EXTENDING LAND MANAGEMENT APPROACHES TO COASTAL AND OCEANS MANAGEMENT: A FRAMEWORK FOR EVALUATING THE ROLE OF TENURE INFORMATION IN CANADIAN MARINE PROTECTED AREAS

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PREFACE

This technical report is a reproduction of a dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Department of Geodesy and Geomatics Engineering, July 2006. The research was supervised by Dr. Sue Nichols and Dr. John McLaughlin and funding was provided by the Natural Sciences and Engineering Research Council of Canada.

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DEDICATION

To the Macharia family: my wife Wairimu and my daughter Imani.

…and to the Ng'ang'a family: my Dad Peter Ng'ang'a, Mum Agnes Kanini Ng'ang'a, brothers Charles Wainaina and Anthony Kuria , and sister Ida Wanjiku.

ABSTRACT

Canada's approach to coastal and oceans management consists of a complex, multi-layered system of laws, policies, organizations, and strategies. It is a fragmented approach to resource management and results in redundant efforts, inefficiency, ineffectiveness, and lack of coordination among agencies. One of the challenges encountered by Canada's approach is to use, share, and manage information resources effectively.

In particular, there is a need to provide complete and integrated inventories of information to mitigate conflicts among the growing ocean users, as well as to reduce administrative, jurisdictional and regulatory complexities. However, there is no comprehensive strategy to deal with the fractured and incomplete sets of data that are the legacy of the complex administrative and legal structures. Managing that information better should be the foundation for better decision-making regarding coastal and oceans resources.

To address this challenge, this research provides a systems view of marine management with a focus on the role of the information on rights, responsibilities, and restraints in marine space, i.e. the tenure information. Marine management consists of several processes including, administration of marine activities, uses and interests; which depend on management of tenure information.

This research investigates the role of tenure information and its management in implementing the Marine Protected Area (MPA) program by the Department of Fisheries and Oceans, Canada. Stakeholders in MPA establishment (e.g., government planners, environmental interest groups, coastal communities, and individual owners) often only

have a vague understanding of the complexity of rights that may exist. Better management of this tenure information can therefore improve stakeholder participation. In this research, a framework for managing tenure information management for Canadian MPAs is designed. This framework is developed from a primary MPA case study - the Musquash Estuary in New Brunswick, and then is tested in a comparative analysis with additional case studies.

The major conclusion of the research is that a framework should be based on three tenure information management activities: (1) determining tenure information requirements; (2) determining tenure information use; and (3) understanding the role of tenure information management groups. These activities facilitate the description of tenure information categories, their characteristics, their management, and their role in MPA establishment. Recommendations on the broader application of this framework in marine space management are also proposed.

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TABLE OF CONTENTS

1 CHAPTER 1: INTRODUCTION

As management becomes more integrated and holistic, MPAs will take on greater importance as a tool for conserving marine resources. In particular, MPAs have been proposed as an integral component of marine and coastal zone management, with establishment of regional networks of MPAs as a means to improve overall governance of the coastal ocean. However, implementation has been hindered by a lack of consensus on how to design MPAs to maximize their utility. The extent of current threats to marine resources may justify establishment of MPAs and reserves, despite the lack of experience, using an adaptive management approach to modify the design as knowledge and experience increase [NRC, 2001].

Marine and coastal degradation is caused by increasing pressure on both terrestrial and marine natural resources, and on the use of the oceans to deposit wastes [UNEP, 2002]. Population growth and increasing urbanization, industrialization and tourism in coastal areas are root causes of this increased pressure. In 1994, an estimated 37% of the global population lived within 60 km of the coast — more people than inhabited the planet in 1950 [Cohen et al., 1997].

Canada is particularly vulnerable. It faces the challenge of managing a continental shelf that is the second largest in the world at 3,700,000 km^2, representing approximately one percent of the surface area of the world's oceans [Canada, 1998, 1999]. Canada's commercial fish stocks have seriously declined in some areas, greatly affecting coastal communities and regional economies [Canada, 1997a, 1997b]. Sensitive habitats are being modified by a wide variety of activities, both inshore and offshore [Canada, 1997a, 1997b, 1998].

Canada's response has been through several policies and programs. These policies and programs have resulted in a complex and multi-layered system of laws, organizations, and strategies that exist to manage and govern use of coastal and marine resources [Hildebrand, 1989; Nichols and Monahan, 1999]. Federal/provincial legislation

and agencies provide a variety of legal frameworks and overlapping authorities and jurisdictions for the governance and management of these resources. This fragmented approach to management of resources is documented as resulting in redundant efforts, inefficiency, ineffectiveness, and lack of coordination among agencies (see for example, Ford, [1990]; Nanton [1993]; Nichols et al. [1997]; Canada [2002]).

By ratifying the *United Nations Convention on Law of the Sea* (*UNCLOS)* on 7 November 2003, Canada has acknowledged this framework as the basis for national interests and sovereign rights beyond the Territorial Sea. The spirit of UNCLOS is already captured in the *Oceans Act* [1996], which consolidates various legislations to provide a more comprehensive approach for the protection and development of coastal and ocean waters [Canada, 2002a]. The 2002 *Oceans Strategy* complements the Act by providing a blueprint that describes policy direction, partnership building strategies, and key activities for coastal and ocean management. The 2005 *Oceans Action Plan*[1] aims to achieve the long-term objectives of the *Oceans Act* [1996] and the *Oceans Strategy* by acting as an umbrella for coordinating and implementing oceans activities as well as sustainably developing and managing Canada's oceans [Canada, 2002b].

One problem is that these policy and program responses do not comprehensively deal with the legacy of fractured and incomplete sets of data that are the basis of decision-making regarding coastal and marine resources. Multiple administrative arrangements and levels of government authority have left a legacy of partial information on resources, resource use, and resource users. Partial information systems - such as for petroleum exploration and drilling, mining, construction of public utilities, or aquaculture - provide

[1] The Plan serves as the overarching umbrella for coordinating and implementing oceans activities, and as the framework to sustainably develop and manage Canada's oceans.

one dimension of resource users and rights to resources. One of the challenges of Canada's *Oceans Act* [1996], the *Oceans Strategy*, and the *Oceans Action Plan* will be to provide complete and integrated inventories of information to mitigate growing oceans user conflicts as well as administrative, jurisdictional and regulatory complexities.

To address this challenge, one has to look at the scale at which these policies, programs, and associated regulations are implemented. Regardless of the scale and intent of Canadian government policy, programs, and associated regulations, they are usually implemented at local, community, and individual levels. This is the level of incremental change[2] where stakeholders experience the effects of restrictions on activities and uses within specific coastal / marine space. Yet within this space, stakeholders in coastal and ocean management (e.g., government planners, environmental interest groups, coastal communities, and individual owners) often have only a vague understanding of the complexity of rights that may exist. This affects stakeholder participation in the policy/program implementation process, identified as a crucial element in Canada's *Oceans Act* [1996], *Oceans Strategy* and *Oceans Action Plan*[3]. This challenge in understanding rights in marine space exists because of: (a) the complex and multi-layered system of laws, organizations, and strategies that exist to manage and govern use of coastal and marine resources; and, (b) subsequent inconsistency/incompleteness in documenting rights to resources.

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[2] McLaughlin [1975] observed that the impact of various land use regulatory policies was felt at the individual proprietary land unit level – what might be called the level of incremental change. This was also observed by Denman [1979]. At this level, policies, programs and regulations gain greater meaning to the individual as they directly impact on enjoyment of resources within the space they "own". For example, a fisheries closure in a specified area will affect a particular resource user in a well-understood manner.

[3] *Oceans Act* [1996] Section 32 (c) affirms a commitment to seek the views of "…other ministers, boards and agencies of the Government of Canada, provincial and territorial governments and affected aboriginal organizations, coastal communities and other persons and bodies". This commitment is subsequently reiterated in the *Oceans Strategy* and *Action Plan*.

This challenge can be addressed in part by designing a framework at the local level that: (1) articulates the importance of rights (*roles and responsibilities*) in coastal and ocean management; (2) describes the information requirements for defining these rights; and, (3) demonstrates how an integrated inventory of information on "*who has what rights to use which resources*" is used in coastal and ocean management. This is the focus of this research.

1.1 The Resource Management Approach

The challenge, as articulated, is in large part a resource (and land) information management problem. It involves a process[4] of decision-making about the allocation and use of land and resources based on a predefined set of objectives. On land, resource management decisions are made in the context of the relationships people have with the land, and with other people. These may be economic, cultural, environmental, institutional, or other relationships [McLaughlin and Nichols, 1989]. From the cultural and institutional perspectives, the decisions are concerned with land resources use and the distribution of resource use within societies.

Resource management decisions have been enhanced by building information systems that highlight rights, responsibilities, and restrictions that individuals and / or groups have with respect to the allocation of land, its use, and enjoyment of its produce.[5] These systems have existed for a long time[6] and provide the information for decision

[4] Because it is considered a process, resource management is perceived as dealing with the inventory, allocation, development and conservation of community's land resources [McLaughlin and Nichols, 1989].

[5] These information systems are referred to as cadastres – parcel based information systems that provide information on ownership, use, and value.

[6] The origins of what has come to be accepted as the modern cadastre concept are to be found in the development of the fiscal or land taxation cadastres of Continental Europe during the 18th and 19th centuries. One of the earliest attempts to establish a fiscal cadastre was the Milanese cadastral mapping program carried out between 1720 and 1723. This program provided a series of estate maps at a scale of 1:2000 for the Italian provinces of Milan and Mantua acquired by the Austrians [McLaughlin, 1975].

makers to be able to balance resource type, location, quantity, quality and environmental factors against associated public and private property rights [see for example Oberlander [1985]; Bernstein [1985]; Dale and McLaughlin [1988]; McLaughlin and Nichols [1989]).

Several authors (e.g., Jones [1971]; McLaughlin and Epstein [1976]; Nichols [1981]; Nichols [1983]; McLaughlin and Nichols [1989]) have historically documented the need for similar systems in coastal and marine space and suggested that: (1) coastal zone planning depends on a decision maker accessing information on, among other things, the legal framework of ownership and control; and (2) there is a need for information systems (integrating property information) for shared and integrated decision-making in marine space.

These observations are still valid in Canada today as: (1) the focus remains on collection of data on the physical marine space and the characteristics that define this space; and, (2) less emphasis is put on providing integrated information at the appropriate "rights" resolution. The first point highlights the problem of understanding the vast frontier of the Canada's coastal and marine spaces.[7] The second point highlights the problem of not investigating the utility of property (and tenure) information in land management. This research addresses this second problem.

Property is defined as an enforceable claim to the use or benefit of some valuable thing [Macpherson, 1978, p.3]. Property information therefore describes a "thing" and the

[7] In the specific case of Canada, what is known today about Canada's ocean frontier is similar to what Canadians knew of the Prairies and the Arctic in the 18th and 19th centuries [Ocean Mapping Group 1999]. Internationally, Hoogsteden and Robertson [1998] observe that the vastness of ocean space has lad to scattered explorations of marine territory have been made primarily in pursuit of narrow goals, e.g., development of identified oil and gas reserves, communication infrastructure, and coastal navigation. The vastness of ocean space leads to information systems being prioritised as monitoring and prediction systems for marine phenomena and processes [Jacob et al., 2003].

enforceable claim one might have to the "thing"[8]. Land tenure can be defined very broadly as the set of relationships that outline the acquisition, use, transfer and distribution of land [McLaughlin, 1973; Crocombe, 1974; Barnes, 1985] or more specifically as the rights, restrictions and responsibilities that people have with respect to land [McLaughlin, 1975; Nichols, 1992]. In this research, property is viewed as a subset of land tenure.[9]

On land, tenure information plays a significant role in the implementation of various land use regulatory policies [Denman, 1971;[10] McLaughlin, 1975; McLaughlin and Nichols, 1989]. This is because regardless of the scale and intent of such policies, their effect will be felt at the spatial extent exercised by individual (or group) stakeholders. Implementation of land use regulatory policies also needs to be socially and politically justified - a task made easier by highlighting the effects of the policies at the proprietary land unit (or property holding) level [McLaughlin, 1975].

As mentioned previously, Canada's policies and programs are implemented and appreciated at local, community, and individual levels because the effects of restrictions are realized here. Coastal and marine resource management consists of policies and programs that (a) affect a specific spatial extent; (b) manage resources within that extent; and, (c) affect rights to resources enjoyed by individual (or group) property holders. As such, it is reasonable to suggest that tenure information will have an effect on policy, programs, and regulations that might be proposed. More specifically, irrespective of the

[8] Property is conceptualised as consisting of the rights, objects, and subjects. In this thesis, property information describes the resource, individual/s with an enforceable claim, and type of resource use claims.
[9] Nichols [1992] suggested that property, with its emphasis on 'rights' is a subset of land tenure, which is a much broader term with emphasis on 'rights', 'restrictions' and 'responsibilities'.
[10] Denman suggested, " if we fail to recognise that land use is a function of property rights in land, our cognisance of the truth is deficient by a whole dimension or reality" (as cited in [McLaughlin, 1975]).

land/marine physical distinction, tenure information might be useful in: (1) making land use planning decisions; and, (2) justification and implementation of coastal and marine policies, programs and regulations.

1.2 A Framework Relevant to Canada's Coastal and Oceans Management

From the foregoing discussion, it is necessary to provide a framework for: (a) clarifying the role of tenure information in coastal and marine management; (b) describing the tenure information requirements; and, (c) demonstrating the use of tenure information in coastal and ocean management. In order for the framework to be relevant to Canada's coastal and oceans management approach it is important to relate the design to the existing policy, program, and regulatory structure described by Canada's *Oceans Act* [1996], the *Oceans Strategy* and the *Oceans Action Plan*. One option is to review this policy, program, and regulatory structure and design a framework that addresses the central pillars described therein.

The *Oceans Act* [1996] represents a legislative commitment to a comprehensive approach for the protection and development of coastal and oceans space [Canada, 2002b]. To achieve this commitment, the *Act* calls for the federal Department of Fisheries and Oceans to lead and facilitate the development of plans for Integrated Management (IM).[11] The IM concept involves: (1) comprehensive planning and managing of human activities to minimize conflict among users; (2) a collaborative approach; and, (3) a flexible/transparent planning process that respects divisions of constitutional and departmental authority [Canada, 2002a]. The concept calls for an IM plan which aims to

[11] A review of the *Oceans Act* [1996] indicates that there are several principles that are central to the Canadian approach to coastal and oceans management. Section 30 of Canada's *Oceans Act* [1996] provides for the *Oceans Strategy* to be based on the principles of sustainable development, integrated management of activities, and the precautionary approach [Canada, 2002b].

guide ocean management decisions by sharing information, consulting with stakeholders, and stakeholder advisory/management participation in the planning process [Canada, 2002b]. Integrated Management is also a fundamental element in Canada's *Oceans Strategy* and *Oceans Action Plan*.

In the *Oceans Strategy*, a number of elements are identified as essential in Integrated Management for coastal and ocean areas. These elements describe a roadmap for applying the integrated management approach. A snapshot of these elements includes [Canada, 2002b, p.8]:

- Using existing governance structures, or establishing new ones that address multiple interest and user conflicts.[12]
- Analyzing implications of development, conflicting uses, and interrelationships between natural physical processes and human activities.[13]
- Considering cumulative effects of current and approved future human activities.
- Integrating data collection, research, synthesis, and information sharing, communication and education.[14]

The *Oceans Action Plan* attempts to assert how this will be accomplished by targeting the development of IM plans for Large Oceans Management Areas (LOMA). However, there is no mention of how to specifically address the fractured and incomplete sets of data that are the basis of decision-making regarding coastal and marine resources. Further, the outlined IM elements suggest spatial management of resources, a focus on rights to resources, and the interaction of individual (or group) stakeholders. This

[12] Includes encouraging all resource managers to consider social, cultural, economic and environmental impacts of decisions.
[13] Includes promoting linkages and harmonization among sectoral coastal and ocean activities.
[14] As part of a full range of relevant knowledge to be applied to the planning and decision-making processes.

assumes that there exists: (1) a consistency and completeness in documenting rights to resources; and, (2) an integrated inventory of this information. As discussed previously, both assumptions are incorrect.

To provide a context for addressing these assumptions, this research draws from the DFO *Policy and Operational Framework for Integrated Management of Estuarine, Coastal and Marine Environments in Canada* [Canada, 2002a]. [15] In this document, the establishment of IM plans includes the development of a system of Marine Protected Areas (MPA) - arising from the legislative mandate outlined in section 35(2) of the *Oceans Act* [1996]. MPAs are designated coastal and marine spaces within which human activities are regulated more stringently than elsewhere, typically to achieve certain conservation objectives (see Canada [1997]; *Oceans Act* [1996]). MPA implementation is a core tactic in Canada's *Oceans Act* [1996], *Oceans Strategy* and *Oceans Action Plan*.

The design of the previously mentioned *Policy and Operational Framework* involves establishing an IM plan, and a network of MPAs within the plan. In this design, individual MPAs are considered the building blocks of this network, and lessons from MPA establishment/management important in the context of the network. However, a closer review of individual MPAs and coastal/marine IM areas highlights some noteworthy similarities.

First, the MPA and IM planning processes are structurally similar. For example, the MPA planning process involves the following steps: *identification of MPA Areas Of Interest (AOIs); initial screening of AOIs; AOI evaluation and recommendation; development of a management plan for a candidate MPA site; designation of an MPA;*

[15] The policy and operational framework document outlines: (1) the policy concepts and principles; and, (2) an operational framework with governance, management by areas, design for management bodies, and type of planning processes involved [Canada, 2002a].

management of an MPA [Canada, 1998]**.** These correlate positively to the IM planning process steps of: *define and assess the IM area; engage affected interests; develop IM plan; endorsement of plan by decision making authorities; implement IM plan; monitor, evaluate and revise IM plan* [Canada, 2002a].

Secondly, this similarity extends beyond the structure of the planning processes to the IM and MPA management plans which [Canada, 1998; 2002]: (1) fall within multiple jurisdictions (i.e., provincial, territorial or community); (2) take into account specific policies, plans and legislation that apply in an area; (3) are tailored to environmental settings and existing proposed oceans uses; (4) may be presented as a series of recommended management actions directed towards specific oceans uses; (5) may be presented as a zone identifying areas of preferred oceans use; and, (6) are built through collaboration as a governance model, and adaptive management as a key philosophy.

It is therefore reasonable to suggest that lessons learnt from addressing the fractured and incomplete sets of data on rights to resources, in an MPA establishment and management context, would benefit Canada's goal of Integrated Management[16]. This in turn justifies the selection of MPAs in designing a framework relevant to Canada's coastal and oceans management.

1.3 MPAs and the Tenure Approach

The Department of Fisheries and Oceans (DFO) MPA program is considered to be unique in Canada in 2 respects [Canada, 1997a; 1998].[17] First, it allows the designation of

[16] The central governance mechanism in the *Oceans Strategy* is the development and integration of Integrated Management plans.

[17] The Canadian Government has three formal protected area programs for the marine environment [Canada, 1998]. These are administered by Canadian Heritage (Parks Canada), by Environment Canada and most recently by Department of Fisheries and Oceans. Canadian Heritage National Marine Conservation Areas (NMCA) program is in the process of establishing a number of NMCAs while Environment Canada has three marine-conservation-oriented

MPAs under broader guidelines than those provided by other programs (*known for dealing with specific habitats or species*). Secondly, designation of MPAs provides protection that is much greater than that afforded by other programs.[18] As such, the ability to establish DFO MPAs provides additional management tools that can be used to enhance stewardship of marine resources and their habitats [Canada, 1997a, 1998]. This MPA program is meant to address a wide range of marine resources and management dilemmas. MPAs can be established for numerous reasons, and as a result, can take a variety of forms and approaches.[19] It is generally accepted that well-planned MPAs not only protect critical habitats and general ecosystem functions but also meet the needs and even enhance the opportunities of many different stakeholders living in the region [National Research Council, 2001].

MPAs attempt to highlight critical habitats/ecosystems; as well as human actions (activities and uses) lying within a spatial extent; [20] in a formal attempt to control these actions. Two general groups of information are therefore considered important in MPA management: (1) for highlighting the conservation values and, (2) for regulating human actions. Human actions translate into land use - which is shown in land management research as depending on tenure information (see for example Denman [1971]; McLaughlin [1975]).

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designations available that focus on habitats for migratory birds: National Wildlife Areas, Migratory Bird Sanctuaries, and Marine Wildlife Areas [Canada 1997a, 1997b].

[18] For example, MPA management plans can define buffer areas adjacent to the MPA boundaries whereby certain activities are restricted [Canada, 1997a].

[19] Generally, it is accepted that MPAs are established for: helping to preserve important fisheries, for protecting historical and cultural resources, for conducting scientific research, for preserving natural communities and freeing them from exploitation, and for establishing parks for diving [Canada, 1997a].

[20] This is the level of incremental change previously articulated. MPAs are implemented within a specific spatial extent within which regulatory restrictions are imposed.

This research uses the establishment of DFO Marine Protected Areas (MPAs) to design a framework that:

(1) Clarifies the role of tenure information in MPAs;

(2) Identifies tenure information requirements in MPAs; [21]

(3) Demonstrates the use of tenure information in the MPA decision-making process;

(4) By association, informs the broader Integrated Management process (of which MPAs are a part).

1.4 Research Motivation

The motivation for this study arose from a Geomatics for Informed Decisions (GEOIDE) Research Network project entitled *Good Governance of Canada's Oceans: The Use and Value of Marine Boundary Information*. The research aimed to address marine boundary issues in Atlantic Canada using case studies [Nichols et al., 2000]. One of the case studies dealt with the management of a proposed DFO Marine Protected Area (MPA), located in the Musquash estuary, in the Bay of Fundy in Atlantic Canada. This case study is used to develop the framework in this thesis.

The research problem in the Ocean Governance project can be paraphrased as a set of questions: (1) whose rights are impacted when decisions are made about marine space? and, (2) how do we visualize this given that there is currently no comprehensive inventory of these rights and boundaries? These questions are even more significant given the relatively new nature of MPAs in Canada (from 1996) and the "learning by doing" approach advocated in the National Framework for identifying and managing

[21] The spatial extent of marine property rights is sometimes based on a license or lease (with explicitly recognized rights) defining the resources being exploited [Nichols et al., 1997]. In some other cases, the extent is based on the legally recognized geographical extent (the so called "property bounds") highlighting the rights enjoyed and restrictions placed on activities within this extent.

MPAs. Since there are *only* two fully designated *offshore* MPAs in Canada, this shows that experience is still being obtained on how to best establish and manage MPAs. [22] MPA managers in Canada are still struggling with operational issues surrounding the steps to establishing and managing *offshore* MPAs in general, and *inshore* MPAs in particular.

A review of information used to establish and manage DFO MPAs suggests that there is greater focus on specific information categories. Generally speaking, information on the marine environment, its resources, and uses, is considered critical in identifying, evaluating, and managing MPAs [Canada, 1997a; Canada 1998]. However, several publications (e.g., Canada [1997b]; Fenton and Westhead [2000]) emphasize that MPAs are to be identified, established and managed with a bias for environmental and ecological data. Reference to resource use, or resource use rights (e.g., tenure information), is de-emphasized. While there is some emphasis on the importance of socioeconomic data (a category that tenure information would fall into), there is less clarity on (*tenure*) information requirements, or use of this data, in MPA establishment and management.[23]

MPA establishment and management involves engaging a diverse range of parties with a decision-making role, interest, or specific knowledge of the area. This collaborative management approach depends on a shared understanding so that "dialogue can occur on the issues, objectives and options" [Canada, 2002a, p.26]. This might

[22] These two designated MPAs are as of May 2005. They consist of : (1) the Gully MPA located in the Scotian Shelf off Nova Scotia, Atlantic Ocean and, (2) the Endeavour Hot vents located in the Juan de Fuca Strait off British Columbia, Pacific Ocean. See http://www.dfo-mpo.gc.ca/canwaters-eauxcan/oceans/mpa-zpm/dmpa_e.asp .

[23] In fact, there is no specific reference to property information in MPA program documentation. The umbrella term of "socio-economic data" is used to capture all other data that is not ecological. The program documentation, which provides guidelines on establishing MPAs, specifically indicates that, "…ecological values may be more important than technical and socio-economic considerations [Canada, 1998, p.17]". This arises from the widely held position that ecological data is the basis for MPA establishment (see Fenton and Westhead [2000]).

include being able to visualize how existing and proposed regulations will affect rights of individuals, community, and other stakeholders (see for example, LSLK [2002]). Additionally, it might be necessary to not only implement but also justify land use regulatory policies associated with the MPA. This depends on tenure information identification and management. Therefore, an investigation into tenure information requirements, and the role of tenure information in MPA establishment and management, is essential.

This leads to the goal of this research, which is to identify, design and test a tenure information management framework for Canadian MPAs. To this end, the thesis begins by developing a conceptual framework for analyzing the role of tenure information in marine environmental management based on three sources: (1) significance of tenure information in marine environmental management; (2) national approach to Canadian oceans and coastal management; and, (3) existing MPA management frameworks. It then uses the results of this analysis to refine the conceptual framework and design a specific framework for tenure information management in Canadian MPAs. The thesis proceeds to design an approach for testing the framework components in a case study setting, and an approach to carry out a comparative analysis of the results against two other case studies. The results from the testing of the framework facilitate visualizing how existing and proposed regulations affected rights of individuals, community, and other stakeholders. The major conclusion of this research is that the research goal can be achieved by developing a framework that is initially modeled using spatial and non-spatially delimited information requirements, and then refined by incorporating the socio-cultural-political roles of this information.

1.5 Research Problems

This research has determined that it is necessary to provide clarification on the various terminologies that are used in Canadian coastal and oceans management. Terms like environmental management, ecosystem management, adaptive management, sustainable development, and integrated management are used (in some cases interchangeably) when referring to various management aspects. In environmental management, terms like conservation, protection and restoration may mean different things depending on the context in which they are used. This research will provide an indepth description of these terms in an attempt to provide clarity regarding coastal and oceans management terminology.

As mentioned in section 1.4, this research deals with the identification, design and development of a tenure information management model for Canadian MPAs. To this end, this research uses the proposed Musquash MPA to: (a) explain the role of tenure information in MPAs; (b) identify MPA tenure information requirements; (c) demonstrate the use of tenure information in the MPA decision-making process; and, (d) inform the broader Integrated Management process. This includes evaluating:

(1) The information currently used in Canadian MPA establishment and management.

(2) The tenure information available for use in Canadian coastal and marine space.

(3) General uses (and associated requirements) of tenure information in marine space decision-making.

(4) The strengths and limitations of existing tenure information management activities.

This research also deals with an emerging (and evolving) concept regarding the governance of marine spaces – the marine cadastre. The concept of a marine cadastre, as

a tool to assist in the governance of marine spaces, is based on the assumption that cadastre functions can be extended from land to marine space. This assumption is justified from three perspectives. First, the underlying principle of the marine cadastre concept is the ideology of the (dry land) cadastre. The similarity in conceptual foundations is often used as justification for extending (dry) land concepts to marine space. Secondly, the definition of a cadastre as "a parcel- based record of interests in land encompassing both the nature and extent of these interests [McLaughlin, 1975]", already includes the marine space. For example, Dale and McLaughlin [1988] suggest that the term "land" is viewed as encompassing both land and water filled spaces.

Thirdly, the marine cadastre concept suggests that the complexity of interests in marine space is similarly encountered in (dry) land. For example, interests in marine space are at least three-dimensional and contain many overlapping parcels. Additionally, they have an important time dimension because the water itself and many living resources change location over time. [24] However, there are similar examples of three-dimensional, overlapping parcels, and time considerations on (dry) land. These examples were used to propose the multipurpose cadastre concept - designed on a 3-dimensional spatial unit (parcel) representing unique, homogeneous, contiguous interests (see McLaughlin [1975]; NRC [1980; 1983]). [25]

These are some of the reasons for assuming that the cadastre concept can be extended to marine space. However, subtle differences exist based on different jurisdictions, focus, and perspectives. This is reflected in current marine cadastre definitions shown in Chapter 2. This shows that the novelty of the marine cadastre concept has led to an

[24] And some non-living resources, such as sand and gravel aggregates.
[25] Other relevant information regarding the physical and biological natures of the environment (among other things) is usually accessed via a parcel—based retrieval mechanism in order to give the cadastre a multipurpose function.

overabundance of ideas and concepts regarding, (1) what it consists of (requirements) and, (2) what it is supposed to do (use). This thesis therefore attempts to "anchor" the definition of a marine cadastre by addressing tenure information requirements, and the socio-political role of this information in managing marine space.

1.5.1 Thesis Questions

The following questions are to be addressed in this thesis:

a) What frameworks exist for studying tenure information requirements for marine space?

b) How are tenure information requirements determined for MPAs?

c) Can boundary delimitation concepts be applied successfully in MPAs? If so, what type of information is required and what is it used for? If not, is there a role for boundaries in MPA establishment and management?

d) How is a tenure information management system identified and modeled for an inshore Marine Protected Area in New Brunswick?

This research reviews several case studies during the MPA establishment process. Therefore, there are questions regarding the use of tenure information in the MPA establishment process that need to be addressed. These are also outlined as a series of questions:

a) Can the MPA tenure information management process be shown to support coastal communities and government in public decision-making?

b) Can the MPA tenure information management process be shown to encourage coastal communities to participate in public decision-making?

c) Can an MPA tenure information management system be used to overcome communication barriers between different marine space stakeholders?

d) Can an MPA tenure information management system be used in other inshore Marine Protected Areas in Atlantic Canada?

1.5.2 Thesis Objectives

Based on the research questions outlined in the preceding section, the following thesis objectives have been outlined:

a) To design an overall framework for modeling the role of tenure information in marine space management. This framework consists of the following sub-frameworks:

   a framework for modeling the tenure information requirements in MPAs;

   a framework for modeling the tenure information use in MPAs;

   a framework for evaluating citizen participation levels during MPA establishment.

b) To use the frameworks to model and evaluate a tenure information management system for an MPA in New Brunswick, Canada.

c) To design a framework for comparing the Musquash MPA with other inshore MPAs.

1.5.3 Thesis Scope

This thesis is limited to a study of tenure information management for an inshore MPA located in Atlantic Canada. This study focuses on the Musquash MPA, located in the Musquash estuary in the Bay of Fundy, in the Province of New Brunswick where fieldwork has been carried out from Spring of 2000 to Fall of 2005. This area represents

one of the first inshore Areas of Interest (AOI) declared by the federal Department of Fisheries and Oceans (DFO).

There are other inshore MPAs under consideration in Atlantic Canada (Basin Head in PEI, EastPort Peninsula, Gilbert Bay, Leading Tickles in Newfoundland).[26] Therefore, this research proposes evaluating the results obtained for the Musquash MPA against other inshore MPAs in order to further validate and test the frameworks designed, and allow a comparison with similar case studies. For this purpose, two inshore MPAs are compared, namely: Basin Head MPA in the Province of Prince Edward Island, and Gilbert Bay MPA in the Province of Newfoundland and Labrador.

1.5.4 Research Methodology

The research methodology consists of five phases as summarised in Figure 1.1. Phase 1 involved conducting a literature review of: tenure and tenure information management concepts and models; marine tenure information examples; marine resource management; marine governance programs in Canada; the DFO MPA program; and, tenure information in Canadian marine space. This led to the design and development of a conceptual framework for analysing and modelling tenure information in Canadian MPAs. This framework depends on the concept of tenure information and its role in marine space management.

[26] The MPA goals are: Basin Head- conservation and protection of Irish moss and the ecosystem that supports it; Eastport- conservation and protection of commercial and non-commercial fisheries resources and their habitats; Gilbert Bay- special protection for important commercial and non-commercial fish species and their habitats; Leading Tickles- key species and habitats that may require special protection.

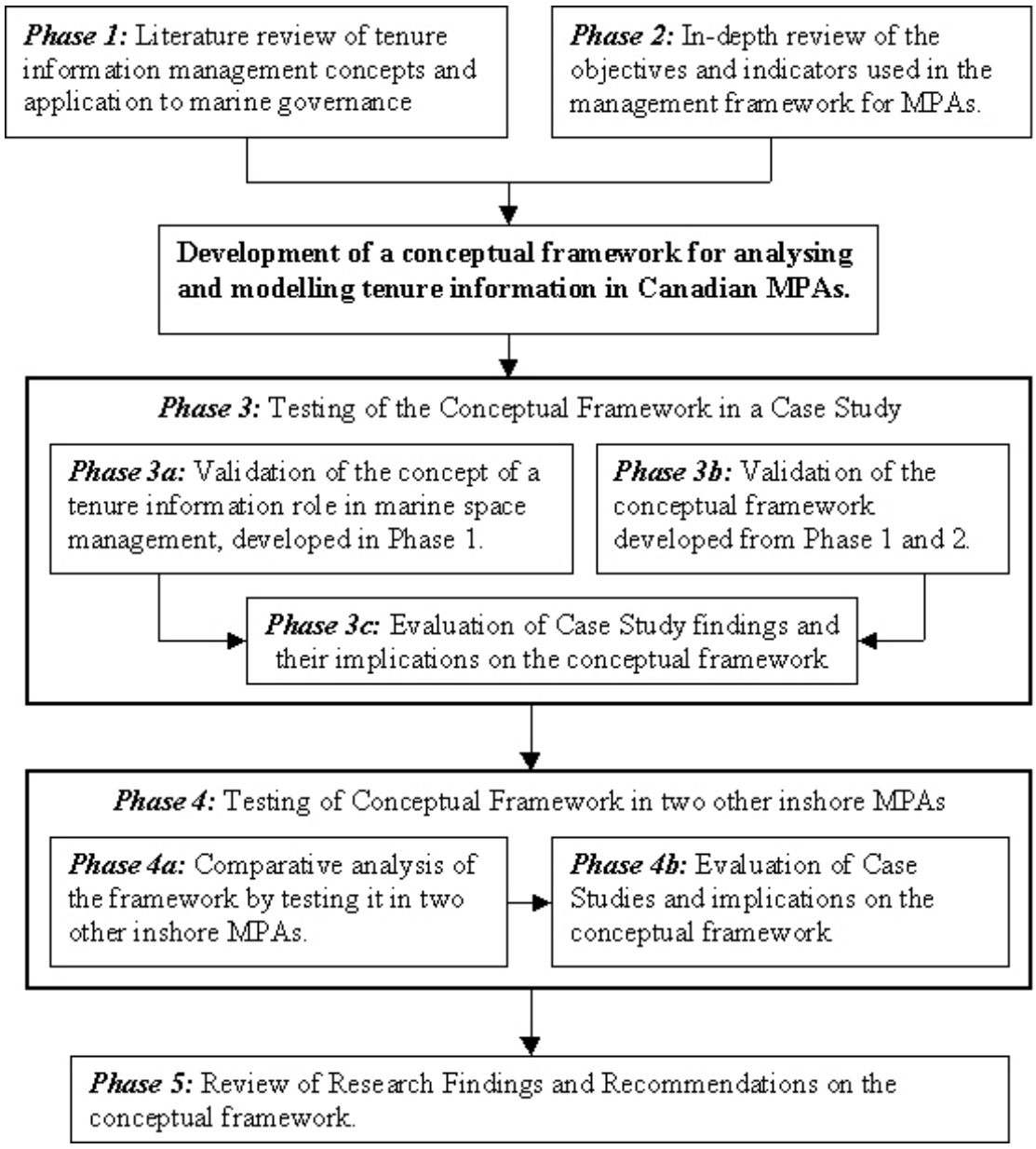

Figure 1.1: The Research Method

Phase 2 involved further development of the conceptual framework. This begun with a broad literature review of the management framework for MPAs in general and Canadian MPAs in particular. It evolved to an in-depth review of the objectives and indicators used in the management framework for MPAs. From this review, three components were identified as important in the framework: (1) tenure information

requirements for MPA establishment (2) the use of tenure information in MPA establishment, and, (3) the role of MPA stakeholders in tenure information identification and use. These were identified as the core components of the framework for analysing and modeling tenure information in inshore Canadian MPAs.

