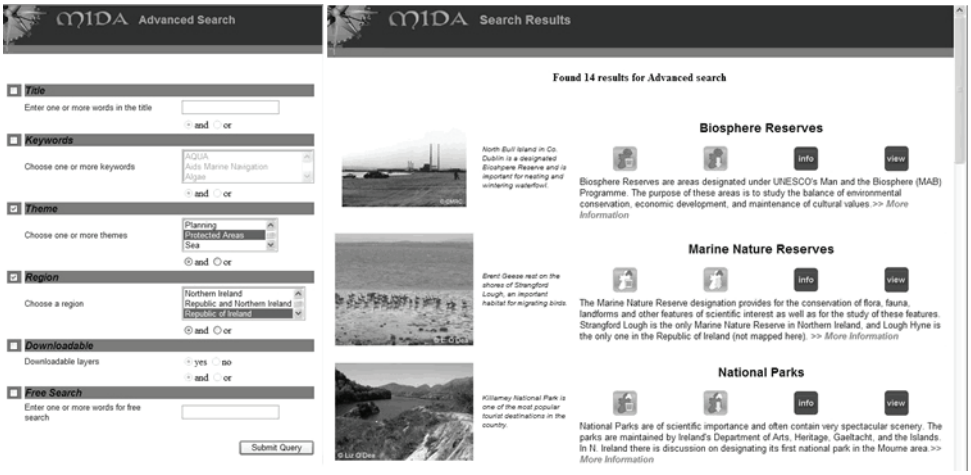
One of the MIDA developers' main intentions was to cater for a broad audience, which would enable professionals, students and casual visitors to find coastal and marine data and information of interest. In order to attract and facilitate such a wide range of user groups, the team developed a number of options to access and search the Atlas. A tutorial, which can be opened from the Atlas start page, was developed to help fist time visitors understand the various ways of using the atlas and it demonstrates the different search options to access specific data layers and information.

A list of all the spatial data layers in the Atlas, which can be accessed from the home page, provides an immediate but extensive overview for first time and casual MIDA visitors. A more controlled exploration of data is possible by using the "add/remove layer" button in the Layer/Legend area (see Figure 3) of the Atlas interface. Here the datasets are organized in pre-grouped themes.

The MIDA search facility was developed with the professional user in mind. The tool provides search options on dataset title, keyword, theme, region or by downloadable datasets. An advanced search tool (Figure 5) permits selection of a combination of these options in addition to selection of geographical area. The search results are presented in a table (Figure 5) providing a summary paragraph on the data. The table provides direct links to the data, metadata, and additional thematic information (if available).

To support research on coastal and marine topics, the MIDA InfoPort (see Figure 4) provides a good starting point for a number of thematic areas. This could be of particular value to students when researching associated subjects. In addition the student can use the InfoPort to view relevant spatial datasets available in the MIDA via in-built links in the information page of interest. It also provides links to external web sites holding related spatial data via the data sources tab. In addition the links tab of the InfoPort lists and links to web sites that can support further research of the thematic information in question.

Figure 5. The advanced search tool within the MIDA and the results of a search presented in an informative scroll down table



PUBLICITY AND ATLAS USAGE

Workshops

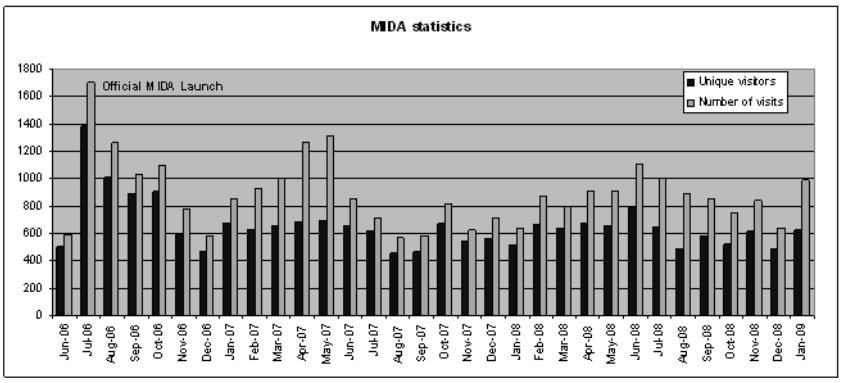
A workshop which targeted some key user groups and potential data contributors was held in Dublin in December 2003 to demonstrate the MIDA prototype. The feedback was used in design changes for the version of the MIDA released in May 2005. Following the release three workshops were held in different locations around the country. The main aims of these were to raise awareness and publicize the Atlas as well as get additional feedback to aid ongoing development of the MIDA. Each workshop was attended by approximately twenty people representing a typical cross-section of users. The attendees had the opportunity to work with the Atlas and had to carry out a number of tasks specified by the workshop facilitators. Both written and oral feedback was gathered. The "one-stop-shop" nature of the Atlas was identified as a key benefit by many participants. Feedback proved to be very useful in tailoring certain aspects of the Atlas. For example a number of participants expressed interest in spatial data for specific additional themes; as of June 2009 over 85% of those themes suggested contain spatial information.

