

Harmonising Marine Data Exchange in Ireland

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ABSTRACT: A number of initiatives are currently under way to develop online catalogues and web GIS to improve access to spatial data of relevance to Ireland’s marine and coastal communities. These developments have had to overcome difficulties in finding data, poor levels of documentation of existing data, data quality issues and lack of standards. The development of one of these, the Marine Irish Digital Atlas, has highlighted challenges related to data sourcing, acquisition and standards from a large number of data owners. Its design has followed a set of open technology and metadata standards and is thus facilitating harmonisation with other independently developed systems. These improvements in data discovery are of great relevance in the context of the development of the Irish Spatial Data Infrastructure.

1.1 Introduction

The complexities of managing the diverse components of the coastal zone are reflected in the challenges of accessing coastal spatial data. Coastal zone management must incorporate input from a large quantity of assorted stakeholders, while integrating spatial data from a broad range of both terrestrial and marine organisations which hold data relevant to these various stakeholders. In Ireland these data owners include, but are not limited to, local and national government agencies, research institutions, industry, private consultants and non-governmental organisations (Bartlett 1999; Dwyer et al. 2003). The time-consuming process of data sourcing and acquisition from these data owners is complicated by added challenges such as the lack of existing data catalogues within organisations, nonexistent or poor-quality metadata and variations in data quality (Bartlett 1999; McCormack 2004; O’Dea et al. 2004a). Among recommendations from members of the coastal community is a need for tools to facilitate searching for and accessing spatial data in order to determine, evaluate and monitor what exists (Bartlett 1999; Connolly et al. 2001; Dwyer et al. 2003).

Advances in web-based geographic information systems (GIS) over the last few years have revolutionised the way in which spatial data is accessed, in particular by making them available to a wider, non-specialist audience. It has also provided an opportunity for organisations to share their data holdings more easily with other professionals (Stachowicz 2004). In Ireland government bodies are now required by law to develop tools to improve access to material for re-use, under the European Commission’s Directive on the re-use of Public Sector Information (European Commission 2005). Some organisations are required to make data publicly available, such as the Environmental Protection Agency (EPA) under the European Union’s Water Framework Directive (Mills and O Riain 2002). Other organisations, such as the Marine Institute and the Geological Survey of Ireland (GSI), share data through a web GIS in order to provide a public service or to market their data. No matter what the purpose, web GIS developers and spatial data managers often run into similar challenges with various issues involved in displaying data on the web, such as variability in data quality, scale, data licencing and metadata (O’Dea et al. 2004a; Department of Environment,

Food and Rural Affairs 2002). When a web GIS displays spatial data from multiple data sources, these issues are compounded by differences in data management practices of the various data owners, including the differences in data catalogues (if they exist) and standard specifications. Even if the technology is in place, the underpinning data issues must also be addressed in order for the technology to be useful (Bartlett et al. 2004).

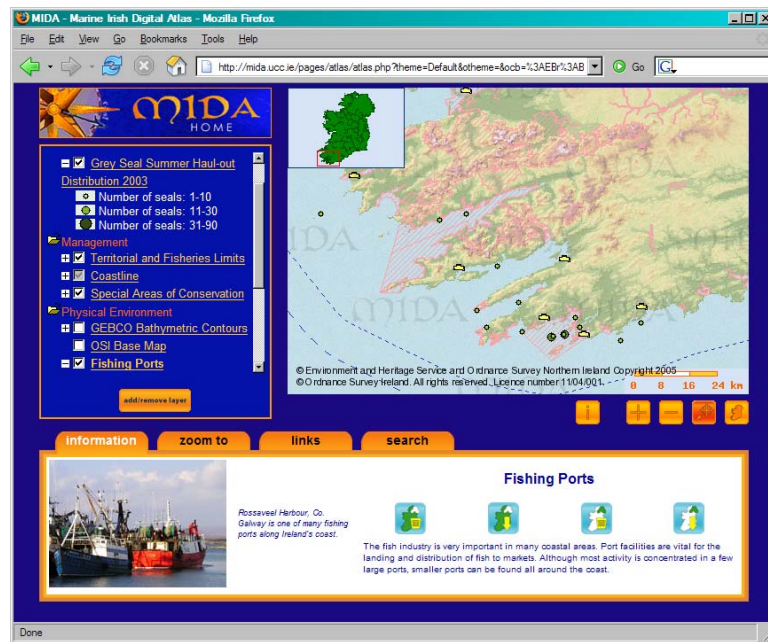


Fig. 1 The main page of the Marine Irish Digital Atlas

In an effort to address the needs of the Irish coastal and marine professional community, the Coastal & Marine Resources Centre (CMRC) at University College Cork developed the Marine Irish Digital Atlas (MIDA; Figure 1). This interactive online tool, centred on a web GIS, was created in part to serve as a resource for professionals to view and source existing spatial data from numerous data owners (Dwyer et al. 2003). In tandem with developing the technology behind the atlas, the process of collecting existing data for display in the MIDA provided the opportunity to gain a good understanding of the various data issues and needs specific to Ireland.