Phase 3 involved the validation of the concept identified in Phase 1 and the core framework components identified in Phase 2. The results were then evaluated and used to refined the conceptual framework. Therefore, there were three sub-phases, referred to as 3a, 3b and 3c. These three phases facilitated the testing and refinement of the concept and framework in a case study setting.

Phase 3a involved validation of the concept of tenure information and its role in marine space management. This concept was developed in Phase 1 and was verified by (1) interviewing various stakeholders, (2) participating in regular meetings of the Musquash MPA Planning Group (MPAPG) and (3) organizing public meetings to obtain opinions of the local community. A simple prototype for managing tenure information was created (see Appendix V). This prototype demonstrated a decision support tool that utilised tenure information. The prototype was intended to stimulate discussion within the Musquash MPA Advisory Committee regarding tenure information requirements (and use) for MPA establishment.

Phase 3b involved validation of the framework developed in Phase 2 during the establishment of the Musquash MPA. This was done by testing the framework during the preparation of various MPA management plan components. This means that during the establishment of the Musquash MPA, the following were investigated: (1) tenure information requirements, (2) tenure information use, and (3) the role of stakeholders.

These were investigated during the preparation of the following MPA management plan components: (1) rationale, (2) conservation and management objectives, and (3) spatial extent.

The results of Phase 3a and 3b were evaluated in Phase 3c. This led to a refinement of the conceptual framework based on the findings from the Musquash MPA case study.

Phase 4 involved a comparative analysis of the framework by testing it in two other inshore MPAs. This involved two sub-phases referred to as 4a and 4b. These two phases facilitated the (1) verification of the conceptual framework, (2) validation of the approach of testing the conceptual framework, and (3) evaluation of the implication of the results on the conceptual framework.

Phase 5 involved recommending a framework for managing the tenure information based on the comparative analysis of Phase 4 and the lessons learnt in Phase 3. A model describing the categories and characteristics of tenure information was proposed. Recommendations on the application of this framework in marine space management were also proposed.

1.6 Thesis Organisation

Chapter 1 discusses the research problems, design, methodology, and thesis organisation.

Chapter 2 provides an introduction to land management perspectives, goals, objectives, functions and processes. From this, a foundation is developed for similarly describing marine environmental management, by highlighting the importance of administering activities and interests, and the specific role of marine tenure information

in accomplishing this. The purpose of this chapter is to outline the role of marine tenure information in marine environmental management.

Chapter 3 reviews the available approaches for managing marine space with special emphasis on MPAs in Canada. From this, a conceptual framework for managing MPAs based on tenure information is developed. The purpose of this chapter is to describe the process of administering marine activities and interests in Canada, identify shortcomings in the process, and identify a strategy for addressing these shortcomings.

Chapter 4 reviews the general criteria for selecting and managing MPAs found in MPA literature and refines the conceptual framework outlined in Chapter 3. The purpose of this chapter is to outline a preliminary framework for describing marine tenure information functions and processes; and their role in MPA implementation. This is accomplished by focusing on MPA goals, objectives, and their respective indicators. It results in an indicator-driven framework for identifying marine tenure information management activities.

Chapter 5 describes the approach to testing the indicator-driven framework that has been developed in Chapter 4. The purpose of this chapter is (a) to describe the approach used in applying the framework to a case study setting, (b) introduce the primary case study, and (c) describe the associated fieldwork used to apply the framework.

Chapter 6 provides the results of testing the conceptual framework in the primary case study. In this chapter, the primary case study is used to investigate the role of tenure information in MPA establishment. This is accomplished by using the indicator-driven framework developed in Chapter 4, and applying the approach developed in Chapter 5. The purpose of the case study is (a) to verify the rationale of the proposed framework,

and (b) highlight how tenure information was used in MPA management plan preparation. This chapter provides the first set of results regarding two management plan components: namely, MPA rationale and objectives.

Chapter 7 provides the second set of results on testing of the conceptual framework in the primary case study. This is done for the remaining management plan component, the MPA spatial extent.

Chapter 8 provides a comparative analysis of the results obtained in Chapter 6 and 7. The conceptual framework developed in Chapter 4 is tested in two other inshore MPAs using the approach developed in Chapter 5. The purpose of this comparative analysis is to verify the rationale of the proposed conceptual framework by applying it in other similar case studies. The chapter highlights how tenure information was used in the two case studies to determine the MPA (a) rationale, (b) objectives, (c) spatial extent.

Chapter 9 summarizes the work carried out and draws conclusions about the research. This purpose of this chapter is to (a) review the results obtained, (b) provide recommendations on the proposed framework and, (c) highlight the use of the framework in the DFO MPA program.

1.7 Research Contributions

There are several research contributions. First, this research provides clarity on the role of tenure information in MPA management. This is important since MPA management frameworks in Canada do not emphasize tenure issues in MPAs nor do they incorporate the approach proposed herein. When this research began in 2000, there was very little appreciation among the scientific community at DFO of the importance of tenure issues in marine space management. This culture has slowly been changed and the

community has slowly begun to incorporate the language of tenure (especially concepts like jurisdiction and property rights) in coastal and offshore management. For example, the Eastern Scotian Shelf Integrated Management Plan (ESSIM-P) explicitly recognizes this by incorporating *human use objectives* in addition to *ecosystem objectives* (ESSIM Planning Office, 2005].

Second, this work can make a significant contribution in the development of boundary delimitation concepts. In particular, this work is seen as dealing with the issue of boundary uncertainty and the subsequent resolution of complex (tenure-related) issues surrounding decision-making in MPAs. A clearer understanding about the nature, location and extent of the boundaries in an MPA, and its relationship to access and availability of tenure information, is considered to be important component of MPA decision-making.

Third, the proposed framework has an immediate impact of providing managers of the MPA process with a "template" for use in the construction of an MPA management plan. The template can also be used as an aid to evaluating proposed MPA regulations and to propose changes to regulations (i.e., the Regulations Impact Assessment process). This is in line with the "learning by doing" approach advocated in the MPA program policy.

Finally, this research benefits the scientific community by advancing an alternative "interest-driven" (as opposed to "boundary-driven") concept of the marine cadastre. A vision of the marine cadastre includes the provision of an inventory of the nature of the interests that exist, location and spatial extent of the interests, and the holders of those interests. The case studies in this research provide insight into the tenure information that

may be resident in such an information system, as well as some of the challenges in implementing such a system.

2 CHAPTER 2:THE SIGNIFICANCE OF TENURE INFORMATION IN MARINE ENVIRONMENTAL MANAGEMENT

> *…By examining all uses of land in an integrated manner, it makes it possible to minimize conflicts, to make the most efficient trade-offs and to link social and economic development with environmental protection and enhancement, thus helping to achieve the objectives of sustainable development. The essence of the integrated approach finds expression in the coordination of the sectoral planning and management activities concerned with the various aspects of land use and land resources (extracted from Agenda 21 [UNCSD, 1992]).*

The purpose of this chapter is to outline the role of marine tenure information in marine environmental management. Chapter 1 has provided an overview of issues surrounding property information management for MPA establishment and management. The research problem has been identified as addressing the fractured and incomplete sets of data on rights to resources that are the basis of Canada's coastal and oceans management. In this chapter, an introduction to resource management perspectives, goals, objectives, functions and processes is provided. From this, a foundation is developed for describing marine environmental management, by highlighting the importance of administering activities and interests, and the specific role of marine tenure information management in accomplishing this.

2.1 Land Management

Land management is the process of making and implementing decisions about how land and its resources will be distributed, used and protected in society [Nichols, 1992[27]; Larsson, 1997].[28] Because land management is considered to be a process, it can be

[27] Based on O'Riordan [1971] and quoted by Nichols [1992].

[28] Although this distinction was originally relevant, land managers do not necessarily distinguish these terms in a similar manner. It is recognized that in practice, the management of any land use or resource cannot be considered in isolation [Nichols, 1992]. Land management is viewed as a larger process whereby resource management (e.g., management of single or multiple resources) and land use management (e.g., management of human related activities) are interrelated subsets [McLaughlin and Nichols, 1993].

perceived as dealing with the inventory, allocation, development and conservation of community's resources [McLaughlin and Nichols, 1989].[29]

Several authors (e.g., Oberlander [1985]; McLaughlin and Nichols [1989]; Holstein [1990]) have suggested that this widely accepted definition implies that land management is essentially a multidimensional process; and, that there is merit in viewing this process from its constituent environmental, economic and institutional perspectives. In other words, based on management goals and objectives, individuals or groups may exert influence on land and resource use from three primary perspectives as shown in Table 2.1[30].

Table 2.1: Land management perspectives, primary objectives, and functions (after Nichols [1992])

Land management perspective	Primary objective	Primary function
Environmental	The primary objective of the environmental perspective is that human activities do not create a permanent imbalance or detrimental effect on the delicate balance that exists in nature.	Conservation of resources
Economic	The primary objective of the economic perspective is that human activities use and develop land and its resources to create wealth.	Resource development
Institutional	The primary objective of the institutional perspective is that human activities are viewed through social priorities and arrangements that control the distribution and use of the land.	Distribution of rights to resources

To achieve management goals such as sustainable development, the three perspectives need to be integrated, and the primary functions simultaneously considered.

[29] For example, the tradition of national surveying and mapping programs on land operates on the notion that it is not possible to make good use of a country's wealth unless there is factual knowledge of a country and its features (see for example [Binns, 1953; Root, 1985]).

[30] This a system view of land management. A system is an organized set of processes designed to accomplish certain objectives. A process is an organized set of activities to accomplish a task. Sometimes processes and activities are interchanged depending on the system objectives. Therefore, the land management system consists of processes, tasks and activities.

This can be carried out in a dual management context of: (1) private management, which deals with individuals and how they arrive at decisions regarding the land; and, (2) public management, which deal with the limitation of activities and uses through public rules and restrictions.

Both contexts are important in land management but the emphasis of this research is management in the public context. This context is founded on the idea that "some public goals cannot be secured by relying on private efforts" [Larsson, 1997, p.11]. This provides public authorities with an opportunity to exert influence on land and resource use by providing laws, stressing land management goals, and making binding decisions.

2.2 Marine Environmental Management

Land management encompasses both dry and water-covered physical spaces[31]. In practice, the term coastal and oceans/offshore management is used to describe the management of predominantly water-covered physical spaces.

There are several terms used to describe the areas of these water-covered physical spaces. A *coastal area* is considered to be a narrow strip of territory on either side of the ordinary high water mark. The term *offshore* refers to areas that are away from the coast, while *oceans* refer to bodies of predominantly salt water. In this research, the all-inclusive term *marine* is preferred, and refers to "matters of, or pertaining to the sea, or connected with the sea" [Merriam-Webster, 2005]. Therefore, *marine management* is an all-inclusive term that will be used in this research to refer to the management of coastal and offshore/oceans areas. This term also encompasses marine activity management and marine resource management.

[31] The definition of land is broad enough as to include water that lies above or below the physical entity commonly perceived as land (e.g., McLaughlin [1975]; NRC [1980,1983]; Dale and McLaughlin [1988]; Larssen [1991]).

2.2.1 Why Marine Environmental Management?

As with land management, marine management is viewed from the three primary perspectives previously outlined. However, the primary focus of this research will be the environmental perspective. This will referred to as *marine environmental management*. This rationale for this focus is outlined in the following paragraphs.

The past 30 years of ocean exploration have revealed the diversity of life inhabiting our oceans, including deep ocean ecosystems and communities of species [Ehler, 2003]. However, what is known today about the marine frontier is comparable to what North American settlers knew of the "new" lands in the 18th and 19th centuries [Ocean Mapping Group 1999]. Much of the oceans remains poorly explored and understood.

In an attempt to improve knowledge and resource consumption, technological advances and expanding human uses in the high seas have ended up depleting fish stocks, and destroying ocean biodiversity, productivity and ecosystem processes [Ehler, 2003]. Increasing industrial expansion, population growth, and resource consumption have led to a marine biodiversity crisis i.e., an accelerated rate of extinction for certain genes, species and ecosystems [Grumbine, 1994; PEW Oceans Commission, 2003]. For example, the Northern Cod stocks in the Atlantic Ocean suffered a lethal dive in population levels in the late 20^{th} century.

However, technological advances have also vastly increased international recognition of the importance of oceans and their resources to sustainable development. The ability to technologically model specific issues such as marine human use impact, climate change, and sea level rise have focused attention on the need to conserve marine resources. In recent years, this focus has been expressed in many international agreements and other instruments, including the United Nations Convention on the Law of the Sea (UNCLOS),

the UN Conference on Environment and Development (UNCED), and the UN Conventions on Biodiversity and Climate Change [CIDA, 1998].

This environmental management focus has also been evident from: (1) the 1992 "Earth Summit" and its Agenda 21, particularly Chapter 17 on "Protection of the Oceans, All kinds of Seas, including Closed and Semi-Closed Seas, and Coastal Areas and the Protection, Rational Use and Development of Their Living Resources"[UNCSD, 1992]; (2) 1995 UN Agreement on the Conservation and Management of Straddling Fish Stocks and Highly-Migratory Fish Stocks [United Nations 1995]; (3) the Global Programme of Action (GPA) on land-based sources of marine pollution [UNEP, 2005]; and, (4) the 1995 Kyoto Declaration and Plan of Action.

This research will therefore reflect the above-mentioned environmental management focus on the marine environment. More specifically, this research will emphasise the primary function of conservation in marine environmental management.

2.2.2 Conservation of Marine Resources

Marine conservation is defined as the long-term protection, maintenance and rehabilitation of native species, their habitats and their life support systems, in order to ensure ecosystem sustainability and biodiversity [Grumbine, 1994; Olver et al., 1995]. The term *conservation* consists of the management goals of protection, preservation and restoration. Protection involves providing a “barrier” that lowers the risk for resource degradation. Preservation involves maintaining the current status and keeping from destruction, or decay. Restoration involves rehabilitating resources that were previously destroyed or decayed, and bringing back to (near) original natural state. This is summarized in Figure 2.1.

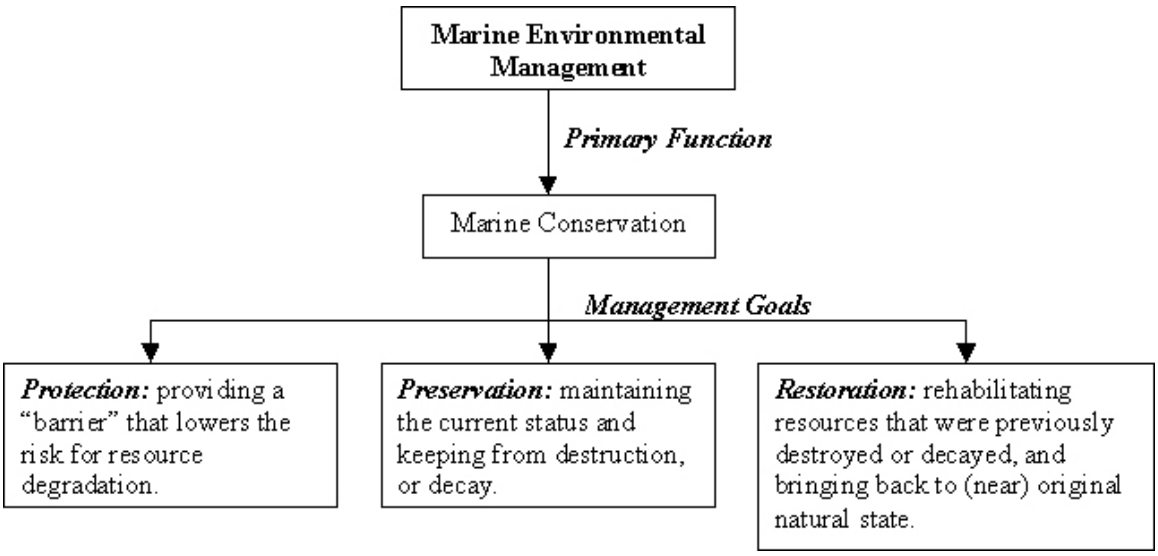

Figure 2.1: The relationship between marine environmental management and conservation

The management goals of protection, preservation and restoration can also be combined depending on the preferred outcome. These are value judgments that may be reflected in policy, program, or legislative objectives. However, marine conservation value judgments have historically been biased towards science [Agee and Johnson, 1988]. Individuals who were biologists, first, and managers, second, were responsible for marine environmental management. As Grumbine [1994, p.29][32] asserts, it took the work of Agee and Johnson [1988] for managers to "no longer discount the effects of humans on ecosystems." These authors also suggested that biologists and managers had to take into consideration the complex social context of environmental management. From this, the concept of ecosystem management emerged.

2.2.3 Marine Environmental Management Concepts

The literature on marine environmental management is inundated with terminology. However, three recurring terms are central to marine environmental management:

[32] Although the work of Agee and Johnson [1988] and the reflections of Grumbine [1994; 1997] were in the context of (dry) land resource management, these ideas and concepts are similarly valid, and valuable, in marine space.

namely, ecosystem management, integrated management, and adaptive management. These three terms are discussed below in the context of marine environmental management.

As mentioned in the previous section, the concept of ecosystem management challenges people to stop thinking about marine environmental management strictly from a conservation science perspective. *Ecosystem management* is an approach that "integrates scientific knowledge of ecological relationships within a complex socio-political and values framework toward the general goal of protecting native ecosystem integrity over the long term" [Grumbine, 1994, p.31]. *Ecosystem management* is essentially a blend of natural science tools and data with administrative and social science techniques. A balance must be struck between the physical and biological features of ecosystems and equally real human factors [AIDEnvironment et al., 2004]. Simply put, the institutional and economic perspectives are equally important in marine environmental management.

In applying this approach to marine environmental management, it is important to note the use of the term *integration*. This is based on the observation that marine environmental management is too often carried out on a "statute by statute, resource by resource, and program by program basis" [Grumbine, 1997, p.42]. In addressing this marine environmental management challenge, the concept of ecosystem management proposes a management goal of *integrated management.* This is based on several objectives [Cicin-Sain and Knecht, 1998]: (1) an integrated spatial strategy for dealing with coastal and marine areas, since natural features and human activities interact across

land and sea (see also Doody [2001]);[33] (2) an inter-sectoral strategy for effective marine management, since marine resources and activities exist inside multiple sectors; (3) an intergovernmental integration strategy, since statutes, programs, and policy need to be vertically and horizontally integrated among governments at different levels; (4) a science-management integration strategy, since natural sciences, social sciences, engineering, and management entities need to collaborate; and, (5) a focus on sustainable development with a strong emphasis on conservation [Doody, 2001].

In acknowledging that *ecosystem management* exists within a complex socio-political and values framework, Grumbine [1994; 1997] suggests that learning is an important goal in environmental management. *Adaptive management* is a process used to accomplish this goal. This term refers to a cyclical process of incorporating the results of previous actions in order to allow managers to remain flexible and adapt to uncertainty Grumbine [1997]. In other words, it is the iterative process of applying lessons learnt to improve ongoing endeavours.

The relationship between ecosystem and marine environmental management is shown in Figure 2.2. In summary, marine environmental management has a primary function of marine conservation. This is accomplished through the *ecosystem management* approach, which is implemented by adopting the management goals of *integrated* and *adaptive management.* In this research, any discussion of marine environmental management will adopt this framework.

[33] In 1972, the United Nations Environmental Program (UNEP) identified the importance of addressing the complexities of environmental problems in an integrated way [Doody, 2001, p.251]. As a result, a regional approach of controlling marine and coastal pollution was endorsed and a Regional Seas Program (with individual Action Plans) implemented. This was the very first endorsement of the importance of integrated marine management.

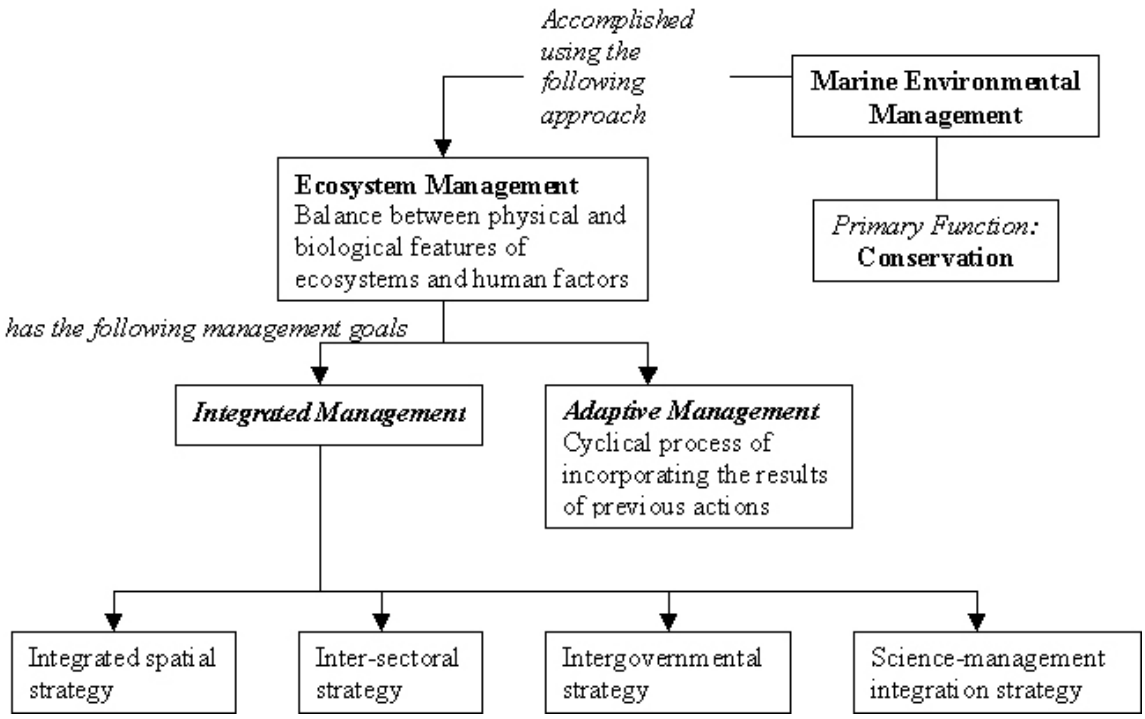

Figure 2.2: The relationship between marine environmental management and the various concepts within it.

2.3 Implementing Marine Environmental Management

Increasingly, marine environmental management is being viewed in the context of the ecosystem management approach. This is an approach where interested parties, stakeholders and regulators reach general agreement on the best mix of conservation, sustainable resource use and economic development for coastal and marine areas [Canada, 2005]. The implementation of marine environmental management is complicated since the combination of stakeholders and sophistication of the issues can be enormous.

As mentioned in the previous section, implicit in the definition of ecosystem management is the incorporation of economic and institutional perspectives in marine environmental management. This implies balancing development and conservation

objectives within a framework that aims for effective transfer, allocation, and regulation of stakeholder interests.

The Canadian perspective of marine environmental management provides a clearer link with ecosystem management by suggesting that it involves [Canada, 2005]: (1) an appreciation for the values and needs of the human societies; (2) a description of management goals; and, (3) specification of management objectives. Marine environmental management also involves the definition of management processes to accomplish these goals and objectives. These management processes[34] are described in the next section.

2.3.1 Marine Environmental Management Processes

The United Nations *Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection* suggests a five-stage marine environmental management process [GESAMP, 1996]. These five consecutive stages form an ongoing, iterative process, in a programme setting. The processes are described as: (1) issue identification and assessment; (2) program preparation; (3) formal adoption and funding; (4) implementation; and, (5) evaluation. The processes are further described in Appendix I.1.

This is comparable to the framework advanced in the book *Integrated Coastal and Ocean Management* by Cicin-Sain and Knecht [1998], as well as that advanced for *Integrated Environmental Management* by Antunes and Santos [1998]. These frameworks outline the processes by using more general terminology but the objectives of the processes are similar to those outlined in the previous paragraph. For example, Cicin-Sain and Knecht [1998] describe the processes as: (1) setting the stage; (2)

[34] A process is a series of actions, activities, changes, or functions that bring about a result [Webster, 2005]. Activities are therefore considered to be part of processes.

infrastructure considerations; (3) information management; (4) program formulation; and, (5) program implementation and operation; and, (6) program evaluation. These processes are further described in Appendix I.2.

In summarizing marine environmental management, several generic processes can be concluded (see also Lang and Armour [1980]; Nichols [1992]):

- Development of broad goals and acceptable procedures.
- Development of more specific and measurable objectives and devising the detailed means for achieving these objectives.
- Determination of interests, rights to use resources, or right to carry out activities in a particular space, including the creation and enforcement of restrictions.
- Implementation of activities outlined in policies and plans as the means for achieving the particular goals and objectives.
- Establishment of baseline data that can be used for monitoring, as well as the tools for assessment and evaluation.
- Management of scientific, socio-economic, and traditional information for all the processes previously outlined.

From this summary, and borrowing from Nichols [1992], marine environmental management processes may be seen as consisting of: (1) strategic planning and policy development, (2) project and program planning, (3) project/program implementation and operation, (4) administration of activities and interests (5) research, monitoring, assessment and (6) information management. This is shown in Figure 2.3.

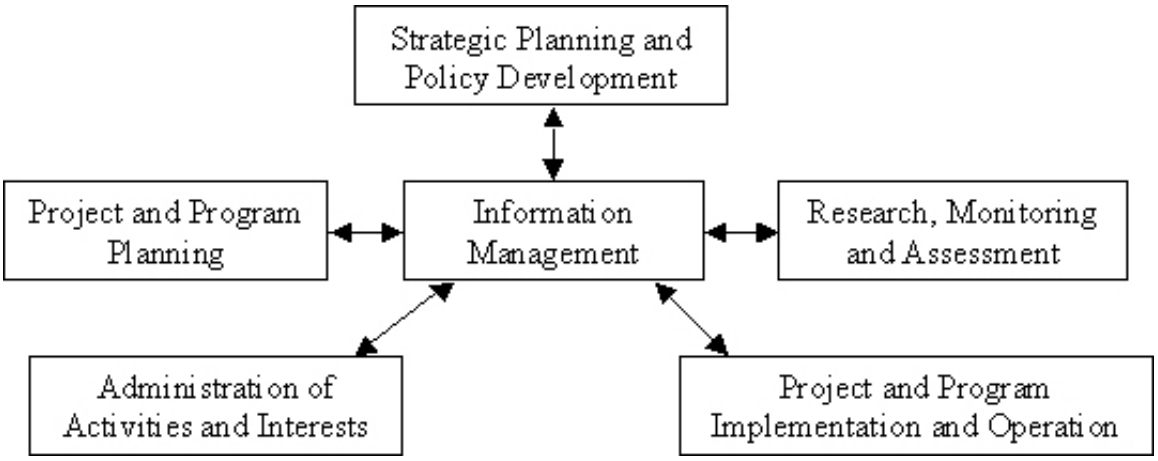

Figure 2.3: Marine management processes (after Nichols [1992]).

2.3.2 Administration of Activities and Interests

Incorporating the institutional view into marine environmental management implies that social priorities and arrangements that control the distribution and use of marine space need to be considered. In marine environmental management, this depends on the processes that administer activities and interests in marine space.

Those processes play a crucial role in marine environmental management as asserted in the report on *Marine Management Approaches for Implementing the Convention on Biological Diversity*,

> *…if we have no control over the dynamic forces and environmental processes that create and sustain coastal ecosystems, we can only manage the human activities that seek to use, or have access to, coastal areas and resources [AIDEnvironment et al., 2004, p.8].*

On land, the term *land administration* has been used to describe this particular process. The process manages the land tenure system and provides a means for the decision maker to view how rights of ownership, use, control, or stewardship are exercised; and their effect on management. For example, several authors (McLaughlin [1975]; Nichols [1992]) suggest that land administration forms the basis for development

activities (e.g., the right to use the land) and many activities related to environmental conservation (e.g., creation and enforcement of land use restrictions). For this reason, the land administration process is described in the next section. This description is in the context of land tenure information management.

2.3.2.1 Borrowing from the Land Tenure Concept

Land tenure information is important in describing the complex relationships between individuals with regard to the use and enjoyment of land. The institution of land tenure[35] is responsible for determining which rights to the use and benefits of land are allocated, as well as how incentives for, and restraints to, the use of land are assigned (see for example Crocombe [1971; 1974]; McLaughlin [1973; 1975]; Barnes [1985; 1988]; Nichols [1992; 1993]).

Land tenure can be defined very broadly as the set of relationships that outline the acquisition, use, transfer and distribution of land [McLaughlin, 1973; Crocombe, 1974; Barnes, 1985] or more specifically as the rights, restrictions and responsibilities that people have with respect to land [McLaughlin, 1975; Nichols, 1992]. In the context of social relationships, rights are seen as person-to-person or person-to-land relationships [Bohanan, 1960; Rakai, 2004]. These social relationships are also a function of culture.[36]

Land tenure may be defined by two principal attributes: cultural and operational [Rakai, 2004]. Cultural attributes govern and define relationships (e.g., describe peoples concepts, values, worldviews etc) while operational attributes define what functions may/may not be done with land (e.g., what rights, restrictions, responsibilities and

[35] Tenure is derived from the latin term "*tenere*" which means "to hold" or "to possess" [Bohanan, 1960].
[36] This cultural distinction is perceived as further distinguishing between a "right", which is a type of interest that contains a benefit to the right holder [Rakai, 2004], and an "interest", which is something that "someone wants or desires" [Stoljar, 1984, p. 31].

possibilities may exist) [Rakai, 2004. p. 36]. In this research, land tenure focuses on the operational attributes, and provides insight into private and public rights, restraints and responsibilities that may exist.

2.3.2.2 The Challenge in Administration of Marine Tenure

Without appropriate information about the nature of land tenure there is great uncertainty in land management because the implementation of plans and policies ultimately rests in rights to use, control, and benefit from the land and its resources [Barnes, 1988]. Management of land tenure information is therefore one of the most important functions in land administration.

The land registration process fulfils the information management function of land administration [Nichols, 1992]. *Ideally*, this process facilitates the documentation of information on rights, restrictions, and responsibilities; thereafter facilitating access to this information by the decision maker. The challenge in marine environmental management is that tenure administration, and particularly, the information systems documenting tenure, have not evolved to the same level as on land. Therefore, our understanding of the information management function in the administration of marine tenure is still very basic. The reasons for this are articulated in the next section.

2.3.2.3 Why is Tenure Administration different in Marine Space?

Tenure administration in marine environmental management differs from land for several reasons. The primary reason is that marine spaces are not physically occupied, owned, or used, to the same extent as (*dry*) land space. Additionally, there is a mix of local, provincial, and national interests in marine space, and the government institutions generally consist of single purpose agencies [Cicin-Sain and Knecht, 1998]. With regard

to the nature of property in marine space, there tends to be a continuum of ownership: coastal areas have a mix of public and private property and offshore areas are dominated by public property. This generalization varies across jurisdictions and cultures [Cicin-Sain and Knecht, 1998, p.44].

More specifically, the physical (and other) characteristics of marine space provide certain tenure administration challenges that affect marine environmental management. These characteristics can be summarised as follows: (1) traditional patterns of management; (2) jurisdiction issues; and, (3) nature of the oceans. These are further described below.

First, the traditional use of marine space before the 20th century was characterized by two uses: navigation and fishing [Cicin-Sain and Knecht, 1998]. Conflicts between these uses were few and as a result, separate institutions managed fishing and navigation. Thus, a sectoral approach to marine management emerged. Additionally, within some fishing sectors, a single species approach was implemented based on the economic value of the species. The single species and sectoral approach to marine management produced several independent programs that were narrow in scope and vision (i.e., they did not consider the long-term, direct and indirect impacts on the social, economic and environmental dimensions [Bowen and Riley, 2003; Ehler, 2003]). This approach is considered to be responsible for the “boom and bust cycles” that often deplete valuable resources and foreclose future options and benefits associated with resources [Canada, 2002a].

Second, the administration of marine activities and uses is much more segmented than on land, creating overlapping jurisdiction and, public and private interests. A starting

point for determining possible marine activities and uses is the framework for use by nations that have ratified the *Third United Nations Convention on Law of the Sea* (*UNCLOS*).[37] While this convention describes internationally recognized rights of coastal and international nations, it has not stopped many international disputes regarding the location of marine boundaries between nations from arising. Additionally, *UNCLOS* does not deal with jurisdiction, administration of resources, or property rights at any level lower than the nation. For this, the nation has to look to its internal arrangements to determine how marine resource jurisdiction, administration, and property rights are to be adjudicated [LaForest, 1963, 1973; Hildebrand, 1989; Juda, 1999]. For example, countries that are federations may have to establish a dispute resolution mechanism to deal with uncertainty over federal vs. provincial/state jurisdiction and administration of marine resources.

Third, the water, living resources (e.g., fish), and non-living resources (e.g., sand and gravel) change location over time, in a vast water-filled frontier that spans much of the earth. This fluid and dynamic nature is further complicated by the intricate relationships that exist between diverse marine ecosystems and the environments that support them [Cicin-Sain and Knecht, 1998]. This provides for a complex physical environment in which marine activities and uses are managed.

2.4 The Significance of Marine Tenure Information Management

The previous section describes the challenges in administering marine tenure. The examples in the previous section have also highlighted that marine tenure information

[37] Nations that haven't ratified UNCLOS III may still claim and enforce their rights to traditionally recognized spatial extents.

management is also a challenge. Therefore, administration of marine activities and interests is affected by the challenges in managing tenure information in marine space.

In the example in the previous sections, some of the processes that are needed for the administration of marine activities and interests can be inferred. For example, in the *UNCLOS* framework, tenure information management can be said to support allocation and creation of interests, as well as dispute resolution. Similarly, tenure information management may be important in revenue generation through valuation and taxation of hydrocarbon deposits. These two examples suggest that tenure information management may support other processes within the administration of marine activities and interests.

Several authors[38] suggest that the previously mentioned processes may also represent land administration functions. Nichols [1992] provides a framework for describing six of these functions: (1) land transfer (including the process of creation and allocation of interests); (2) adjudication (including the process of parcel delimitation and dispute resolution); (3) revenue generation (including the process of valuation and taxation); (4) estate management; (5) regulation (including the process of land tenure regulation); and, (6) information management (including the process of land registration).

This research asserts that a similar model for "marine administration" cannot be proposed unless there is research showing comparable linkages with "marine administration" functions/processes. This marine environmental management challenge can be addressed by focusing on the role of tenure information in the administration of marine activities and interests. The goal is therefore one of determining whether adequate tenure information is being collected, and whether appropriate tenure information is being managed well. This may involve evaluating tenure information requirements,

[38] See for example, Dale and McLaughlin [1988], Dale [1995], Nichols [1992], Williamson [1997].

organizing the tenure information to meet these requirements, and controlling how tenure information is accessed, presented, and used.

2.4.1 Tenure Information Characteristics

Several authors (e.g., Larsson [1975]; Dale and McLaughlin [1988]; Holstein [1990]) assert that decision makers must have reliable physical, social, and cultural information (on the condition of the environment) in order to deal with land (and by extension marine environmental) management challenges.[39] The characteristic of *reliability* is one of several characteristics used to qualify the type of information that is needed for management.

This research asserts that these and other characteristics of information need to be investigated in order for them to be used as qualifying labels for tenure information used in marine environmental management. This research proposes the investigation of the characteristics of marine tenure information, how they affect administration of marine activities and interests, and by extension marine environmental management.

2.4.2 Tenure Information Use

Countries around the world have now started involving local communities and lower-level decision-making units more in protecting and managing the environment [FAO, 1999]. Agrawal [2003] suggests that these new policy trends are based on the recognition that the fiscal capacity of the state to undertake coercive conservation is limited and that communities can often manage their resources better than either private actors negotiating through market-based exchanges or state actors regulating through command and control policies.

[39] This information may be used for assessment of the health of the environment, and /or monitor the effects of human activities over time.

