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THE CASE FOR A EUROPEAN DIGITAL MARINE ATLAS

by Gary J. ROBINSON [1]

INTRODUCTION

The majority of research into the European seas has generally been undertaken on a national basis by independent organisations involved in either the exploitation, management or protection of the marine environment. This has led to the generation of an enormous volume of heterogeneous information that is difficult to handle, let alone visualise, in any sensible manner. Initiatives such as the Marine Science and Technology (MAST) programme of the Commission of the European Communities (CEC) provide an ideal opportunity to adopt a more coordinated approach. Indeed a supra-national approach is imperative given the increasing levels of economic and social integration with Europe. A more practical reason is of course that the marine environment, and man's influence upon it, does not recognise political boundaries.

The rectification of this state of affairs is clearly a difficult task. However, a good starting point is the use of a traditional mechanism for bringing together information from diverse sources and presenting it in a uniform format to a wide range of users, namely the atlas. This paper covers many of the major issues involved in using such a medium, specifically in the handling of information relating to the marine environment of the seas surrounding the member states (and affiliated countries) of the European Community. Many of the comments made are however appropriate to other disciplines and geographical regions.

The following discussion is based on two studies and a workshop, all funded by the CEC.

[1] NERC Unit for Thematic Information Systems, Department of Geography, University of Reading, England.

BACKGROUND

The first study, undertaken by the Institute of Oceanographic Sciences, Deacon Laboratory of the UK Natural Environment Research Council, took the form of a definition study. Through the use of a questionnaire sent to many organisations involved in the marine environment throughout Europe (and elsewhere) the level and type of interest in an atlas of European waters was established. The major finding was that there is a definite need for a series of maps of many physical, chemical, biological and other parameters in a consistent format. The relative order of importance of the regional waters to be mapped naturally reflected the geographical distribution of the respondents (or their study areas) but did show a strong demand for a European atlas as opposed to a series of distinct regional atlases. This requirement is enhanced when the needs of other potential users such as the general public, schools, politicians and administrators, are considered. An interesting result was that the great majority of respondents felt that traditional paper atlases were of greater use than other formats, such as digital atlases. This probably arises from the current methods of working with marine information. In carrying out the subsequent review it was believed that the greater benefits presented by digital atlases would convert many of the traditionalists. Indeed, there is no reason why paper maps and charts,or even a series of atlases, could not be produced from a digital system.

The review concentrated on current research initiatives in digital marine atlases and related areas, coupled with a technical investigation into how such a system should be established so that it could satisfy the demand for paper products identified in the definition study and the expected future demands in terms of their digital equivalents and novel products.

After the review was completed, a workshop was held at Reading University in which invited delegates discussed the review and proposed methods for moving forward in the development of a marine atlas of European waters.

THE REQUIREMENT FOR A EUROPEAN MARINE ATLAS

Having established that there is a clear need for such a product the obvious first question that has to be asked is: is the requirement already satisfied? Although atlases such as the MAFF Atlas of the Seas Surrounding the British Isles have comprehensive coverage in terms of content it is too limited in geographic extent. It is also at a scale inappropriate for much of the information that had been identified as being useful by the definition study. Similar comments apply to many other atlases. The answer to the question is therefore no.

The next question is what form does this requirement take? This was investigated by the definition study and amplified by the review. The main

geographical areas of interest emerged as: the NW European shelf, NE Atlantic and the Mediterranean Sea, although the Baltic Sea, Norwegian/Greenland Sea, Barents Sea and Black Sea also received strong interest. Physical and chemical parameters received the majority of interest in terms of content, with slightly less for geology/geophysics, biology, exploitation and resources. Another strong requirement was for data input and output: many users were keen on either extracting data from an atlas or adding their own to it. Perhaps somewhat surprisingly the requirement for time variation did not appear strongly in the response.

OBJECTIVES OF A EUROPEAN MARINE ATLAS

How best to satisfy these requirements was the task of the review. It became evident at a very early stage that the only sensible way of doing this, and reconciling many mutually exclusive requirements, was to adopt a computer-based approach. However, the primary objectives of establishing such an atlas are independent of the methods with which it is implemented.

The first objective is sufficiently general that it is equally valid in application areas other than the marine environment:

> To provide a uniform mechanism for the handling and dissemination of mapped marine information to a broad spectrum of users.