Publicity

The Atlas was promoted at both national and international specialist conferences. Initially articles were written for a number of popular publications in the marine domain which are distributed in Ireland and Britain. To enable quick and easy dissemination of MIDA news and to raise the profile of the resource an email list of those with an interest in the coastal and marine environment and web GIS developments was compiled. Furthermore an Atlas brochure was published and distributed widely. A specific email address (mida@ucc.ie) was set up when the Atlas went online so that users could send queries and comments to the MIDA team. This has been less used than expected with just over 50 emails received since June 2005. Most have been requests for data or information not included in the Atlas whilst others have been questions on specific data layers or technical aspects of the Atlas. In addition there have been many positive comments on the Atlas.

The Atlas was officially launched by the President of University College Cork during the Coastal Mapping and Informatics Trans-Atlantic Workshop held in Cork in July 2006. This generated significant media interest and led to articles

Figure 6. Number of unique visitors to the MIDA and visits per months since June 2006



being published in the national and regional press. Furthermore, through all the ICAN Workshops and the Network's outreach work, the MIDA has become known as a good example of Coastal Web mapping to an international audience. MIDA statistics show external links to the MIDA are incorporated in at least 40 web sites, while there are dozens of references to the Atlas in various online documents and publications (e.g., González Del Campo, 2009; IWEA, 2008; CSA Group/Circa Group/Swiftsure, 2005).

Usage

Figure 6 shows usage statistics for the Atlas since June 2006. The publicity associated with the official launch in July 2006 led to an increase in visits to the Atlas which was sustained for about three months, visits thereafter reducing somewhat. No additional significant publicity events have been carried out since July 2006 but with approximately six hundred unique visitors per month, the MIDA is proving to be a relevant and popular resource.

A further analysis of the 2008 MIDA user statistics confirmed that most Atlas visitors were from the Republic of Ireland, followed by visitors from the UK and the USA. High UK interest was expected as the MIDA was a cross border collaboration featuring island-wide datasets as well as some specific Northern Irish data layers.

The 2005 workshop participants stated that the most appealing aspects of the MIDA included the amount of data in one site as well as the downloadable data layers and metadata records. The 2008 MIDA statistics showed that of the 53 data layers that were directly downloadable from the Atlas, the most popular were from the socio-economic activity section, specifically water-based recreation. Three of the five most popular downloads in 2008 belonged to the sub-section of water based recreation:

1. The Blue Flag Beaches in the Republic of Ireland,
2. The Blue Flag beaches in Northern Ireland,
3. The Location and relevant information of Marinas and Pontoons on the Island of Ireland,
4. A MODIS Satellite Image of Ireland,
5. The Territorial and Fisheries Limits of the Republic of Ireland.

The keen interest in spatial data regarding water based recreation, as shown by the MIDA visitor statistics, indicate that this type of information was not readily available elsewhere for the Island of Ireland, therefore supporting the decision of the MIDA team to create such layers in-house.

The MIDA is used in teaching on a number of courses organized by the department of Geography

within UCC. Technology and web GIS aspects are presented in GIS courses and many students use the Atlas as a resource for their research in coastal management related courses. Furthermore, since 2004, the CMRC facilitates work experience for trainees through the Atlas developing skills in web mapping and GIS and data and metadata management. Trainees improve their writing skills through work on the information pages, which also raises their awareness of coastal and marine concerns. To date nine trainees from five different countries have joined the MIDA team on placements that last from three to twelve months. Most of these placements were funded through the European Union's Leonardo da Vinci vocational training program. Local students and secondary school transition year students on shorter term placements with the CMRC have also worked on the MIDA. Feedback given by the students indicates that MIDA is utilized as a tool by teachers in some secondary schools.

The Marine and Coastal Heritage Directory (http://www.coastalheritage.ie/), developed by the Heritage Council features text and imagery related to Ireland's coastal heritage. Links from the directory to specific spatial data layers within the MIDA are used to illustrate the text within this Directory. Such collaborations help to expand the user community for the Atlas.

THE ATLAS SYSTEM: A DEVELOPER PERSPECTIVE

Selection of Web GIS Software

Visualization and overlay of the many data layers on a map within a web browser was one of the key objectives of the MIDA. Therefore, a web mapping software package had to be selected. Two were evaluated: ESRI ArcIMS and University of Minnesota MapServer. Table 1 presents the main advantages and disadvantages of each system. MapServer was chosen as the most appropriate solution as display and navigation of layers rather than elaborate processing were sufficient for the Atlas; significant programming experience was available with the CMRC and the absence of a license fee made it a more low-cost, long-term solution.

Data and Metadata Preparation

As the number of data layers to be included in the MIDA was in the hundreds, a geospatial database

Table 1. Advantages and disadvantages of the ESRI ArcIMS and the Minnesota MapServer

ESRI ArcIMS	Minnesota MapServer
Advantages	**Advantages**
"out of the box" web GIS	Non-proprietary technology
High level of built-in GIS functionality	No licensing fees
Large user base	Large community of users
Good online support	Simple configuration structure
Integrated metadata server	
Disadvantages	**Disadvantages**
Significant cost	Not "out of the box" web GIS
Proprietary technology	Limited GIS functionality
Complex configuration structure	Require programming skills to build and customise web GIS
Require programming skills for customization	Lacks integrated metadata system

was considered unnecessary. Instead, standard file formats are used. Shapefiles store vector data and GeoTIFF store imagery/raster data. Data preparation principally involved conversion, cleaning, reprojection, tiling and attribute table editing. Most data preparation tasks were carried out in ESRI ArcGIS. However, for certain operations that enhanced MapServer performance other tools were employed. For example, the open source utilities *gdaltindex* was used for tiling large raster layers and *shptree* for optimizing vector display.

