

DEFINING A MARINE CADASTRE FOR AUSTRALIA

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Key Words: marine cadastre, maritime boundaries, spatial data infrastructure, marine rights and responsibilities

ABSTRACT

As the world's largest island, Australia has a coastline length of approximately 36,700 km. The nation's relative isolation from its neighbours enables it to claim one of the largest maritime jurisdictions in the world. The ocean territory to which Australia lays claim is about 1.5 times larger than the Australian land mass. Given the diversity and extent of Australia's ocean resources, there is an economic and social need to manage, explore and exploit the nation's ocean territories in a way that will maximise benefit, while at the same time protecting the ocean environment.

An essential requirement for the consistent and effective management of the oceans is reliable, comprehensive and accurate spatial information. This introduces the complex issue of defining and quantifying the spatial and temporal interaction of a vast array of rights and responsibilities.

Not only are our oceans subject to the interests of a diverse group of individuals and organisations, they are also governed by a complex web of government legislation. International treaties such as the *United Nations Convention on the Law of the Sea* (UNCLOS) also need to be considered. Many pieces of legislation contain geographical definitions for areas of jurisdiction. Understanding and managing the relationship and interaction between overlapping and sometimes competing rights is a complex problem.

The objective behind the development of a *marine cadastre* is to provide a comprehensive spatial data infrastructure whereby rights, restrictions and responsibilities in the marine environment can be assessed, administered and managed.

This paper describes a multi-faceted, collaborative project between the Department of Geomatics, the Australian Surveying and Land Information Group, the Queensland Department of Natural Resources and Mines, and Land Victoria to define the issues relevant to the development of a marine cadastre for Australia.

INTRODUCTION

The concept of a land-based cadastre has existed for many years. A cadastre is the basis or core of a land administration system and is defined as a parcel based and up-to-date information system containing a record of interests in land (e.g. rights, restrictions and responsibilities). It usually includes a geometric description of land parcels linked to other records describing the nature of the interest, and ownership or control of those interests, and often the value of the parcel and its improvements (FIG, 1995). More recently, work in the area of designing and developing a Spatial Data Infrastructure

(SDI) has gained considerable momentum in government, industry and academia. The need for SDI has arisen from an increased importance and use of geographical information. SDI's provide an environment of co-operation and sharing through the development of a dynamic partnership between inter- and intra-jurisdictional organisations (Radjabifard and Williamson, 2001). Advances in computer technology (hardware and software) have led to the compilation of huge volumes of land-related data, much of which has a significant spatial component. But such activity in the management and utilisation of land-related data naturally begs the question : what about the marine environment? One would be forgiven for thinking that there has been little interest in the use of spatial data in the administration and management of maritime jurisdictions. Perhaps it is more correct to say that whatever interest there has been has developed outside the geomatics industry. Whichever is true, the situation is about to change.

There is an increasing realisation that the interests of the nation do not stop at the land-sea interface. In fact, the area of marine rights and responsibility to which Australia lays claim is 1.5 times greater than the size of its land mass. The need to manage and govern this environment for the good of the nation is imperative. Competition for the vast array of natural resources in the marine environment is increasing, so too is their economic and social value. Suddenly there is an awareness of the need to gather, manage and utilise spatial data in the marine environment to assist in the preservation, protection and exploitation of this environment in a sustainable, equitable and consistent manner.

A common reaction when the prospect of a marine cadastre is raised is to suggest that all that we have learnt in managing land-related spatial data over many years can be applied to the marine environment. However, a cursory examination of the issues reveals that this simplistic approach suffers some major flaws. The marine environment poses a number of unique problems that do not apply in the case of land data. For example :

- The concept of *tenure* does not exist at sea
- It is not possible to use classical means of boundary demarcation offshore
- The marine environment is three dimensional – classical 2D simplifications will not suffice
- It is possible (common) for multiple (overlapping) rights to exist in a single locality
- Rights can vary with time, adding a fourth dimension to the spatial data
- The baseline to which many maritime boundaries are related is ambulatory

Thus the design and development of a spatial data infrastructure for the marine environment poses a number of new and challenging problems for researchers and practitioners alike.

As is the case with land administration systems, in the marine environment there are some issues that are common on an international basis but many which are country and even locally specific. It is not possible to make a blanket adoption of a model for a marine cadastre developed somewhere else in the world and apply it in the Australian context. A simple example is the application of national and state legislation. Such

legislation varies from country to country, and, even within Australia, from state to state. Unlike many countries, Australia operates on a State/Federal system of government under which there is a maritime zone, 3 nautical miles in width (called *Coastal Waters*) which defines the region of sovereign jurisdiction for the states and the Northern Territory. Federal jurisdiction commences at the outer limit of the 3 nautical mile zone and extends with varying rights and responsibilities out to the *Territorial Sea* at 12 nautical miles, the *Contiguous Zone* at 24 nautical miles and the *Exclusive Economic Zone* at 200 nautical miles (see Figure 1).