The use of the word 'mapped' is deliberate and emphasises the difference between an *atlas* product and a *catalogue* of data sets, be these digital or analogue. Catalogues are important: for example the North Sea Research Database, published by the UK Department of the Environment, is an important compendium of marine projects targeted at the research community. However, a graphically based atlas product is essential if many diverse end users are to be serviced. This is not to say that the two are mutually exclusive - an atlas product can contain some elements of a catalogue, or at least reference other detailed catalogues (and *vice versa*).

The second objective is more specific and relates to the potential role of a central administrative body such as the CEC:

> To provide for the better understanding, and thereby better management, of the resources and protection of the seas surrounding the European Community member States.

This highlights the importance of the atlas as a monitoring and modelling tool - essential elements of any attempt to gain an insight into many complicated interacting processes, such as those encountered in the marine environment.

In achieving these primary objectives the review identified several benefits of a marine atlas. The first involves the more efficient management of available resources. This is particularly important in times of increasing financial constraints within certain countries and would be achieved through the reduction of duplication of effort, both within and between nations. Another benefit of an atlas is its ability

to reveal areas, both in terms of geographical and thematic content, of data sparsity. A related topic is data quality: this is particularly important in the context of an atlas, since data of differing quality can lead to apparently conflicting results. The experience of many atlas publishers is that users very quickly make it known that it would be nice to 'include such and such a data set'. Atlases can therefore have a direct influence of the type of data that is collected, or at least in establishing the relative priorities for doing so. The feedback factor of atlas should therefore never be underestimated. The final benefit of an atlas identified by the review is in its educational role. This can be wide ranging, from providing project work within secondary schools as a more concrete example through to the more subtle one of raising general awareness of the importance of the marine environment.

IMPLEMENTATION ISSUES

The issues which will be raised by the development of an atlas of European waters may be conveniently divided into three sections: technical, administrative and financial. These are addressed in turn.

Technical

A range of options is available for the design and establishment of the technical infrastructure of the atlas. These vary from a large integrated marine information system, containing all available marine data with direct user access, through to a distributed system with computers located at each user and data provider site. Each option has advantages and disadvantages. For example, the main criticism of the first option is that of access: data providers would be unwilling to relinquish control, either in terms of ownership or scientific validation, of their data. Tremendous technical difficulties of providing on-line access to a graphical product to potentially many hundreds of users throughout Europe would also have to be overcome. The review favoured an option which leaves data in the hands of the data generators, who would then generate mapped results to an agreed set of standards for subsequent assembly and dissemination to users in the form of digital and paper products (Fig.1).

The workshop addressed some of the more detailed aspects of the atlas system. One of the most important in the context of a multi-national initiative is language: multiple languages would be required for those map products containing text. The translation of descriptive textual information was thought to be straightforward. However difficulties were foreseen in providing different languages for the user interfaces (*e.g.* menus and prompt messages) and the variation of lengths of text labels on maps and diagrams with source language. The first could be solved by providing 'loadable' multi-lingual text information for the generation of menus etc., whilst the second was seen as a topic for further research.

The PC was generally preferred as the likely platform for the atlas despite it is less attractive user interface compared to the Apple Macintosh PC. However, it does have a much wider user base within Europe. The adoption of portable software, either proprietary or written 'in-house', for both platforms was thought to be worth pursuing.