These collaborative management approaches depend on the general public being aware of the issues in order to participate as a partner in decision-making [Holstein, 1990; FAO, 1999]. The challenge is therefore a clear definition of a problem that people may only be partially aware of, through a better understanding of the physical, social, and cultural environment. This may involve visualizing how the problem affects an individual's personal space; or how it affects them at the local, group or community level. As McLaughlin and Nichols [1989, p.79] suggest,

> *" the challenge in resource management is…. to capture the imagination of politicians and general public…bring issues closer to home...(and answer the question) what can the local land owner or community do about it?"*

This research suggests that in order to qualify the characteristics of tenure information availability and access, an investigation into these characteristics is needed. The research proposes that this can be done by demonstrating the role of marine tenure information in administration of activities and interests.

2.4.3 Boundary Delimitation and Associated Marine Tenure Information

Uncertainty on who has the right to act, and the right to benefit from land is considered to be counter-productive to marine environmental management in general [Grumbine, 1997; Cicin-Sain and Knecht, 1998; FAO, 1999]. The definition of different rights is therefore important because it provides information on the roles of the parties concerned. As a process in land administration, tenure information management generally provides information on the definition of certain rights.

However, the definition of rights can also be an independent process. Several authors (Mclaughlin [1975]; Larsson [1997, p.12]) have suggested, for example, that the definition of rights to land consists of three dimensions: (1) what is included in a certain

right; (2) who is the holder of the right; and, (3) which physical extension the right has. The first two dimensions can be thought of as consisting of interest characteristics dealing with two land administration processes: interest allocation and land tenure regulation [Nichols, 1992]. McLaughlin [1975, p.79] suggests that they generally refer to (a) the legal conditions in which the interests exist, (b) the populations associated with the interests, (c) the duration of the interests. The third dimension describes the parcel delimitation process, which is used to define the spatial extent of interests in land.

This research asserts that there is a need to investigate the role (validity, relevance and importance) of interest allocation, land tenure regulation, and parcel delimitation processes in marine administration.

2.5 Emerging Trends in Marine Tenure Information Management

Previous sections have outlined some of the issues in marine tenure information management. Some of the outlined issues may lead to a challenge in availability and access of marine tenure information. For example: (1) marine tenure information might be incomplete due to jurisdictional/administrative uncertainty arising from the governance structure in a Nation; (2) it might not be possible to define the spatial dimensions and / or type of interests that are represented in marine space because resources and activities can co-exist and move over time and space; (3) it might not be possible to borrow land-based tenure information management systems (e.g., cadastre) to represent tenure in marine space. This is because the basic component in these systems may not be the best unit of representation for all interests.

This latter point is particularly important because, in spite of the shortcomings in applying land-based tenure information management systems to marine space, these

systems are still being proposed as marine management tools. In particular, the marine cadastre concept is in recent years being publicized as a tool for use in marine management. The motivation for this publicity is mentioned as: (1) the shift in focus from single species and sectors, to spatial management; (2) increase in multiple uses/activities within a given marine space; (3) the increasing acknowledgement of rights of indigenous people in marine space; (4) increasing assertion of public rights to marine commons e.g., through marine stewardship initiatives; (5) the need to administer a substantive marine area under the United Nations Convention on Law of the Sea (UNCLOS); and, (6) the established "pedigree" of the cadastre concept in land resource management.

In the following section, the marine cadastre concept is described in order to highlight the effect of this approach on marine tenure information management.

2.6 The Marine Cadastre Concept

Information systems that focus on land tenure have existed to assist land and resource management for millennium. These systems are in modern times called cadastres and provide information to support various land and resource management decisions, such as assessment and taxation of real property, legal transfer of real property rights, orderly settlement of land, planning and other administrative uses (see for example, Moyer and Fisher [1973]; McLaughlin [1975]; Dale [1976]; Larsson [1991]; FIG [1997]). The defining feature of these information systems is that information about people and their relationships with the land are associated with units of space called cadastral parcels.

While there are several types of cadastres that exist, a cadastre is defined in this research as a community-oriented, parcel-based, and up-to-date land information system

containing a record of interests in land [McLaughlin, 1975].[40] In principle, it includes a geometric description of land parcels linked to other records describing the nature of the interests, the ownership or control of those interests, and the value of the parcel and its improvements [McLaughlin, 1975; Larsson, 1991; FIG, 1997]. Cadastres have evolved to include computerized records of interests in land (often linked to other records to increase the value of the information to users), and a set of maps, which provide the location of the parcels.[41] The basic component of a cadastre is the cadastral parcel, which can be the unit of property ownership, possession, or land use [Moyer and Fisher, 1973; McLaughlin, 1975].

The idea of a coastal and ocean information system based on, or including, legal interests in these spaces goes back for several decades. The use of cadastre terminology in marine space can be traced to its use in the near shore context (focusing on the legal boundary between land and sea). Jones [1971] suggested the use of technology to establish valid coastal boundaries in order to resolve the problem of offshore rights. Baldwin [1982][42] and Nichols [1983] reviewed cadastral surveys of tidal boundaries, with the latter suggesting the need for an information system that contained these boundaries.

Recent focus on the application of the cadastre concept in marine space is first found in the *1999 Coastal Cadastre Conference* held in New Zealand. At this conference, several international authors highlighted the need for a marine tenure information system. For example, Grant [1999, p.15] indicated that the New Zealand government needed this

[40] Although there are 3 classic types of cadastres (juridical, fiscal and multipurpose), the cadastre definition is generalized as a parcel-based record of interests in land encompassing both the nature and extent of these interests.
[41] Land cadastral information systems today can be integrated, with varying degrees of ease, with information on land use, resource type and quantity, municipal zoning restrictions, etc. This has been traditionally referred to as a multi-purpose cadastre, that is, a parcel-based land information system.
[42] Compared seaward cadastral boundaries established from tidal datums and biological criteria in proposing which was a better limit of riparian rights.

information to enable the government to decide how future rights to the seabed would be defined and held. Nichols and Monahan [1999, p. 33] indicated that Canadians needed this information in order to know who had rights to ocean spaces and who could manage and control marine resources. Hoogsteden et al., [1999, p.23] indicated that this information was important in underpinning offshore rights and responsibilities. Holmes [1999, p.45] described the importance of this information in determining the extent, value and ownership of New Zealand's sea floor.

From this, and other international conferences and meetings, several international definitions of the marine cadastre have begun to emerge. Subtle differences exist in the definitions reflecting the different focus and perspectives that exist internationally (see Appendix I.3 for a review of these definitions). [43] These varying marine cadastre definitions show that there is as yet no consensus as to what the term stands for.

This research asserts that an investigation into this concept, its relevance and utility, as well as its role in marine environmental management, is needed. This research proposes that this can be demonstrated by highlighting the processes involved in the administration of activities and interests in marine space.

2.7 Chapter Summary and Conclusions

This chapter has provided a literature review of marine management, which has highlighted the significance of tenure information in marine environmental management. The foundation is an introduction to resource management perspectives, goals, objectives, functions and processes. From this, a definition of marine environmental

[43] The author has taken liberty in paraphrasing the opinions in the articles summarized in Appendix I.3. While the articles have been closely scrutinized and every effort made to be as accurate as possible, it is possible that there are errors or omissions. As such, the author suggests that for a strict interpretation of each marine cadastre definition, one should contact the author of the article directly.

management has been established. The relationship between marine environmental management and marine conservation, ecosystem management, and adaptive management has also been highlighted. A description of the processes in marine environmental management has been provided as well as the specific role of administering marine activities and interests. Several challenges in managing marine interests and activities have also been outlined.

These challenges in “marine administration” have suggested that there is an important role for tenure information. This research has proposed an investigation into the role of tenure information in the administration of marine activities and interests in order to further clarify this relationship. The goal is one of determining the quality and quantity of tenure information being collected, whether appropriate tenure information is being managed, and how the tenure information is being used in marine environmental management.

3 CHAPTER 3: AN OUTLINE OF CANADIAN MARINE ENVIRONMENTAL MANAGEMENT AND MARINE TENURE INFORMATION MANAGEMENT

Today, the growing number of different and competing interests makes management of Canada's oceans much more difficult and complex. Where once traditional fishing and shipping industries were nearly alone, they now share oceans with many others. The conflicts among ocean uses make it essential to ensure that policies are cohesive (from Canada's Oceans Strategy [Canada, 2002b]).

In Chapter 2, the role of tenure information in marine environmental management was outlined. The chapter described the role of tenure information in administering marine activities and interests, and how this is an important process in marine environmental management. In this chapter, these elements are described in the context of Canadian marine environmental management. The purpose of this chapter is to describe the process of administering marine activities and interests in Canada, identify shortcomings in the process, and identify a strategy for addressing these shortcomings.

3.1 Canada's Marine Environmental Management Framework

Canada's *Oceans Act* [1996] provides a framework for coastal and oceans management initiatives and mandates the preparation of a national strategy. *Canada's Oceans Strategy* (*COS*) responds to this by providing a policy framework intended to guide the co-ordination and management of marine activities [Canada, 1997b; 2002b]. In the *Act*, the leadership and coordination of marine environmental management in Canada is mandated to DFO. Therefore, while the implementation of *Canada's Oceans Strategy (COS)* is a shared responsibility with other government departments, DFO has the responsibility to lead and facilitate the development of a national marine environmental management strategy [Canada, 2002b].

3.1.1 Policy Objectives in Canada's Oceans Strategy

Three policy objectives (or outcomes) of *COS* have been identified for the advancement of marine environmental management activities [Canada, 2002a]: (1) understanding and protecting the marine environment; (2) supporting sustainable economic opportunities; and, (3) international leadership.

Understanding and protecting the marine environment is viewed from 2 perspectives [Canada, 2002a; 2002b]: (1) integrating social and environmental information so that human activity is better factored into sound decision-making; and, (2) sharing this knowledge with the Canadian public in order to enhance awareness and engage in debate. *Supporting sustainable economic opportunities* involves applying the management principles of integrated management, sustainable development, and the precautionary approach to marine-based economic opportunities. *International leadership* is about providing the improved co-ordination and increased capabilities needed to address immediate and future international marine issues [Canada, 2002b].

3.1.2 Management Objectives in Canada's Oceans Strategy

The management objectives used to accomplish the previously mentioned policy objectives are defined in *Canada's Oceans Strategy* (*COS)* as guiding principles. These three principles (or management objectives) are [Canada, 2002a; 2002b]: (1) sustainable development, (2) integrated management, and (3) the precautionary approach. The relationship between these management objectives and the policy objectives is outlined in Figure 3.1.

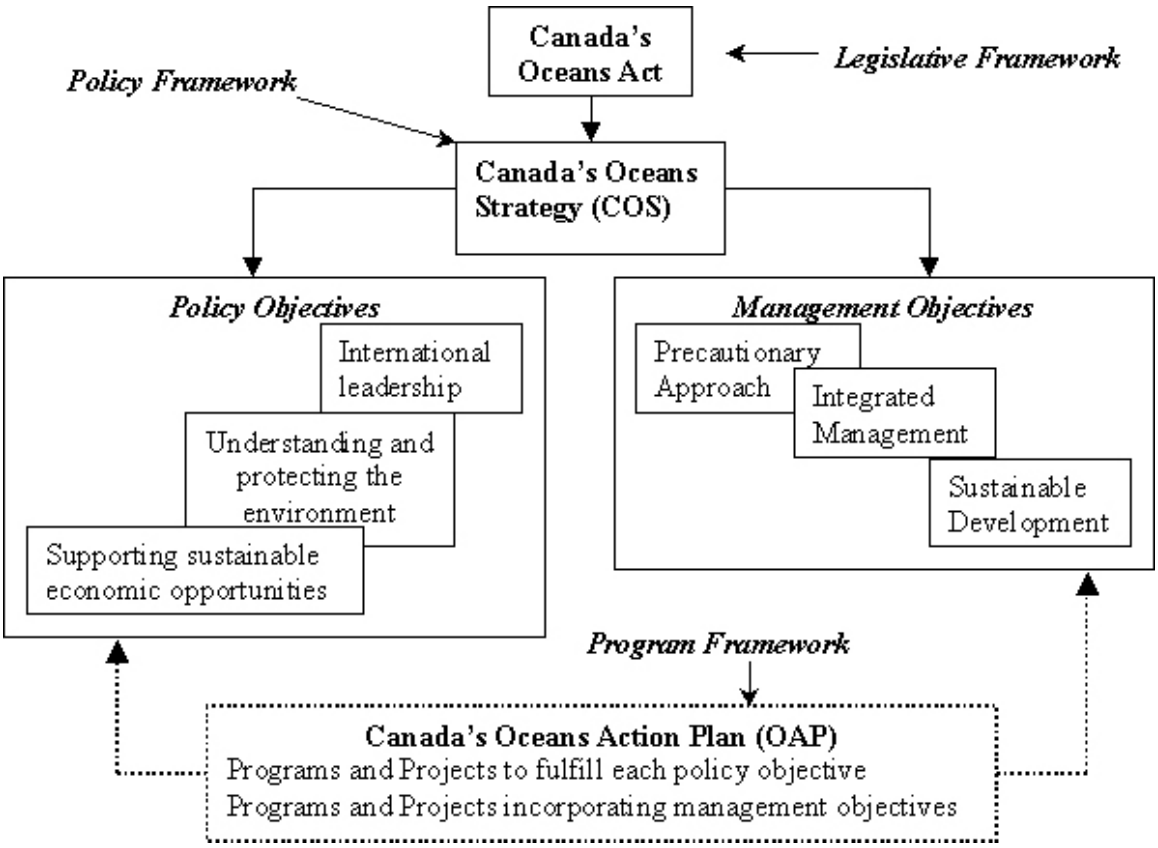

Figure 3.1: Canada's marine environmental management framework

The *precautionary* approach management objective is seen as emphasizing the environmental objective in marine management, as well as the primary goal of conservation [Canada, 2002b]. This approach is defined in the *Oceans Act* [1996] as "erring on the side of caution" and provides a priority to maintaining ecosystem health and integrity when managing human activities. It also adopts the ecosystem management approach described in Chapter 2.

The *sustainable development* management objective reflects a strong emphasis on including institutional and economic perspectives into marine environmental management [Canada, 2002b]. This principle recognizes the need for integration of institutional (social), economic, and environmental aspects of decision-making.

COS suggests that *sustainable development* and *precautionary approach* objectives be implemented through the *Integrated Management* (*IM*) objective [Canada, 2002a; 2002b]. This objective is described in the next section.

3.1.3 Integrated Management Objectives

As described in *Canada's Oceans Strategy* (*COS)*, *IM* is more than just a management objective; it is simultaneously a management goal, objective, and process [Canada, 2002a]. *IM* has a goal of conservation and sustainable use of marine resources by managing shared use of ocean spaces. *IM* has an objective of planning and managing human activities in a *comprehensive* manner. *IM* is also a management process involving the development of large-scale and local *IM* plans for Canada's oceans [Canada, 2002a].

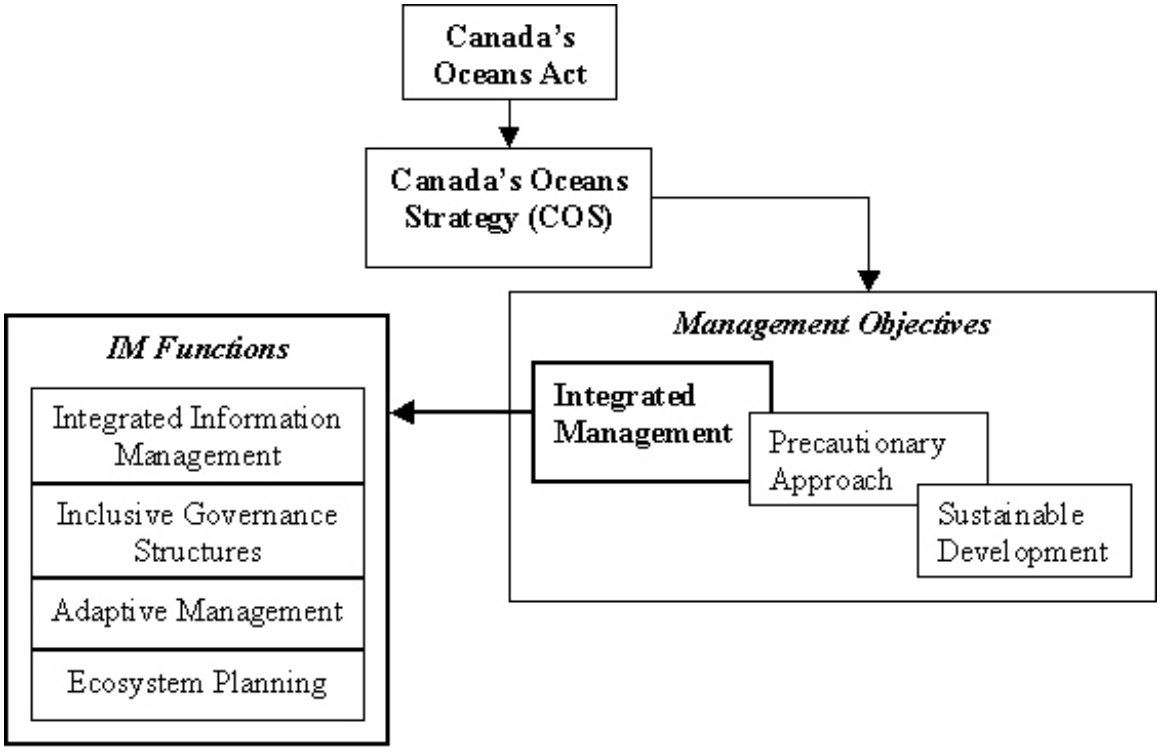

Figure 3.2: The role of Integrated Management (IM) in Canada's Oceans Strategy and its constituent functions.

The four *IM* functions outlined in Figure 3.2 also have specific objectives associated with each of them. These are outlined in Table 3.1.

Table 3.1: Integrated Management Functions and their objectives (after Canada [2002a; 2002b])

Integrated Management Function	Objective
Integrated information management	To have a full range of relevant knowledge applied to the planning and decision making process.
Inclusive governance structures	To enhance coordinated, collaborative decision making across the federal government; with other levels of government; and, in partnership with citizens.
Adaptive management	To deal with uncertainty in the understanding of marine species and ecosystems by applying lessons learnt.
Ecosystem planning	Planning on the basis of natural and economic systems together: rather than principally depending on political or administrative boundaries.

3.1.4 Management Processes in Marine Environmental Management

Implementing *Canada's Oceans Strategy* (*COS)* requires action under each of the strategy's policy objectives. It also requires that these actions incorporate management objectives of sustainable development, integrated management, and the precautionary approach. As shown in Figure 3.1, Canada's *Oceans Action Plan*[44]*(OAP)* pursues several specific programs that implement *COS*[45]. *OAP* serves as an umbrella for coordinating and implementing marine environmental management [Canada, 2002a].

The legislative framework of Canada's *Oceans Act* [1996], policy framework of *Canada's Oceans Strategy* (*COS*), and program operational framework of Canada's *Oceans Action Plan (OAP)*, describe some of the processes in Canadian marine environmental management. While these types of processes can be realized at the federal

[44] The Government of Canada committed to moving forward on its *Oceans Action Plan (OAP)* in the October 2004 speech from the throne.

[45] The OAP describes the programs as*"… maximizing the use and development of oceans technology, establishing a network of marine protected areas, implementing integrated management plans, and enhancing the enforcement of rules governing oceans and fisheries, including rules governing straddling stocks* [Canada, 2005a,p.5]."

and provincial level, the focus of this research is a federal program that is representative of a national approach to Canadian marine environmental management processes.

In Chapter 2, a framework for describing the processes in marine environmental management was outlined. Using this framework, and following the national strategy for managing Canada's coasts and oceans, marine environmental management processes can be described as shown in Table 3.2.

Table 3.2: Canadian marine environmental management processes at the federal level (after Canada [2002a; 2002b]).

Marine Environmental Management Process	Canadian process at the Federal level	
Strategic planning and policy development	Oceans Act Oceans Strategy	
Program / Project planning	Oceans Action Plan	
Program / Project implementation and operation	Programs	Projects and sub-programs
	International leadership, sovereignty and security	▪ International oceans management ▪ Security and prosperity partnership (North America) ▪ Gulf of Maine ▪ Arctic Marine Strategic Plan ▪ Over fishing ▪ Continental Shelf
	Integrated oceans management	▪ Integrated Management Plans (IM) ▪ Oceans Management Tools
	Health of the Oceans	▪ Marine Protected Area (MPA) Network Planning ▪ Ballast Water and Marine Pollution Regulations ▪ Pollution prevention surveillance for sea-based sources ▪ Birds oiled at sea
	Oceans science and technology	▪ Oceans technology network ▪ Placentia Bay technology demonstration platform
Administration of marine activities and interests	"Smart" Regulation Integrated information management	
Research, Monitoring, and Assessment	Program and project research, monitoring and assessment e.g., ▪ IM research and monitoring	

	▪ MPA research and monitoring ▪ MEQ research and monitoring ▪ Mapping programs research and monitoring
Information Management	Sector– by-sector marine information systems Program activities information management Integrated information management (focus on science information)

3.2 Administration of Marine Activities and Interests

A review of the policy framework in *Canada's Oceans Strategy* (*COS*), as well as the program operational framework in Canada's *Oceans Action Plan (OAP)*, suggests that the administration of marine activities and interests is not as comprehensively addressed as the other marine environmental management processes. The framework of federal marine environmental management processes outlined in Table 3.2 indicates that the other processes are well addressed by several initiatives. However, this research has only been able to identify two specific federal initiatives dealing with the administration of marine activities and interests: namely, "smart" regulation and integrated information management. These are further described in the following sections.

3.2.1 "Smart" Regulation

Federal departments, in conjunction with provincial governments, conduct regulation of human activity in marine space. As a result, human activities face a complex, duplicative and costly array of approval processes. "Smart" regulation[46] represents a pro-active approach to improve the administration of activities and interests. This approach is meant to motivate public decision making to be inclusive and the general idea is to make the system less complex, more responsive and effective. It facilitates the evaluation of

[46] "Smart" regulation is a federal government initiative whose objective is to "modernize regulation to enhance conditions for an innovative economy while finding improved ways to meet high standards of social and environmental protection"[Canada, 2005b]. See the website at http://www.pco-bcp.gc.ca/smartreg-regint/

proposed activities using a standardized and harmonized approach across jurisdictions. Strategies for this approach are shown in Figure 3.3.

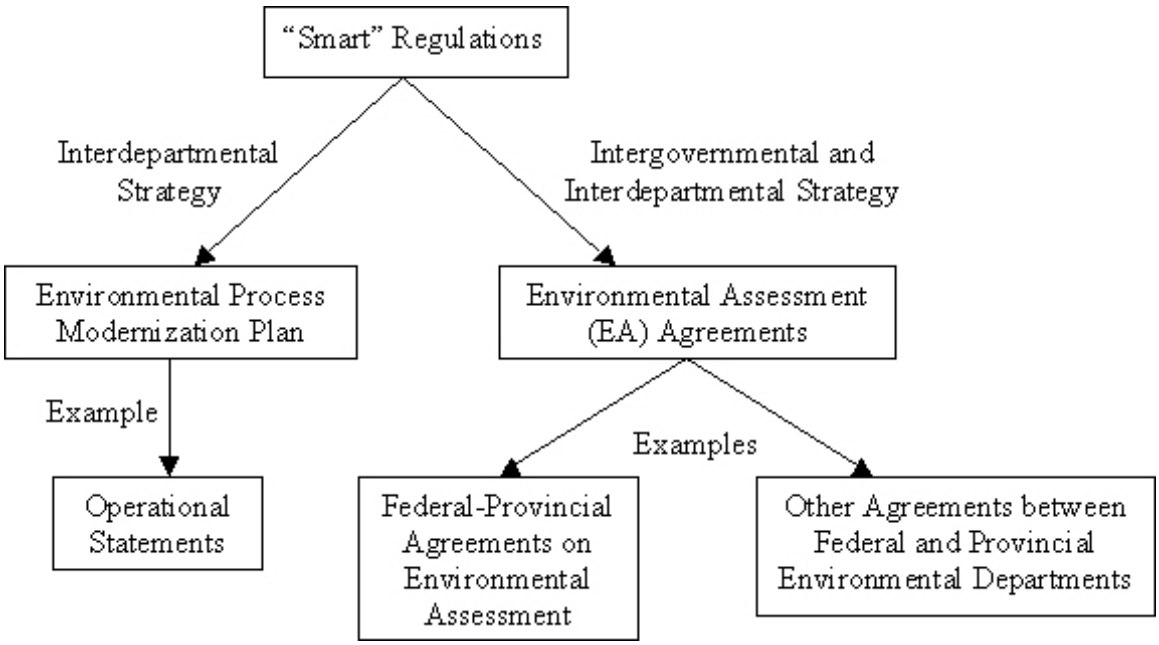

Figure 3.3: "Smart" regulation activities and examples

"Smart" regulation initiatives can therefore be considered a form of marine tenure regulatory reform, where the focus is on simultaneously trying to improve the administration of activities controlled by public authorities, and the comprehensive enforcement of public interests. However, there are several marine tenure challenges that can be identified from this initiative:

It focuses on simplifying regulatory complexity by addressing the application process. There is no mention of what happens with the marine tenure information arising from the application process.

There is an implicit assumption in this initiative that the regulatory instruments being harmonized are the primary source of marine tenure information.

While new applicants may benefit from the regulatory harmonization, there is no mention of holders of previously approved applications. As such, tenure information from previous application procedures may not be available.

Initiatives such as Operational Statements (see Figure 3.3) only deal with activities that might result in harmful alteration, disruption or destruction of fish habitat. This represents a sectoral approach to resolving issues, which may exclude other sectors' activities and stakeholder interests.

3.2.2 Integrated Information Management

The integrated information management approach can be determined from a review of *Canada's Oceans Strategy* (*COS*) and Canada's *Oceans Action Plan* (*OAP).* This research suggests that there are in fact two strategies: (1) *COS* advocates an approach focused on inclusive information management i.e., the inclusion of local and traditional knowledge [Canada, 2002b, p.22]; and, (2) *OAP* adopts an approach focused on governance reform: improving information management through [Canada, 2005a, p.8]: (a) governments working together; (b) bringing sectors and citizens together using more open and transparent management and advisory bodies; and, (c) pursuing ecosystem-based approaches.

Both strategies have several challenges that affect their ability to incorporate tenure information as part of their integrated information management approach. In the first strategy, two challenges are observed: (1) marine tenure information management is more than just including local and traditional knowledge and may represent other information types that are currently overlooked; (2) use of this information is contingent on it being provided in a form and format that can be reconciled with other tenure information. In the

second strategy, two other challenges are observed: (1) there is an unproven assumption that governance reform will result in improved marine tenure information management; and, (2) the indirect focus on governance suggests a lack of emphasis on the importance of information management in administering marine activities and interests.

Taken together, these two integrated "interests" information management strategies (and their articulated challenges) suggest that marine tenure information management is: (1) considered in the narrow context of individual programs and projects, and not in the broader marine environmental management context; and, (2) may not be considered as an independent (and important) process in marine environmental management.

Both these points are reinforced by two observations in Canada's *OAP* Phase 1 initiatives. First, these initiatives refer indirectly to the management of marine activities and interests in proposed programs and projects.[47] For example, under the program initiative of *integrated oceans management for sustainable development*, the *Integrated Management* (*IM*) planning sub-program proposes five[48] priority areas, which have several objectives. One of these objectives is to provide insight into the challenges in managing the wide range of marine activities and interests.

Second, a review of Canada's *OAP* program initiatives indicates a source of concern. For example, the proposed *Oceans Management Tools* program initiative in Canada's *OAP* Phase 1 does not indicate any initiative to develop (or improve) tools for managing marine activities and interests. A further review of the order of priority in the proposed

[47] Program initiatives fall under the general Policy objectives outlined in Canada's Oceans Strategy. There are multiple projects within each program [Canada, 2005a].
[48] They are listed as: (1) Placentia Bay and Grand Banks; (2) The Scotian Shelf; (3) Gulf of St. Lawrence; (4) Beaufort Sea; and, (5) Pacific North Coast. See Canada's *Oceans Action Plan* (Canada, 2005, p. 13-15).

tools suggests that improving access to science information is the primary concern[49]. There is reference to developing tools for applying the ecosystem-based management approaches to the management of human activity in the oceans. However, the vision is to develop tools that use science to more comprehensively identify ecosystem objectives. Only then are "permissible types and levels of activity subsequently identified" [Canada, 2005a, p.16]. Noticeable in this approach is that the tools and methods for marine tenure information management are not highlighted.

3.2.3 The Challenge in Marine Tenure Information Management

This research suggests that the previous observations contain two assumptions: (1) activities and interests in an area can be easily identified, and (2) unidentified interests, or other associated issues, will only pose a small or insignificant challenge in marine environmental management. These assumptions suggest several conclusions: (1) marine tenure information management is not deemed a major issue; (2) marine tenure information management is not understood as a major issue; or, (3) marine tenure information management is assumed to be an issue that is appropriately dealt with by policy, project, or program initiatives.

Combined, these three conclusions suggest a lack of clarity in the functions and processes involved in the administration of marine activities and interests. This research suggests that this is the major challenge of marine tenure information management. [50]

[49] These tools are listed as, (1) ecosystem overview and assessment reports, (2) seabed mapping, (3) ecosystem objectives, (4) identification of ecologically significant areas.

[50] There is little evidence indicating how marine activities and interests (marine tenure) are defined or determined, including the sources of information and the procedures used to create, store, and access this information. The research suggests that such a focus is necessary or significant challenges to marine environmental management will result.

3.3 A Strategy for Investigating Marine Tenure Information Management

To further clarify how administration of marine activities and interests affects marine environmental management, this research proposes investigating marine tenure information management in the context of the federal Department of Fisheries and Oceans (DFO) MPA program. [51] This program is one of three federal marine conservation programs administered by Canadian Heritage (Parks Canada), Environment Canada, and DFO (see Table 3.3).

Table 3.3: Federal Marine Protected Areas Programs (after Canada [2002c])

Agency	Legislation	Protected Areas Program
DFO	Oceans Act	Marine Protected Areas
Parks Canada	National Parks Act	National Marine Conservation Areas (NMCA)
Environment Canada	Canada Wildlife Act	National Wildlife Areas and Marine Wildlife Areas
Environment Canada	Migratory Bird Conservation Act	Migratory Bird Sanctuaries

Of the three programs shown in Table 3.3, the DFO-MPA program (referred to in this research simply as MPAs) stands out for several reasons. First, MPAs are established under broader guidelines unlike those provided by the other programs (*known for dealing with specific habitats or species*). Secondly, designation of MPAs provides protection that is much greater than that afforded by the other programs. For example, MPA management plans can define buffer areas adjacent to the MPA boundaries whereby certain activities are restricted. Third, MPAs represent a new approach, having been mandated in 1996 by the *Oceans Act* [1996], and having established only two offshore MPAs as of January 2005. Finally, MPAs have a broader role in Canada's overall

[51] In this research, an MPA refers specifically to a Marine Protected Area under the DFO program and the *Oceans Act* [1996].

strategy for marine environmental management. This latter point is further elaborated in the following section.

3.3.1 The Importance of MPAs to Marine Environmental Management

Canada's strategy for marine environmental management describes a central role for MPAs. For example, Canada's *Oceans Act* [1996] describes MPAs as a core component in the oceans management strategy. *Canada's Oceans Strategy (COS)* describes a network of MPAs as crucial to fulfilling the policy objective of *understanding and protecting the marine environment.* Additionally, Canada's *Oceans Action Plan* (*OAP*) describes a network of MPAs as a sub-program initiative in the *Health of the Oceans* program initiative. Clearly, MPAs are an integral part of Canada's marine environmental management strategy as described in the legislative, policy, and program framework.

MPAs apply the *Integrated Management (IM)* approach (as well as other approaches) outlined in *Canada's Oceans Strategy (COS)*. *IM* functions are central to MPA implementation. Therefore, integrated information management, inclusive governance structures[52], adaptive management, and ecosystem planning are roles that MPA implementation must fulfill [Canada, 1997a, 1998]. In fact, an *IM* area may consist of a network of MPAs nested within it, and individual MPA boundaries may be part of the larger ecosystem boundary identified by the *IM* plan [Canada, 2002a].[53]

3.3.2 The Information Management Challenge in MPA Implementation

MPAs are created to protect a specified location from certain human impacts. This implies that just as in marine environmental management, marine activities and interests

[52] Consultation has been observed to increase the level of understanding and support for marine protection, thereby reducing potential conflicts and the need for heavy enforcement [Brody, 1998].
[53] MPA and *IM* planning processes are structurally similar as outlined in Chapter 1.

are important in establishing MPAs. Therefore, the information systems used to establish marine activities and interests are as important as the ones used to determine the state of the marine environment in which activities take place.

When this research began in 2000, there was an increasing focus on establishing a network of MPA and the information requirements associated with this process [Canada, 1998, p.10]. DFO[54] was initially focused on identifying the requirements and components of a "national network of MPAs", bringing together individuals that shared an interest in MPAs, and collaboratively developing the conceptual frameworks and outlining general information requirements [Fenton and Westhead, 2000, p.2].

The marine information requirements mentioned in the previous paragraph were biased towards science. For example, several publications [e.g. Canada, 1997b, Fenton and Westhead, 2000] stressed the need to identify and manage MPAs (including a network of MPAs) based on science information. This is not surprising since the ecosystem based management approach, as well as the precautionary approach, suggest that science has priority in marine environmental management. However, the application of the ecosystem based management approach to MPA establishment also references the importance of other information types. For example, in the description of the MPA program other information types are important in the technical and socio-economic assessment of a proposed Area of Interest (AOI)[55] [Canada, 1998]. These other types of information would include marine tenure information.

[54] Identified as the lead agency for administering the MPA program under the *Oceans Act* [1996].
[55] This is where a proposed area is considered as an MPA candidate [Canada, 1998].

3.3.3 The Marine Tenure Information Management Challenge for MPAs

As mentioned previously, other information types are important in the technical and socio-economic assessment of MPAs. However, they seem to be considered "inferior" to science information. For example, the document describing the policy and program elements of the MPA program states that, "an AOI's ecological values may be more important than technical and socio-economic considerations" [Canada, 1998, p.17].

The fact that this information is regarded as secondary[56] to ecological goals seems to contradict its multiple listing as an important information requirement in MPA implementation (see for example Appendix II.2 and Canada [1998]). This gives the impression that its use in the decision making process is as a secondary (*and never primary*) modifier in MPA implementation. The challenge for protecting marine ecosystems involves more than a cursory inspection of other information types, including information on marine activities and interests. As observed by some researchers, "…science by itself cannot answer all the (*planning and management*) questions…[LSLK, 2002, p.10]".[57]

A review of Canadian MPA management literature (see for example articles in SAMPAA Conference [Munro et al., 2003]) indicates vague descriptions regarding: marine activity and interests information sources; their use in the decision-making process; and their specific characteristics. There is little knowledge regarding whether

[56] This apparently is an internationally accepted practice. For example, based on its long time MPA experience Australia proposed to Canada "…that non-ecological goals should be regarded as modifiers of the primary biodiversity or ecological goals once candidate MPAs have been identified and selected [Fenton and Westhead, 2000,p.13]". This suggests that these non-ecological goals have a negligible role in the identification and selection of MPAs.

[57] The conference on "Making the Linkages work in Canada's MPAs" dealt with this by recommending that, "MPAs are about managing peoples activities and therefore their success depends on how well cultural, economic and social values are integrated. Issues like land-use, property rights, distribution of income, community decisions cannot be considered separately from ecological objectives. If certain values are considered separately or ignored, then the overall effectiveness of an MPA as a management tool is diminished [LSLK, 2002, p.32]".

coastal zone information systems being assembled are adequate for establishing or managing MPAs. Additionally, little is known about how organizations and groups will be able to share their information within these systems, or the appropriate form, format, and content. The collaborative and co-management approaches (in the MPA *IM* approach) suggest that stakeholder groups may have certain types of information that may impact on decisions. However, there is little guidance as to the types of information these agencies and groups may have in their possession; examples of how it is to be used; and whether any information sharing protocols and standards are established.