Metadata forms an integral part of the MIDA by consistently documenting each dataset held. Although no national metadata standard existed in Ireland at the project's outset, many key organizations that handle spatial data have been adopting ISO 19115 in view of its inclusion as the standard of choice in the implementation of the European Union's INSPIRE Directive (European Union 2007). After a review of a number of metadata standards, and taking into account the limited availability of metadata associated with spatial data in Ireland, it was decided to devise a customized profile of the ISO 19115 standard for the MIDA. A total of 55 elements were selected as the Discovery Metadata for each layer in the Atlas (see Appendix B). These included all elements defined as obligatory in the ISO standard and a number of optional ones believed to be necessary in order to have a minimum acceptable amount of information for each dataset. This metadata was saved in Extensible Markup Language (XML), using the Short Names defined in the ISO 19115 as tags (ISO 2003). ISO 19139 tags were not used as this standard had not yet been released when this phase of the project was undertaken.

A number of metadata entry tools available at the project's outset, such as the ESRI ArcCatalog ISO wizard, M³Cat™ (http://www.intelec.ca/html/en/technologies/m3cat.html), Enraemed (http://geoinfo.uneca.org/geoinfo/ethiopia/enraemed.html) and the ANZLIC Metadata Collector (http://www.walis.wa.gov.au/anzlic_met_project) were reviewed but were not deemed suitable for MIDA metadata collection. Therefore a customized, HTML web-enabled, data entry wizard was designed and implemented in order to ease the task of Discovery metadata collection and entry. This wizard was developed using HTML, JavaScript and JavaServer Pages (JSP) technologies. Metadata were entered in a sequence of HTML forms. Once submitted they were saved on the web server in a flat XML document. The MIDA administrator collected this metadata, reviewed it, and registered it, in the MIDA system. An XSLT (Extensible Stylesheet Language Transformation) stylesheet was created in order to visualize the XML metadata in HTML.

ESRI's ArcCatalog was used to help the MIDA team with management of the datasets included in the Atlas. This system was separate from the Discovery Metadata described above. ArcCatalog provided a way of recording details vital for data management and update, such as when and how data from external organizations were acquired and what modifications were made in order to display those datasets in the Atlas. When the project started only a limited profile of ISO elements was available within ArcCatalog therefore the more complete and extensive FGDC (Federal Geographic Data Committee) standard was chosen for the management of metadata.

The MIDA Prototype

The MIDA prototype consisted of the main Atlas page (including the map and toolbar, the layer/legend area and the information area), and the InfoPort page. The technologies used were HTML, JavaScript and MapServer, running in CGI (Common Gateway Interface) mode. It was deployed within the Apache web server in a Linux Operating System. This prototype was inherently static, which led to update and maintenance problems. In order to incorporate a new layer, the MIDA administrator needed to edit the HTML code manually, and register the layer both in the layer/legend area, and the information area. Another

problem was the system's inability to perform dynamic searching for datasets using metadata elements. In order to overcome these problems the 'MIDA Engine' was conceived.

The MIDA Engine

The "MIDA Engine" is a customized mini content management system (CMS) designed to handle the main Atlas page. At the time of the development, no operational framework for implementing MapServer web GIS applications existed. Although generic frameworks such as CartoWeb (http://www.cartoweb.org/), Mapbender (http://www.mapbender.org/) and Openlayers (http://openlayers.org/) now exist, they still require customizations to meet specific web GIS development needs. The "MIDA Engine" consisted of three main components: the map and toolbar, the layer/legend area and the information area. The content for these components was entered into two database tables which interact with MapServer's main configuration file (known as the mapfile). One table dynamically controls the layer/legend area. It contains layer information such as the filename, keywords and location of downloadable data among others. This structure facilitates user data search. The full XML metadata for each layer is also stored in this table. Currently each new metadata record must be manually uploaded to the database by the MIDA administrator, but there are plans to automate and streamline this process. The other table contains: information theme title; a brief description of the thematic content of the layer; a photo/image and a caption.

The "MIDA Engine" is principally implemented using PHP (hypertext preprocessor) and MapServer's MapScript/PHP module. MapScript provides a scripting API (application programming interface) to MapServer which enables a programmer to extend/customize MapServer's default functionality contained in the CGI version. MapScript supports programming languages/environments including PHP, Python, Perl, Ruby, Java, and .NET. PHP was chosen because it is the best supported MapScript module and it is also used in frameworks such as CartoWeb and Mapbender. The PHP code controls the Atlas functions including layer display and overlay, the zoom extent, watermarking and attribute display.

When a user queries a vector feature in the map, its attributes are displayed. For this the CGI version of MapServer requires that HTML templates are created for each dataset. As this is a cumbersome task, the "MIDA Engine" uses PHP code to register a layer's attributes in the mapfile and control their display in a pop-up window.

The MIDA search facility is implemented via SQL queries on the two database tables described above. The "MIDA Engine" can connect to any RDBMS (relational database management system) database supported by PHP; in this case the open source database PostGreSQL is used.