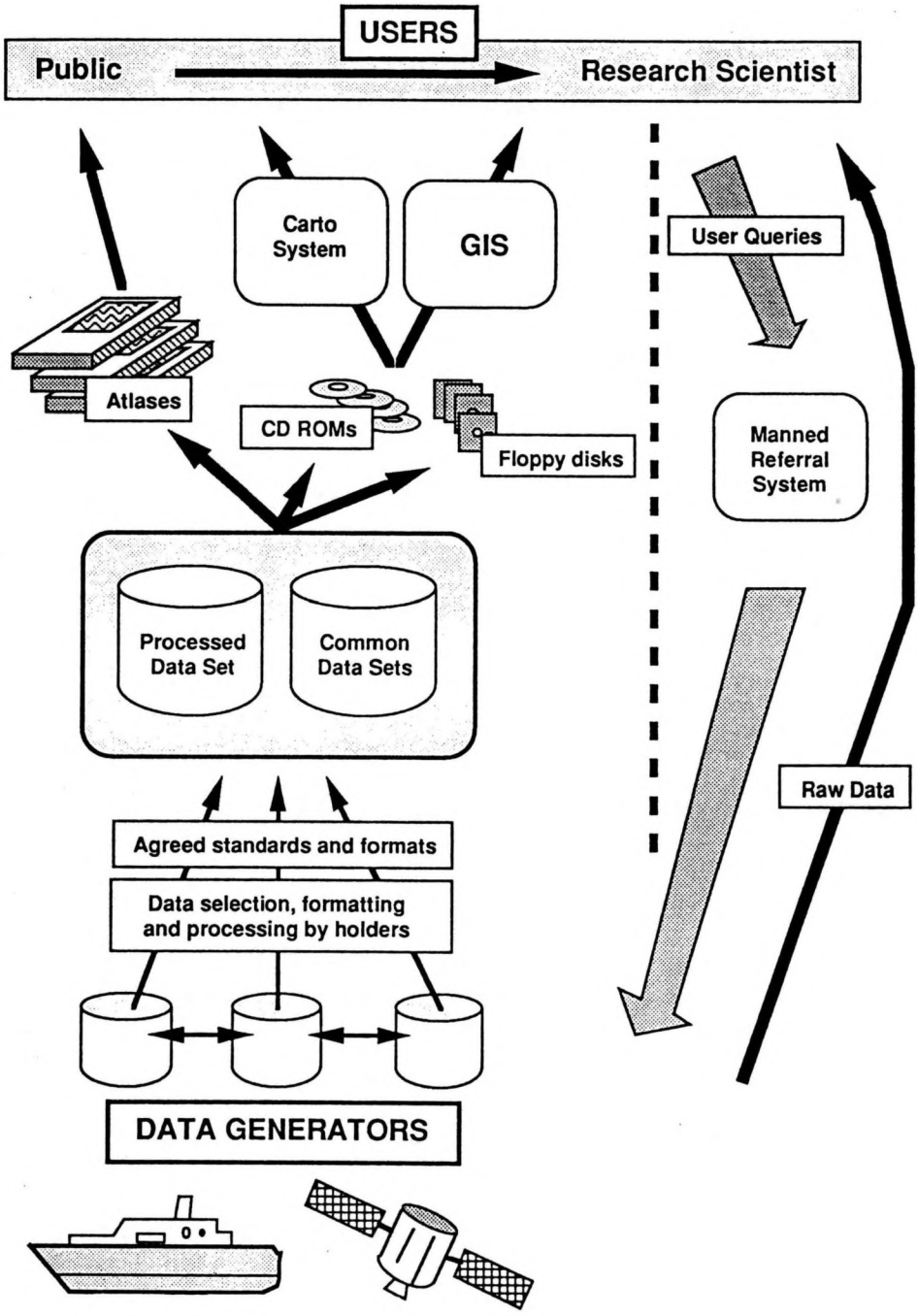

FIG. 1.- Schematic outline of marine atlas system.

The workshop delegates felt that full three dimensional data sets should not be handled (at least initially) due to the complexities of data storage and presentation. However, selected 2.5 data sets, portrayed as special products (e.g. perspective views, or 2D slices) could be feasible. Time could be handled in the same way as in paper atlases, i.e. separate maps of seasonal variation.

No problems were foreseen with producing maps on different projections, either statically or 'on the fly'. 1:250,000 scale was thought to be the optimum scale for holding and portraying information generally. Larger scales would be used for more detailed information, for example at the national level, especially in coastal regions.

Raster and vector data formats were believed to be required, as appropriate for each data set. Some data sets, such as bathymetry, would be stored in both formats.

To prevent, or at least discourage, the unauthorised extraction of information from the digital atlas, some form of security was thought to be desirable.

Administrative

The key to the successful development, implementation and exploitation of an atlas system lies in the administrative structure. Figure 2 illustrates the model suggested by the review which is based on that used in the GEBCO bathymetric mapping programme.

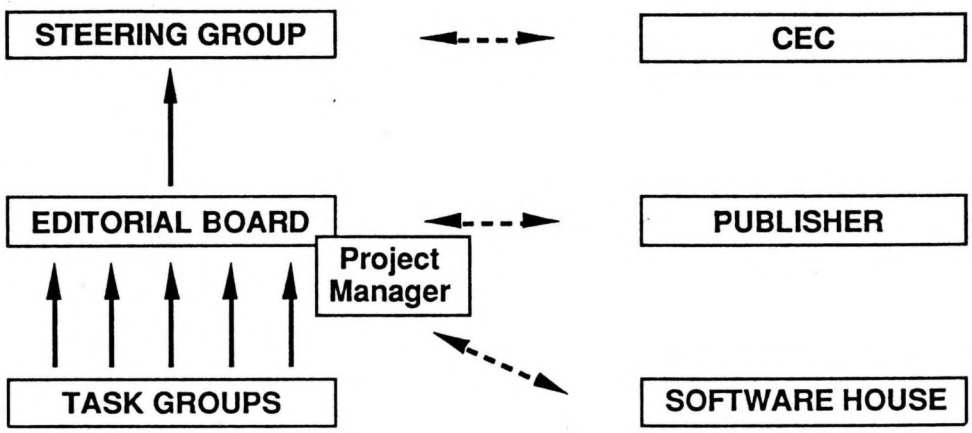

FIG. 2.- Possible administrative structure of European marine atlas project.