3.4 Chapter Summary and Conclusions

This chapter has carried out a literature review of the national approach to Canadian oceans and coastal management. Specifically, this chapter has reviewed the marine environmental management context of this national approach and the "tentative" role of tenure information management.

This research concludes from this chapter that there is an opportunity and a need to: (1) describe marine tenure information requirements in the specific context of MPA management; (2) describe marine tenure information use in MPAs; and (3) demonstrate the broader role of tenure information beyond MPAs, to marine environmental management. This can be carried out by investigating the information management challenges associated with demonstrating how MPAs affect (and are affected by) the rights of the community of interest, stakeholders and the general public. This means demonstrating the processes and activities that support, or depend on, marine tenure information management. The approach to accomplish this, in the context of MPAs, is described in Chapter 4.

4 CHAPTER 4: DESIGN OF A CONCEPTUAL FRAMEWORK FOR MARINE TENURE INFORMATION MANAGEMENT IN CANADIAN MARINE PROTECTED AREAS

Chapter 3 has outlined the role of marine tenure information in Canadian marine environmental management., described the process of administering marine activities and interests in Canada, identified shortcomings in the process, and a strategy for addressing these shortcomings. This chapter outlines a preliminary framework for describing MPA tenure information management functions and processes, and their role in MPA implementation, by focusing on MPA goals, objectives, and indicators.

4.1 MPA Implementation in Canada

Implementation of Department of Fisheries and Oceans (DFO) Marine Protected Areas (MPAs) may be conceptualized as two primary processes: establishment and management (see Figure 4.1). MPA *establishment* refers to the processes accomplished leading up to MPA designation (i.e., legal recognition). MPA *management* refers to the processes carried out after MPA designation.

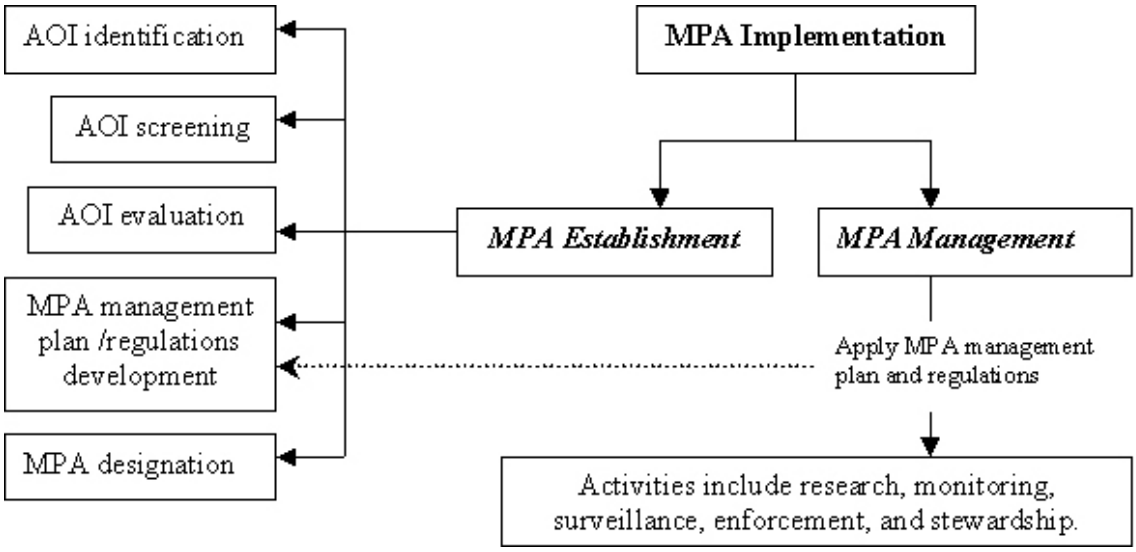

Figure 4.1: Conceptual model of MPA implementation processes

Although this research primarily focuses on MPA establishment, it is important to first describe the umbrella term *MPA implementation*. In Canada, this involves a series of stages (or processes) defined in the DFO MPA program implementation framework (hereafter referred to as *the framework*). This *framework* consists of six processes, as outlined in Table 4.1.

Table 4.1: Framework for establishing and managing DFO MPAs (after Canada [1998])

Stage	Description
Identification of MPA Areas of Interest (AOIs)	This involves a procedure for nominating areas for consideration as MPAs. The MPA definition[58] encapsulated in the *Oceans Act* [1996] provides guidance as to what criteria are used to evaluate whether an area should be considered under this program.
Initial Screening of AOIs	This involves an assessment of an AOI to determine if it should be evaluated in more detail. This screening usually checks the purposes stated for the AOI against the criteria for establishing MPAs under the *Oceans Act* [1996].
AOI Evaluation and Recommendation	This involves an ecological, technical and socio-economic assessment of the AOI. This step involves a public engagement and consultation process, which leads to the recommendation of whether the area should be accepted as a candidate MPA.
Development of a Management Plan for a Candidate MPA site	This involves creating a management plan that states the reasons for the MPA, its goals and objectives, how the goals and objectives are to be reached, and how the success of the MPA will be measured. This step also involves providing details such as the location and boundaries of MPA, zoning, prohibited activities, and other relevant regulations. Other initiatives may be necessary e.g. resource studies (inventories, research and monitoring), public awareness and education, surveillance, enforcement, and resource use management.
Designation of an MPA	This involves the acquiescence of MPA regulations under section 35 (3) of the *Oceans Act* [1996] by the Governor in Council. The Minister of Fisheries and Oceans is responsible for recommending whether the Governor in Council should designate an MPA. This step also involves partnering, co-management agreements, or signing of Memoranda of Understanding between DFO and partnering governments/ organizations. It also involves allocation of financial and staff resources and other commitments.
Management of	This involves site planning, research, monitoring, surveillance, enforcement,

[58] Under Section 35(1) of the Canada *Oceans Act* (1996) an MPA is defined as "an area of the sea designated for special protection that forms part of the internal waters of Canada or the exclusive economic zone of Canada". An area can be designated as an MPA to conserve and protect one or more of the following: (1) Commercial and non-commercial fisheries resources, including marine mammals and their habitats;(2) Endangered and threatened marine species, and their habitats;(3) Unique habitats;(4) Marine areas of high biodiversity or biological productivity (5) Any other marine resource or habitat as is necessary to fulfill the mandate of the Minister of Fisheries and Oceans.

an MPA	visitor management and stewardship initiatives. This is accomplished using the MPA management plan.

In this research, MPA establishment is very narrowly construed as consisting of the first five processes in the framework. Therefore, in the context of managing tenure information for MPA establishment, this research is referring to the use of this information for the purposes of: (1) Area of Interest (AOI) identification; (2) initial screening; (3) evaluation and recommendation; (4) MPA management plan development; and, (5) MPA designation.

4.2 Tenure Information for MPA establishment

A review of Canadian MPAs suggests that the primary information focus is on understanding the dynamics of marine ecosystems (for example, Canada [1998, p.6]). However, there are other types of information used in various processes of the framework [Canada, 1998; 2002c]. These include information on marine activities and uses.

A further review of program documentation describing MPA implementation exposes two observations regarding MPA tenure information considerations: (1) the program documentation refers to tenure information in the narrow context of use rights; (2) the program provides superficial descriptions of the other categories of information used in MPA implementation; and, (3) the program displays a bias for scientific information requirements.

This suggests a lack of clarity regarding the role of tenure information in MPA implementation. For example, designation of an MPA suggests that there will be a transfer of property rights within the MPA spatial extent, which may lead to expropriation of private/public property rights. In some cases, this may take the form of federal-provincial jurisdictional transfer especially in MPA locations where this

jurisdiction is not clear. Clearly, a broader understanding of these tenure-related issues is needed. More specifically, there is a need to determine: tenure information sources, their specific characteristics, and their use in the decision-making process. This is particularly important given that information on marine activities and interests is repeatedly identified as core information in several stages of *the framework.*

This research suggests that the role of tenure information in MPA implementation can be addressed more appropriately within a general framework for identifying information requirements. This is further described in the following section.

4.2.1 A General Framework for identifying Information Requirements

In order to describe the role of tenure information in MPA implementation, this research proposes a framework based on MPA goals, associated objectives, and corresponding information needs. Several such frameworks have been described in MPA research (see for example Fiske [1992], Kelleher et al.[1995], Kelleher and Recchia [1998], Brody [1998], Hockings et al. [2000], Sutinen et al. [2000], Berkes et al. [2001], Ehler [2003], Pomeroy et al. [2004]). These frameworks generally describe: (1) MPA goals and objectives; (2) indicators that measure the objectives; and, (3) data /information requirements to support the measurement of the indicators. As outlined in Figure 4.2, MPA objectives are measured using several indicators and an analysis of these indicators will identify whether MPA objectives have been met. These indicators are measured using data that is collected, and information that is retrieved, from several different sources.

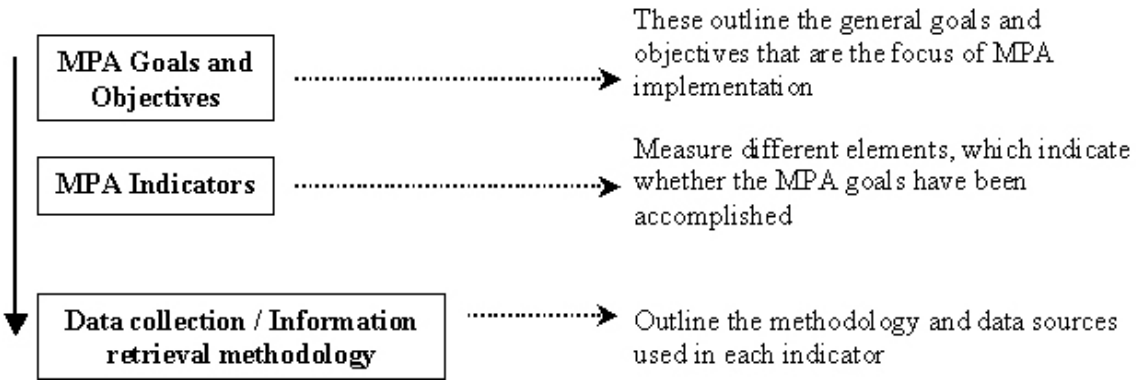

Figure 4.2: The general framework used to identify information requirements for MPA implementation

The above-mentioned framework for MPA implementation would identify both scientific and other information. The goal of MPAs is to protect the sensitive and vulnerable ecosystems[59] by effectively managing human use and effects. Information on human use and effects is part of MPA tenure information.

4.2.2 Focusing on MPA Tenure Information

While natural sciences are vital to understanding ecosystem functions and change, social sciences are valuable for identifying human induced changes, and testing and applying appropriate solutions [Pomeroy et al., 2004, p.180; WCPA/WWF, 2005]. As shown in Figure 4.3, effective management of complex MPA ecosystems cannot occur in the absence of (1) natural sciences to understand the ecosystem functioning and, (2) social sciences to design appropriate management solutions.

Figure 4.3 suggests that MPA objectives, indicators, and information arise from two general categories: biological and non-biological. MPA research generally prefers distinguishing between biological and non-biological criteria for MPA implementation

[59] In conservation biology, the general methodology for determining marine conservation areas is tied to the assumption that certain geographic areas are more sensitive or vulnerable than their surroundings [Zacharias and Gregr, 2005]. The concepts of sensitivity and vulnerability (along with representativeness and uniqueness) are commonly used as biological criteria for identification of areas that require special management or protection.

(see for example Pollnac and Crawford [2000]; Pomeroy et al. [2004]). While this research will use the distinction of biological vs. non-biological criteria, it is important to note that the literature also shows preference for other distinctions. [60]

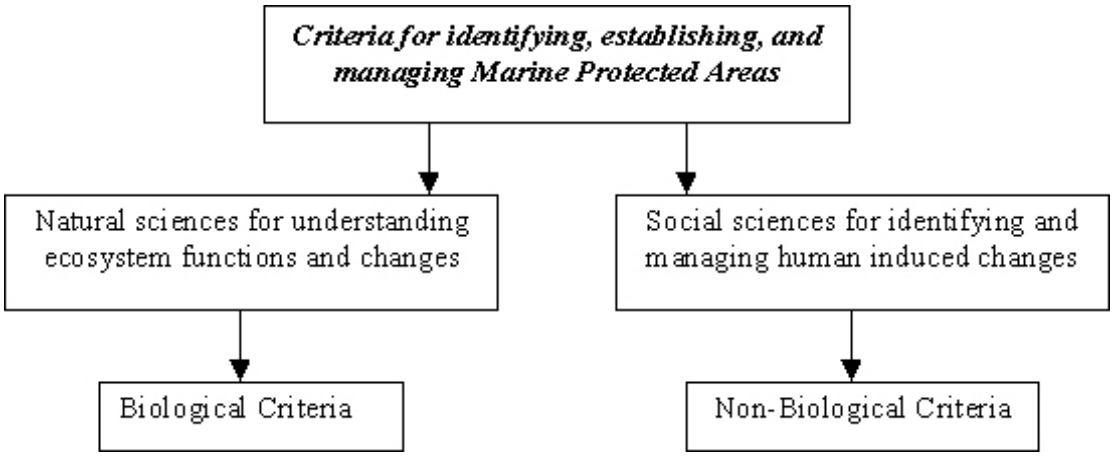

Figure 4.3: General information categories for MPA implementation

Experience shows that social, economic, cultural, and political factors (more than biological and physical factors) shape the development management and performance of MPAs [Fiske, 1992; Kelleher and Rechia, 1998; Mascia, 2002; Roberts, 2000; Pomeroy et al., 2004]. Tenure information falls within the non-biological criteria for MPA implementation because it focuses on the effect of human activities on the environment.

MPA research also indicates that non-biological criteria falls into two sub-categories: socioeconomic and governance criteria (see Figure 4.4). [61] Each of these criteria has a specific purpose in MPA implementation. The use of socio-economic criteria facilitates [Pomeroy et al., 2004]: (1) incorporation and monitoring of stakeholder group concerns and interests into the management process, (2) determination of management decision

[60]. For example, Brody [1998] prefers to use categories and sub categories that mix both biological and non-biological criteria. He suggests the following sub-categories: economic importance, social importance, feasibility, and international significance.

[61] MPA governance and socioeconomic criteria are important in measuring management effectiveness. Assessing management effectiveness is a way to document how the management of a protected area influences its success [WCPA/WWF, 2005].

impacts on stakeholders; and, (3) demonstration of the value of the MPA to the public and decision makers. MPAs are considered to be socioeconomic tools because they affect (and are affected by) people.

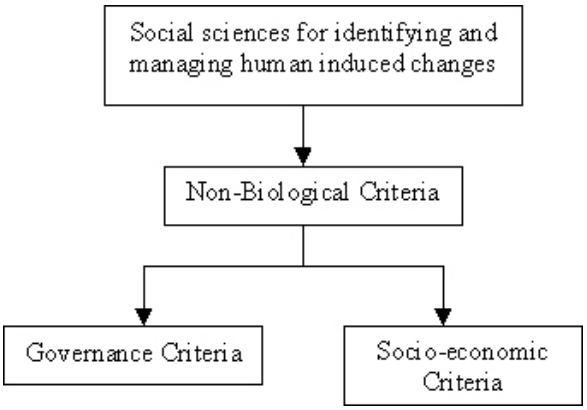

Figure 4.4: The sub-categories within the non-biological criteria for MPA implementation

The use of governance criteria facilitates the management of [Pomeroy et al., 2004]: (1) users and their intentions; (2) sets of rights and rules; and, (3) sets of shared norms and strategies. MPAs are considered to be governance tools because they limit, forbid or otherwise control use patterns and human activity through a structure of rights and rules.

4.3 A Role for Tenure Information from MPA Governance and Socioeconomic Criteria

In this research, the framework of governance/socioeconomic goals, objectives, and indicators will be used to identify the role of tenure information in MPA implementation. This framework will be sourced from the research previously mentioned in section 4.2.1, and from a publication from international experts of World Commission on Protected Areas (WCPA) Marine and the World Wide Fund for Nature (WWF). This publication represents a comprehensive summary of MPA management research.

The title of the publication is "*How is your MPA doing?*" and it assembles and reviews various sources of MPA management research. From the review, it describes

how to select MPA indicators and how to use these indicators in assessing MPA management effectiveness [Ehler, 2003; Pomeroy et al., 2004]. The indicators have been tested on several pilot sites around the world, providing a variety of geographic and regional representations, marine ecosystems, protection systems, protected area sizes, and years of management experience.

This research suggests that a review of the above-mentioned MPA governance/socioeconomic frameworks will identify the specific role of tenure information in MPA implementation. This research has already indicated that these frameworks are important in evaluating *MPA management* effectiveness. However, Figure 4.1 has established that in MPA implementation, *MPA management* is a process that follows *MPA establishment*. Therefore, baseline governance and socioeconomic information has to be collected during *MPA establishment* in order to evaluate *MPA management* effectiveness.

In the ensuing sections, a review of *MPA management* governance and socioeconomic frameworks will aid in describing the baseline information that is required. This research will specifically investigate the baseline MPA tenure information required. To begin this review, section 4.3.1 looks at MPA governance goals and objectives.

4.3.1 MPA Governance Goals and Objectives

From a literature review of MPA management, this research has identified the governance goals and objectives outlined in Table 4.2. The goals and objectives deal with the establishment of, (1) management plans, (2) legal structures, and (3) stakeholder

participation. These three components are supposed to ensure that MPA *establishment* provides the necessary basis for MPA *management*.

A review of the governance goals and objectives in Table 4.2 provides evidence of tenure information as a critical decision-making component. For example, the governance goal of *reducing resource use conflict* focuses on community harmony through dispute resolution. In this example, several types of information need to be determined e.g., stakeholders, their rights, and how these rights impact (or are impacted by) the MPA. For resource use conflicts to be managed there must be information regarding the different human activities and interests within (and adjacent to) the MPA. This type of tenure information is better understood by reviewing the indicators that are used to measure specific objectives.

4.3.2 Evaluating MPA Governance Indicators

An inspection of MPA governance objectives only provides a general indication of information that is needed for MPA implementation. To be able to determine the specific information that is needed, one needs to review the indicators used to measure the accomplishment of governance goals. From a review of the MPA research, the governance indicators outlined in Table 4.3 are the most frequently mentioned.

Based on a further review of these indicators, this research proposes that they fall into four categories. The four categories deal with: (1) information management; (2) resource use patterns and legal structures; (3) capacity building and other management actions; and (4) governance tools and institutions. The indicator categories are described in Figure 4.5.

Table 4.2: Governance goals / objectives commonly associated with MPA implementation (after Borrini-Feyerabend [1997]; Buckles [1999]; Pomeroy et al. [2004])

Governance goals	Objectives
Effective management structures and strategies maintained	Management plan implemented and process effective. Rules for resource use and access clearly defined and socially acceptable. Decision making and management bodies present, effective and accountable. Human and financial resources sufficient and used efficiently and effectively. Local and / or informal governance system recognized and strategically incorporated into management planning. Periodic monitoring, evaluation, and effective adaptation of management plan ensured.
Effective legal structures and strategies for management maintained	Existence of adequate legislation ensured. Compatibility between local (informal) and legal (formal) arrangements maximized and ensured. National and / or local legislation effectively incorporates rights and obligations set out in international legal instruments. Compatibility between international, national, state, local rights and obligations maximized and ensured. Enforceability of arrangements ensured.
Effective stakeholder participation and representation ensured	Representativeness, equity and efficacy of collaborative arrangements ensured. Resource user capacity effectively built to participate in co-management. Community organization and participation strengthened and enhanced .
Management plan compliance by resource users enhanced	Surveillance and monitoring of coastal areas improved. Willingness and acceptance of people increased to behave in ways that allow for sustainable settlement. Local ability and capacity built to use resources sustainably. User participation in surveillance, monitoring, and enforcement increased. Application of laws and regulations adequately maintained or improved. Access to transparency and simplicity of management plan ensured and compliance fostered.
Resource use conflicts managed and reduced	User conflicts managed/reduced (a) within and between user groups and / or (b) between user groups and the local community, or between the community and users outside it.

Table 4.3: Governance indicators and their measurement rationale (after Borrini-Feyerabend [1997]; Buckles [1999]; Pomeroy et al. [2004])

Indicator title	What the indicator is used for
1. Level of resource conflicts	This indicator will allow an evaluation of whether conflicts associated with the MPA are increasing/decreasing over time as well as the nature and characteristics of the conflict. To determine how well MPA management is responding to conflicts associated with the MPA.
2. Existence of decision making and management body	This is a measure of the recognition of an institution that governs how an MPA is managed and used, and a transparent process for management planning, including establishing and enforcing rules and regulations.
3. Existence and adoption of management plan	This means that there are strategic directions and actions for implementation of an MPA and existence of legislative support for the plan.
4. Local understanding of MPA rules and regulations	This is a measure of whether stakeholders are aware of the existence and intent of rules and regulations. This directly affects the success of the MPA.
5. Existence and adequacy of enabling legislation	To ensure that the MPA management plan is supported by adequate legislation to support successful implementation.
6. Availability and allocation of MPA administrative resources	Measure of the capacity of the management team to administer and complete various MPA activities over time based on available human, equipment, and financial resources.
7. Existence and application of scientific research and input	Measure of how research activities and scientific knowledge generated by studies at the MPA feedback into improved management.
8. Existence and activity level of community organizations	Measure the existence, active organization and participation of community organizations in MPA decision-making and management.
9. Degree of interaction between MPA manager and stakeholders	Measure the level of discussion, input and participation from stakeholders with MPA staff about compliance with MPA management plans. This will lead to greater compliance and increased success of the MPA.
10. Proportion of	Measure of the number of stakeholders who participated in training and who have knowledge of sustainable

stakeholders trained in sustainable use	resource use. Whether MPA capacity building efforts have any effect towards sustainable resource use.
11. Level of training provided to stakeholders in participation	Measure of the amount of effectiveness of capacity building efforts to empower stakeholders with knowledge, skills and attitudes to participate in MPA management.
12. Level of stakeholder participation and satisfaction in management	Measure of the amount of active involvement of people in making MPA management decisions or management activities and of their satisfaction with their level of participation. This includes being heard or considered by the MPA manager.
13. Level of stakeholder involvement in surveillance	Measure of the number of people who have been involved in patrolling or other monitoring and surveillance activities.
14. Clearly defined enforcement procedures	Measure of the existence and description of guidelines and procedures developed for staff charged with enforcement responsibilities.
15. Enforcement coverage	Measure of the number of surveillance and monitoring patrols by MPA staff during a given period.
16. Information dissemination	Measure of the number and effectiveness of the capacity building efforts for stakeholders on the objectives, benefits, rules, regulations and enforcement arrangements of the MPA.

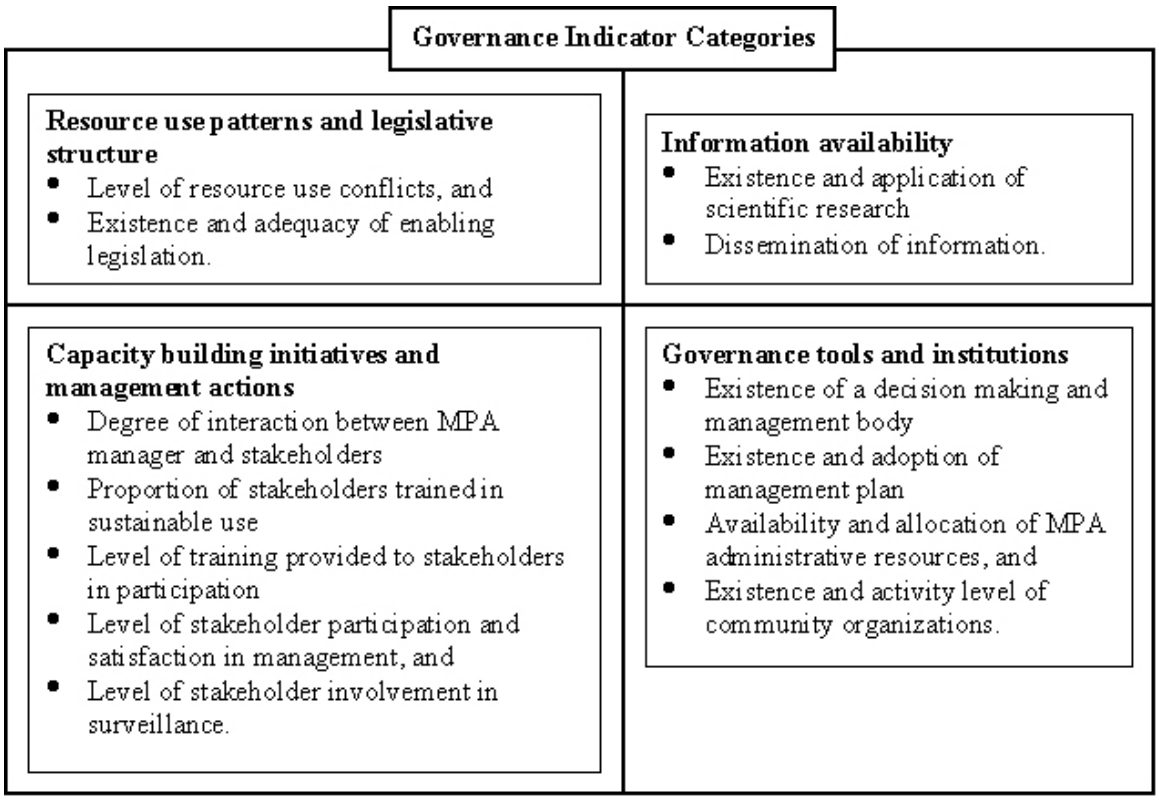

Figure 4.5: The categories of governance indicators identified in the research

The indicator categories deal with various MPA objectives. For example, the *information availability* category deals with determining, (1) the existence and application of scientific research, and (2) the dissemination of information. *Resource use patterns and legislative structure* indicator category deals with determining, (1) the level of resource use conflicts, and (2) the existence and adequacy of enabling legislation. The other indicator categories deal with the remaining MPA objectives as outlined in Figure 4.5.

4.3.3 MPA Socioeconomic Goals and Objectives

An approach similar to the one for governance goals/objectives can be used to evaluate socioeconomic goals/objectives. From a review of MPA management, this research has identified socioeconomic goals and objectives outlined in Table 4.4. These

goals and objectives deal with the establishment of, (1) food security, (2) livelihood opportunities, (3) monetary/non-monetary benefits, (4) equitable distribution of benefits, (5) compatibility with local culture, and (6) environmental awareness/knowledge [Pollnac and Crawford, 2000; Pomeroy et al., 2004].

As with governance, a review of the socioeconomic goals and objectives in Table 4.4 indicates that marine tenure information is an important component. For example, the socioeconomic goal of *compatibility between management approaches and local culture* focuses on determining the local resource use patterns and reconciling these against proposed restriction to activities. This depends on identifying the location of activities and interests, stakeholders, and use/other rights to marine resources. This type of tenure information can be further clarified by reviewing the indicators used to measure individual objectives.

Table 4.4: Socioeconomic goals / objectives commonly associated with MPA implementation (after Bunce et al [2000]; Berkes et al [2001];Pomeroy et al [2004])

Socioeconomic Goals	Objectives
Food security enhanced or maintained	Nutritional needs for coast residents met or improved Improved availability of locally caught seafood for public consumption
Livelihoods enhanced or maintained	Economic status and relative wealth of coastal residents or resource users improved Household occupational income structure stabilized or diversified through reduced marine resource dependency Local access to markets and capital improved Health of coastal residents/resource users improved
Non monetary benefits to society enhanced or maintained	Aesthetic value enhanced or maintained Existence value enhanced or maintained Wilderness value enhanced or maintained Recreational opportunities enhanced or maintained Cultural value enhanced or maintained Ecological services value enhanced or maintained
Benefits from the MPA equitable distributed	Monetary benefits distributed equitably to and through coastal communities Non monetary benefits distributed equitably to and through coastal communities Equity within social structures and between social groups improved and fair
Maximize Compatibility between local culture and management	Adverse effects on traditional practices and relationships or social systems avoided or minimized Cultural features or historical sites and monuments linked to coastal resources protected
Environmental awareness and knowledge enhanced	Respect for and /or understanding of local knowledge enhanced Publics understanding of environmental and social sustainability improved Level of scientific knowledge held by public increased Scientific understanding expanded through research and monitoring

4.3.4 Evaluating MPA Socioeconomic Indicators

From a review of the MPA research, the socioeconomic indicators outlined in Table 4.4 have been identified as being the most common (see Pollnac and Crawford [2000]; Pomeroy et al., [2004]). Generally speaking, these socio-economic indicators focus on measuring people's perception, understanding people's values, and access to information on marine resources. Using a similar approach to the one used to evaluate governance indicators in section 4.3.2, this research proposes that the socioeconomic indicators fall into five categories. The five indicator categories deal with: (1) personal and community welfare; (2) community perceptions of resource availability; (3) community perceptions of MPA value; (4) characteristics of community organization; and, (5) resource use information management. This is shown in Figure 4.6.

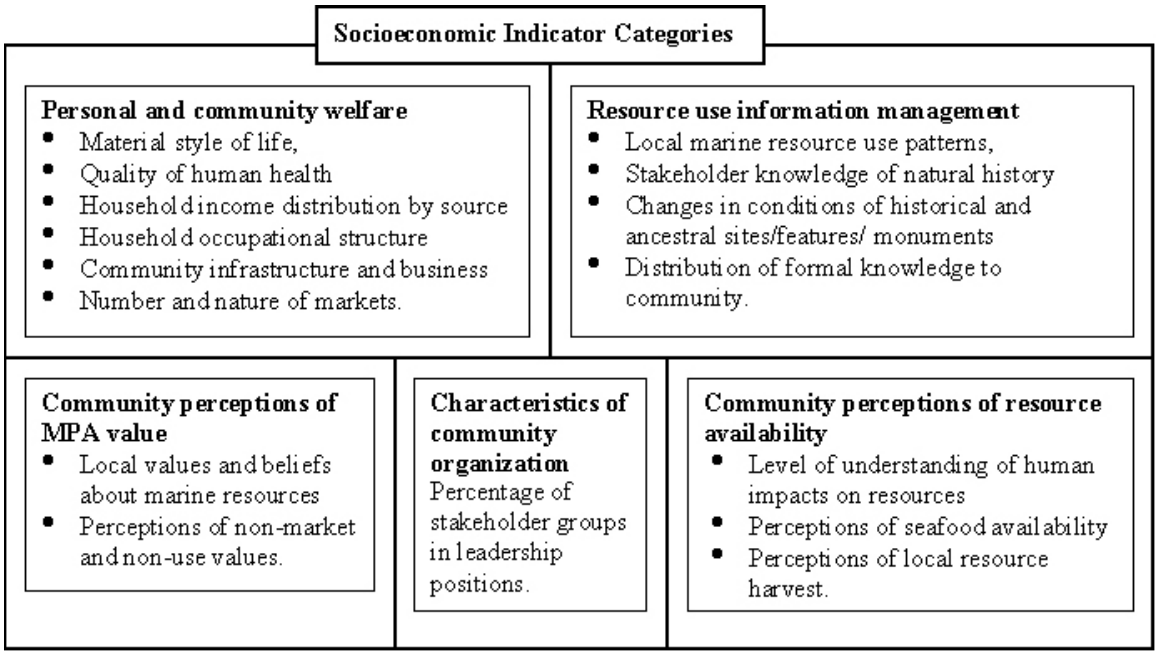

Figure 4.6: The categories of socioeconomic indicators

Table 4.5:Socioeconomic indicators and their measurement rationale (after Bunce et al [2000]; Berkes et al [2001];Pomeroy et al [2004])

Indicator	How the indicator is used in MPA management
1. Local marine resource use patterns	By understanding local marine resource use patterns, it is possible to determine whether management strategies are affecting income, livelihood patterns and cultural traditions.
2. Local values and beliefs about marine resources	Understanding this indicator helps MPA managers integrate more effectively people's local values and beliefs into MPA management and therefore avoid adverse effects of management.
3. Level of understanding of human impacts on resources	Used to identify the distribution of faulty as well as accurate perceptions of factors affecting marine resources. Can be used in education programmes.
4. Perceptions of seafood availability	Used to understand the contribution of the MPA to food security in the area. Used for responding to complaints about an MPA regarding food availability.
5. Perceptions of local resource harvest	Used to provide an understanding of fishers perceptions regarding the availability of target species. Positive perceptions may indicate willingness for MPA management.
6. Perceptions of non market and non use values	Used to understand the value of the MPA in non-monetary terms; Demonstrate the importance of the MPA to a larger community by showing the value of resources to community; Understand the changing value of the MPA to stakeholders over time.
7. Material style of life	Positive economic impacts of the MPA should be seen in the increasing material style of life of the local community and across identified social groups.
8. Quality of human health	If the MPA is providing improvements in livelihood and income, and overall improvements in the wealth of the community, it is expected that quality of human health will increase. Information on quality of human health is used to indicate the general health and nutrition of the local community.
9. Household income distribution by source	Understanding of livelihood and income sources will allow the MPA manager to understand the impact of the MPA on local households.
10. Household occupational structure	Useful for determining the impact of the MPA and associated activities on households in the community. Identifies whether people are switching to alternative sources of livelihood and income due to the MPA.
11. Community infrastructure and business	Useful for determining the impact of the MPA on wealth and economic status of communities in the area. An increase in certain kinds of businesses indicates an increase in economic development due to the MPA.
12. Number and nature of	This indicator allows for measurement of the income on markets for major marine products from the

markets	area. It allows for an analysis of changes over time of the supply and demand for marine products and market channels as a result of MPA management. Market demands also have an impact on the MPA through economic incentives.
13. Stakeholder knowledge of natural history	Provides an appreciation of local knowledge by scientists and MPA managers and facilitates compliance and MPA implementation success
14. Distribution of formal knowledge to community	Provides useful information for improving scientific research and MPA educational programs
15. Percentage of stakeholder groups in leadership positions	Measures % of stakeholder groups in leadership positions
16. Changes in conditions of historical and ancestral sites/features/ monuments	Measures impact of MPA and activities on features in order to maximize compatibility between MPA management and local culture

The other indicator categories address the remaining previously mentioned MPA objectives as outlined in Figure 4.6. For example, *personal and community welfare* deals with determining, (1) the material style of life, (2) quality of human health, (3) household income distribution by source, (4) household occupational structure, (5) community infrastructure and business, and (6) number and nature of markets. *Community perceptions of resource availability* deals with determining, (1) level of understanding of human impacts on resources, (2) perceptions of seafood availability, and (3) perceptions of local resource harvest.

4.4 Tenure Information to fulfill MPA Governance and Socioeconomic Criteria

This research has shown that it is possible to group MPA governance and socioeconomic indicators and to highlight their emphasis on tenure information. From this, it is possible to design a framework showing the context in which tenure information (and associated management) may be viewed. This is described in the following sections.

4.4.1 Defining a Role for Tenure Information from Governance Indicators

From an inspection of the groups of governance indicators previously outlined in section 4.3.2, specific indicator groups stand out as relying more on tenure information. From a further review of the same governance indicators, the following observations can be made:

(1) The *information management* category has governance indicators that primarily deal with information retrieval and dissemination, which are aspects of the information management process. Two indicators are of particular interest: (i) dealing with the collection/retrieval of scientific data (social and natural science) and its use in accomplishing MPA management objectives; and, (ii) dealing with how regulatory

(and other) information is disseminated to stakeholders to encourage compliance with MPA regulations.

(2) The *resource use patterns and legal structures* category has governance indicators that primarily deal with conflict resolution. Again, two indicators are of particular interest: (i) dealing with the availability of information on different human use patterns in an MPA area; and, (ii) dealing with the availability of information on available legislation in an MPA area.