The MIDA Engine Legacy

The "MIDA Engine" has proven to be a robust platform which can be deployed on both UNIX and Windows platforms. It has provided excellent added value as it has been used to support other initiatives requiring web GIS portals. For example, the European Commission, Framework Program 6, funded InterRisk project which provided tools for management of marine pollution events (Hamre *et al.,* 2009) and the Interreg III A funded IMAGIN project which studied sustainable aggregate exploitation in the Irish Sea (O' Mahony *et al*., 2008) have both used the "MIDA Engine." As neither project required a dynamic database search facility, the "MIDA Engine" was deployed without an RDBMS and used dynamic layer management via the mapfile directly. Moreover, as the "MIDA Engine" uses MapServer, it automatically supports OGC (Open Geospatial Consortium) technologies including WMS (Web Map Service), WFS (Web Feature Service) and WCS (Web Coverage Service), as demonstrated in InterRisk. In early 2009 an agreement was reached

with the National Institute of Marine Sciences and Technologies (INSTM), Carthage, Tunisia to use the "MIDA Engine" in the development of a Tunisian Marine Atlas (Y. Lassoued, pers. comm., 2009).

There is a need for constant innovation in web GIS data presentation and management in order to meet the expectation of users. New open source technologies such as OpenLayers are being investigated in order to enhance the user interface. With regard to metadata management, as part of the ICAN semantic interoperability initiative, selected MIDA metadata records have been transposed into the open source GeoNetwork metadata management system, which supports the ISO 19115/19139 metadata standards and the CSW (Catalogue Services for the Web) standard (described elsewhere in this book). This will improve metadata management and interoperability with data sharing initiatives.

DISCUSSION

An Assessment of the MIDA

The MIDA has met its primary goal as a key access point for spatial data and information on Ireland's coastal and marine areas for a broad audience. The user statistics confirm that the Atlas is constantly visited attesting to its relevance and usefulness. Recognizing that the Atlas is an extremely valuable resource for the coastal and marine community, the CMRC maintains the Atlas from its own resources, since the initial development concluded in 2007, when the project funding period ended. Overcoming difficulties and finding solutions to problems that emerged early in Atlas development have equipped the MIDA team with experience and skills that are invaluable in maintaining and enhancing the Atlas. The use of the 'MIDA Engine' in other national and international initiatives requiring web GIS portals illustrates the added value of the project as it highlights the technical skills within the Centre which in turn has led to additional project work.

The MIDA team was able to overcome initial obstacles concerning data licensing agreements and cost but will have to continuously address these issues, adopting new solutions that will benefit the data owners and the Atlas simultaneously. The lack of data catalogues and the non-existence of metadata for most layers, except for a few institutions was a major barrier. Almost all the Discovery Metadata had to be compiled by the development team. This often involved phone calls with the data providers in order to collect a minimum of information on the datasets. New developments such as the European INSPIRE Directive should lead to an improvement in coastal and marine data documentation and discovery ability. The requirement to provide metadata with all spatial data generated by public bodies should not only benefit existing CWAs such as the MIDA but aid new CWA developments in Europe. Initial MIDA data classification and organization has proven to be extremely useful and has developed into a strong data classification system. However, a shortcoming of the Atlas from a developer's perspective is the lack of a streamlined and automated data management system. MIDA metadata entry and update is currently a time consuming process but the emergence of GeoNetwork and other data management tools now offer the possibility for improved and more streamlined metadata management and can also enhance interoperability within distributed systems.

The MIDA has proven to have numerous uses from providing data and information to different end-user groups to being a valuable training resource for skills in web mapping, data and metadata management. Throughout the design and development phase MIDA developers consulted a representative cross-section of end-users. Such consultation is vital in CWA development as end-user input can ensure that the atlas meets their needs. Face-to-face meetings are more effective than anonymous web-based surveys as a means

of gathering feedback. In addition to keeping the atlas up to date, sustained promotion and publicity is vital for any CWA in order to raise awareness and attract new users. Analysis of the Atlas usage statistics has highlighted the most popular aspects of the Atlas and is informing ongoing development work. Furthermore, the MIDA is useful with regard to the implementation of Integrated Coastal Zone Management and the emergence of Marine Spatial Planning initiatives as supported by the proposed Integrated Maritime Policy for Europe (Commission of the European Communities 2007). As the Atlas allows the visualization of multiple data layers from a wide range of sectors it can help inform marine and coastal planners and managers. Although it is not a decision support tool, access to the data and information that can form the basis for such tools is provided. It also complements the European Atlas of the Seas which is being developed by the European Commission (Commission of the European Communities 2007)

Challenges

A major challenge for any atlas developer and the current MIDA team is the on-going financing of the atlas. Research funds are often available for the development of new and innovative solutions. However, it is more difficult to get funding for the maintenance of existing tools. There is a need for constant innovation to keep the Atlas relevant. Advances in the display of spatial data in environments such as Google Earth (http://www.openioos.org/real_time_data/gm_sos.html) and Google Maps (e.g., http://marinemap.org/marinemap/) raise expectations of web GIS users concerning the look and feel of such applications. The MIDA team needs to address not only maintenance but also updates to develop a new technology interface as well as a data management system. Furthermore these updates have to take into consideration people with limited knowledge of GIS functionality, who have found it somewhat difficult to operate the current interface. However these challenges also offer opportunity for technical innovation and therefore the ability to target appropriate funding programs.