The various components of the model are as follows:

Steering Group: The primary role of the Steering Group would be to oversee the initial establishment of the project, in terms of finance, administration and

technology. Once the system was up and running, the Steering Group would then be responsible for the future directions the project took.

Editorial Board: An Editorial Board, or equivalent, would be responsible for the establishment and maintenance of standards and guidelines within the atlas project, both in terms of the design and format of output products, and the format of the input data.

Project Manager: This person, who would be on the Editorial Board, would be responsible for the day-to-day running of the project. The manager could also be responsible for a small team involved in the technical side of the project, possibly based at a central site as appropriate.

Task Groups: These would be created by either the Steering Group or the Editorial Board for undertaking specific tasks concerned with the development and/or implementation of the project. These tasks would be of short or long duration as necessary. Some may run indefinitely, for example the search for additional useful data-sets, new markets and research into novel products.

Financial

In order to carry out this project a substantial level of capital and initial recurrent expenditure is required. There are several possibilities for achieving this:

Firstly, the necessary finance could be obtained wholly from the likely major data contributors and end users. This is the model used in the UK marine atlas and MARIS projects. However, the development of a European atlas is likely to entail much greater funding requirements. Data providers are unlikely to be able to find sufficient resources at the outset. Indeed, this situation would be compounded by the additional call on resources for the generation of data-sets for the atlas which would arise if the project went ahead.

A second option would be to involve a commercial concern in the project, either to a large extent, or a lesser extent as is done in the MARIS project. For example a software house or publishing company could collaborate in the project. The drawbacks with this option are that some control over the entire atlas project would need to be relinquished, and there are risks of total failure for reasons outside the control of the participants.

As a third alternative a central organisational body, such as the CEC, could lead the initiative, perhaps providing initial 'pump-priming" and administrative assistance. A gradual transition towards supporting the project by the marketing of the products and charging for referral and other services could then follow.

A fourth option could be to mix elements from these options as appropriate. For example there is no reason why a company could not become involved in a sub-contractoral role in the provision of software, or the generation and publication of the end-products, namely: paper atlases, floppy disk, optical disks and CD-ROMS.

THE NEXT STEP?

The review proposed that the next step should be the undertaking of a 3 year pilot study. This would be planned by a small working group who should also undertake a detailed feasibility study to look into the best strategy for the implementation and establishment of a technical, administrative and financial infrastructure for an atlas. The working group would also investigate in detail the issues involved in data assembly and product design outlines above, namely: content, format, level of detail, geographic coverage, and scales.

To assist with these tasks the working group would assemble common data sets, such as coastlines, bathymetry and several representative examples of physical, chemical and biological data sets into a simple demonstrator system. This would probably involve the digitisation of some existing maps and charts, and the conversion of others which may already be in digital form. The demonstrator system would act as a "test-bench' for trying out various options and could also be used to attract additional interest in the concept of a European marine atlas from other potential users within the European Community.

CONCLUSION

The development of a digital atlas-based marine information for European waters is clearly a complicated undertaking, but one that should reap considerable benefits to a broad spectrum of users. The approach taken must be a careful evolutionary one for two reasons: Firstly, it is difficult to see how the project could be fully financed at the level required (unless a commercial concern were involved). Secondly, and perhaps most crucially, the data is simply not of sufficient thematic or geographical coverage to create a comprehensive atlas right at the outset, even assuming that the data is in mapped form. It is essential therefore to ensure that sufficient elements of the atlas are in place in order to encourage marine scientists to work their data up into a suitable form. A two-pronged line of attack is therefore suggested, aiming at a complete coverage of European waters with one or two data sets, for example, surface temperature or bathymetry, together with a more comprehensive study of one or two selected regional areas. This will hopefully achieve the desired effect of encouraging participation in the project by individual scientists, planners and co-ordinators of application programmes, whilst at the same time allowing development of the system to suit the needs of the end users.