(3) The *capacity building and other management actions* category has governance indicators that primarily deal with management actions after MPA *establishment*. These indicators focus on ensuring that stakeholders are able to participate in management and enforcement of MPA regulations, and the capacity building initiatives to accomplish this. These indicators are overlooked since they deal exclusively with activities occurring after MPA *establishment* and are outside the scope of this research.

(4) The *governance tools and institutions* category contains indicators that primarily deal with the presence and degree of participation of decision-making bodies e.g., community groups or management bodies. Three indicators are of particular interest: (i) dealing with the existence and participation of a decision-making and management body including involvement in information management; (ii) dealing with the existence and activity level of community organizations; and, (iii) dealing with the existence and adoption of management plan that represents the restrictions on activities and interests within an MPA.

4.4.2 A Preliminary Framework from MPA Governance Indicators

From a review of the governance indicator categories, the following specific observations with regard to tenure information can be made:

1) As has been demonstrated in the previous section, the *resource use patterns and legal structures* category also deals with information on resource use patterns and the associated legislative structure. This can be merged with the *information management* category. Therefore, the indicators can be said to represent an activity of determining the MPA ***tenure information requirements***. This activity would identify information on marine resources, their locations, the rights and rules regarding the marine resources, and the effective formal legislation surrounding the MPA location.
2) The *governance tools and institutions* category has two indicators that suggest a role for governance groups in tenure information management. These indicators measure (i) the existence of decision-making and / or MPA management organizations, and (ii) the existence and activity level of community organizations. These groups will probably participate in tenure information management processes i.e., data collection, retrieval, storage, analysis, and dissemination. Therefore, another important activity represented by the indicators is determining the ***role of tenure information management groups***.
3) The *governance tools and institutions* category also has an indicator that suggests the specific use of tenure information. This indicator suggests the use of tenure information in a management plan, which displays the restrictions on activities and interests within an MPA. This is complemented by indicators in the *information management* category, which describe methods of disseminating information on

rules, regulations and enforcement arrangements. This research proposes that this falls under the activity of determining MPA ***tenure information use***.

These three activities are outlined in Figure 4.7. They are important for understanding the role of tenure information in fulfilling governance criteria

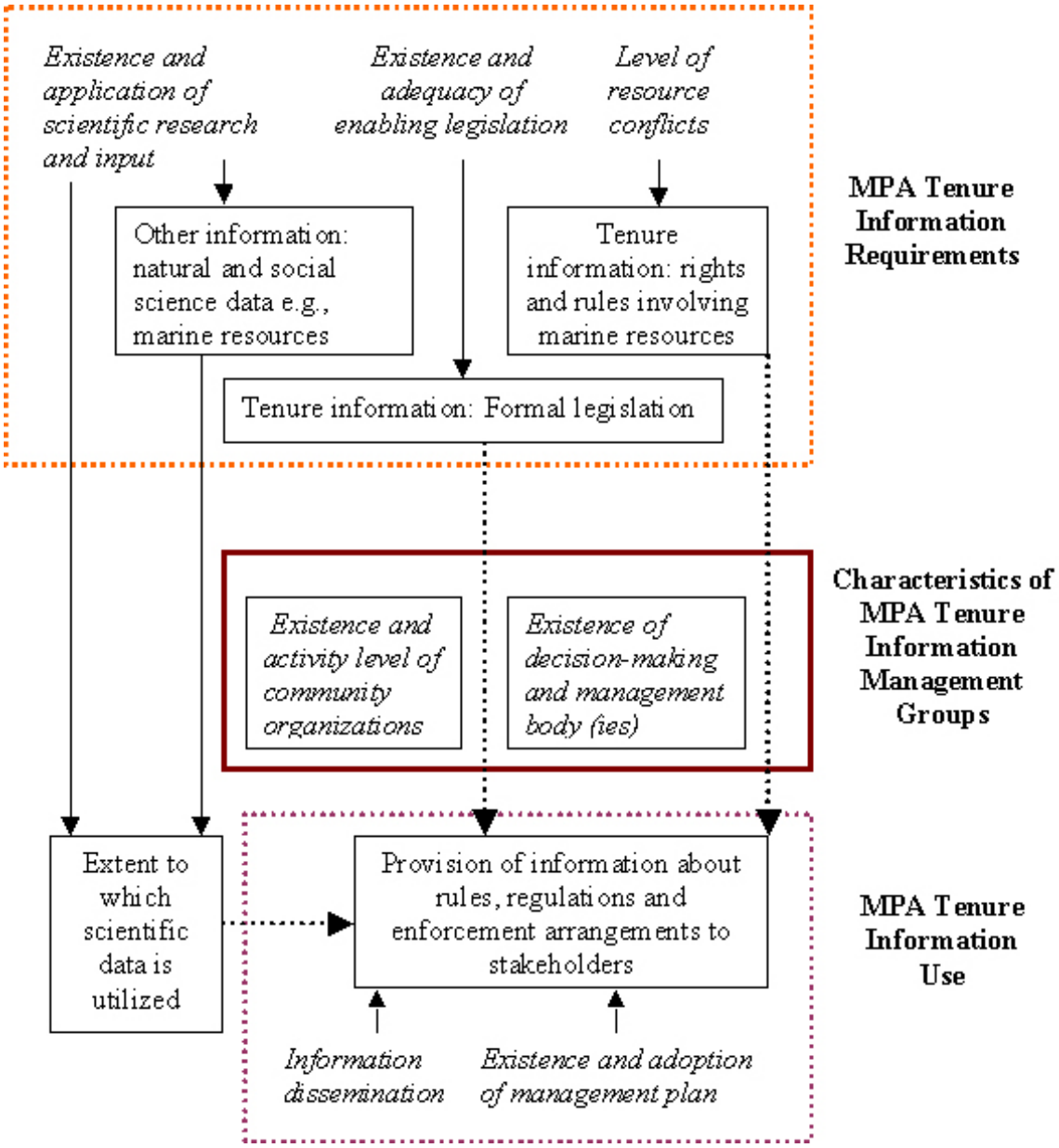

Figure 4.7: A governance indicator-driven framework for determining MPA tenure information requirements, management, and use.

The framework for understanding the role of tenure information in MPA establishment therefore requires three primary activities: (i) determining tenure information requirements, (ii) determining characteristics of information management groups, (iii) determining the use of tenure information in MPA establishment. This framework provides a starting point for discussion (and modeling) of the role of tenure information. To provide further insight, the next section reviews the role of tenure information in accomplishing MPA socioeconomic goals and objectives.

4.4.3 Defining a Role for Tenure Information from Socioeconomic Indicators

Socioeconomic indicators can also be evaluated in a similar manner to governance indicators. This means that the categories of MPA socioeconomic indicators previously described can be evaluated for their reliance on tenure information. Recall that the five indicator categories dealt with: (1) personal and community welfare; (2) community perceptions of resource availability; (3) community perceptions of MPA value; (4) characteristics of community organization; and, (5) resource use information management.

From a further review of these categories and the indicators they contain, the following observations regarding tenure information can be made:

(1) The *personal and community welfare* indicator category can be overlooked because it focuses more on the economic perspective. This was determined from a further review of the indicators and the data collected (see Pollnac and Crawford [2000]; Pomeroy et al., [2004]).

(2) *Community perceptions of resource availability* indicators primarily deal with perceptions of marine resource availability as a function of human impacts. In the

context of tenure, this can be interpreted as measuring the perception of how the quality of rights is affected, prior to and, after MPA implementation. For example, one indicator measures local stakeholder understanding of the impact of human activities on marine environment. The objective is to identify the methods used to visualize how rights to resources impact the environment. Another indicator measures seafood availability by determining how rights to access food resources are affected by MPA implementation. A third indicator measures how the community perceives use rights have affected resource harvest quantities.

(3) *Community perceptions of MPA value* indicators primarily deal with how the MPA affects rights to marine resources, and other values. In the context of tenure, the indicator objectives are to determine what non-consumptive use rights exist as a result of MPA implementation. For example, one indicator in this category measures local beliefs and values regarding marine activities. An underlying objective of this indicator is to determine if participation in MPA implementation (including information management) will affect community beliefs and views (for example, Pomeroy et al. [2004, p.123]). Another indicator measures community perceptions of (non-market) MPA value. The objective of this latter indicator is to capture other cultural and community values.

(4) *Characteristics of community organizations* indicators primarily deal with stakeholder participation. The primary objective is to provide an opportunity for bringing about a degree of equity in social groups involved in MPA implementation. One way of determining this is making sure that stakeholder groups have access to the same (tenure) information.

(5) *Resource use information management* indicators primarily deal with information on resource use patterns and marine resources, and their use in MPA implementation. One indicator measures marine resource use patterns including the boundaries of these resource use patterns (i.e., political, biological / ecosystem, physical / oceanographic) [Pollnac and Crawford, 2000; Pomeroy et al., 2004]. Another measures stakeholder knowledge of natural history including the locations of marine resources and activities. This indicator has an objective of also identifying significant places and associated activities, as well as cross-referencing local knowledge with scientific information.

A third indicator in this category measures the dissemination of formal knowledge to the stakeholder community. This suggests that data collection (or information retrieval) should be complemented by dissemination to the stakeholder community. A fourth indicator facilitates the measurement of location and condition of other resources, by measuring the available local knowledge and scientific data sources used for determining the location and condition of ancestral/ cultural/historical monuments.

4.4.4 Refining the Preliminary Framework using Socioeconomic Indicators

The evaluation of groups of socioeconomic indicators in the previous section allows the framework in Figure 4.7 (defined using governance indicators) to be refined. This framework has been defined as consisting of three primary activities. In the following sections, a review of MPA socioeconomic indicators will be used to refine each of these activities.

4.4.4.1 Refining the *MPA Tenure Information Requirements* Component

A combined review of governance/socioeconomic indicators provides valuable insight into MPA tenure information requirements. For example, governance indicators suggest that collection/retrieval of scientific data (social and natural science) is necessary for accomplishing MPA objectives. Socioeconomic indicators clarify this role by suggesting that measuring marine resource availability should provide information on the specific characteristics of resource location, quantity and quality. This information is used to determine resource use patterns and boundaries.

Governance indicators have indicated that formal regulations within an MPA area represent tenure information requirements. The objective of these regulations is to identify the existence and adequacy of enabling (and existing) legislation in supporting MPA implementation. Socioeconomic indicators also suggest that other information categories are important. For example, local beliefs and values regarding marine activities are also important, as is local knowledge of natural history. These are captured in Figure 4.8.

From the review of both governance and socioeconomic indicators, this research proposes MPA tenure information requirements can be clarified by answering the following question: what tenure data management processes are involved in identifying, (1) resource use patterns and boundaries, (2) rights and rules involving marine resources, and, (3) formal legislation? The answer to this question will facilitate a better understanding of tenure information requirements during *MPA establishment*.

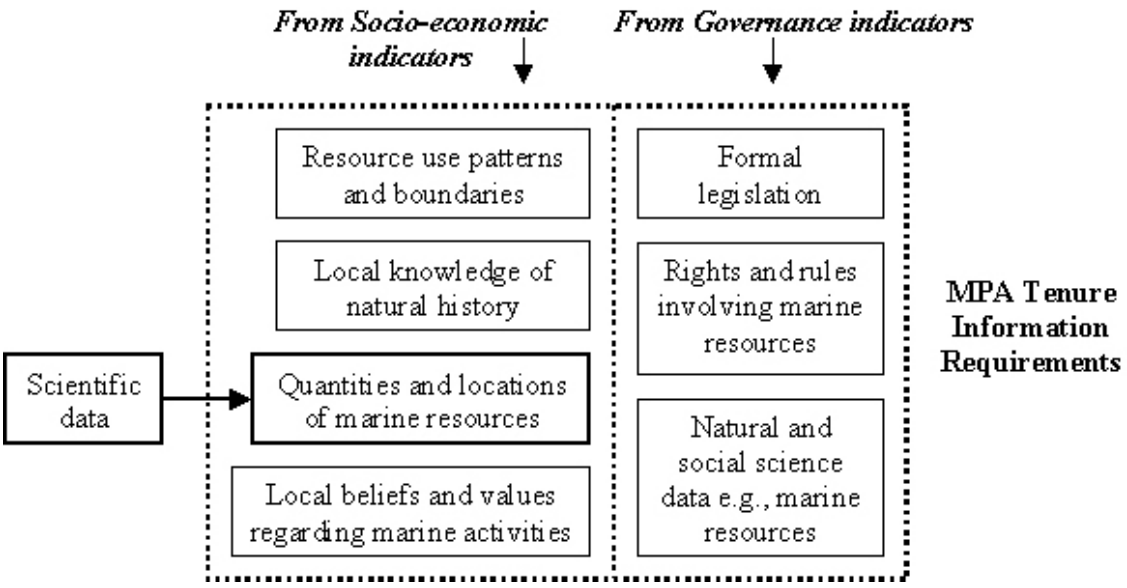

Figure 4.8: Refining MPA tenure information requirements using socioeconomic indicators

4.4.4.2 Refining the *MPA Tenure Information Management Groups* Component

A combined review of governance/socioeconomic indicators also provides valuable insight into the role of groups that may be involved in MPA tenure information management. For example, governance indicators have suggested that some characteristics of MPA management groups determine how effectively these groups are able to manage MPA tenure information. Socioeconomic indicators suggest that management of MPA tenure information involves active participation of these groups. For example, some socioeconomic indicators suggest measuring community participation in determining perceptions of marine resource availability and human impacts. Others suggest measuring participation of decision-making organizations in tenure data management and how this may affect community views and beliefs.

This suggests that groups have a dual role of determining tenure information requirements and use. For example, some indicators suggest measuring stakeholder participation in tenure data management and how this may affect stakeholder

participation in MPA management. Others suggest measuring community participation in determining cultural marine resources, including the use of local and scientific data.

This research proposes that these groups have a role to play in, (i) determining tenure information requirements, and (ii) determining tenure information use. This may be affected by, (1) the tenure data management objectives of these groups and, (2) by the tenure data management abilities of these groups. This is shown in Figure 4.9.

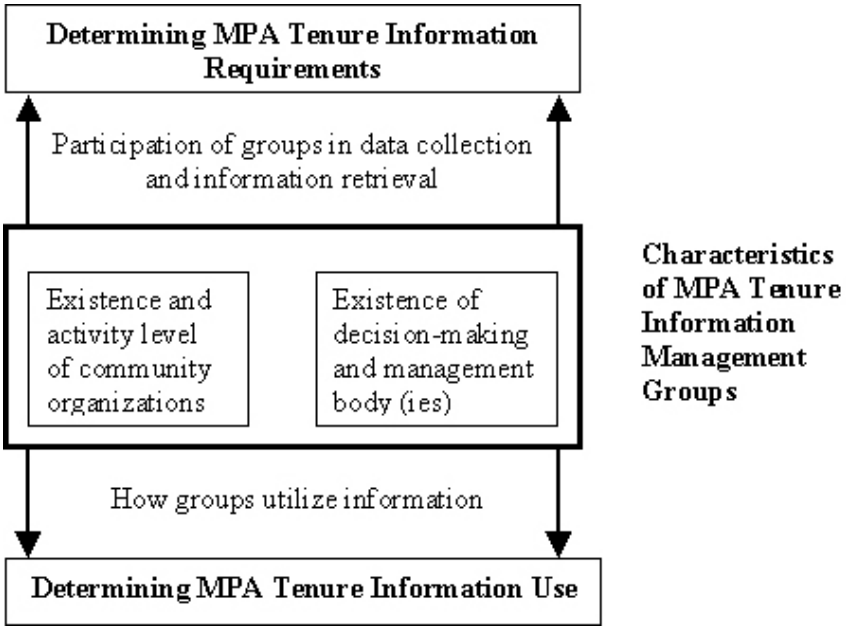

Figure 4.9: Refining the functions of MPA tenure information management groups from socioeconomic indicators

This research proposes that to better understand how tenure information is managed during *MPA establishment*, two questions need to be answered: (1) Are community organizations, as well as MPA decision-making and management organizations involved in marine tenure information management? (2) What is the role of marine tenure information management groups in determining marine tenure information requirements and use? The answer to these questions will facilitate a better understanding of the role of tenure information management groups during *MPA establishment*.

4.4.4.3 Refining the *MPA Tenure Information Use* Component

A review of governance/socioeconomic indicators also provides valuable insight into MPA tenure information use. Recall that governance indicators had suggested that scientific data should be used in identifying marine resources in the MPA area and in providing information about rules, regulations and enforcement arrangements to stakeholders. Socioeconomic indicators provide insight into broader MPA tenure information use. For example, one socioeconomic indicator measures the dissemination of formal knowledge to the stakeholder community. This suggests that tenure data collection/information retrieval should be complemented by dissemination to the stakeholder community. This means that the tenure information also has an educational role to fulfill.

Other uses of MPA tenure information are outlined as: (1) to explain impact of human activities on environment; (2) to visualize how rights to resources are impacted by MPA; (3) to determine non market and non-use MPA values; (4) to bring a degree of social equity in social groups; and, (5) to determine the locations and types of other cultural resources.

The MPA tenure information uses outlined in the previous paragraphs represent assumptions that need to be verified. This is particularly important because some uses suggest that tenure information may accomplish substantial MPA goals. For example, tenure information is assumed to address conflict resolution and avoidance. Recall that a governance indicator highlighted this. Socioeconomic indicators support this by proposing that resource use patterns and boundaries may assist in accomplishing this goal. These assumptions need to be verified as they form a core component of this research. They are outlined in Figure 4.10.

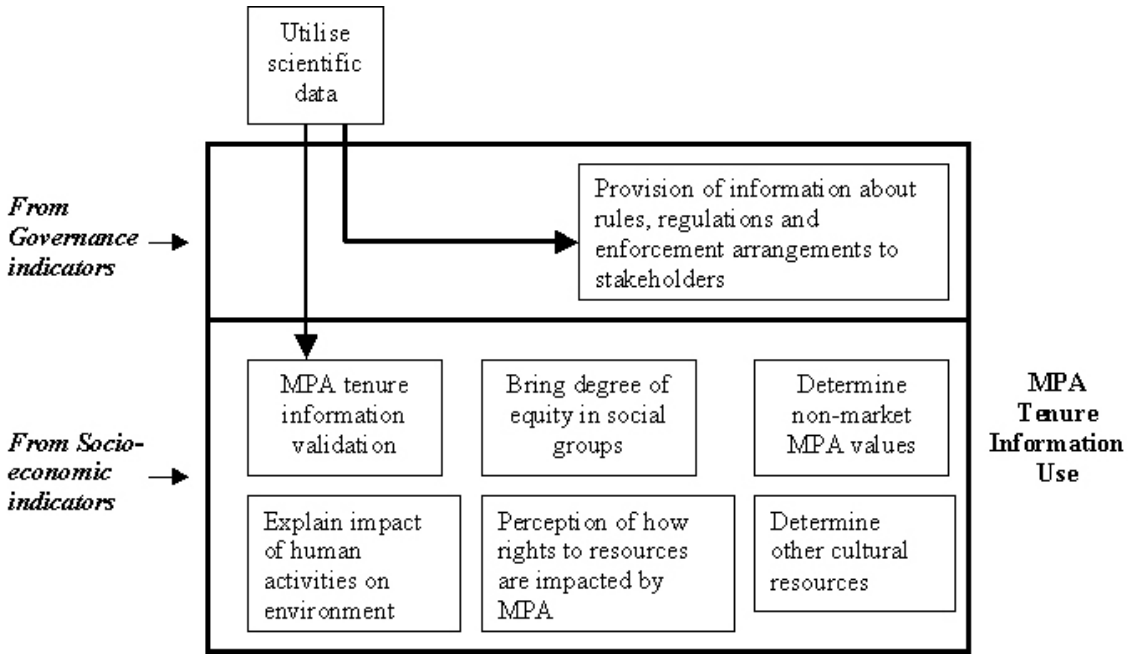

Figure 4.10: Refining MPA tenure information use from socioeconomic indicators

Figure 4.10 also suggests that there is an important relationship between tenure information and scientific data. This relationship suggests another use for tenure information: cross reference local knowledge (used to identify significant places and activities) with scientific information. Socioeconomic indicators suggest that this is accomplished during the identification of culturally significant places, when measuring stakeholder knowledge of natural history. This identifies an important function for the scientific data collected: validation of marine tenure information.

Tenure information use will also provide insight into information gaps and the need for adaptive information management. Therefore, responses may be formulated to deal with, (1) characteristics of tenure information management groups, and/ or (2) tenure information requirements.

From the foregoing review, this research proposes that to better understand how tenure information is used during *MPA establishment*, four questions need to be

answered: (1) Can the highlighted tenure information uses be verified? (2) Does MPA tenure information use depend on the characteristics of MPA tenure information management groups? (3) Does MPA tenure information use affect MPA tenure information requirements? (4) Is scientific data used to validate MPA tenure information? The answer to these questions will facilitate a better understanding of tenure information use during *MPA establishment*.

4.5 Chapter Summary and Conclusions

This chapter has verified the research premise through the review of MPA management frameworks. The research premise was that there is a role for tenure information in MPA establishment. In this chapter, MPA governance and socioeconomic goals, objectives, and indicators have been used to develop a framework for identifying MPA tenure information management processes, functions, and activities. This research has proposed the framework as facilitating a better understanding of the role of tenure information in *MPA establishment*.

The framework suggests investigating the role of tenure information under three activities: (1) determining MPA tenure information requirements; (2) determining the role of MPA tenure information management groups; and, (3) determining MPA tenure information use. This research proposes that each activity involves several tasks and that these can be represented by a series of questions. These tasks (in the form of questions) are intended to further clarify the role of tenure information in *MPA establishment*. The framework of activities and tasks is shown in Figures 4.1.1, 4.1.2, and 4.1.3 and Table 4.6.

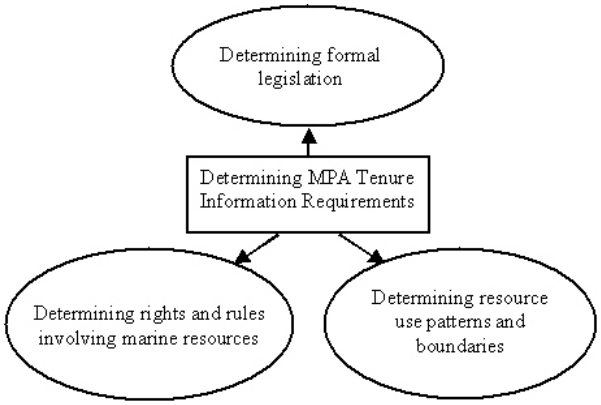

Figure 4.11: The tasks involved in determining MPA tenure information requirements

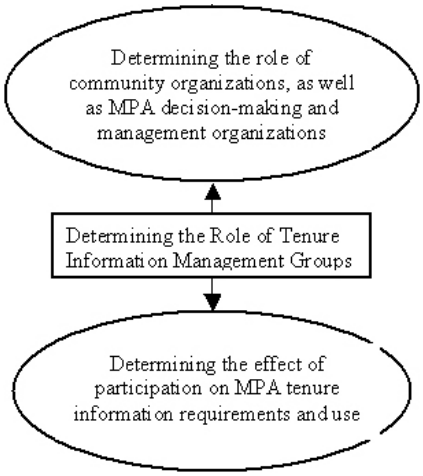

Figure 4.12: The tasks involved in determining MPA tenure information management groups

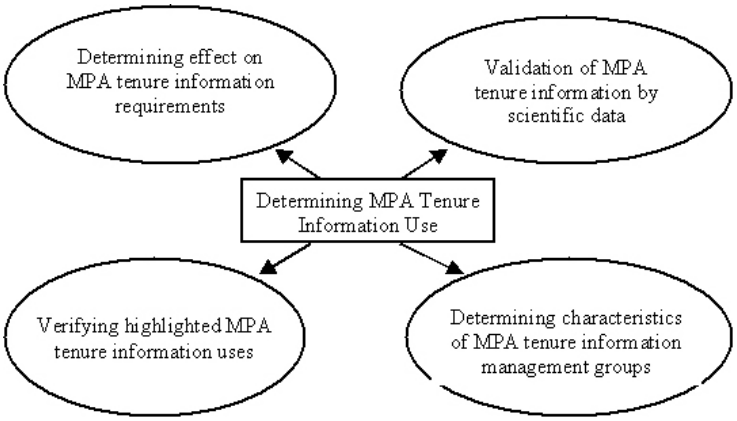

Figure 4.13: The tasks involved in determining MPA tenure information use

Table 4.6: General Research Findings on Tenure Information Management Activities

Determining MPA Tenure Information Requirements: From a review of MPA governance/socioeconomic criteria frameworks in Chapter 4, ***this research has shown that MPA tenure information requirements could be clarified by a***

single task in the tenure information management system shown in Figure 4.11.
Determining MPA Tenure Information Use: From the review of MPA governance/socioeconomic criteria, ***this research showed that tenure data collection/information retrieval should be complemented by dissemination to the stakeholder community.*** This awareness/ educational role was summarized as: (1) explaining impact of human activities on environment; (2) visualizing how rights to resources are impacted by MPA; (3) determining non market and non-use MPA values; (4) bringing a degree of social equity in social groups; and, (5) determining the locations and types of other cultural resources. ***A better understanding of how tenure information is used is obtained by answering four questions.*** These questions are shown in Figure 4.13.
Determining the Role of Tenure Information Management Groups: ***Stakeholders may have the following roles***: (1) determining tenure information requirements, and (2) determining tenure information use. This may be affected by: (1) the tenure data management objectives of these groups and, (2) by the tenure data management abilities of these groups. ***A better understanding of how tenure information is managed is obtained by answering two questions.*** These questions are shown in Figure 4.12.

The next chapter will describe an approach for testing this activity-driven framework, and answering these (task) questions, in a case study setting.

5 CHAPTER 5: AN APPROACH TO TEST THE CONCEPTUAL FRAMEWORK IN A CASE STUDY SETTING

In Chapter 4, an indicator-driven framework identifying MPA tenure information management activities has been outlined. These activities may be used to clarify the role of tenure information in MPA establishment. This chapter applies the framework in an MPA case study in order to verify the framework rationale, and the postulated role of tenure information in MPA establishment. It describes the approach used in applying the framework to a case study setting, introduces the primary case study, and describes the associated fieldwork used to apply the framework.

5.1 Approach

The indicator-driven framework developed in Chapter 4 describes three MPA tenure information management activities, the determination of: (1) MPA tenure information requirements; (2) characteristics of tenure information management groups; and, (3) MPA tenure information use. As mentioned in Chapter 4, these activities are clarified by answering several questions. Therefore, this research will refer to the framework as the *MPA question-based activity framework.*

The *MPA question-based activity framework* is outlined in Figure 5.1. It summarizes the role of tenure information by posing questions that address information requirements, management groups, and uses.

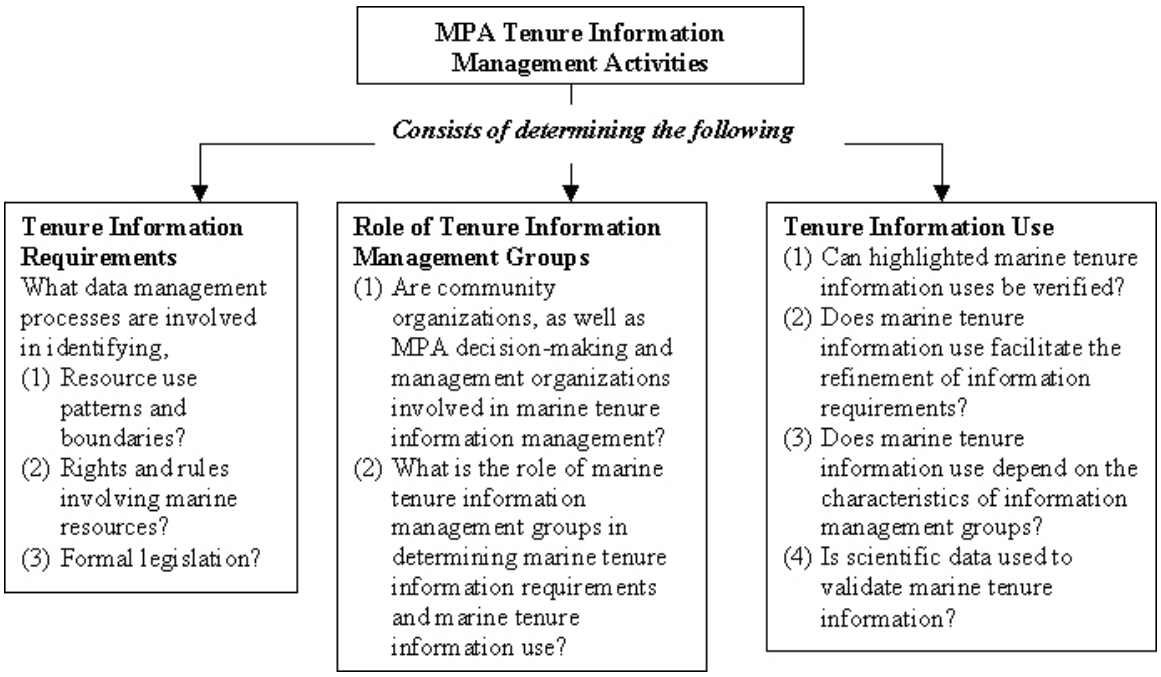

Figure 5.1: The question-based framework developed in Chapter 4 for determining MPA tenure information management activities

5.1.1 Investigating MPA Tenure Information Requirements

The first activity in the *MPA question-based activity framework* involves identifying MPA tenure information requirements. In Chapter 4, these requirements have been stated as, (1) resource use patterns and boundaries, (2) rights and rules involving marine resources, and (3) formal legislation.

In order to determine resource-based activities, interests, and uses that may be affected by MPA establishment, it is important to define marine resources, associated spatial extents, and tenure associated with these resources. Tenure information may be visualized as consisting of the following three components: (1) Tenure objects, such as marine resources and their associated characteristics e.g., location, size, boundaries etc; (2) Tenure subjects, consisting of individuals/groups that use, or have an interest in, marine resources; and, (3) Tenure, consisting of rights, restrictions and responsibilities

that individuals/groups hold. These are referred to as *tenure information components* in this research.

Determining these MPA *tenure information components* faces several challenges. For example, a review of the literature found several challenges in identifying and retrieving MPA tenure information. However, how this affects MPA establishment is as yet unclear. For clarification, the data management processes associated with tenure information will be reviewed below.

As shown in Figure 5.2, data management processes are broadly described as collection, storage, retrieval, analysis, and dissemination of data. This research proposes that each of the processes provides insight into specific challenges associated with determining tenure information requirements. For example, there lacks a single agency that is the focal point for managing resource and tenure information associated with marine space. The impact of this on MPA establishment is that this may create time delays, information gaps, and other inefficiencies. This research suggests verifying this effect.

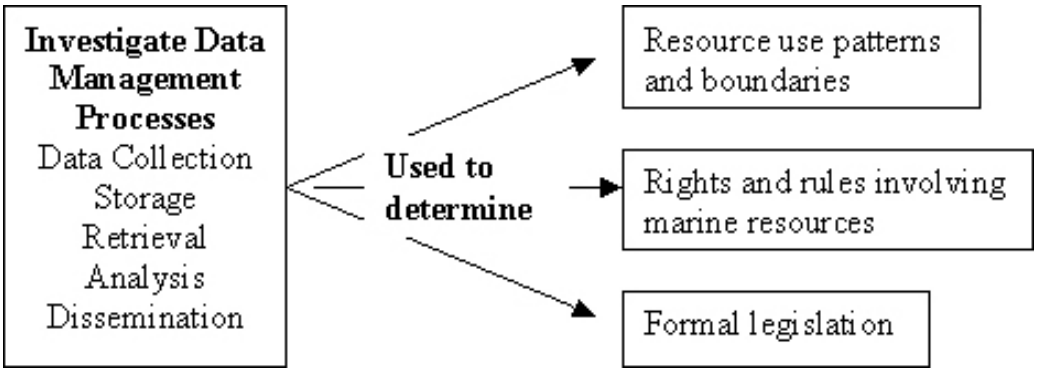

Figure 5.2: The approach for investigating MPA tenure information requirements

This research advocates verifying other data management challenges that may affect tenure information requirements. For example, literature research has identified data

categories (e.g., scientific information and local knowledge) as resident in several different geographic and custodial locations. The challenge is one of describing retrieval methods for marine tenure information across departments, agencies, and organizations. This research suggests that there may be complex data integration issues (involving scale, datums, projections etc) that may need to be highlighted and addressed. The impact of these challenges on MPA establishment should also be described.

This research therefore proposes investigating tenure data management challenges and their effect on MPA tenure information requirements. As shown in Figure 5.2, this implies investigating tenure data collection, storage, retrieval, analysis, and dissemination when determining, (1) resource use patterns and boundaries, (2) rights and rules involving marine resources, and, (3) formal legislation.

5.1.2 Investigating MPA Tenure Information Management Groups

The second activity in the *MPA question-based activity framework* involves investigating the role of individuals and groups in MPA tenure information management. Review of governance / socioeconomic criteria has demonstrated that groups, such as community organizations and MPA decision-making/management groups, need to be involved in tenure information management.

Literature research has hypothesized this role as one where the groups are primarily involved in providing information on the location and nature of MPA tenure. It is therefore important to verify whether this role exists, and further, whether it is one of several roles fulfilled by these groups. To further clarify this, this research suggests investigating the participation of these groups in the tenure data management processes. This is summarized in Figure 5.3.

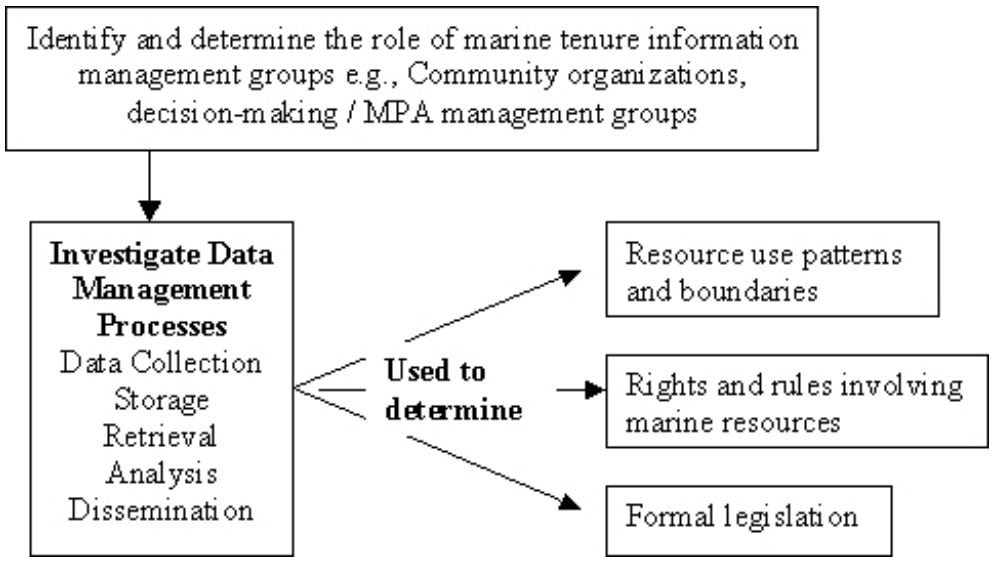

Figure 5.3: An approach that combines investigating MPA tenure information requirements and the role of tenure information management groups

MPA tenure information management groups may also affect information availability and use in MPA establishment. For example, these groups may be involved in resolving inconsistencies in MPA tenure information, and recommending the future use of specific information. This role may be one of providing supplementary data sources and / or validating available information. Investigating these (and other) roles includes documenting group activities during MPA establishment.