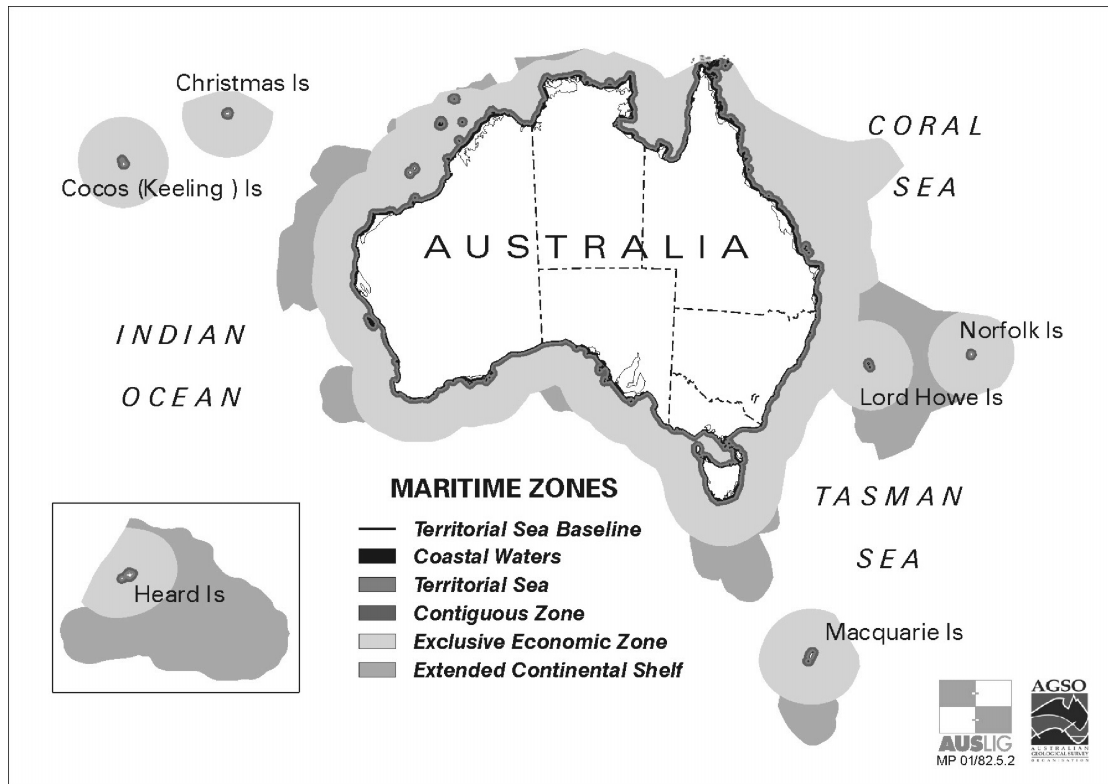


Figure 1 – Maritime Zones in Australia (courtesy of AUSLIG and AGSO)

The development of a marine cadastre for Australia is not a simple task. The complex interaction of various rights and responsibilities in time and space imposes complexities that do not occur when dealing with land based spatial data. Similarly, the locally specific nature of many of the issues demands the design and development of a solution suited to the Australian environment, whilst still wanting to take advantage of relevant international research.

In view of the increasing interest in the marine environment and the need to develop a comprehensive system of maritime management and administration, the Department of Geomatics at the University of Melbourne has joined with the Australian Surveying and Land Information Group, the Queensland Department of Natural Resources and Mines and Land Victoria to put a joint proposal to the Australian Research Council for funding for a two year project titled *Defining and Developing a Marine Cadastre for Australia*. The project will investigate and delineate the issues that need to be considered in the construction of a marine cadastre. This will be achieved through extensive consultation with government and industry and a detailed pilot project.

At the same time the Department of Geomatics at the University of Melbourne is supporting a graduate student to define the concept of the marine cadastre. The aim is to identify and document rights, restrictions and responsibilities in marine related activities, identifying the problems and needs from various users in the marine environment. A particular focus of the research is a review of the administrative interests at the land-marine interface. This project will conclude at the end of 2002.

CURRENT STATUS OF RESEARCH

While blanket adoption of international research in the area of the marine cadastre is not possible, much of the work that has been done is of relevance and provides a useful point of reference for beginning research in the Australian context. That which follows is a brief summary of the current status of research in Australia and overseas.