This review discusses the current situation in Ireland regarding the cataloguing and exchange of coastal and marine data in Ireland. It also summarises data and technology issues related to data sharing which the MIDA

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development team has encountered in its development. Finally, Ireland's progress is discussed with regards to adopting standards as well as developing partnerships for creating distributed systems between key data holders.

1.2 Current Realities

The coast has always played an important role in Irish life historically, culturally and economically. Over 50% of the total population of 5.7 million (1.7 million in Northern Ireland) lives within 10km of the coast (Central Statistics Office 2004; Northern Ireland Statistics and Research Agency 2004). The immense pressures which this places on the coastal zone require integrated coastal management in order to sustain resources and the environment (Cummins et al. 2004; Devoy 2000). Managers must have access to appropriate data and information covering a diverse cross-section of coastal topics in order to make informed decisions.

Access to quality spatial data has historically been poor in Ireland, and although difficulties remain a number of efforts are helping to improve how coastal and marine spatial data are accessed and shared. In the development of the MIDA, a number of issues regarding coastal and marine data sharing have been brought to light. These include the variability in the quality of existing data; the need for data cataloguing by owners to improve data accessibility; and the adoption of both data and technology standards to enable data sharing. There are no simple solutions to these issues, however raising awareness of their existence is an important step to making progress.

1.2.1 Data Access

While in some countries, such as the United States, base datasets are easy and free/inexpensive to acquire, in Ireland their cost is one of the first barriers one encounters when compiling data for a project. The Ordnance Survey of Ireland (OSI), the Ordnance Survey of Northern Ireland and the United Kingdom Hydrographic Office (UKHO) are responsible for Ireland's terrestrial and marine base data, and all charge for the licencing 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. 2004a). Access to other proprietary data may also be difficult due to strategic and commercial factors that limit their availability (Bartlett 1999). The MIDA project team encountered access issues when some data owners were hesitant to share their data online due to the commercial nature of their data or the development of their own web GIS.

Data accessibility in Ireland is constrained by the vast number of data owners. According to Bartlett (1999), administrative organisations responsible for Ireland’s coastal zone include central government departments and at least 45 local authorities. Numerous other organisations such as semi-state bodies, non-governmental organisations, universities and private companies also work in the coastal zone, on the terrestrial and/or marine side of the coastal divide (Bartlett 1999; O’Dea et al. 2004a). Data acquisition often involves personal knowledge, word of mouth and time to contact potential data sources. When acquiring data for the MIDA, significant time was spent sourcing important national or island-wide datasets. In some cases, datasets took months to locate (O’Dea et al. 2004a). There can be data access issues within organisations as well. The large organisational structures of some key data holders can make it difficult for people within those organisations to be aware of existing spatial data within the agency, let alone for people from outside the organisation to determine what is available. Without a data cataloguing system in place data can easily be lost. Many organisations are aware of this and in some cases efforts are being made to catalogue their own data in order to improve knowledge and data sharing capabilities, as described later.

1.2.2 Data Quality

There is great disparity in the quality of available coastal spatial data and metadata in Ireland (Bartlett 1999; O’Dea et al. 2004a). Variations in scale are one contributing factor. There is significant potential for misinterpretation when data from different sources are displayed together. The cost of base data may affect the scale of a base map used to create data and information, thus affecting quality. For example in the MIDA, the OSI licensing fees for the distribution of data generated from their base maps impinged on the quality of the ports dataset

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generated by the CMRC. In order to make the dataset freely available, it was created as a generalised point dataset rather than a more detailed polygon dataset to show the location of ports.

The attributes within a dataset also impact data quality. While some datasets have detailed tables with many fields, others contain very few, if any, attributes, thus not providing adequate information to the data user. In some cases ambiguous attributes are not defined in accompanying documentation, which reduces the dataset's usefulness when it is shared outside an organisation. For example, the lighthouses data supplied to the MIDA contained many coded attributes which were difficult to interpret and were therefore not displayed in the atlas.

Metadata quality is another significant issue. More often than not, metadata does not exist for any given dataset (including base data), thus significantly reducing its value. If it does exist, quite often it is sparse and not in a standard format. Some Irish organisations, such as the Marine Institute and the EPA, recognise the importance of metadata and efforts are under way to improve data documentation (O'Dea et al. 2004b).