5.1.3 Investigating Marine Tenure Information Use

The third activity in the *MPA question-based activity framework* involves investigating MPA tenure information use. From a review of governance and socioeconomic indicators, several uses of tenure information in MPA establishment can be identified. To further clarify use of tenure information in MPA establishment, the questions outlined for this activity in the *MPA question-based activity framework* will be verified and used. For example, this research proposes investigating whether tenure

information use in MPA establishment depends on the characteristics (including participation) of tenure information management groups.

The verification of MPA tenure information use is also related to tenure information requirements. This means that the following tenure information is applied during MPA establishment: resource use patterns and boundaries; rights and rules involving marine resources; and, formal legislation. Additional uses may be identified, which may modify existing tenure information requirements. The challenge is therefore one of determining whether tenure information requirements will be updated using this knowledge.

The combined approach to applying the *MPA question-based activity framework* is outlined in Figure 5.4

5.1.4 Defining an Outcome-Based Approach

Measuring several ‘inputs’ and ‘outputs’ e.g., the number of development permits issued or the number of laws and regulations adopted, is one way of applying the framework in Figure 5.4. However, marine environmental management approaches generally advocate for outcome-based results as opposed to input-based accounting [Ehler, 2003]. Outputs indicate the products and services that were delivered while outcomes indicate ‘on-the ground’ results achieved.

This research distinguishes between input, output, and outcome-based measures when describing a role for tenure information in MPA establishment. It draws a parallel between the outcome-based approach and the approach proposed for applying the framework in Figure 5.4.

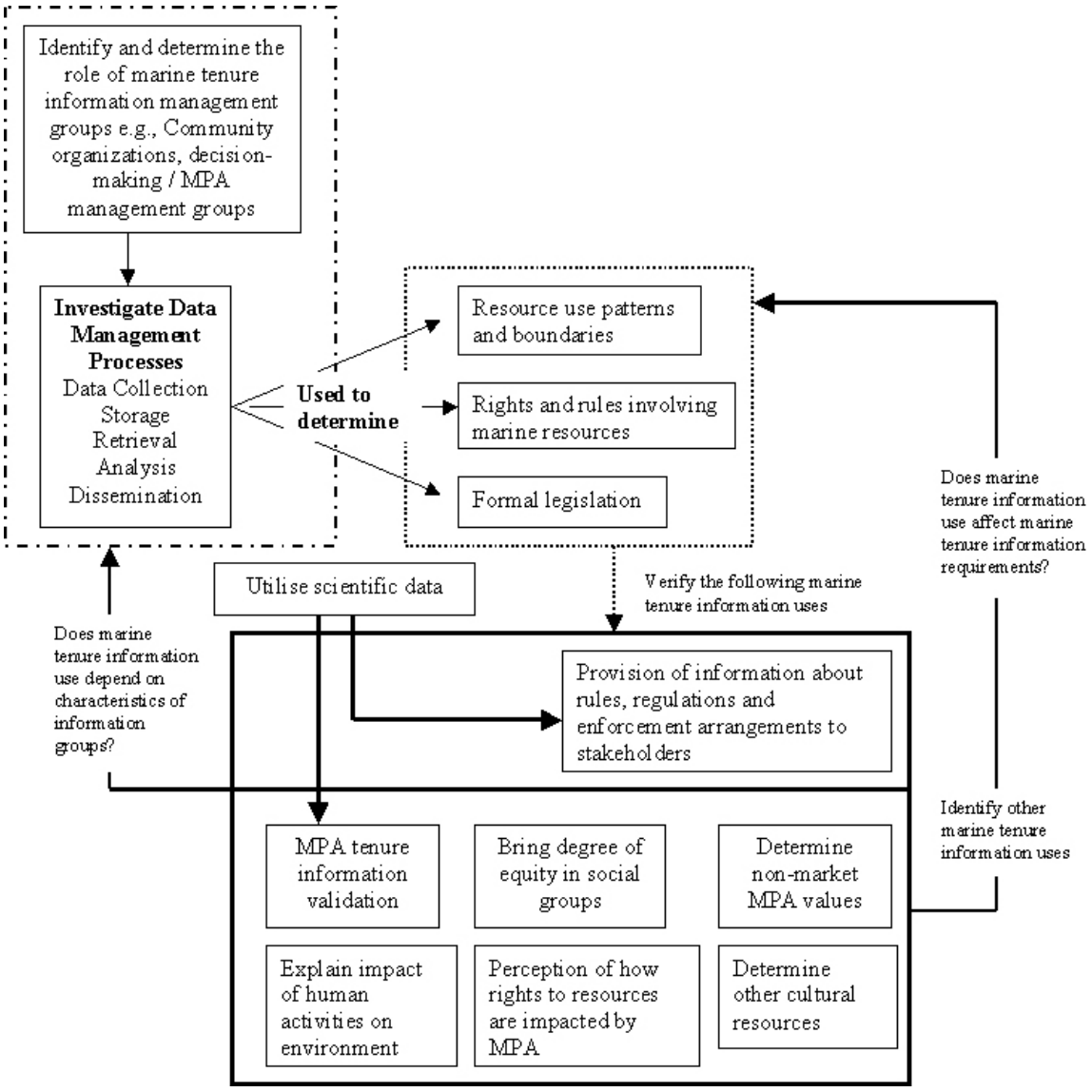

Figure 5.4: An integrated approach investigating marine tenure information requirements, marine tenure information management groups, and marine tenure information use

For example, the challenge in defining inputs (e.g., number of laws and regulations in effect in the MPA area) is comparable to the challenge in determining MPA tenure information requirements. Resolving this challenge results in MPA tenure information products (outputs). These outputs may be utilized to help produce expected MPA outcomes, including recommendations on MPA inputs and outputs. This is outlined in Figure 5.5.

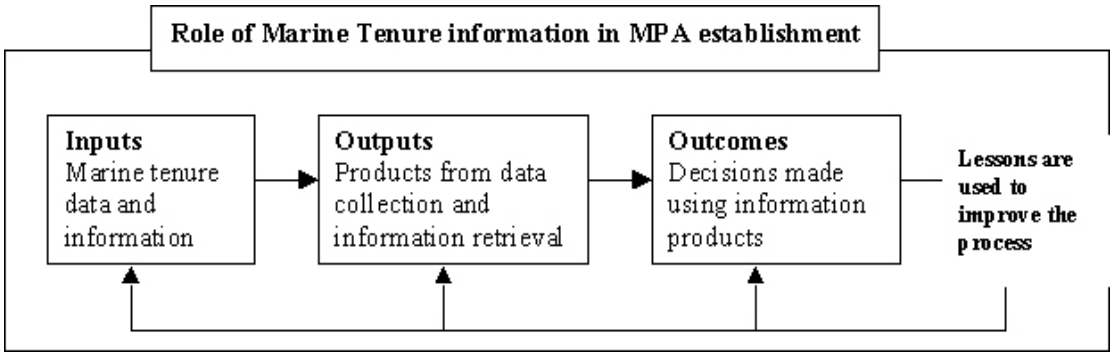

Figure 5.5: An outcome-based approach for investigating the role of marine tenure information in MPA establishment

To implement this approach, MPA establishment outcomes need to be first clarified. One option is to use the expected outcomes that have been highlighted as governance and socioeconomic objectives. However, until these expected outcomes are verified as attainable in MPA establishment, they remain a matter of conjecture. An "on-the-ground" deliverable of MPA establishment can instead be used as an outcome. This deliverable should reflect a decision-making outcome from MPA tenure information use.

For this purpose, this research proposes using the MPA management plan as an outcome of MPA establishment. The management plan states the MPA rationale, its goals and objectives, how the goals and objectives are to be reached, and how the success of the MPA will be measured. The management plan also provides details such as the location and boundaries of MPA, zoning, prohibited activities, and relevant regulations (see for example, Canada [1998]; Pollnac and Crawford [2000]; Pomeroy et al [2004]).

As shown in Figure 5.6, the inputs are identified from MPA tenure information requirements. These inputs consist of resource use patterns and boundaries, rights and rules involving marine resources, and formal legislation. Traditional input-based accounting would focus on the number of inputs e.g., number of resource use patterns or boundaries identified. However, this research adopts a broader approach to input-based

accounting, and investigates the challenges in determining the inputs. For example, this research focuses on the challenge of determining tenure in an area and its effect on MPA establishment, as opposed to the number of tenure boundaries identified in an area.

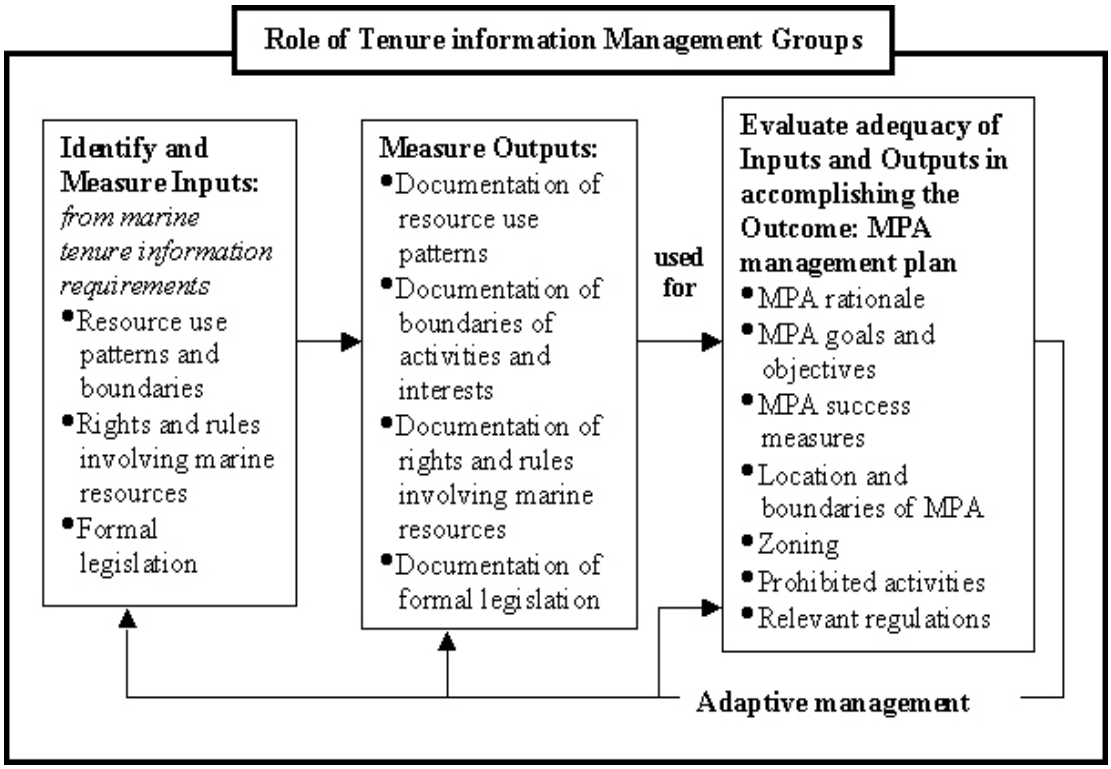

Figure 5.6: Applying the outcome-based approach to the conceptual framework

Outputs have been identified as products arising from inputs. Figure 5.6 indicates that these consist of collected/retrieved information on resource use patterns, boundaries of activities and interests, rights and rules involving marine resources, and formal legislation. These outputs will be used for a particular outcome i.e., the MPA management plan. The use of these tenure information products (i.e., outputs) in defining the components of an MPA management plan can then be investigated. These components include MPA rationale, goals and objectives, and spatial extent.[62]

[62] The MPA spatial extent captures the nature and extent of MPA tenure. Therefore, the determination of this will include: locations and boundaries, zoning options, prohibited activities, and relevant regulations.

In this outcome-based approach, the MPA management plan also becomes a vehicle for investigating issues surrounding tenure information use. For example, highlighted tenure information uses can be verified during the process of preparing an MPA management plan. Further, the hypothesis that the role of scientific data extends to validating MPA tenure information can be investigated by observing whether this exists in MPA management plan preparation. Finally, an investigation may also be carried out into whether an adaptive management role arises out of tenure information use.

Figure 5.6 also shows that the outcome-based approach provides a context for testing the role of tenure information management groups in MPA establishment. This role can be postulated as follows, the participation of these groups may effect: (1) determination of tenure information requirements in the MPA management plan; and, (2) the use of tenure information in the management plan.

5.1.5 Summary of the Approach

The proposed approach can be summarized as follows: an approach to investigate tenure data management challenges during MPA management plan development. As shown in Figure 5.7, this means identifying tenure data collection, storage, retrieval, analysis, and dissemination challenges in the process of developing an MPA management plan. More specifically, it means investigating the use of tenure information in determining the MPA rationale, goals and objectives, and spatial extent.

As shown in Figure 5.7, MPA management plan development also facilitates the investigation of proposed tenure information uses (highlighted from an analysis of socioeconomic and governance objectives). Tenure information uses can therefore be verified during the preparation of a management plan. Further, the hypothesis that the

role of scientific data extends to validating marine tenure information can be also be investigated by reviewing the use of this data in MPA management plan preparation. Additionally, an investigation into how lessons learnt affect tenure information use, or requirements, may also be carried out.

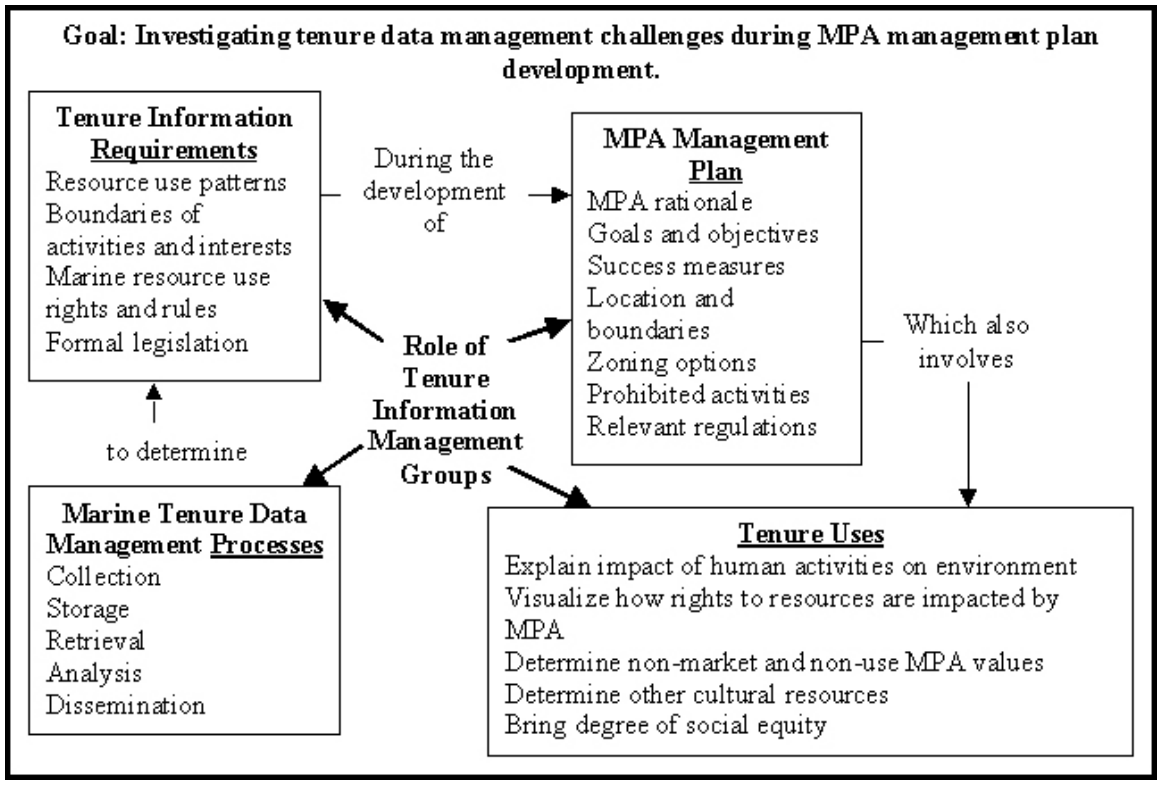

Figure 5.7: Summary of the proposed approach and its application in the primary case study

From the conceptual framework developed, the role of tenure information management groups in MPA management plan development is critical. The approach therefore investigates the role of these groups in tenure data collection, storage, retrieval, analysis, and dissemination. This is done in the context of MPA management plan development process. Specifically, it means investigating the role of these groups in determining the MPA rationale, goals and objectives, and spatial extent.

5.2 Applying the Approach to the Primary MPA Case Study

The above-mentioned methodology will be applied to an inshore MPA case study. The case study involves an MPA located in an estuary off the Bay of Fundy in New Brunswick. The focus of the case study is to verify the rationale of the proposed framework, and highlight how tenure information is used. This is done in the context of MPA management plan preparation.

5.2.1 Background of the Musquash MPA Case Study

In 1998, the New Brunswick Conservation Council, with support from the Fundy North Fishermen's Association, proposed the Musquash estuary and the surrounding salt marshes, as a potential MPA under the *Oceans Act* [1996]. In February 2000, the Musquash was announced as an "Area of Interest" (AOI), the first step in the process of designating an MPA by the federal Department of Fisheries and Oceans (DFO).

As part of management plan preparation for the Musquash MPA, the Land Studies and Ocean Mapping Groups at the University of New Brunswick (UNB) were invited to participate in the determination of MPA location and boundaries, zoning options, prohibited activities, and relevant regulations. An MPA planning group had been established for this purpose, and the UNB groups were requested to join the existing membership. The planning group's mandate was to collect community viewpoints and proposals for the future management of the Musquash estuary [Buzeta, 2002; Canada Gazette, 2005]. The planning group evolved into a not-for-profit community association called the *Friends of Musquash*.

A committee, the Musquash Advisory Committee (MAC), was established in 2002 to facilitate stakeholder and community input into a management plan for the proposed

MPA [Buzeta, 2002]. It includes participants from the *Friends of the Musquash* and is chaired by Department of Fisheries and Oceans [DFO, 2002]. The group's social and governance mandate is broad: from raising awareness and informing local citizens on the MPA proposal; to reaching citizens and stakeholders who have an interest, or are involved with, the Musquash area [Canada Gazette, 2005c]. Participation of UNB members in the MAC has provided an opportunity to identify tenure data collection, storage, retrieval, analysis, and dissemination challenges that were encountered in the process of developing the Musquash MPA management plan.

The MAC mandate is to develop the original Musquash MPA proposal until designation [Buzeta, 2002]. A key activity in accomplishing this mandate is the preparation of the MPA management plan. The MAC has had a major role in the preparation of this plan. The group also has a broader role of promoting the MPA to the wider audience and identifying issues in the development of a management plan [DFO, 2002c; Buzeta, 2002].

5.2.2 Applying the Approach to MPA Management Plan Preparation

The focus of this case study is to verify the rationale of the proposed framework, and highlight how tenure information was used in MPA management plan preparation. For example, the framework can be applied in the determination of the MPA spatial extent. In the case of the Musquash MPA, this involved a review of proposed boundaries, including the recommendation of options regarding the placement of boundaries. This also involved the collection (and retrieval) of various types of data to provide a rationale for the location of Musquash MPA boundaries. Additionally, since approval of the boundary locations was subject to stakeholder support, several meetings were organized in order to

disseminate information (including boundary location recommendations), and provide an opportunity for scrutiny and discussion.

The example in the previous paragraph highlights an opportunity to investigate the tenure data management processes involved in determining one of three management plan components (the others are MPA rationale and goals/objectives). This research proposes that the application of this approach provides an opportunity to: (1) identify the role of tenure information in determining various management plan components; (2) identify tenure information management groups; (3) identify data management roles played by these groups; (4) verify tenure information uses highlighted from the analysis of socioeconomic and governance objectives; (5) identify the effect of these groups on tenure information use, or requirements; and, (6) test the hypothesis that scientific data may validate marine tenure information, and vice versa.

5.2.3 A Modification of the Approach for the Musquash MPA Case Study

Although the framework suggests that the management plan is composed of separate components, the process of determining these components is not disconnected. As shown in Figure 5.8, some of the components may be simultaneously determined during the application of the Canadian framework for establishing and managing MPAs (referred to as *the framework*) [Canada, 1997a; 1998; 2002c]. For example, MPA rationale, goals and objectives, and spatial extent (boundary locations) are usually determined within the first three stages of *the framework* (i.e., Area of Interest identification, screening, evaluation and recommendation). These are then refined in a second stage (i.e., development of a management plan for a candidate MPA site). It was therefore reasonable to first

investigate the role of tenure information in determining the first three management plan components. This is accomplished in Chapter 6 and 7.

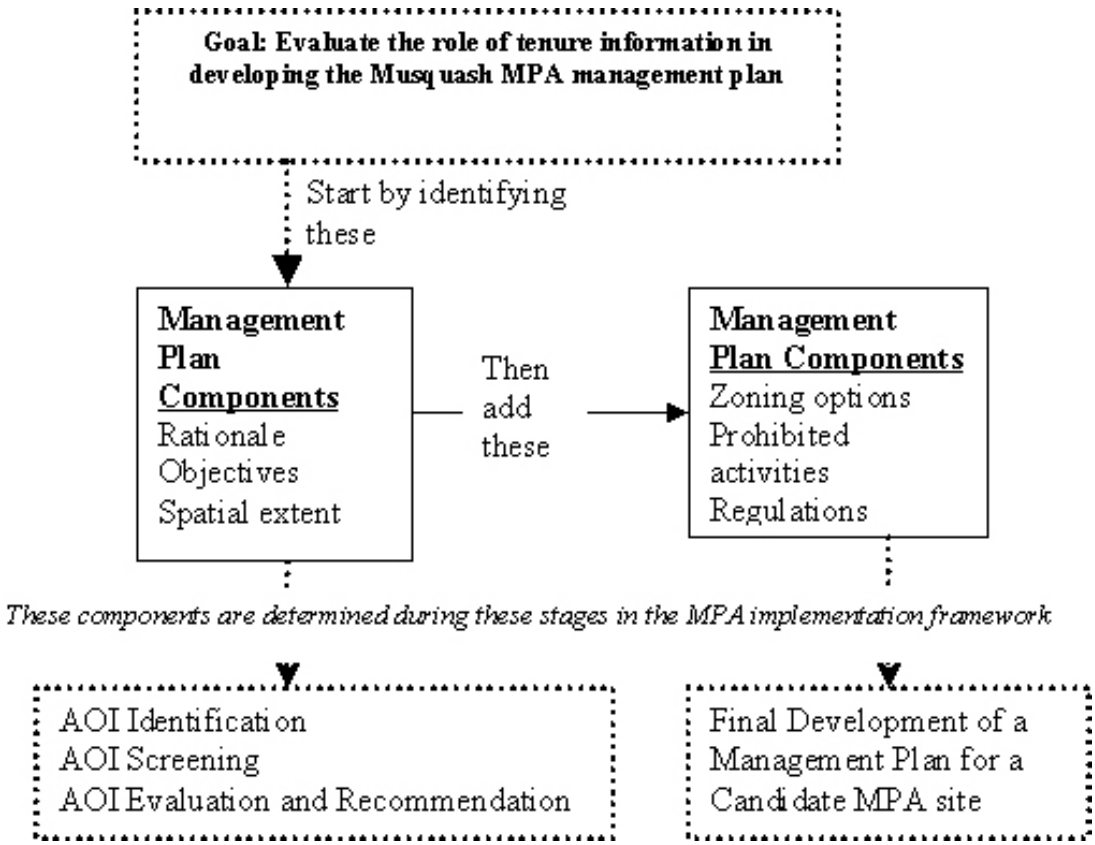

Figure 5.8: The conceptual split in determining management plan components that was used to modify the approach in the Musquash MPA.

As shown in Figure 5.9, the latter three-management plan components (determining zoning options, prohibited activities, and MPA regulations) greatly depend on the former three management plan components. Due to time constraints, this research opted to focus on the former management plan components, arguing that this would significantly describe the role of tenure information in MPA management plan preparation.

5.2.4 Evaluating the Framework by comparing with other Inshore MPAs

This results obtained in the Musquash MPA are then evaluated against other inshore MPAs in order to further validate the framework, and allow a comparison with similar

case studies. Two inshore MPAs in Atlantic Canada will be used for this purpose. They are Gilbert Bay in the Province of Newfoundland and Labrador; and Basin Head in Prince Edward Island. Various constraints have limited a review of these MPAs to literature research, supplemented by interviews of key personnel involved in MPA establishment. This is shown in Figure 5.9 and further explained in Chapter 8.

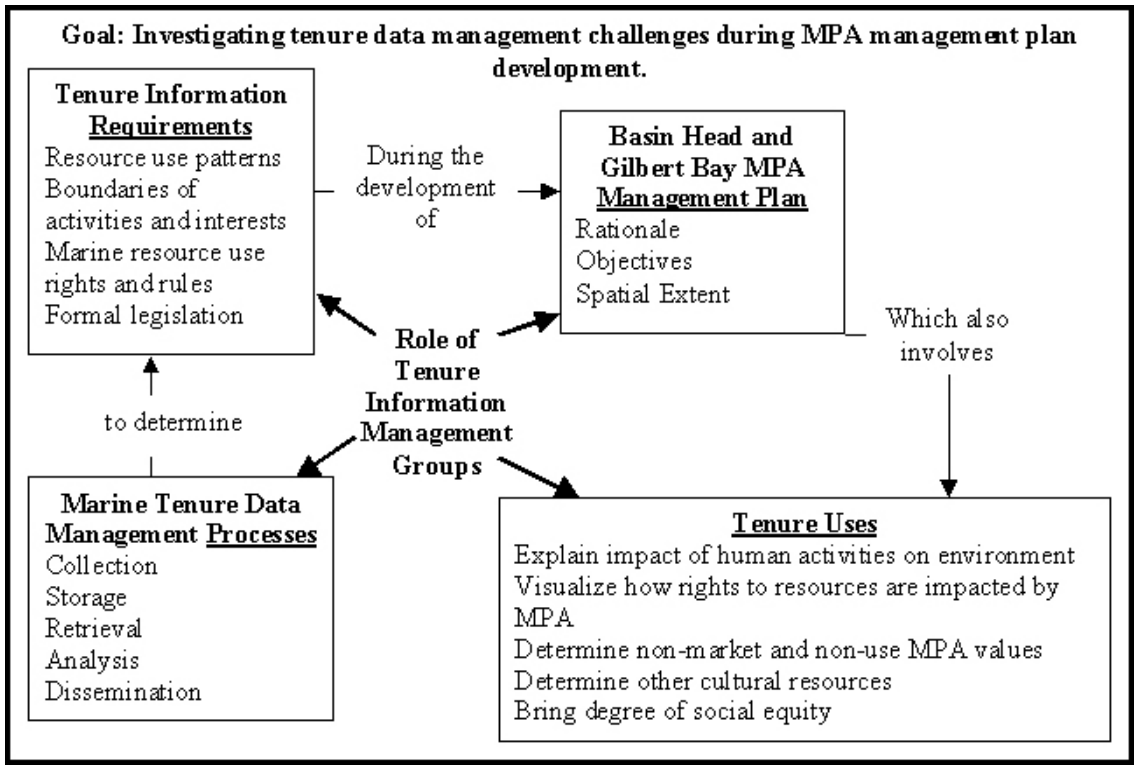

Figure 5.9: Extending the approach to other inshore MPAs in order to further evaluate the framework

5.3 Chapter Summary and Conclusions

This chapter has developed an approach to applying the framework to a case study setting. More specifically, an outcome-based approach was developed which advocated for outcome-based results as opposed to input-based accounting. An "on-the-ground" deliverable of MPA establishment, the MPA management plan, was used as the preferred outcome. The approach developed is based on the idea that the inputs-outputs-outcomes technique can be used to describe the role of tenure information in *MPA establishment*.

Therefore, the challenges in determining tenure information inputs, outputs, and outcomes symbolize the challenges in the three activities in the conceptual framework.

The proposed outcome-based approach can be summarized as follows: it investigates tenure data management challenges during MPA management plan development. This involves investigating the context in which tenure information is used to determine the MPA rationale, goals and objectives, and spatial extent. This is described in Table 5.1 below.

Table 5.1: Summary of major points in Chapter 5

General approach: To investigate the role of tenure information in developing three MPA management plan components (MPA Rationale, Objectives,Spatial Extent) . This role is investigated under three activities.	
Activity 1: determining information requirements	As shown in Figure 5.2, this implies investigating tenure data collection, storage, retrieval, analysis, and dissemination when determining: (1) Resource use patterns and boundaries, (2) Rights and rules involving marine resources, and, (3) Formal legislation.
Activity 2: determining the role of tenure information management groups	This activity involves: (1) Verifying whether there is a role for individuals and groups in MPA tenure information management and specifically the tenure data management process (2) Determining the tenure information management role
Activity 3: determining tenure information use	This activity involves: (1) Verifying the uses identified from the governance and socioeconomic indicators (2) Determining whether tenure information requirements are updated once new uses for tenure information are determined

This research has proposed an inshore MPA, located in an estuary off the Bay of Fundy in New Brunswick, as primary case study to investigate various tenure information activities in the framework. This research has also proposed two other inshore MPAs in Atlantic Canada, to further validate the framework, and to facilitate a comparison with the results from the primary case study.

6 CHAPTER 6: ANALYSING THE ROLE OF TENURE INFORMATION IN DETERMINING THE MUSQUASH MPA RATIONALE AND OBJECTIVES

In this chapter, an inshore MPA located in an estuary off the Bay of Fundy in New Brunswick, is used as a primary case study to investigate the role of tenure information in MPA establishment. This is accomplished in the context of the conceptual framework developed in Chapter 4, and by applying the approach developed in Chapter 5. The purpose of the case study is to verify the rationale of the proposed framework, and highlight how tenure information was used in MPA management plan preparation. More specifically, it involves demonstrating how tenure information was used to determine the Musquash MPA rationale, and objectives. The chapter begins by describing the Musquash MPA case study.

6.1 A Description of the Musquash MPA Case Study

Musquash Estuary is located approximately 20 kilometres west of the city of Saint John, New Brunswick. The estuary is 16.3 kilometres long and drains the Musquash River and surrounding saltmarshes [DFO, 2002c]. The estuary, which is approximately one kilometre wide at the mouth, empties into the Bay of Fundy, the site of one of the highest tides in the world. Reports on the total area vary from approximately 400-700 hectares; including minor creeks, ditches, and intertidal areas within the saltmarsh [Thompson, 2001].

As shown in Figure 6.1, the two rocky exposed headlands at the mouth of the estuary are Musquash Head and Western Head. The 27-meter (90-foot) cliffs on Musquash Head

overlook the Bay of Fundy and provide an excellent position for an existing lighthouse.[63] At the mouth of the estuary and across from Musquash Head is Gooseberry Island. This is a private island that is located approximately a half kilometre from Western Head. The landward side of Gooseberry Island forms a natural shelter from the full effect of the Bay of Fundy; an area referred to as Gooseberry Cove [DFO, 2002c].

Figure 6.1: Map showing important areas in the Musquash estuary and the original proposed boundaries in the Musquash MPA (after Singh et al. [2000] and Thompson [2001])

The large estuarine embayment of the Musquash estuary is locally referred to as Musquash Harbour. This is the location for Musquash Island, used as a resting location by the occasional seal. To the west of this island is Hepburn Basin, a crescent shaped area

[63] The first lighthouse was established at Musquash Head in 1879 and the current lighthouse was built in the 1950's. In 1967 a foghorn was established at Musquash Head after the foghorn station at Tiner Point five kilometers to the east was shut down. The lighthouse was automated in the early 1980's and the last lighthouse keeper was removed from Musquash Head in 1987 [Thompson, 2001].

providing shelter from effects in the Bay. To the east of the island are several intertidal mud/sand flats including Black Beach, a local beach opening into the Bay [Thompson, 2001].

Above Musquash island the river channel narrows. Further up the river is the Five Fathom Hole wharf. This fishermen's wharf is the only remaining wharf within the Musquash Estuary. It is a DFO small craft harbour facility, owned by the Government of Canada. The wharf is a pile work structure 40' X 70' in size with a small floating dock attached [DFO, 2002c].[64] Further upriver, tracts of saltmarsh with a few rock outcrops bound the river. The freshwater flow is regulated by discharge through turbines from a small hydro generating station. The New Brunswick Electric Power Commission (NB Power) runs this station: a 2-turbine system producing 5 megawatts.[65]

Past the hydro generating station, and further up the Musquash River, is the Loch Alva Lake. This is the largest lake on the Musquash River watershed and the adjacent lands surrounding it have not been disturbed. These are referred to as the Loch Alva Wild lands and in May 2001, the Province of New Brunswick announced the establishment of these lands as part of a network of terrestrial protected areas [Thompson, 2001; DNRE, 2005].

6.2 The Musquash MPA Communities

Several local communities live adjacent to the Musquash estuary and surrounding lands. These groups were involved, in various capacities, in the process of establishing

[64] This wharf was built in 1975 and is in reasonably good condition, but does need some minor repairs. Seven lobster and scallop vessels regularly use this facility during the fishing seasons [Thompson, 2001].
[65] After the First World War, NB Power constructed a 7.5-megawatt, three turbine hydro generating system. Dams were built on both the East and West Branches of the Musquash River and the hydro station was completed in 1922. In the 1970's the West Branch water pipeline was decommissioned, as was one of the turbines, lowering the plant capacity to five megawatts [Thompson, 2001].

the Musquash as an MPA. The stake holding of local communities extended beyond ownership of upland property, to deriving a livelihood from the estuary and surrounding areas. Their interest and knowledge of the Musquash allowed them to be involved in several different capacities in MPA establishment (see Appendix II.1).

As part of the MPA co-management strategy, DFO representatives participated in the Musquash Marine Protected Areas Planning Group (MPAPG) which facilitated stakeholder and community input into a management plan for the proposed MPA [Buzeta, 2002]. As the MPA process progressed, the objectives changed and a formal group was constituted to address regulatory and non-regulatory management actions to address MPA objectives [Buzeta, 2002]. This group, Musquash Advisory Committee, consisted of a diverse range of individuals and groups and included representatives from: CCNB, Fundy North Fishermen's Association, DFO, Province of New Brunswick, Musquash Local Service District Representatives, Union of New Brunswick Indians, Aboriginal Peoples Council, Lorneville Recreation Association, Ducks Unlimited, Eastern Habitat Joint Venture, Canadian Wildlife Service, coastal land owners, and other private individuals [DFO, 2002c]. Other supporters include members of the following groups: the World Wildlife Fund, Eastern Charlotte Waterways, Atlantic Coastal Action Plan (Saint John), and the Saint John Naturalists Club [DFO, 2002c].

There were several other communities that were involved in programs separate from the MPA. Three of the groups were particularly involved in information management processes involving the MPA and surrounding lands. These three groups were the Nature Conservancy (an environmental NGO), Friends of the Musquash (a local public interest

group), and the Ocean Mapping Group at the University of New Brunswick (an academic research group). Their roles will be outlined in other sections of this chapter.

6.3 Determining the MPA Rationale

The Musquash Estuary contains approximately 773 hectares (1,700 acres) of marshland, including the largest salt marsh complex in the lower Bay of Fundy [Thompson, 2001]. Of this area, 141.5 hectares (350 acres) are currently dyked to create fresh water ponds and marsh habitat for ducks.[66] These saltmarshes are the focus of the MPA proposal.

In 1996, the Conservation Council of New Brunswick (CCNB), in partnership with the Conservation Law Foundation (Boston and Rockland) and the Island Institute (Rockland), launched the Gulf of Maine Estuaries Restoration Project. This was part of a broad initiative called "Restore America's Estuaries", funded in large part by The Pew Charitable Trusts [Thompson, 2001]. Between 1996 and 1998, the Conservation Council of New Brunswick (CCNB) surveyed the state of habitat in 12 major estuaries in the Bay of Fundy region, from St. Croix to Lobster Bay. The survey revealed that all Fundy estuaries have been seriously altered and degraded, except for the Musquash Estuary [Rangeley and Singh, 2000]**.** This was the rationale for CCNB's campaign to have the Musquash Estuary designated a MPA under the *Oceans Act* [1996].