United States

The Coastal Services Center (CSC) of the National Oceanic and Atmospheric Administration (NOAA), in conjunction with various industry, government and academic collaborators, has been conducting an investigation into the construction of a comprehensive marine information system since the mid 1990's. The project is based on a pilot study covering the states of Florida, Georgia and North and South Carolina and has produced an on-line *Ocean Planning Information System (OPIS)* which can be accessed at <http://www.csc.noaa.gov/opis>. The OPIS project has investigated the broad range of issues that need to be considered in the construction of a marine cadastre and has successfully built a marine information system for the pilot project area. The study effectively delineates and emphasises the importance of a number of issues, including :

- The diverse range of players that have a role in the marine environment
- The plethora of legislation and regulation that impacts on marine operations
- The need to consider the requirements of all stake-holders
- The complex spatial and temporal interactions
- The importance of accurate and well defined spatial boundary information
- The poorly expressed and ambiguous nature of the spatial component of much of the legislation
- The problem of dealing with an ambulatory baseline for boundary definition

Members of the OPIS project team have produced a number of journal and on-line articles. In preparing the above summary, reference was made to : Fowler and Trembl (2001), Neely et al. (1998), Trembl et al. (1999), Lockwood and Fowler (1999).

Canada

Commencing in July 2000, a research project incorporating four Canadian universities and five industry and government partners was commenced under the title : *Good Governance of Canada's Oceans : The Use, Value and Potential of Marine Boundary Data*. The direction and objectives of this project are quite different from the OPIS project. The primary research focus is to consider the issues of maritime limits and boundaries. This aim is clear from the published project summary :

Resolving the boundary issues will ... be a critical first step towards a comprehensive marine geospatial data infrastructure which provides the foundation for effective and equitable governance of the oceans. (Nichols, 1999)

Key to achieving the objectives of the project is an understanding of the interactions and spatial relationships between various types of marine boundaries such as : the limits of private and public ownership; municipal, county, provincial and territorial limits of jurisdiction and administration; national and international boundaries; environmental protection areas; military limits, and pipeline and cable rights-of-way

Regular updates on the Canadian project are published on the project web-site at <http://www.unb.ca/GGE/Research/OceanGov/>. An important aspect of the project in the Australian context is the emphasis placed on maritime boundaries and their accurate delimitation. Additional details can be found in Nichols and Monahan (1999) and Nichols et al. (2000).

New Zealand

In the past two to three years, academics and government authorities in New Zealand have been defining the concept and developing a framework whereby the principles that govern the management of the land cadastre can be extended to the maritime environment. One of the strategic goals of Land Information New Zealand (LINZ) is the need to “...provide information and advice to enable the government to decide how future rights to the seabed will be defined and held”. As a consequence of this, a series of basic principles for the development of a seabed cadastre have been drafted (Grant, 1999). While the New Zealand efforts have been purely at the policy level, the relevant publications will provide a useful source of information for Australian research in the early stages. This includes those of Hoogsteden et al. (1999) and Robertson et al. (1999).

Australia

There has been no substantive research in Australia in the area of designing and developing a marine cadastre. However, at both the Federal and State levels, the issue has been raised and is receiving some preliminary attention. For example, the Intergovernmental Committee on Surveying and Mapping (ICSM) has a working group considering the complex issue of the *intertidal interface* – the boundary where land rights cease and maritime rights commence. Furthermore, AUSLIG has been given the responsibility of drafting a position paper for the Federal government to review the role and requirements of various government agencies in the marine environment.

At both the State and Federal levels, agencies responsible for managing offshore petroleum and mineral exploration have made efforts to maintain digital chart information recording the location of various tenements and permit areas. An example which illustrates a task-specific marine information system, can be seen at <http://www.enpex.com.au>. The intention of the current project is to go beyond task-specific systems and to build a comprehensive infrastructure that simultaneously administers the rights, restrictions and responsibilities of all stake-holders.

Researchers in the Department of Geomatics at the University of Melbourne have been working in the field of marine geodesy, including the geodetic definition of Australia's

maritime boundaries and extended continental shelf, since the mid 1990's. Various aspects of this work are presented in : Leahy et al. (1996a), Leahy et al. (1996b), Murphy et al. (1999), Hirst et al. (1999) and Collier et al. (2001). The majority of the work has been carried out under contract to AUSLIG and has resulted in the production of two commercially available software packages known as *MarBound* and *MarZone* (<http://www.sli.unimelb.edu.au/marzone/>). In the latter half of 2000, *MarZone* was used to compute all of Australia's maritime boundaries. *MarZone* will also be a key computational tool used to prepare Australia's claim to the United Nations (UN) for extended continental shelf. As is clear from the Canadian study, an understanding of the issues associated with maritime boundary delimitation is an essential pre-requisite for the construction of a spatially reliable and comprehensive marine cadastre.