The age of some base data, particularly certain areas of UKHO Admiralty Charts, also affects the quality of data created from those base maps. Political issues are partly to blame. Since the Republic of Ireland gained its independence in 1922, the UKHO has only made efforts to update its Irish hydrographic charts on an ad-hoc basis, with ports getting the only regular attention. Because Ireland does not have its own hydrographic office, some sections of charts covering the coast are as old as when they were first mapped in 1840-1860 (Marine Institute 2006a).

1.2.3 Web Catalogue and Web GIS Efforts

Some organisations have developed or are developing web catalogue systems of their spatial data holdings which are either available via the Internet or an Intranet. The Marine Institute has led the way in Ireland with Marine Data Online, a publicly available, centralized metadata database that enables users to search its spatial data holdings (Figure 2). In some cases the data can be displayed in a web GIS system (Marine Institute 2006b). The EPA has also

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created an online searchable metadata catalogue for data related to the Water Framework Directive, as well as an Intranet site for providing staff access to various EPA spatial data (McHugh 2005). The GSI provide some of their geological and Irish National Seabed Survey data in various web GIS (Figure 2; Geological Survey of Ireland 2006). The Department of Communication, Marine and Natural Resources (DCMNR) has also developed a web GIS for displaying data held by the Exploration and Mining Division, and another called the National Coastal Infrastructure Service, which is in partnership with a number of other organisations including the Marine Institute (Department of Communications, Marine and Natural Resources 2005a and 2005b).

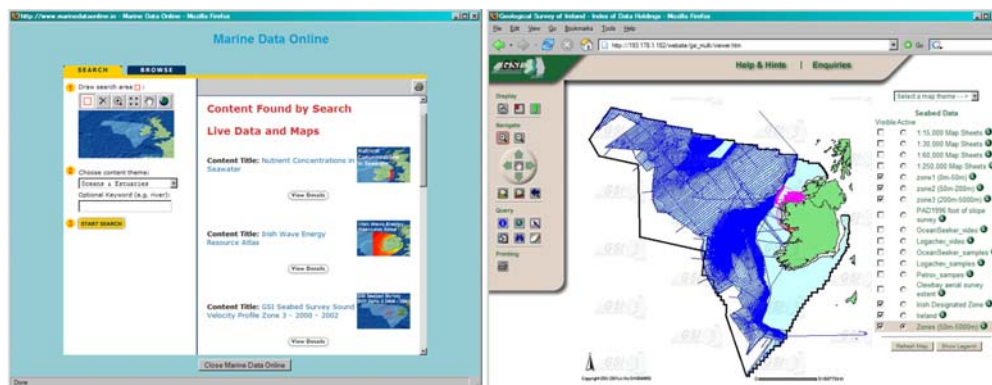


Fig. 2 The Marine Institute's Marine Data Online portal, left, and the Geological Survey of Ireland's Irish National Seabed Survey web GIS, right. (Marine Institute 2006b; Geological Survey of Ireland 2006)

The MIDA was developed by the CMRC as a web portal to coastal and inshore marine spatial data and information in Ireland, with a web GIS at its core (Dwyer et al. 2003). While it is one of a handful of efforts to bring Irish coastal and marine spatial data to the Internet, it is unique in that it displays data from a large number of data owners, ranging from government agencies to individuals. The atlas provides over 100 data layers and accompanying metadata from over 30 data owners (at the time of writing) as well as informational pages about various coastal topics and issues.

Coastal and marine organisations in Ireland have chosen different products as their web mapping software to make their data available online. Factors

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influencing the selection of software include the availability of financial and technological support within an organisation as well as the functionality and ease of use of the final product. A majority of organisations, including the Marine Institute, the GSI, the DCMNR and the EPA (on their Intranet site) are currently using proprietary software for their web GIS efforts: the Environmental System Research Institute (ESRI) Arc Internet Map Server (ArcIMS), which, while expensive, offers extensive functionality along with site creation and management tools. The MIDA uses open source software University of Minnesota MapServer as its web mapping software. This program is freely available and, while offering simple zoom and feature query functionality, is fully customisable with the appropriate technical resources.

1.2.4 Standards

There are currently no widely accepted standards for data and metadata in Ireland. Some organisations, such as the Marine Institute, the EPA, the GSI and the CMRC have implemented various profiles of the International Standards Organisation (ISO) 19115 metadata standard, which has been adopted by the European Committee for Standardisation (CEN; European Committee for Standardisation 2006). In 2002 the Irish government began developing the Irish Spatial Data Infrastructure (ISDI; McCormack 2004). From the beginning, the ISDI has recognised the need to incorporate coastal and marine data (Bartlett et al. 2004). The development of the ISDI is in line with work on the establishment of a directive for developing a European spatial data infrastructure (INSPIRE). ISO 19115 is the core of the metadata standards of the ISDI and INSPIRE, therefore current coastal and marine metadata collection efforts are in line with these future standard infrastructures (McCormack 2004).