6.3.1 Information Requirements to determine the MPA Rationale

Designating the Musquash MPA is primarily based on a scientific rationale. This was determined by a survey that identified the Musquash Estuary as a relatively unpolluted

[66] In the 1960's and 70's, C. N. Wilson dyked some 136 hectares (300 acres) of the upper marshes for cattle pasture. In the 1980s, the Wilson family turned this marshland over to Ducks Unlimited, who then converted it to fresh water impoundments and marshes for ducks [Thompson, 2001].

and undeveloped saltmarsh complex. The survey focused on environmental conditions and ecological characteristics e.g., key species distribution and critical habitats. Scientific data collection consisted of: area morphology, oceanography, water quality (i.e. nutrients and contaminants), plankton and fish larvae, marsh ecology, birds, and terrestrial plants [Singh et al., 2000]. Data retrieval also consisted of reviewing historical and current scientific reports concerning the state of the Musquash Estuary habitat.

For example historical responsibilities to protect the Musquash estuary date back to the 1970's, with Wein and Jones [1975] suggesting that it was a potential ecological reserve because it was a characteristic example of a saltmarsh ecosystem along the coast. In 1980's there were several other reports arising out of research in the area that further advanced the case for the Musquash as a regionally significant area (see for example Hunter and Associates [1982]). In the 1990's renewed interest in having the area designated as a significant area was highlighted by its classification as a Class 1 saltmarsh[67]. This was followed by several reports by the Conservation Council of New Brunswick (CCNB), an organization that advocated for the Musquash to be considered for formal protection (see for example Harvey et al. [1998]; Platt [1998]).

Dissemination of the MPA rationale involved a 1998 partnership between the CCNB and the Fundy North Fishermen's Association (FNFA). The FNFA was a key user of the Musquash estuary and its members held licences to fish several species in the surrounding areas. The MPA rationale dissemination occurred when the Musquash was being proposed as a potential MPA. It was generally perceived by the CCNB that support from the FNFA was beneficial to the MPA proposal [Singh et al., 2000; Thompson,

[67] Class 1 saltmarshes are large with a known or assumed high value of wildlife, and represent the highest priority for protection and management [Buzeta et al., 2003].

2004]. In other words, FNFA was an influential resource user group whose endorsement was considered important to the proposal.

6.3.2 Investigating the Role of Stakeholders in determining the MPA Rationale

The previous section has begun to describe how tenure information was used in determining the MPA rationale. Partnership with FNFA (an influential resource user group) was essential for the Musquash MPA rationale. This suggests that tenure holders are important in supporting the dissemination of the scientific aspects of the MPA rationale. On investigating this for the Musquash MPA, various groups involved in MPA establishment had a greater role in determining the MPA rationale than merely assisting in determining the scientific MPA rationale. These roles are further outlined in Table 6.1.

From the foregoing, this research concludes that there were two parts to the Musquash MPA rationale. First, there was the scientific rationale that identified: (1) the saltmarsh resources, (2) their location and spatial extent, and (3) the scientific justification for why the resources should be protected. Second, there was the *social rationale* that provides a supporting role to the afore-mentioned scientific rationale.

Social rationale is a term used to reflect the shared community support needed to advance the MPA proposal. As previously shown in Table 6.1, several groups had various roles to play in determining the MPA rationale. For example, while carrying out a preliminary review of the protection afforded to the saltmarsh ecosystem, CCNB noted that a significant acreage of the saltmarsh was located on land under the ownership of a *Ducks Unlimited.*

Table 6.1: Groups involved in MPA establishment and their specific use of tenure information to support the MPA rationale

Group	Role in supporting the MPA rationale
Conservation Council of New Brunswick (CCNB)	CCNB adopted a leading role. After identifying the saltmarshes resources to be protected, CCNB was interested in advancing the MPA rationale by identifying the existing rights, restrictions, and responsibilities associated with the saltmarsh resources. This included identifying the holders of the rights to the saltmarsh resources, as well as the real property holders in the vicinity. In determining interests and the holders, CCNB depended on its partnership with the other groups. CCNB identified whether these groups held tenure information and used this information to identify tenure holders in the Musquash MPA. CCNB was also involved in analysing the effect of the collected/retrieved tenure information on the scientific MPA rationale. Additionally, CCNB evaluated the importance of partnering with the FNFA stakeholder in disseminating the MPA rationale.
Fundy North Fishermen's Association	This groups' knowledge of fishing resource use patterns, restrictions on activities in the proposed MPA, and the effect of the proposed MPA on their resource use, allowed FNFA to analyse how the proposed MPA would collectively affect their resource use rights. However, the primary role of this group was organisational support in disseminating the MPA rationale.
Government departments	Federal and Provincial government departments were contacted by CCNB in order to provide access to information regarding programs and legislation that was in effect in the areas surrounding the proposed MPA. The programs and legislation outlined restrictions to activities, and government responsibilities for resources, in the areas surrounding the Musquash MPA. The role of the departments was as a tenure data source, and also to provide a preliminary analysis of the tenure data indicating available protection to the saltmarsh resources.
Real property owners	The real property owners in the Musquash MPA were involved in providing background information on tenure and tenure arrangements in the area. This information was based on traditional and local knowledge. A lot of this information could not be verified because secondary sources of information were not necessarily used to validate the information provided. The role of the owners also extended to providing support for the MPA rationale, and for the MPA program proposal.
Local (geographic) communities	Local communities in the Musquash MPA included real property owners, marine resource users, and individuals who lived in close geographic proximity to the area. The role of these communities was similar to that of the real property owners described previously.
Communities of interest	As previously mentioned, CCNB had initially partnered with the Conservation Law Foundation (Boston and Rockland) and the Island Institute (Rockland), in the Gulf of Maine Estuaries Restoration Project. This project, funded in large part by The Pew Charitable Trusts, was responsible for developing the scientific rationale of the Musquash MPA. [Thompson, 2001]. The role of these groups was to provide financial and project management support during the determination of the MPA rationale.
Academia	The primary role was to provide scientific reports and / or provide advice regarding the MPA rationale.

CCNB used this knowledge of the ownership information to further investigate the owners' saltmarsh conservation objectives, and compare against protections needed for the saltmarsh ecosystem [Thompson, 2003; Musquash MPA, 2006]. The goal was to determine: (1) whether the owners' responsibilities were complementary to the goals of protecting and maintaining the saltmarsh; and, (2) whether these responsibilities were adequate in accomplishing the scientific MPA rationale.

CCNB also carried out a preliminary analysis of the regulations in the saltmarsh complex. This involved informal discussions with government representatives to obtain information on existing legislation that was pertinent to saltmarsh conservation [Thompson, 2003]. This also involved identifying government (and other) programs that protected other habitats in the vicinity of the Musquash estuary, and further identifying whether they affected the geographical extent of the proposed MPA.

While investigating the previously mentioned tenure in the Musquash MPA, CCNB was able to interact with the local communities surrounding the proposed MPA area. This allowed public sentiment regarding the proposal to be gauged. It also allowed CCNB to determine support for protecting the saltmarsh complex under the DFO MPA program [Singh et al., 2000; Thompson, 2001]. This was important because it allowed baseline community support for MPA protection to be established. In this scenario, tenure information was used to define the chances of MPA proposal success. Additionally, CCNB was also able assist in identifying primary stakeholders, and associated interests. In the case of the Fundy North Fishermen's Association (FNFA), this translated into valuable stakeholder support for the scientific MPA rationale.

6.3.3 Use of Tenure Information in determining the MPA Rationale

From the foregoing observations, this research suggests two roles for tenure information in determining the MPA rationale. These roles are, (1) to strengthen the scientific rationale for the MPA, and (2) stakeholder identification. Both roles define the *social rationale*, which represents the community support needed to advance the scientific MPA rationale. The use of tenure information in determining the *social rationale* in the Musquash MPA is captured in Figure 6.2.

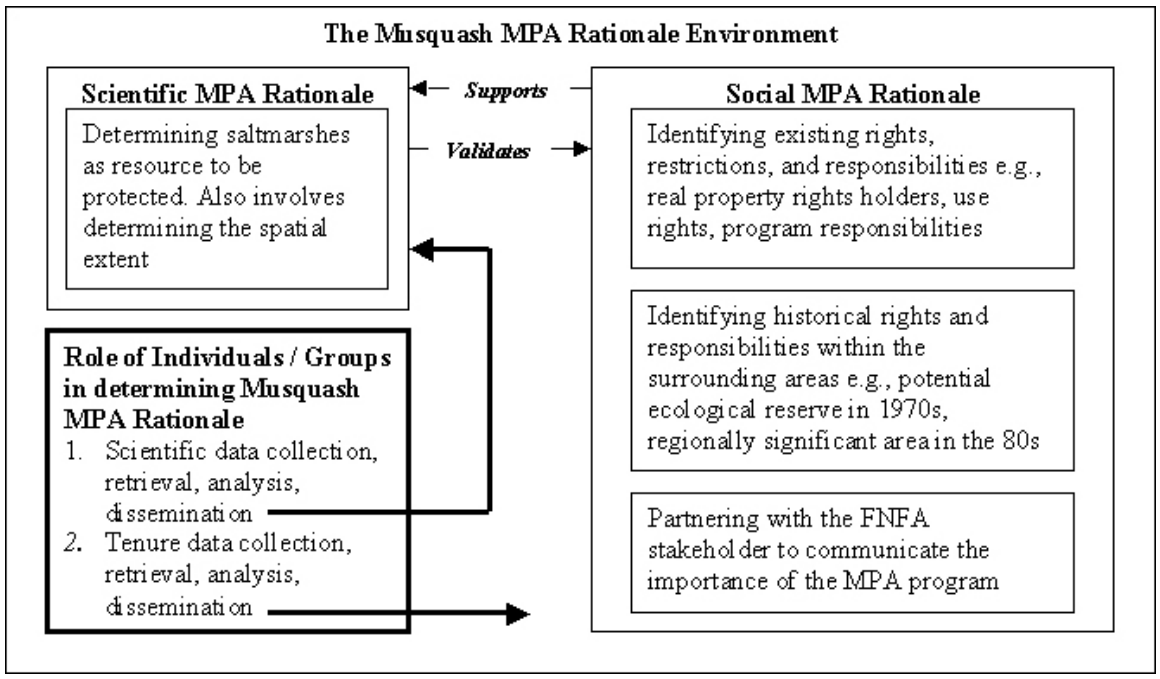

Figure 6.2: The use of Tenure Information to strengthen the MPA rationale

There were two roles observed for tenure information in the Musquash MPA. First, the role was to strengthen the scientific rationale for the MPA, by providing a preliminary demonstration of the shortcomings of tenure arrangements in the area. Examples of these shortcomings in the Musquash MPA include: (1) real property owner's objectives regarding saltmarsh conservation, (2) group objectives outlined in community and NGO-driven programs, (3) government objectives outlined in legislation, programs, and policy.

Second, the observed role for tenure information was for stakeholder identification. This provides a means to identify opportunities for partnering/collaboration in accomplishing the scientific MPA rationale. Resources users, real property owners, jurisdictional representatives, and other interest holders are important stakeholders that need to participate in the MPA establishment process.

As shown in Figure 6.2, observations in the Musquash MPA suggest that the *social rationale* has an important role in communicating the overall MPA rationale. The *social rationale* depends on tenure information to identify: (1) real property holders and resource users; (2) the interests of these holders i.e., rights, restraints, and responsibilities; and, (3) how the interests of these individuals can be used to support the scientific rationale.

6.4 Determining MPA Objectives

During the initial stages of the Musquash MPA proposal, the Conservation Council of New Brunswick (CCNB) proposed several conservation objectives. These were reviewed by the Marine Protected Area Planning Group (MPAPG), and again by the Musquash Advisory Committee (MAC). A representative list of objectives was then outlined.

An inspection of these objectives (shown in Table 6.2) notes a focus on *habitat* and *resource* conservation. This is because they describe key ecological issues and a broad set of actions to protect the health of the Musquash MPA. However, objectives such as “preserving the area for future generations” and “sustainable use of the marsh” suggest

values that extend beyond ecology.[68] The information requirements for these objectives are described in the next section.

Table 6.2: The Musquash MPA goal and supporting objectives (after Singh et al [2000]).

Musquash MPA Goal	Objectives
The protection and restoration of the Musquash estuary and surrounding salt marshes.	1. Maintain biodiversity of the area. 2. Maintaining a healthy fishing industry. 3. Protecting highly productive habitats. 4. Increasing the natural habitat and bird life in the marsh and surrounding land. 5. Preserving the area for future generations. 6. Ensuring the conservation and the sustainable use of the marsh.

6.4.1 Information Requirements to define the MPA Objectives

Several information products were used to define the Musquash MPA goals and objectives. The reports were intended to collectively contribute to the future development of the Musquash MPA management plan, and enhance support for designation as an MPA. These information products are outlined in Table 6.3.

Table 6.3: Information used to determine and support the Musquash MPA objectives

Information Product	Description
A Survey of Bird Life in the Musquash Estuary on the Bay of Fundy	This survey by Deichmann [1999] contains a bird survey of the Musquash conducted in 1999. This report contains tabular data outlining 150 species of birds that were found and the locations at which they were observed.
A Vascular Plant Survey of the Musquash Estuary in New Brunswick, Canada	This survey by Hinds [1999] contains a survey of plants on 7 locations in the Musquash. This survey estimates 85-90% completeness. The report outlines major communities of plants and some specific species. The report does NOT indicate the locations of species of plants.
A Framework for Biological Monitoring in Marine Protected Areas, A Proposal for the Musquash Estuary	This report by Rangeley and Singh [2000] proposes a general framework for conservation of Marine Protected Areas. Proposes a 1-year pilot study that will lay the groundwork for inventory and monitoring programs i.e. design the baseline and monitoring studies and coordinate activities.

[68] Ecology is the branch of science that studies habitats and the interactions between living things and the environment. It is concerned with the life histories, distribution, and behavior of individual species as well as the structure and function of natural systems at the level of populations, communities, and ecosystems.

Settlements and Landscapes of the Musquash Estuary: Past and Present	This report by Thompson [2001] provides historical information about the Musquash settlements; describes the Musquash as it is today; describes land and artifacts that can be found in the Musquash; and outlines work and leisure activities in the Musquash.
Community Based Resource Management and Shellfish Restoration	This report by the Eastern Charlotte Waterways Inc. describes how community based resource management has addressed environmental issues that were affecting clams in southwest New Brunswick.
Video: Musquash - Worth Protecting	This 8-minute video produced by the CCNB [2001] profiles the species and habitats of the Musquash. It is considered to be a compelling story of why this special area is worth protecting.
CCNB Musquash Website http://www.musquashmpa.ca	This website consist of several reports and studies and provides an overview of the Musquash MPA and adjacent area. It also contains maps that provide a graphic description of the history and present status of the Musquash.

A review of Table 6.3 demonstrates that MPA objectives were also associated with other non-ecological values. For example, the report on *Settlements and Landscapes of the Musquash Estuary* identifies several (cultural, community and economic) values of the Musquash estuary and surrounding lands [Thompson, 2000]. This perspective allows individuals and groups to associate additional importance to the MPA proposal, by relating the proposal to non-ecological values.

The previously mentioned report outlines, among other things, historical aboriginal settlements that persisted in the Musquash area until the 1880s. This is an example of cultural values associated with the Musquash MPA. Table 6.4 describes a list of other values that were also identified for the Musquash MPA, including the tenure information used to describe these values.

Table 6.4: A summary of MPA values and the tenure information used to define the MPA values

Musquash MPA Value	Description	Tenure information used to determine the MPA objective value
Cultural and Community value	There were no archaeological records of aboriginal settlements in the Musquash area. There was local knowledge of a small summer campsite that persisted until the mid 1800's [Thompson, 2000]. Thompson [2000] also notes that there is general acceptance that the Musquash estuary derived its name from the description "a place of muskrats" and the native Canadian word *musquash* for muskrat.	Records of aboriginal settlements. Local knowledge of aboriginal settlements.
Economic value	Residential land use dominates the use of the watershed lands, but it is very low along the shoreline itself, and can be considered undeveloped in comparison to other estuaries. There are no developments in the estuary, but major developments in the surrounding lands consist of (1) the hydro dam on Musquash river, (2) Ducks Unlimited Impoundments, (3) a highway over the east branch of the Musquash river, and (4) a former landfill which has been converted to a contaminated soils/garbage transfer site.	Land use patterns. Land development in the estuary and surrounding lands.
Economic value	10 members of the Fundy North Fishermen's Association (FNFA) fish in the estuary. There are a total of 30 combined licences, including lobster, groundfish and scallop. During the fall lobster fishing season traps are placed at Gooseberry Island, Musquash Head, and across the mouth of the estuary. Scallop dragging is carried out inside the mouth of the estuary. Rock crab, sea urchins, and herring are also harvested at Gooseberry Cove and the mouth of the estuary. Periwinkle, clams, and dulce are harvested within the estuary for commercial and recreational purposes. Five Fathom Hole wharf is used as a homeport for fishing vessels, and also for landing catches.	Fishing licences. Fishing areas. Fishing infrastructure.
Community value	There are several recreational activities that are carried out in the Musquash estuary and surrounding land. There is black duck hunting carried out along the marshes during the fall. During the summer, Black Beach is used as a community recreational site. Kayaking is a popular recreational activity carried out when weather permits. Recreational fishing is also carried out within the estuary. Bird watching is also a favourite community pastime.	Recreational infrastructure Recreational activity licences Recreational areas Recreational activity

One of the conclusions that can be drawn from Table 6.4 is that cultural, economic, and community oriented values are as important as habitat/resource conservation. This suggests that MPA objectives have two sub-categories: human value-based objectives and habitat/resource conservation based objectives. This table also suggests that these human values depend on (1) activities and uses in the MPA and surrounding lands, (2) identity of stakeholders, (3) the nature of stakeholder interests. This relationship is shown in Figure 6.3.

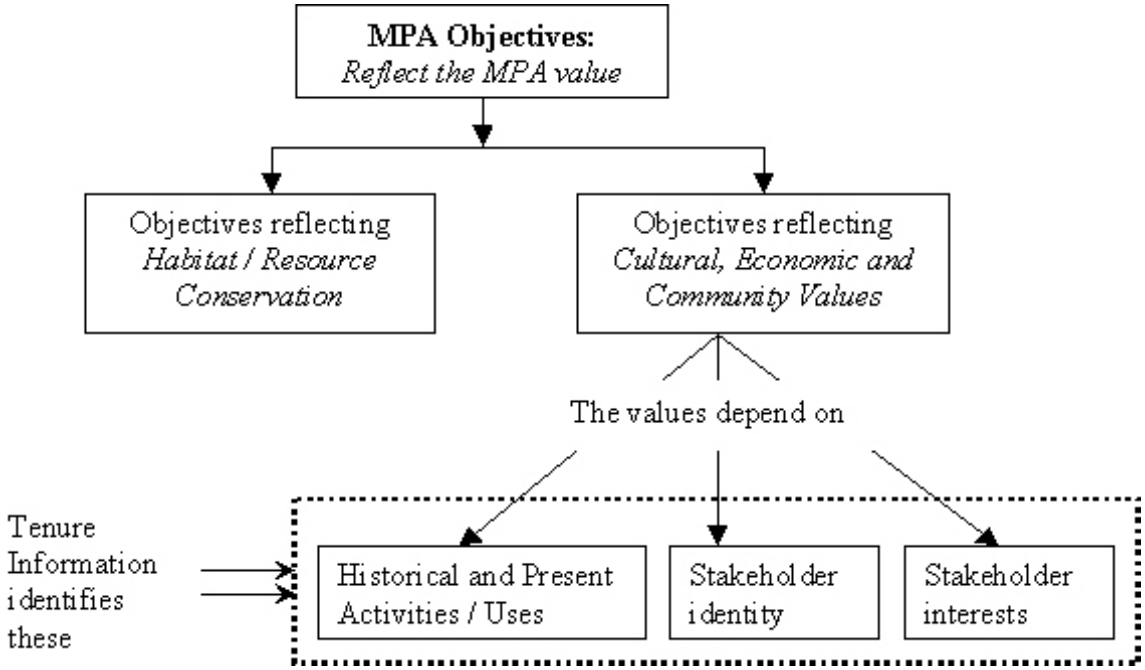

Figure 6.3: The relationship between Tenure information, MPA values and MPA objectives.

6.4.2 Use of Tenure Information to define MPA Objectives

The list of Musquash MPA objectives previously outlined in Table 6.2 can also be shown in the context of managing rights, restrictions, and responsibilities. This perspective represents proposed tenure arrangements, arising from MPA establishment. This perspective shows that existing tenure in the MPA would be modified in various ways as shown in Table 6.5.

Table 6.5: Describing the Musquash MPA objectives in the context of tenure

Musquash MPA Conservation and Values Objectives	Proposed tenure arrangements
Maintain biodiversity	Respect existing tenure and restrain exploitative activities
Maintain healthy fishing industry	Respect existing fish harvesting rights
Protect highly productive habitats	Restrain activities that affect these habitats
Increase the natural habitat and bird life in the marsh and surrounding land	Expropriate rights in areas, and restrict activities
Preserve the area for future generations	Place general restrictions on new or currently existing activities
Ensure conservation and the sustainable use of the marsh	Place restrictions on other activities that occur within, or adjacent to, the saltmarshes

Table 6.5 suggests that existing activities, uses, and interests in the area need to be managed in order to accomplish the articulated objectives. This means that habitat/resource conservation and human values objectives are converted into *management objectives*. For the Musquash MPA, this was captured as four *management objectives*: (1) protecting ecosystem health, integrity, biodiversity and community values; (2) increasing awareness and stewardship towards ecology, conservation, and management issues of Musquash; (3) building a better understanding of the ecosystem through research; and, (4) improving governance of the Musquash MPA.

The first Musquash MPA *management objective* suggests addressing interests outlined by community values, as well as restraints and responsibilities to protect the ecosystem. The second and third *management objectives* suggest a responsibility for improving awareness of the Musquash MPA through education and research initiatives. The fourth *management objective* suggests that rights to "govern" the MPA are important.

The first *management objective* is of particular interest because it focuses on activities/uses/interests and their impact on the ecosystem. For the Musquash MPA, these

possible ecosystem impacts had to be individually addressed. There were eight possible impacts that were outlined for management objective 1. These are outlined in Figure 6.4.

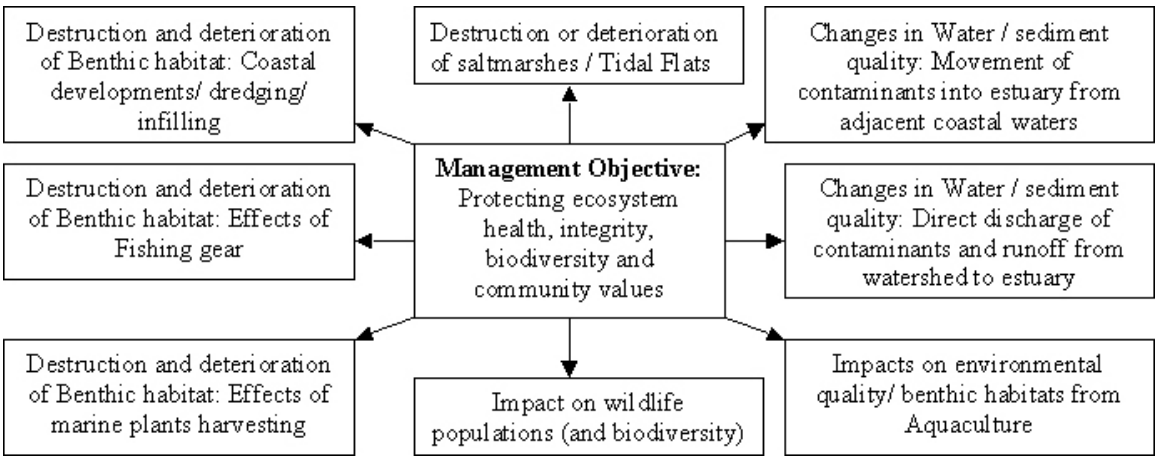

Figure 6.4: An example of Musquash MPA management objective and associated conservation concerns

Each of the ecosystem impacts in Figure 6.4 depends on a review of tenure information in the Musquash MPA. For example, physical works in the coastal zone have a direct impact on benthic communities and water quality. These activities affect the intertidal and subtidal areas where the saltmarshes are located and are governed by programs and legislation.

As can be seen in Figure 6.4, tenure arrangements allow management options to be identified. For example, in order to control discharge of contaminants from land use activities, land use controls available through provincial / municipal regulations can be utilised. Knowledge of these regulations, and their effect on land use, was essential in evaluating whether they were adequate in protecting ecosystem health of the Musquash MPA. This is s shown in Figure 6.5.

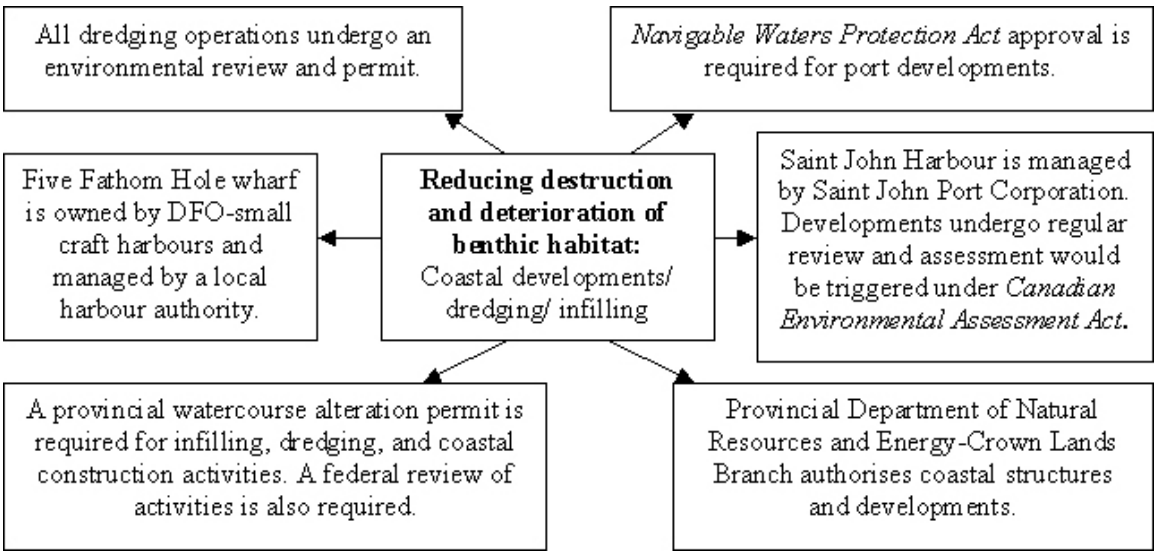

Figure 6.5: Tenure information is used in the Musquash MPA to highlight the adequacy of existing tenure arrangements, and the ability to accomplish management objectives

From the foregoing discussions, the role of tenure information in determining Musquash MPA objectives can be summarised as follows:

Tenure information was used to describe historical and current activities, uses and interests.

These activities / interests and uses were in the form of rights, restrictions, and responsibilities.

These were in turn found in various government policy, programs and legislation, as well as in NGO driven and community programs.

These were captured as community, cultural and economic values, which were as important as habitat/resource conservation values.

They were in turn used to describe *management objectives* and to evaluate management options. *Management objectives* describe common threats and impacts to the Musquash MPA. Management options are identified from reviewing existing tenure arrangements in the area.

6.4.3 Investigating the Role of Stakeholders in determining MPA Objectives

The previously mentioned *management objectives* were defined, reviewed, and ranked by members of the Marine Protected Area Planning Group (MPAPG). While the MPAPG had participated in a preliminary review of management of activities and interests in the Musquash MPA, it did not have the mandate, or stakeholder participation, to carry out and in-depth legal, policy, and program review of existing tenure arrangements in the Musquash MPA area [Buzeta, 2003]. The MPAPG had served primarily as a means to gather community input on the future management of the MPA. It was therefore necessary to form a group that incorporated federal/provincial/municipal government stakeholders, as well as other stakeholders, to review the overall tenure (legal, policy, and program) framework [DFO 2002c]. This group would also be involved in drafting components of the MPA management plan, and reviewing proposed changes.

This necessity was reflected in the fourth Musquash MPA *management objective*, which specifically addressed the governance of the Musquash MPA implementation process. This resulted in the Musquash Advisory Committee[69] (MAC), whose mandate was to further develop a management plan and assist with the requirements of the MPA establishment process. A DFO representative chaired the MAC.

The tenure information management role of the MAC (and its constituent stakeholders) can be summarised as twofold: (1) to assist in identifying activities, uses, and interests; and, (2) to assist in evaluating the effect of these on the proposed MPA. This called for collaboration between the stakeholders within the MAC governance

[69] This group was made up of a committed team of community and government participants. It was originally proposed as the Musquash Management Committee but there was concern that this group did not have the legislative mandate and recognition to carry out MPA management. As such, the term “advisory committee” was deemed as best suited to reflect the role and mandate of this group.

structure. For example, this collaboration provided a means to evaluate regulatory (and other) options that could be used to accomplish *management objectives* outlined in Figure 6.5.

However, stakeholder participation extended beyond the MAC structure to several community meetings held regarding the Musquash MPA. Stakeholder participation provided for two points worth noting. First, stakeholders were able to ensure that a variety of possible tenure arrangements were considered. These included regulatory, voluntary, educational and scientific research options.

Second, stakeholders were keen to ensure that their interests were recognised and favourably "ranked". This is important because it suggests that stakeholders influence:

1) Tenure information requirements – Stakeholders influence the identification of community, cultural and economic values. Stakeholders will also assist in identifying existing regulatory, voluntary, educational and research tenure arrangements in the area.
2) Tenure information use - Stakeholders influence the subsequent ranking of these values within the MPA objectives. For example, the Fundy North Fishermen's Association (FNFA) emphasised that their rights to a scallop fishing zone had to be respected. The MPAPG and MAC considered stopping this activity based on its unknown (and potentially harmful) effect on the saltmarsh ecosystem. In the end, this activity was allowed in the final MPA regulations largely because the participation of FNFA in the MPA establishment process had allowed their interests to be favourably ranked [Thompson, 2004].

6.5 Chapter Summary and Conclusions

This chapter has provided insight into several issues regarding the role of tenure information in determining the MPA rationale and objectives. These issues are summarised below.

1) MPA tenure information requirements for determining the MPA rationale are: (a) real property and resource use rights, restraints, and responsibilities; (b) the holders of these interests; and, (c) how the interests of these individuals can be used to support the scientific rationale.
2) The use of tenure information in determining the MPA rationale was for identifying: (a) whether the owners' responsibilities extended to protecting and maintaining the saltmarsh; and, (b) whether these responsibilities were adequate in accomplishing the scientific MPA rationale, and (c) how the interests of individuals can be used to support the scientific rationale. The term *social rationale* is used to reflect the shared community support needed to advance the scientific rationale.
3) Tenure information requirements for determining MPA objectives are: (a) economic, community, and cultural values, and (b) programs, policy, and regulations. These are needed in order to investigate options and strategies for managing activities and interests.
4) The use of tenure information in determining MPA objectives was in: (a) identifying the cultural, economic, and community values; and, (b) determining whether the activities and interests that make up these values, were compatible with conservation values.
5) Clearly the cultural / community / economic values are dependent on stakeholders. Stakeholders influence the identification of community, cultural and economic

values. Stakeholders will also assist in identifying existing regulatory, voluntary, educational and research tenure arrangements in the area. Finally, stakeholders influence the ranking of these values within the MPA objectives.

The last point in this list is particularly important. For example, stakeholder priorities can change at a later date. What happens then if these values change and the MPA is no longer representative of these values? Does the dynamic nature of community / economic / cultural values change the MPA? This is a question that is investigated in the next chapter by showing how these values are captured in the MPA spatial extent.

This chapter has also identified research findings on tenure information management processes during the determination of the MPA rationale and objectives. The major points of these findings are summarised in Table 6.6 and 6.7 respectively.

This chapter has demonstrated that the role of tenure information management in the administration of marine activities and interests can be explained by the three activities. These activities were identified in the conceptual framework developed in Chapter 4, sections 4.3 and 4.4. The three activities are: (1) determining MPA tenure information requirements, (2) determining MPA tenure information management groups, and (3) determining MPA tenure information use.

This chapter has further shown that each activity is adequately clarified by several tasks (represented by a series of questions). This has been verified during the determination of two management plan components: namely, MPA rationale and objectives. In the next chapter, this is verified for a third management plan component: the MPA spatial extent.

Table 6.6: Summary of major research findings on tenure information management and determination of the MPA Social Rationale

Activities include (1) determining ownership of real property adjacent to the proposed MPA, (2) further investigating the owner's saltmarsh conservation objectives, and (3) comparison against protections needed for the saltmarsh ecosystem.
Activities also include (1) identifying government (and other) programs that protected other habitats in the vicinity of the Musquash estuary, and (2) further identifying whether they affected the geographical extent of the proposed MPA.
CCNB was able to interact with the local communities surrounding the proposed MPA area. This allowed public sentiment regarding the proposal to be gauged. It also allowed CCNB to determine support for protecting the saltmarsh complex under the DFO MPA program. This was important because it allowed baseline community support for MPA protection to be established.

Table 6.7: Summary of major research findings on tenure information management and determination of MPA Objectives

An inspection of MPA objectives notes a focus on habitat and resource conservation values. However, objectives such as "preserving the area for future generations" and "sustainable use of the marsh" suggest values that extend beyond conservation.
Cultural, community and economic values of the Musquash estuary and surrounding lands allows individuals and groups to associate additional importance to the MPA proposal, by relating the proposal to non-ecological values.
The list of Musquash MPA objectives can be shown in the context of managing rights, restrictions, and responsibilities. This perspective represents proposed tenure arrangements, arising from MPA establishment.

7 CHAPTER 7: ANALYSING THE ROLE OF TENURE INFORMATION IN DETERMINING THE MUSQUASH MPA SPATIAL EXTENT

In this chapter, the conceptual framework developed in Chapter 4 continues to be tested in the Musquash MPA case study using the approach developed in Chapter 5. This chapter demonstrates how tenure information was used to determine the Musquash MPA spatial extent. The purpose of the case study is to verify the rationale of the proposed framework, and highlight how tenure information was used in MPA management plan preparation.

7.1 Determining the MPA Spatial Extent

In order to accomplish the Musquash MPA management objectives that have been outlined, the spatial extent had to be determined. There were several spatial extent components that were originally proposed, and later refined. The proposed MPA spatial extent components are described in Table 7.1.[1]

Table 7.1: Musquash MPA boundary descriptions (after Singh et al [2000])

Spatial Extent Component	Description
General description of the proposed MPA lands	All saltmarshes and mudflats located in subtidal and intertidal areas of the Musquash estuary.
Innermost limit of the proposed MPA	Located at the head of the tide at the Musquash Hydro Station, on the eastern branch of the Musquash River.
External limit of the proposed MPA on the Bay of Fundy side	A straight line drawn from Musquash Head to the southern tip of Gooseberry Island, and extending to the coastline, at the western tip of Gooseberry Cove.
Landward MPA limit adjacent to upland property	The ordinary high water mark.
Scallop fishing zone	Proposed by the Fundy North Fishermen's Association (FNFA), bounded on the inside by a line drawn from Black Beach to Robinson's Head, and on the outside by the external limit.

[1] The author has paraphrased the wording that describes the spatial extent of the proposed MPA in order to highlight the different components. Note also that throughout this research, the words "spatial extent components", "limits" and "boundaries" are constantly interchanged. Spatial extent components include boundaries and their locations, as well as zoning options.

The boundaries described in Table 7.1 were based on several sources of information. The information used to identify and refine the proposed boundaries of the Musquash MPA is described in the next section.