It is important to keep the Atlas in the public eye and to engage in ongoing publicity and promotion. This will be an ongoing challenge but also creates opportunities to address other issues such as funding. It is imperative that the data and information in the Atlas are kept up to date and that new data are constantly added. Many such initiatives fail because web-sites are not updated once the initial projects which brought them into being are concluded. The CMRC has assured the MIDA's future by dedicating resources to maintain it. Moreover active participation in initiatives such as ICAN provides constant exposure for the Atlas and a stimulus to undertake additional development work.

Future Developments

With advances in technology and CMRC expertise gained through the MIDA and related projects the potential exists to develop a new technology interface and data management system. New open source technologies such as OpenLayers for data visualization and GeoNetwork for metadata management will be investigated in order to enhance the system. This could provide the requisite funding to update the technological aspects of the Atlas as well as resources to address ongoing issues with regards to data acquisition and maintenance. Efforts will be made to complete the InfoPort therefore strengthening the thematic aspects of the Atlas. Ideas for further development of the Atlas include a tiered approach to address the needs of different audiences. For example, the MIDA team has evidence that the Atlas is sporadically used in some schools to aid teaching. Creating a tailored version to compliment the secondary school geography curriculum for use by both teachers and students would not only fulfill the MIDA potential as a teaching tool but also raise awareness and profile of the resource in general.

Other ideas include a second tier targeting tourism and recreation and a third tier for professionals, designed with advanced mapping tools for use in coastal management and spatial planning.

Since the MIDA project began, there has been significant progress in interoperable solutions and the development of OGC standards to facilitate the sharing of geospatial data and metadata. Indeed the CMRC together with the Marine Institute, the Environmental Protection Agency (EPA) and the Department of Communications, Energy and Natural Resources (DCENR) have set up the Irish Spatial Data Exchange (http://www.isde.ie). This Exchange enables the sharing of metadata from these institutions' online catalogues across a distributed network. The MIDA is using open source solutions whilst the other partners are using proprietary tools from ESRI, however with the use of CSW and ISO standards, it is possible to share the metadata seamlessly. The next step will be to expand the efforts to include the seamless display of spatial data within each portal's web GIS. This will allow access to the data source instead of potentially outdated versions on individual servers. As part of the ISDE network, the ability to implement WMS and potentially WFS/WCS will be investigated further.

On an international level, as presented in Chapter 4, the MIDA is one of the nodes of the ICAN global atlas prototype which is testing semantic interoperability between two coastal web atlases. This work is currently incorporating additional nodes and extending OGC services to include CSW and WMS. This project is relevant in regard to the emerging EU Integrated Maritime Policy, in which the need for data and infrastructure is highlighted as well as awareness raising tools such as the European Atlas of Seas. Interoperability approaches and coastal web mapping in general are innovations that can facilitate those visions on a very practical level.

CONCLUSION

The MIDA is facilitating better sourcing of and improved access to spatial data in Ireland and will continue to do so with ongoing maintenance assured by CMRC. Usage statistics illustrate that the site is in constant use and that many of the accessible data layers are being downloaded. The Atlas has also been extremely valuable as a technology demonstrator as acknowledged by its use in other web GIS initiatives including the ICAN semantic interoperability prototype. However, ongoing development is crucial to the MIDA's long term survival. Funding, technology and data management issues all need to be addressed. The MIDA's key driving role in regard to developing catalogue and atlas interoperability on a national and international level offers new opportunities for advanced deployment and future development of the Atlas.

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KEY TERMS AND DEFINITIONS

Coastal Web Atlas: 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, all of which are accessible via the Internet.

Atlas Interoperability: The ability to interrogate two or more unrelated atlas systems and potentially exchange metadata, images, vector and raster data.

Coastal and Marine Information: Both spatial and non-spatial information regarding the coastal and marine areas of a region or country.

Integrated Coastal Zone Management: A dynamic, multi-sectoral approach to managing the coast which takes into account social, economic and environmental concerns of all parties with an interest in the coastal space.

Ireland: European Island in the Northeast Atlantic.

Metadata: Metadata in the geographical domain is structured information on a dataset, which helps the data owner to document and catalogue the data, whilst helping a data user to understand the content and fitness for use of a dataset.

MIDA: Marine Irish Digital Atlas.

Spatial Data Visualization: The ability to view digital data with a spatial dimension in a computer environment containing a coordinate reference system.

Web GIS: A geographical information system which can be accessed over the Internet and allow visualization and interaction with spatial data via a map as well as providing analysis functionality such as spatial analysis, querying and buffering.

APPENDIX A

Data layers currently contained in the Marine Irish Digital Atlas organized by the four main categories