Technological standards have also been developed for web GIS. Their rapid growth has resulted in an extensive selection of different software products on the market. All offer different levels of GIS functionality, web site design tools and capabilities. In response to the increasing usage of web GIS products, the Open Geospatial Consortium (OGC) is actively developing numerous standards, called OpenGIS specifications, to address the lack of interoperability among such web GIS systems. For example, the Web Map Service (WMS)

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OpenGIS specification, which was approved as an international standard (ISO 19128) in November 2004, enables different geospatial software systems to interoperate and more easily share data imagery across distributed networks (De La Beaujardiere 2006). However the OGC do not actually implement the specifications, instead they are implemented both by open source developers and commercial companies. For example, the WMS standard has been implemented by the open source UMN MapServer and by the proprietary ESRI ArcIMS OGC WMS Connector (De La Beaujardiere 2006; Environmental Systems Research Institute 2005). Furthermore, as OpenGIS technology is still evolving, industry is implementing various OpenGIS compliant servers and clients. Thus, current coastal and marine web GIS endeavours in Ireland are adopting technologies that meet these new standards.

1.3 The Way Forward

While there have been many challenges with coastal and marine data and their accessibility, some of the key data owners in Ireland are making efforts to improve the quality of their own data and metadata, adopt standards, catalogue their data holdings and make their data more accessible. These efforts are in line with expected future standards and technological developments.

1.3.1 Data and Metadata Standards

Once the ISDI is in place it will provide, among other things, spatial data and metadata standards that government agencies will be required to implement. It is expected that these standards will also be adopted by outside organisations (McCormack 2004). The establishment of the ISDI is part of the larger National Spatial Strategy for Ireland, established by the government in 2002 (Department of the Environment, Heritage and Local Government 2002). The adoption of the ISDI will better enable data sharing within Europe with the corresponding development and adoption of INSPIRE.

The development of these standards should involve ample opportunities for input from members of the spatial data community. Engaging them in the development of final standards will ensure a better chance of adoption once those

standards are implemented. Both the ISDI and the INSPIRE communities have made significant efforts in this regard. The current trend among various organisations in Ireland's coastal and marine community in adopting ISO 19115 as a metadata standard, even before it becomes a statutory requirement, demonstrates the community's eagerness for clear spatial data management guidelines.

1.3.2 Technological Standards

Key coastal and marine data holders in Ireland who have developed web GIS are aware of the importance of using technology that is OGC compliant. While different coastal and marine organisations have implemented either proprietary or open source software as their web GIS for sharing their data, their software choice should not impact their ability to share data and metadata across a distributed network due to this compliance.

The Irish Spatial Data Exchange project, initiated in late 2005 and funded by the Irish government, is a partnership between the Marine Institute, the GSI, the EPA and the CMRC. The aim is to develop technology that will enable the sharing of key coastal and marine data catalogues online across a distributed network. This is building on existing individual data catalogue and web GIS efforts and enables users to search all metadata holdings from each organisation's web portal. The Catalog Services for the Web (CSW) protocol is used to encode eXtensible Markup Language (XML) queries and responses allowing communications with heterogeneous data catalogues. When a user initiates a query, a catalogue metadata record is returned, adhering to an agreed profile of the ISO 19115 standard. This will improve access to data by pointing users to the most up to date original data source instead of potentially outdated versions replicated on other servers. It is envisioned that the next action will be to include the seamless display of spatial data within each portal's web GIS.

1.4 Conclusions

Technology pertaining to web GIS and data catalogues is developing quickly and there are pressures on organisations to keep up with these advances,

while also meeting the demands of the marine spatial data community. It is important for organisations not to lose sight of the various data issues that must be addressed in tandem with focusing on the technology. Without quality spatial data and metadata to populate the systems developed, the technology alone will not meet the needs of the user community.

Experience from the development of the MIDA has shown that more work needs to be done within organisations themselves to address data and metadata issues. The establishment of the INSPIRE Directive and the Irish Spatial Data Infrastructure will provide a framework for data owners. Continued efforts must be made to ensure that data and technological standards are properly adopted, data holdings are adequately catalogued and tools are in place to make data more accessible. Once these are in place then data sharing between organisations will be easier to implement. Current endeavors within Ireland's coastal and marine organisations demonstrate key data owners' awareness of the issues and movements in the right direction. The growing pace of strategic efforts to develop joint projects to address these data access and technology issues, such as with the Irish Spatial Data Exchange project, provides promise for future data sharing among Ireland's coastal and marine community.

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