At the same time the Department of Geomatics has considerable expertise and international recognition for research in the area of cadastres, land administration and spatial data infrastructures. The Spatial Data Infrastructure and Cadastral Research Group (http://www.geom.unimelb.edu.au/research/SDI_research/) comprises eight full-time researchers and attracts significant funding from industry and the ARC.

RESEARCH PLAN

Table 1 shows a timeline for the project. It can be seen that a two year programme of research is planned (2002 and 2003). Details of all tasks shown will not be given here. Rather, attention will be focussed on three major components of the project – the pilot study, the process of industry consultation and a comparative review of land-based and marine cadastres and the applicability of the Australian Spatial Data Infrastructure (ASDI).

Pilot Project

In both the American and Canadian projects discussed above, significant pilot studies are underway. It seems logical in planning to identify and define the issues that need to be considered for an Australian marine cadastre that a pilot project should be undertaken here also. The benefit of a pilot project is that it allows theoretical ideas and concepts to be tested, evaluated and refined. Real data can be compiled and synthetic data can also be incorporated to simulate situations that may not be present in the pilot project area.

One of the decisions that is yet to be made is the location of the pilot study area. Ideally the area should be complex, allowing for as much variability and interaction of various data types and sources as possible. Alternatives considered include Bass Strait, because this area involves the federal government, two State jurisdictions (Tasmania and Victoria) as well as the complexities introduced by the existence of many oil and gas production leases, proposed marine parks and fishing rights. Sections of the Queensland coast are also likely possibilities, particularly an area including part of the Great Barrier Reef Marine Park. Again, it is complexity and diversity of data that is key to the selection of a good pilot project area.

Industry Consultation

The success of the proposed project will depend on input from key players in the maritime sector. While this will include industry partners in the project, the objective is to consult more broadly and to take as much input as possible from as many interested players as possible. This will be done through face-to-face interviews with major stakeholders and a national questionnaire. In addition, two workshops will be conducted, the first at the mid-point of the project and the second at its conclusion. The objective of the workshops is to present current findings, identify the direction of future research and to take feedback from the workshop participants.

One of the objectives in preparing this paper is to have interested organisations and individuals made aware of the project and to invite an informal registration of interest from those who would like to be involved. This can be done by sending an email to the first author at p.collier@unimelb.edu.au. Those who register will be added to a project database and will be encouraged to participate in whatever way is most appropriate (interview, questionnaire, workshop).

Extension of the land cadastre and application of the NSDI

While it has been pointed out in the introduction that there are many distinctions to be made between a land and a marine cadastre, there are also undoubtedly many similarities. The objective of this part of the project is to identify that which is common and that which is different and to thereby determine what can be applied from land-based experience to the marine case and where new expertise and techniques need to be developed.

Similarly, the NSDI has been developed primarily with a view to facilitating the exchange of land-related data. The NSDI will need to be reviewed and possibly extended in order to cover the maritime case.

CONCLUSION

Spatial data will be a critical component in the management of Australia's ocean territories. This paper has described a project to be undertaken by a group of researchers from the Department of Geomatics at the University of Melbourne, AUSLIG, DNRM Queensland and Land Victoria. The project, through industry consultation, a pilot project and applied research will define the development of a marine cadastre for Australia. It is argued that such a project is a necessary first step toward the implementation of a marine cadastre. The objective of such a marine cadastre must be to ensure that the rights and responsibilities of all stake holders (government, industry and private) are adequately and equitably defined and managed.

Research Task	Year 1 (2002)												Year 2 (2003)											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
1. Identify and evaluate relevant maritime conventions and legislation																								
2. Identify Federal, State and Local agencies with administrative and jurisdictional responsibilities																								
3. Identify industry groups and private bodies with maritime interests																								
4. Assess theories and principles of land based cadastres which may apply to the marine environment																								
5. Evaluate the potential role of the Australian Spatial Data Infrastructure in supporting management of the marine environment																								
6. Identify and evaluate potential areas and commence scoping for pilot project																								
7. Consult with selected agencies and industry bodies to assess problems and issues that could be addressed through a marine cadastre																								
8. Assess the current status and adequacy of mapping and charting of these groups																								
9. Undertake a broadly based questionnaire to assess current and potential uses of spatial data in the marine environment																								
10. Identify and quantify the spatial data requirements of the various authorities and groups																								
11. First seminar – present current findings, take feedback																								
12. Undertake pilot project																								
13. Assess levels of spatial compatibility and the nature and extent of spatial interaction (2D, 3D, 4D, other?)																								
14. Develop techniques for computing and visualising intersecting areas and associated responsibilities																								
15. Consider issues of accuracy when defining and administering areas of responsibility																								
16. Second seminar – review findings of pilot project, propose directions for future work																								
17. Evaluate and report findings																								

Table 1 – Proposed timeline for marine cadastre project

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