Table 2. Management

First Category: Management		
Name	**Description**	**Owner**
AONB	Areas of Outstanding Natural Beauty	Environment and Heritage Service Northern Ireland (EHSNI)
ASSI	Areas of Special Scientific Interest	Environment and Heritage Service Northern Ireland (EHSNI)
Biosphere Reserves	UNESCO sites to promote solutions to reconciling conservation of biodiversity with sustainable use.	Coastal and Marine Resources Centre (CMRC)
Border	Border of the Rep. of Ireland	Environmental Protection Agency (EPA), Ordnance Survey Ireland (OSI)
Celtic Sea Cod Spawning Box	Location of Cod restriction area	Coastal and Marine Resources Centre (CMRC), European Commission
Coastline	Coastline of Ireland	Ordnance Survey Ireland (OSI); Global Self-consistent, Hierarchical, High-resolution Shoreline Database (GSHHS)
Country Parks	Country Parks of Northern Ireland	Environment and Heritage Service Northern Ireland
Clár Areas	Rural areas targeted for investment	National University of Ireland Maynooth (NUIM)
Current PAD Authorizations	The current exploration authorizations given by the Petroleum Affairs Division (PAD)	Department of Communications, Energy and Natural Resources (DCENR)
Hydro-chemical properties	Station sites. North of Ireland Joint Agency Coastal Monitoring Programming (NI-JACMP).	Department of Agriculture and Rural Development (NI) / Agri-Food and Biosciences Institute (AFBI)
High & Low Watermarks	High & Low Watermarks	Ordnance Survey Ireland (OSI)
ICES areas	ICES fishing blocks	International Council for Exploration of the Sea (ICES)
Irish Conservation Box	Irish Conservation Box	Coastal and Marine Resources Centre (CMRC), European Commission
Gaeltacht Boundaries	Gaeltacht Boundaries	GAMMA company
MNR	Marine Nature Reserves	Environment and Heritage Service Northern Ireland (EHSNI)
National Monuments	National Monuments in state care	National Parks and Wildlife Service (NPWS)
National Parks	National Parks	National Parks and Wildlife Service (NPWS)
NHAs	Natural Heritage Areas	National Parks and Wildlife Service (NPWS)
Nature Reserves	Statutory Nature Reserves	National Parks and Wildlife Service (NPWS), Environment and Heritage Service Northern Ireland (EHSNI)
Outline NI	Coastline and border of Northern Ireland	Ordnance Survey of Northern Ireland (OSNI)

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Table 2. continued

First Category: Management		
Name	**Description**	**Owner**
Petroleum Licensed Blocks	License Blocks designated by the Petroleum Affairs Division (PAD)	Department of Communications, Energy and Natural Resources (DCENR)
Ports	Commercial and Ferry Ports	Coastal and Marine Resources Centre (CMRC)
Ramsar Sites	Wetlands of international importance	National Parks and Wildlife Service (NPWS); Environment and Heritage Service Northern Ireland (EHSNI)
Regions	Local Authority Regions of the Republic of Ireland	Environmental Protection Agency (EPA), Ordnance Survey Ireland (OSI)
River Basin Districts	River Basin Districts for the Water Framework Directive	Environmental Protection Agency (EPA)
Rockall Haddock Box	Location of Fishery Protected Area Rockall Haddock Box	Coastal and Marine Resources Centre (CMRC), European Commission
SACs	Special Areas of Conservation (NATURA 2000)	National Parks and Wildlife Service (NPWS); Environment and Heritage Service Northern Ireland (EHSNI)
SLNCI	Sites of Local Nature Conservation Importance	Environment and Heritage Service Northern Ireland (EHSNI)
SPAs	Special Protection Areas (NATURA 2000)	National Parks and Wildlife Service (NPWS); Environment and Heritage Service Northern Ireland (EHSNI)
Straight Baselines	Irish Straight baselines	Irish Naval Service (INS)
Territorial limits	Location of 6,12 and 200 nautical mile limits	Irish Naval Service (INS)
Towns	Towns over 2,000 people (1995)	Environmental Protection Agency (EPA); Ordnance Survey Ireland (OSI)
Water Quality	Bathing Water Quality	Environmental Protection Agency (EPA); The Northern Ireland Environment Agency (NIEA)
Whitefish Restriction Area	Location of Whitefish Restriction Area	Coastal and Marine Resources Centre (CMRC), European Commission
World Heritage Sites	World Heritage Sites on the island of Ireland	Coastal and Marine Resources Centre (CMRC)

Table 3. Physical environment

First Category: Physical Environment		
Name	**Description**	**Owner**
450,000 base map	1:450,000 base map image	Ordnance Survey Ireland (OSI)
50,000 Webmap	1:50,000 OSI Webmap images (coastal tiles only)	Ordnance Survey Ireland (OSI)
Bathymetry	GEBCO vector and gridded bathymetry	Natural Environment Research Council (NERC)
Bedrock Geology	1:500,000 bedrock geology map	Geological Survey Ireland (GSI)

continued on following page

Table 3. continued

First Category: Physical Environment		
Name	**Description**	**Owner**
Coastal Geology	Coastal protection classified in the European EUrosion Project	European Environmental Agency (EEA)
Coastal Geomorphology	Coastal protection classified in the European EUrosion Project	European Environmental Agency (EEA)
Coastal Defense Works	Coastal protection classified in the European EUrosion Project	European Environmental Agency (EEA)
Coastal Lagoons	Distribution of lagoons	Dr. Marinus Otte; Coastal and Marine Resources Centre (CMRC)
Coastal Waters	Coastal Waters	Environmental Protection Agency (EPA)
CORINE Landcover	Satellite interpreted landcover for 1990 and 2000	Environmental Protection Agency (EPA); European Environmental Agency (EEA)
CORINE Landcover Change	Satellite interpreted landcover change between 1990 and 2000	Environmental Protection Agency (EPA); European Environmental Agency (EEA)
Erosion Trends	Coastal erosion trends classified in the European EUrosion Project	European Environmental Agency (EEA)
General Soil Map	General Soil Classification Map	Teagasc
General Soil Map of Northern Ireland	Soil Classification Map of Northern Ireland at a scale of 1:250,000	Department of Agriculture and Rural Development (DARD); Agri-Food and Biosciences Institute (AFBI)
Landsat Image	LANDSAT Satellite Image of Ireland	European Environmental Agency (EEA); Joint Research Centre (JRC)
LaCoast	Coastal Land Cover Change between 1975 and 1990	ERA Maptec Ltd; European Environmental Agency (EEA)
LCA	Landscape Character Areas	Environment and Heritage Service Northern Ireland (EHSNI)
Lifeboat Stations	Lifeboat stations	Royal National Lifeboat Institution (RNLI)
Lighthouses	Lighthouses and other navigational aids	Commissioners of Irish Lights
Main Lakes	Main Lakes	Environmental Protection Agency (EPA)
Main Rivers	Main Rivers	Environmental Protection Agency (EPA)
Mean Tidal Amplitude	Mean Tidal Amplitude classified in the European EUrosion Project	European Environmental Agency (EEA)
MODIS Image	MODIS Satellite Image	National Aeronautics and Space Administration (NASA)
Rainfall	Average monthly rainfall grid	Met Éireann
River Basins	River Basins	Environmental Protection Agency (EPA)
Salt marshes	Significant salt marshes on the island of Ireland	Coastal and Marine Resources Centre (CMRC); T. Curtis and M. Sheehy Skeffington
Seabed Survey	Irish National Seabed Survey - areas surveyed	Geological Survey Ireland (GSI)
Sea Level Rise	Sea level rise classified in the European EUrosion Project	European Environmental Agency (EEA)
Sea Waves	Sea wave height classified in the European EUrosion Project	European Environmental Agency (EEA)

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Table 3. continued

First Category: Physical Environment		
Name	**Description**	**Owner**
SPOT Image	SPOT (Satellite Pour l'Observation de la Terre) -Satellite Image of Ireland	LANDMAP (a service to provide spatial data to academic users in the UK and Ireland)
SST	Average Monthly Sea Surface Temperature (SST) grid	National Aeronautics and Space Administration (NASA)
Stable lights	Image of Irish urban areas taken from space	National Oceanic and Atmospheric Administration (NOAA)
Submarine Cables	Location of underwater cables	Coastal and Marine Resources Centre (CMRC); Kingfisher Information Service
Swell Waves	Swell wave height classified in the European EUrosion Project	European Environmental Agency (EEA)
Tide Gauges	Location of tide gauges	Coastal and Marine Resources Centre (CMRC)
Topography	Shaded Topographic Relief at 50m spatial resolution	ERA Maptec Ltd; Shuttle Radar Topography Mission (SRTM); Coastal and Marine Resources Centre (CMRC)
Marine Data Buoys	Location of marine data buoys around the island of Ireland	Coastal and Marine Resources Centre (CMRC)
Waves	Wave height average classified in the European EUrosion Project	European Environmental Agency (EEA)
Weather Stations	Weather Data Collection Stations	Met Eireann; Coastal and Marine Resources Centre (CMRC)

Table 4. Biological environment

First Category: Biological Environment		
Name	**Description**	**Owner**
Brown Crab	Brown Crab fishing areas in Northwest and Southwest	Bord Iascaigh Mhara – Irish Sea Fisheries Board (BIM)
Cetacean sightings	Cetacean (whales, dolphins, porpoises) sighted in Irish waters	Coastal and Marine Resources Centre (CMRC)
Cockle	Cockle fishing areas around Dundalk bay	Bord Iascaigh Mhara – Irish Sea Fisheries Board (BIM)
Crayfish	Crayfish fishing areas	Bord Iascaigh Mhara – Irish Sea Fisheries Board (BIM)
Harbour Seals 1968-2002 (N. Ireland)	Harbour Seals sighted in NI	CEDaR, Ulster Museum
IBAs	Important Bird Areas	Birdlife International; Bird Watch Ireland (BWI); Royal Society for the Protection of Birds (RSPB)
Lobster	Lobster fishing areas	Bord Iascaigh Mhara – Irish Sea Fisheries Board (BIM)
Scallop	Scallop fishing areas	Bord Iascaigh Mhara – Irish Sea Fisheries Board (BIM)
Shrimp	Shrimp fishing areas	Bord Iascaigh Mhara – Irish Sea Fisheries Board (BIM)

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Table 4. continued

First Category: Biological Environment		
Name	**Description**	**Owner**
Seaweeds	Seaweeds	NUI Galway
Seals - Harbor	Harbor Seal Distribution	Coastal and Marine Resources Centre (CMRC); National Parks and Wildlife Service (NPWS); Environment and Heritage Service Northern Ireland (EHSNI)
Seals - Grey	Grey Seal Distribution	Coastal and Marine Resources Centre (CMRC); NPWS
Periwinkles	Distribution of significant periwinkle sites	Coastal and Marine Resources Centre (CMRC), MI
Whelk	Whelk fishing areas	Bord Iascaigh Mhara – Irish Sea Fisheries Board (BIM)

Table 5. Socio-Economic activity

First Category: Socio-Economic Activity		
Name	**Description**	**Owner**
Blue Flag Beaches	Blue Flag Beaches	An Taisce; Tidy Northern Ireland; Coastal and Marine Resources Centre (CMRC)
Fishing Ports	Fishing Port Locations	Coastal and Marine Resources Centre (CMRC)
Irish Surfing Association Clubs	Members of ISA	Irish Sailing Association; Coastal and Marine Resources Centre (CMRC)
Marinas	Location of marinas and pontoons around the island of Ireland	Coastal and Marine Resources Centre (CMRC)
Moorings	Location of tourist moorings	Coastal and Marine Resources Centre (CMRC)
Sailing Clubs	Location of ISA affiliated sailing clubs	Coastal and Marine Resources Centre (CMRC), Irish Sailing Association (ISA)
Surf Spots	Location of Surfing Spots	Coastal and Marine Resources Centre (CMRC)
Webcam	Location of coastal web cameras	Coastal and Marine Resources Centre (CMRC)

APPENDIX B

Table 6. Description of the 55 elements from ISO 19115 included in the Discovery Metadata

Plain English Description	Short Name	Definition
Title of the dataset	ResTitle	Name by which the cited resource is known
Filename of dataset to which this metadata corresponds	ResAltTitle	Short name or other language name by which the cited information is known
Brief description, or abstract for the dataset	IdAbs	Brief narrative summary of the content of the resource
When the dataset was created or published	ResRefDate	Reference date for the cited resource
See table	*RefDateType*	*Event used for reference date*
Main themes of dataset (see table)	TpCat	Main theme(s) of the dataset
A list of keywords	Keyword	Commonly used word ….used to describe the subject
	GraphOver	A graphic that illustrates the resource
	DataLang	*Language used within the dataset*
	DataChar	*Full name of the character coding standard used for the dataset*
Use a scale value (e.g., 1:50000) for vector data	EquScale	Level of detail expressed as the scale of a comparable map or chart
Use pixel spacing (e.g., 30 m) for raster data	ScaleDist	Ground sample distance
Is it vector, grid, data etc	SpatRpType	Method used to spatially represent geographic information
Describe which area the dataset covers	GeoDesc	Description of the geographic area within which data is available
What area does the data set cover	ExDesc	Spatial and temporal extent for the referring object
Name of the projection system used	RefSysId	Name of reference system used
Western most coord in lon	WestBL	Western-most coordinate of the limit of the dataset extent, expressed in longitude in decimal degrees (positive east)
Eastern most coord in lon	EastBL	Eastern-most coordinate of the limit of the dataset extent, expressed in longitude in decimal degrees (positive east)
Southern most coord in lat	southBL	Southern-most coordinate of the limit of the dataset extent, expressed in latitude in decimal degrees (positive north)
Northern most coord in lat	northBL	Northern-most coordinate of the limit of the dataset extent, expressed in latitude in decimal degrees (positive north)
Local projection system (west)	*WestEx	Western-most coordinate of the limit of the dataset extent
Local projection system (east)	*EastEx	Eastern-most coordinate of the limit of the dataset extent
Local projection system (south)	*SouthEx	Southern-most coordinate of the limit of the dataset extent

continued on following page

Table 6. continued

Plain English Description	Short Name	Definition
Local projection system (north)	*NorthEx	Northern-most coordinate of the limit of the dataset extent
When was the data collected or created	TM_CalDate	Date for the content of the dataset
	DqScope	*The specific data to which the data quality information applies*
How was the dataset generated	Lineage Statement	General explanation of the data producer's knowledge about the lineage of a dataset
Is dataset, complete, being updated, etc	IdStatus	Status of the resource
How often the dataset is updated	MaintFreq	Frequency with which changes and additions are made to the resource after the initial resource is completed
In what format is the data distributed	FormatName	Name of the data transfer format
Is there a version number	FormatVer	Version of the format (date, number, etc)
What media is the data distributed on	MedName	Name of the medium on which the resource can be received
Is the data free, commercial, research price etc	ResFes	Fees and terms for retrieving the resource, including monetary units
What constraints exist on accessing and using the data	OthConsts	Other restrictions and legal prerequisites for accessing and using the resource
Name of distributor	RpIndName	Name of the responsible person – surname, given name, title separated by a delimiter
Their organization	RpOrgName	Name of the responsible organization
Their role (see table)	Role	Function performed by the responsible party
Address	DelPoint	Address line for the location
	City	City of the location
County. For NI or GB insert postcode here as well	AdminArea	County
	Country	Country of the physical address
	VoiceNum	Telephone number
	FaxNum	Fax number
	EMailAdd	Email
	Linkage/ orName/ orDesc	Location for on-line access to additional info.
This filename	MdFileID	Unique identifier for this metadata file
Language	*MdLang*	*Language used for documenting metadata*
Character coding	*MdChar*	*Full name of the character coding standard used for the metadata set*
When was this MD record created	MdDateSt	Date that the metadata was created
Metadata standard	*MdStanName*	*Name of the metadata standard (including profile name used)*
Standard version	*mdStanVer*	*Version (profile) of the metadata standard used*
Who is responsible for this metadata	RpOrgName	Name of the responsible organization for metadata

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Table 6. continued

Plain English Description	Short Name	Definition
	Role	Function performed by the responsible party
Availability of extended metadata	SuppInfo	Supplementary information regarding the dataset
Online link to extended metadata, if available	CI_Contact – Online Resource	Online linkage to further information

Those elements shown in italics are required for interoperability of the XML, but are hardcoded in the file and not displayed in the atlas. Elements marked with * are not part of the ISO standard and are defined in the implementation.