7.1.1 Information Requirements to define the MPA Spatial Extent

The innermost, landward, and external Musquash MPA limits were based on background research on saltmarsh conditions in the Bay of Fundy, conducted by CCNB [Singh et al., 2000]. However, majority of these limits contained reference to physical reference points that were locally known and recognised. For example, the hydro station was selected as the innermost limit because it was a well-recognised landmark connected to the saltmarsh ecosystem through the Musquash River.

Similarly, reference to the straight-line MPA external limit was based on two physical landmarks: Musquash and Western Head. High cliffs characterize Western Head while Musquash Head contains a lighthouse. These two headlands could easily be distinguished as one navigated into the Musquash estuary from the Bay of Fundy side. They provided clear reference points for navigation as vessels steamed into the estuary [Thompson, 2003]. Additionally, these two headlands are historically linked to navigation and other cultural/community values in the Musquash area.

Some boundaries originated from the Conservation Council of New Brunswick (CCNB) survey, while others originated from other stakeholders. Some stakeholders were more vocal in ensuring that their interests were formally recognised in the MPA boundaries. For example, the Musquash MPA contains a scallop-fishing zone that was delimited when local fishermen were provided with a map of the estuary and asked to outline “valuable fishing areas” [Buzeta, 2001].

This reference to the scallop zone is based on one of several economic values identified by the Fundy North Fishermen's Association (FNFA). The FNFA's members wanted scallop-dragging activities in the area to be maintained in the proposed MPA. Normally, these would not be considered due to the adverse action of the scallop dragging activities on benthic habitat [Canada Gazette, 2005c]. However, by supporting the original proposal, the FNFA was able to ensure that its resource use rights remained unaffected within the proposed MPA [Buzeta, 2002; Thompson, 2003].

The preliminary boundary descriptions in Table 7.1 were a starting point for discussions regarding the MPA spatial extent. This spatial extent was later to be encapsulated in the final Musquash MPA management plan. As discussed in the previous paragraphs the boundary descriptions in Table 7.1 depended on preliminary review of tenure information. For example, information on the high water mark being proposed as the landward limit was based on general knowledge regarding upland real property rights in the area [Ocean Governance, 2000; Buzeta, 2002]. This meant that this limit was not based on a thorough review of individual parcels in the Musquash area.

This is in contrast to the expected description of the MPA spatial extent, and associated boundaries, in the final Musquash MPA management plan. In this plan, the rationale of the boundaries, and their descriptions, is a critical element [DFO, 2002c]. This research suggests that there are several criteria that were used to provide this rationale and descriptions. This criterion is as follows: (1) Do the boundaries facilitate accomplishment of conservation objectives? (2) Do they facilitate accomplishment of management objectives? (3) Are they the most legally appropriate? The criteria are summarised in Figure 7.1.

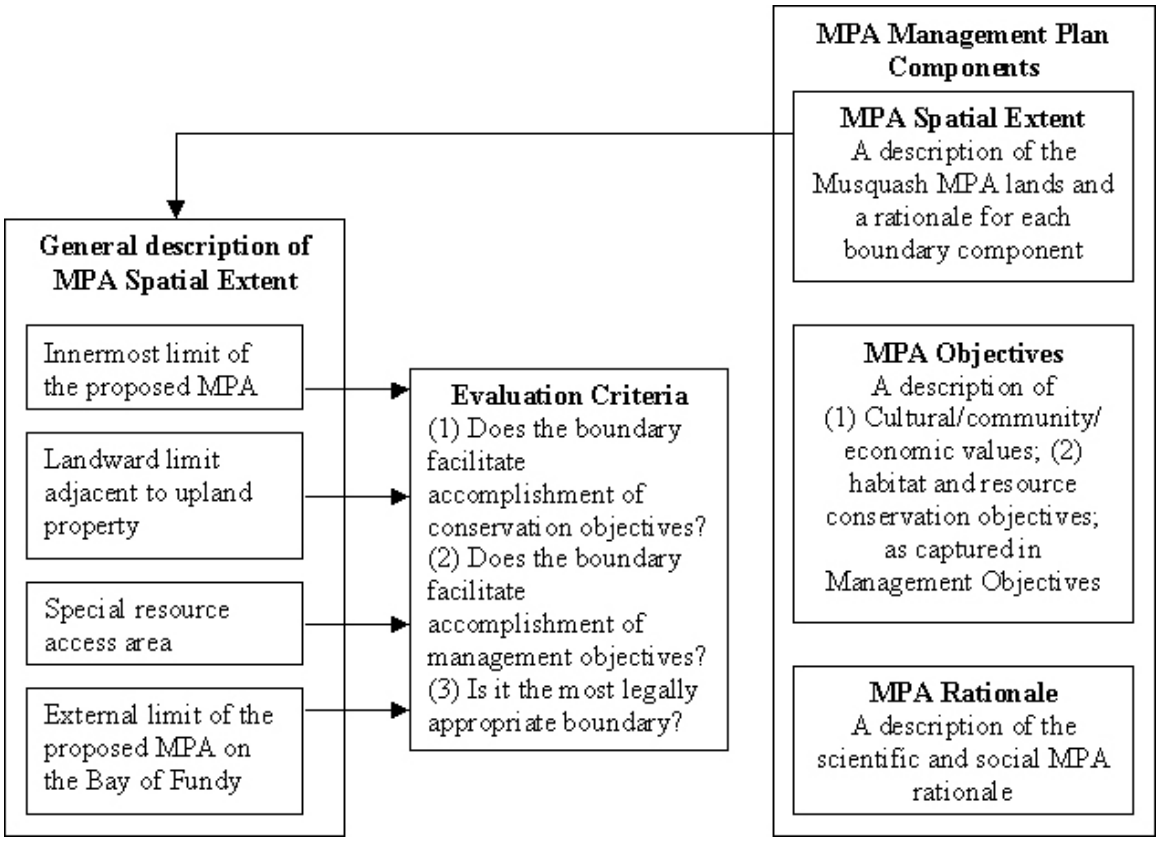

Figure 7.1: The criteria for describing the Musquash MPA spatial extent.

To provide answers to these questions, research groups from UNB carried out scientific and tenure data collection, analysis, and dissemination in the Musquash MPA. The following sections will highlight how the information management process (i.e., data collection, analysis, and dissemination) impacted on the Musquash MPA spatial extent.

7.1.2 Use of Tenure Information in defining MPA Spatial Extent

The decision on the Musquash MPA spatial extent was the responsibility of stakeholders in the Musquash Advisory Committee (MAC). They had to determine how the available scientific and tenure information could be used to address the three criteria that have been outlined. Recall that the criteria are: (1) Do the boundaries facilitate accomplishment of conservation objectives? (2) Do they facilitate accomplishment of management objectives? (3) Are they the most legally appropriate?

The first criteria involved habitat and resource conservation objectives. This depended on reviewing scientific information regarding the saltmarsh ecosystem dynamics, and as a result, selecting the most representative spatial extent. A review of the associated scientific research is summarised in Singh et al [2000].

The latter two criteria used to evaluate the Musquash MPA spatial extent depended less on conservation science and more on human uses/interests. This research reviewed the tenure information used in determining Musquash MPA rationale/objectives and identified three primary activities that had to be carried out in order to fulfill these two criteria. These activities are: (1) identifying tenure issues; (2) identifying the location and proximity of these issues to proposed MPA boundaries; and, (3) identifying the impact of these issues on the MPA spatial extent.

As shown in Figure 7.2, the previously mentioned activities consist of several tasks. For the Musquash MPA, the first task involved an investigation of existing tenure issues (*jurisdiction, administration, and private property rights*) in Atlantic Provinces. The second task involved revisiting the tenure information used in determining MPA rationale and objectives. In the third task, the tenure issues (from task 1) and tenure information (from task 2) were associated with spatial extents. The fourth task involved determining whether the tenure issues/information were constraint or justified the proposed Musquash MPA spatial extent boundaries.

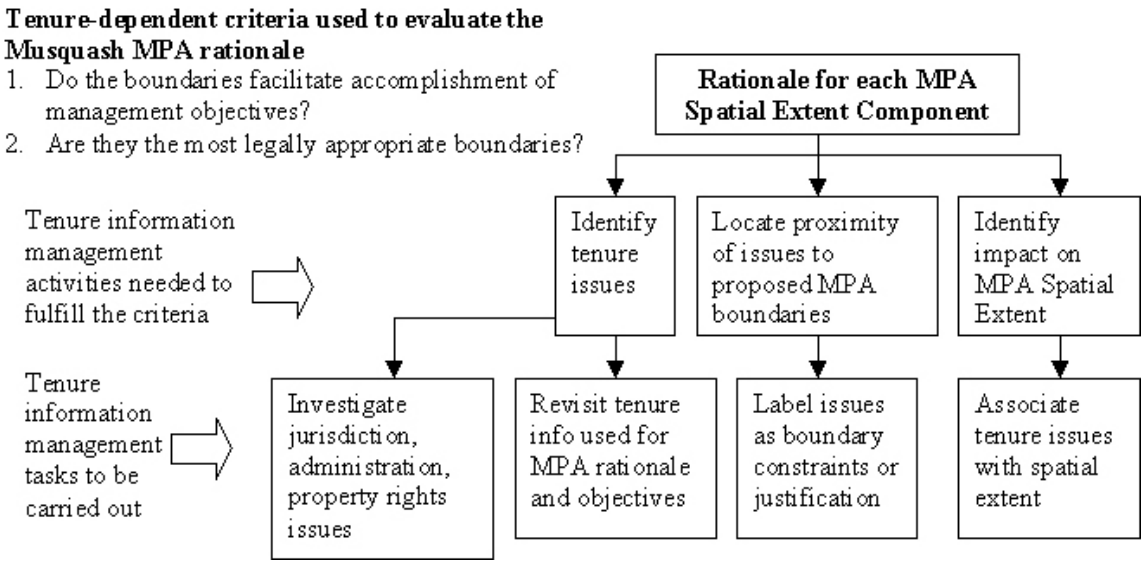

Figure 7.2: Tasks involved in determining the rationale for the Musquash MPA Spatial Extent

To accomplish the first task, an investigation into tenure issues arising from real property rights, administration, and jurisdiction was carried out. These issues had an important effect in determining the MPA spatial extent. For example, coastal areas in the Atlantic Provinces are well known for being the source of great jurisdictional uncertainty (see for example LaForest [1963]). It was clear in the Musquash MPA that some of this uncertainty could affect the rationale of some spatial extent components. This in turn could translate into uncertainty over the spatial extent of downstream management plan components, such as, (1) the zoning options that may be considered, (2) the activities that may be prohibited, and (3) the regulations that may be proposed.

This task involves several tenure issues that were identified and then determined to fall within a broader topical discussion; as further elaborated in Appendix III. On the other hand, the second, third and fourth tasks are briefly described in the succeeding sections because they involve tenure information that has been previously mentioned under MPA rationale and objectives.

7.1.2.1 Revisiting Tenure Information used in MPA Rationale and Objectives

The second task involved reviewing tenure information from the MPA rationale and objectives and determining whether the information affected the spatial extent components or descriptions. Recall that tenure information had previously been used to determine: (1) the social MPA rationale; (2) cultural, economic, and community values; and, (3) management objectives. This is shown in Table 7.2.

Table 7.2: The Role of tenure data in determining Musquash MPA rationale and objectives

Management plan component	Tenure data information to highlight...
Social MPA rationale	(1) Real property holders and resource users; (2) the interests of these holders i.e., rights, restraints, and responsibilities; and, (3) how the interests of these individuals can be used to support the scientific rationale.
MPA values as indicators of MPA objectives	(1) Identifying the cultural, economic, and community values; and, (2) determining whether the activities and interests making up these values, were compatible with the ecological values.
Management objectives	(1) Identify activities and uses within and surrounding the Musquash MPA; (2) rights to activities and uses; (3) the restrictions provided by the various government programs and regulations; and (4) responsibilities described by voluntary, research, and educational initiatives.

In reviewing the Musquash MPA tenure information in Table 7.2, this research noted that cultural, economic, and community values usually referred to objects. These are considered in this research under the umbrella term *tenure objects.* These refer to natural and man-made features that can be associated with activities and interests. They also include real property objects. These are summarised in Figure 7.3.

Some of these *tenure objects* coincided with the proposed MPA boundaries. For example, the inner limit of the MPA was proposed by the community as a Hydro-power station located at the "head of the tide". Other *tenure objects* did not coincide with the MPA boundaries and indicated features that could constrain or justify the location of proposed boundaries. For example, within the Musquash estuary are several water lots

granted to provincial government departments and agencies.[2] The spatial extent of these water lots affected the description of MPA internal limit as the ordinary high water mark.

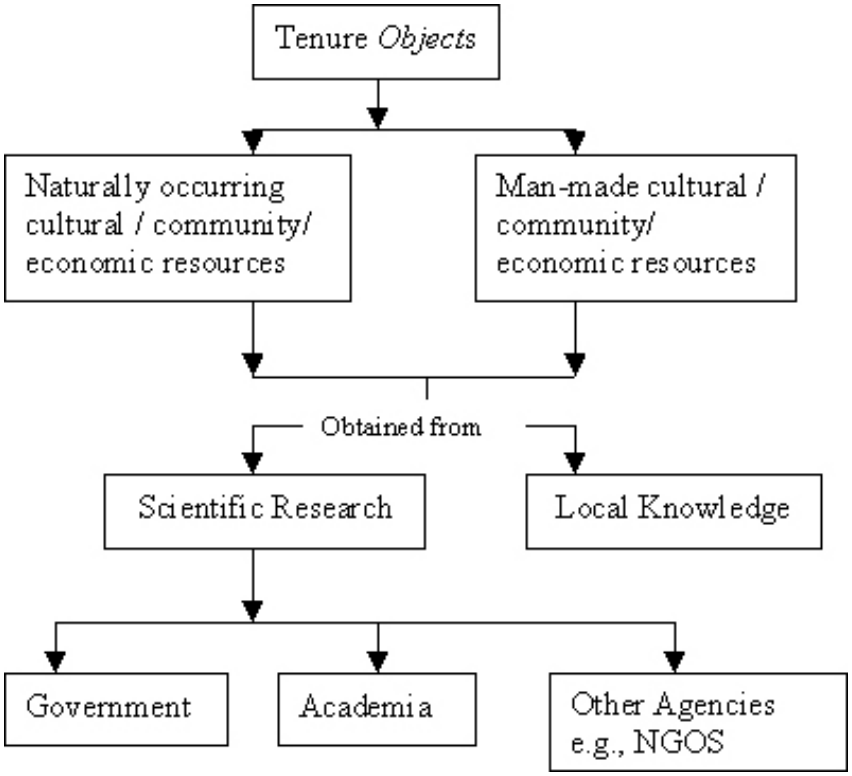

Figure 7.3: The definition of Tenure Objects in the Musquash MPA

It was also noted that in the Musquash MPA there were several areas with poorly defined spatial extents that were associated with certain rights, and / or restrictions, and / or responsibilities. These are described in under the general term *tenure spaces*. For example, there were areas with poorly delineated cultural / community / economic resources. These also existed in areas that were described by government programs and regulations, which identified restrictions and responsibilities within broadly defined space. In both these examples, the *tenure spaces* had the possibility of impacting on the proposed MPA boundaries. This is summarised in Figure 7.4.

[2] The provincial Department of Natural Resources and Energy (DNRE) had two water lots with a total area of 594.64m^2 (located in the estuary and in Hepburn Basin), while New Brunswick Power Corporation had a water lot with an area of 596.91 m2 located off the Colesone Cove power generating station [SNB, 2005].

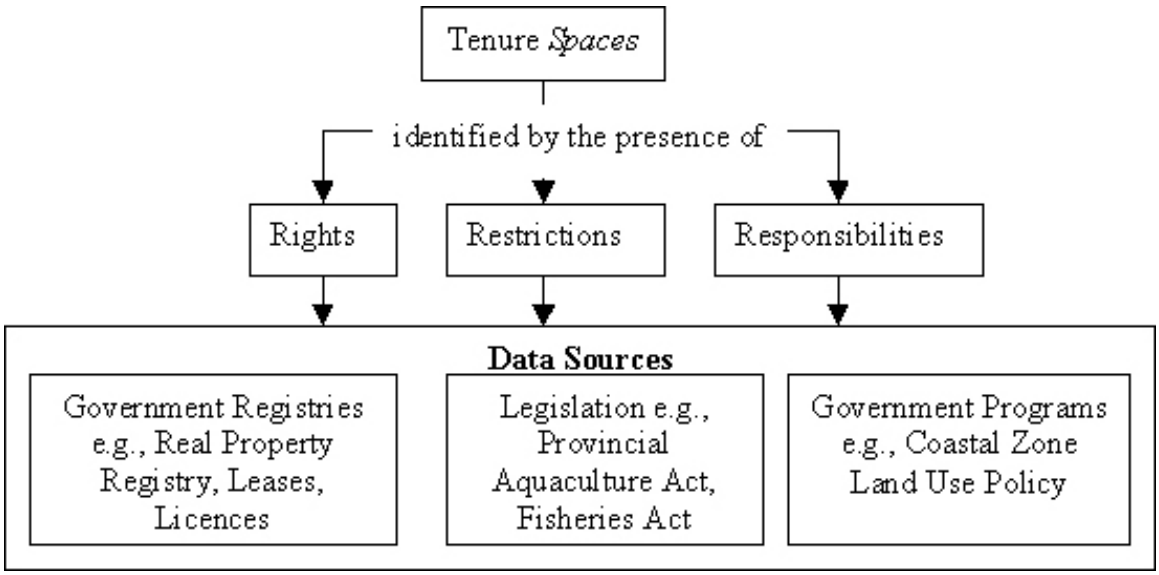

Figure 7.4: The definition of Tenure Spaces in the Musquash MPA

7.1.2.2 Associating *Tenure Objects / Spaces* with Spatial Extents

Once *tenure objects / spaces* are identified then it is necessary to proceed to the third and fourth tasks previously mentioned. These tasks involve delimiting the spatial extent of *tenure objects/spaces.* The necessity for associating spatial extents with identified *tenure objects / spaces* is in order to determine whether there is an overlap with the proposed MPA boundaries. This in turn assists in determining whether *tenure objects / spaces* may affect the proposed MPA spatial extent.

For *tenure objects / spaces* that had defined spatial extents, some knowledge of the boundary functions facilitates boundary delimitation. For example, some *tenure objects / spaces* provided notice in written form. Others had their spatial extents recognised through local knowledge. In both examples, the boundaries provide notice through different dissemination mechanisms. This difference in dissemination mechanisms determines the uncertainty associated with the impact of these *tenure objects / spaces* on proposed MPA boundaries. For example, the spatial extent of the Saint John Harbour was

well publicized in digital media and regulations. In contrast, knowledge about the location of abandoned fishing weirs within the Musquash estuary was based on proximity to the estuary and familiarity with local knowledge.

The example in the previous paragraph also suggests that the characteristics of *tenure objects / spaces* were important because they provide information that may be used to evaluate their impact on proposed boundaries. In the Musquash MPA, two primary characteristics were important i.e., *type* and *location*. The *location* characteristic provides information on the *tenure object*/*space* extent, and / or location within the proposed MPA boundaries. The *type* characteristic provides information on the cultural/ economic/ community value of the *tenure object*/*space*. These two characteristics are further described in the following sections.

7.1.2.2.1 The Importance of Tenure *Location* Characteristics

As mentioned in the previous section, the *location* characteristic identifies two information categories (a) the physical location, and (b) the spatial extent of *tenure object*/*space*. In the Musquash MPA, it was necessary to categorize the physical location of *tenure objects / spaces* using the vertical and horizontal spaces "occupied". This might entail distinguishing whether the tenure (i.e., regulatory, voluntary, educational, research) is associated with an object (e.g., fish or marine plant species) found on the sea surface, water column, seabed, or subsurface. It may also entail distinguishing whether it is found in the intertidal zone, which may be seabed or dry land, depending on the tidal cycle. For example, rockweed harvesting is licensed and managed by the provincial Department of Fisheries and Aquaculture. The provincial regulations deal with marine plants (*tenure object*) that are located in the intertidal area.

As shown in Figure 7.5, the *location* characteristic also identifies the spatial extent of *tenure object*/*space*. In the Musquash MPA, it was necessary to label these spatial extents as "general" or "specific". Respectively, these were synonymous with (a) unknown / fuzzy spatial extents, and (b) more defined / not necessarily precise spatial extents. For example, Musquash is classified as a "scientific study area" and has not had any harvesting of substantial rockweed resources found within it [DFO, 2002c]. The spatial extent of this "study area" is poorly delineated and the impact of this designation known primarily by the scientific and management community. This area can be labelled as a "general" spatial extent, indicating the existence of a *tenure object*/*space*, but containing delimitation uncertainty.

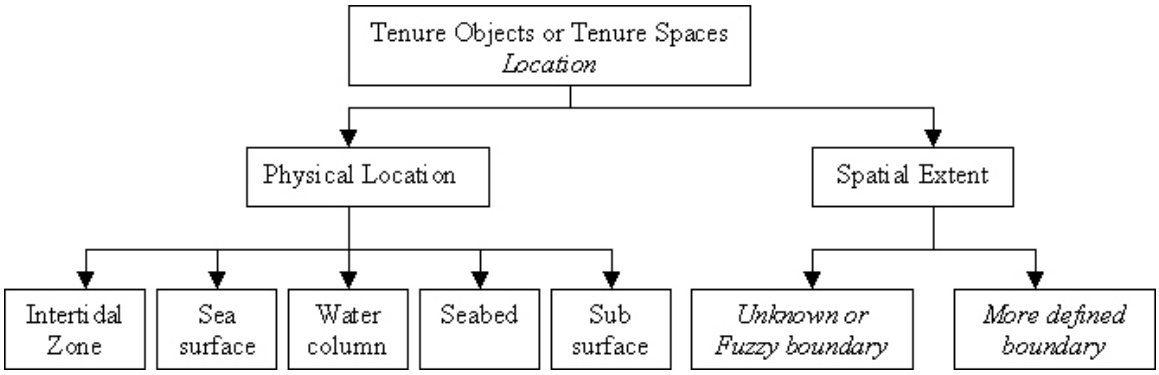

Figure 7.5: The Information contained in the Tenure *Location* characteristic

7.1.2.2.2 The Importance of Tenure *Type* Characteristics

The *type* of *tenure object*/*space* was the other characteristic that was important in the Musquash MPA. This characteristic provided information on the cultural / community / economic values associated with these *tenure objects/spaces*. To assist in evaluating the impact of *tenure objects / spaces* on the proposed boundaries, it was necessary to first distinguish whether the values represented *resource features* and / or *legal features*. *Resource features* were considered to *tenure spaces* or *objects* that were not legally

recognised and enforced. In contrast, *legal features* were considered to be *tenure objects / spaces* that were legally recognised and / or enforced. This is summarised in Figure 7.6.

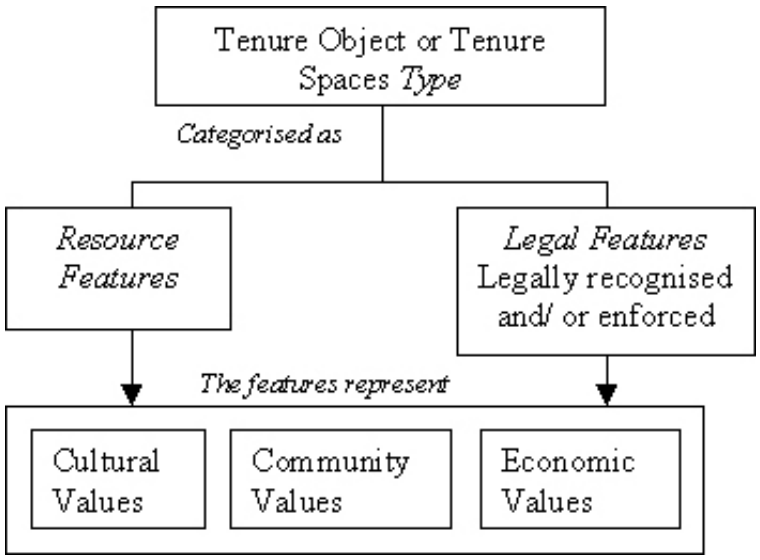

Figure 7.6: The information contained in the Tenure *Type* characteristic

This distinction was important in the Musquash MPA case study because it facilitated evaluating the impact of *tenure spaces/objects* on the proposed MPA spatial extent.[3] However, there were instances where this distinction was not important. Therefore, although some *resource features* were not legally recognised, they obtained a *quasi-legal* standing by virtue of the community/cultural/economic value associated with them. For example, several World War II vessels were abandoned within the proposed boundaries of the Musquash MPA [Thompson, 2001]. Although these vessels are not protected by any government program or legislation, the local community identified them as having cultural value. Therefore, the boundaries of the proposed MPA had to be extended to accommodate these cultural *resource features*. This is an important observation as it

[3] There were also instances when *legal features* were coincident with *resource features.* For example, Five Fathom Hole wharf is owned by DFO-small craft harbours and managed by a local harbour authority. It is a man-made feature (*artificial resource feature)* that also defines the spatial extent of regulations (*legal feature*) associated with these harbours.

suggests that, some *resource features* may be equally as important as the so-called *legal features*.

Tenure objects / spaces that were identified as *legal* features were easier to visualise as having an impact on the proposed MPA boundaries. Most *legal features* identified in the Musquash MPA were based on real property ownership and government regulations, as well as broader jurisdiction and administrative criteria. Additionally, there were *tenure objects / spaces* that were identified by government programs/policies but uncertainty existed in the legality and / or enforcement of the tenure in these declarations. Recall the designation of the Musquash as a "scientific study area" and the associated restrictions on harvesting marine plants. While this designation seemed to restrain commercial activities by restricting the issuance of commercial licences, non-commercial rockweed harvesting activities were still carried out [DFO, 2002c]. It was therefore unclear whether there was a legal distinction between the two types of activities, and whether enforcement was able to make the distinction.

7.1.2.3 Impact of *Tenure objects / spaces* on the MPA Spatial Extent

The impact of *tenure objects / spaces* on the MPA spatial extent can be viewed from two contexts. The first context involves determining the effect of *tenure objects / spaces* on the location and description of proposed MPA boundaries. This involves determining the proximity and extent of *tenure objects / spaces* and how it impacts on the proposed MPA boundaries. For example, a large sand wave feature (*tenure object*) can be observed on inspecting the bathymetry of the area off Musquash Head [Byrne et al., 2002]. The local community and conservation groups in the area claimed "ownership" of this *resource feature* and were exploring means of using it to advance their case for

protection. This sand wave feature was part of the community justification for providing a buffer zone in this area, which would effectively extend the proposed MPA external limit. This is an example of how a tenure object would impact on the possible location of the proposed MPA boundary.

The second context involves determining the effect of *tenure objects / spaces* on proposed MPA rights, restrictions, and responsibilities. Specifically, this determines whether there is a need for further restraint of activities to be captured in the MPA regulations. For example, although there are no licences for aquaculture sites within the proposed boundaries of the Musquash MPA, the surrounding area is outside the *tenure space* defined as the provincial *zones of exclusion.* Within these zones, aquaculture is prohibited [DFO, 2002c]. This implies that the proposed Musquash MPA and the surrounding marine areas are open to aquaculture site consideration. Since aquaculture activities conflict with Musquash MPA conservation objectives, other approaches for addressing these possible activities are necessary. This is an example of how the rights, restrictions and responsibilities described by *tenure objects / spaces* would impact on the proposed MPA tenure, encapsulated within the MPA spatial extent.

7.1.2.4 Using Tenure Information to Determine Spatial Extent Uncertainty

The previous section has suggested that tenure information can be used to outline two sources of uncertainty associated with the MPA spatial extent. The first source of uncertainty lies in the process of determining the spatial extent of *tenure objects/spaces*, and their subsequent proximity to proposed MPA boundaries. The second source of uncertainty lies in the process of determining the proposed MPA tenure within the *tenure objects/spaces*. These are further described as follows.

1. ***Uncertainty in determining the spatial extent of tenure objects / spaces and their proximity to proposed MPA boundaries:*** This research suggests that this depends on the *location* characteristic. Specifically, uncertainty can be identified within two previously mentioned sub-categories: (a) identifying the physical location of *tenure objects/spaces*; and, (b) identifying the boundary type of *tenure objects/spaces*.

   a) The ability to distinguish whether tenure objects are located in specific horizontal and vertical space determines whether the MPA boundaries are physically adequate. For example, the final Musquash MPA boundaries did not protect the physical space where the saltmarsh resources are located because the intertidal zone was in some instances under private ownership. However, the New Brunswick Coastal Zone Policy (CZP) restrictions on activities that might harm the saltmarsh resources in these areas were able to partially mitigate the physical inadequacy of the MPA spatial extent [DELG, 2004]. This is an example where the delineation of the MPA may possibly be physically inadequate for accomplishing the conservation objective. However, this seems to be mitigated by restrictions provided by adjacent *tenure spaces*.

   b) There are also several instances of multiple *tenures spaces/objects* co-existing within the same space. This might exist within a tenure category i.e., legislated, voluntary, education, and scientific programs For example, the *tenure space* defined by the provincial *Aquaculture Act* [1988] co-exists within the same space as the Federal *Federal Real Property and Immovables Act* [1991], *Navigable Waters Protection Act* [1985], *Canada Shipping Act* [1985], *Canada Environmental Protection Act* [1999], as well as other legislation. In other cases, legislation as well

as voluntary, education, and scientific programs simultaneously define *tenure spaces/ objects*. Interpreting this complex relationship in the context of possible impact on the MPA spatial extent is a major source of uncertainty.

c) Uncertainty in distinguishing whether *tenure objects / spaces* have "general" or "specific" spatial extents may propagate to the MPA spatial extent. Some *tenure objects/ spaces* may indicate the existence of tenure in an area but their spatial extent is unknown or poorly defined. For example, the location of previously mentioned historical aboriginal camps in the Musquash area was difficult to ascertain. This means that the MPA spatial extent may be infringing on these cultural features and may consequently have to be modified.

d) Even the "specific" boundaries of *tenure objects/ spaces* are cause for MPA boundary uncertainty. For example, the New Brunswick Coastal Zone Policy (CZP) restricts new development within 30 meters of a coastal feature [DELG, 2004]. This policy goes on to define several types of coastal features, which are located at various locations. The challenge is therefore one of interpreting the spatial extent of this policy by identifying the coastal features. This is not easy, especially given the changing physical nature of some of these features due to sea level rise. This uncertainty may have legal consequences. For example, the CZP has been accused of infringing on private property rights [Nichols and Monahan, 2000].

2. ***Uncertainty in determining the proposed MPA tenure within the tenure objects/spaces:*** This research suggests that this depends on the *type* characteristic. Specifically, uncertainty can be identified within two previously mentioned sub-

categories: (1) identification of cultural / community / economic values, and (2) distinction of these values as *resource* and / or *legal features*.

a) The *type* characteristic captures *tenure object*/*space* values, and then distinguishes them as *resource* and / or *legal features*. While there are several means of determining the cultural / community / economic values, any uncertainty in this process will propagate to the proposed MPA spatial extent. For example, there was a difficulty in obtaining consensus regarding the value of some of the resources in the Musquash MPA. For example, to the Saint John Naturalists community, the value of the saltmarsh was as a habitat for black ducks, to be appreciated by birdwatchers. However, the saltmarshes were located on land owned by Ducks Unlimited, which was an organisation whose objective was habitat preservation for duck hunting [Thompson, 2001]. This represented a divergence in economic and community values associated with saltmarsh resources. Clearly these are two opposing perspectives on the value of resources. The uncertainty arising from these dissimilar perspectives propagates to their consideration in the MPA spatial extent, and consequently the location and extent of proposed MPA boundaries.

b) The uncertainty in categorizing the *tenure objects / spaces* as *resource* and / or *legal* features will propagate to the proposed MPA spatial extent. In the Musquash MPA, the ability to categorize these objects was based on: (1) real property and other registries, (2) Musquash Advisory Committee (MAC) interpretation of the spatial extent of government programs, (3) MAC interpretation of the legal framework in the immediate and surrounding areas, and (4) activities and uses identified by local community members living in the vicinity of the MPA. Shortcomings in these

sources of information, or the interpretations arising from the available information, added to the uncertainty in the proposed MPA spatial extent.

For example, there were several fishing weirs that were located in the Musquash MPA. Although they have since been abandoned, the status of the property rights associated with these abandoned weirs is still unknown. This is because there is no registry available that provides information on historical weir rights [Buzeta, 2002; Thompson, 2003]. While this might not be currently important, the recent trend of "rejuvenated" values for abandoned fishing weirs in Atlantic Canada is cause for concern. Marshall [2001] describes how the development of aquaculture in the Bay of Fundy created a demand for historical fishing weirs, and market value for these locations.

c) The use of *tenure objects/space* information to evaluate the uncertainty of proposed tenure in the MPA is based on the assumption that tenure is well defined, and that *location* and *type* are the characteristics that need to be determined. This may not always be the case. Sources of tenure information e.g., formal registries, may indicate present tenure and provide a general overview of historical rights that previously existed. Missing documents in the registry may compromise the information trail. As mentioned in previous paragraph, this has consequences on the MPA spatial extent and the "future" tenure within it.

The two major types of uncertainty addressed in this section affect two important MPA spatial extent elements: the *accuracy* and the *precision*. The *accuracy* of the MPA boundaries is captured by the ability to fulfill the original three criteria: namely,

conservation objectives, human value and management objectives, and legal appropriateness.

The *precision* of the spatial extent is a function of the *location* and *type* characteristics. In other words, uncertainty in the *location* and *type* characteristic propagates to the *precision* of the MPA spatial extent. For example, the federal government policy on dealing with aboriginal rights within an MPA is to provide an opening commentary within legislation that acknowledges possible existence of these rights. This can be interpreted to mean that the MPA spatial extent is not necessarily "fixed" by MPA regulations and may be modified by uncertainty regarding the *location* and *type* of aboriginal rights.

7.1.3 Investigating the Role of Stakeholders in determining the MPA Spatial Extent

As mentioned in Chapter 5, scientific research was carried out in the Musquash MPA. The scientific research was used for several purposes including: (1) to complement the sources of information identifying *tenure objects* and *spaces*, and (2) to compare the results against some of the tenure *objects* identified.

The hydrographic, oceanographic, and topographic field surveys was carried out by the Ocean Mapping Group (OMG) to identify (among other things) marine resources and their boundaries. Chapter 5 has hypothesised that the participation of groups in data management processes affects, (1) the definition of tenure information requirements, and (2) the use of information in MPA establishment. The participation of groups in the scientific research provided an opportunity to verify this hypothesis.

7.1.3.1 Delimiting the External and Scallop Zone Boundaries

The hydrographic and oceanographic survey data was used for specific boundary purposes [Ng'ang'a and Nichols, 2002]: (1) to identify resource boundaries, (2) to assist groups in determining the external boundary of the proposed MPA, and (3) to assist groups in determining the location of a scallop fishing limit. This data was used for boundary delimitation based on three assumptions[4]: (1) it can be used to identify and locate resources; (2) it can be used to identify private or public rights (and restraints) to the resource; and, (3) access to information, to assist in decision making, can be provided.

In the Musquash MPA, this data was used to outline, (1) past and current human use/activities, (2) past and current resource objects, and (3) restrictions and responsibilities associated with resource use or activity. Examples of past human use and associated objects include fishing weirs in the Hepburn Basin area. Examples of restrictions include sand wave features that were used to identify support for a proposed buffer area adjacent to the external MPA boundary. Examples of responsibilities include the cultural value of abandoned World War 2 vessels located in the Musquash River.

From the hydrographic survey data, the Ocean Mapping Group (OMG) was able to identify a sediment boundary as narrowly collocated with the proposed external boundary (see Byrne et al. [2002]). This was considered coincidental by the OMG. Stakeholders from the local community and MAC argued that this was important indicator of MPA boundaries because of two reasons (1) the results provided scientific evidence to justify the location of the proposed external boundary; and, (2) by supporting the preliminary boundary proposal, the science had validated local knowledge.

[4] These assumptions can be summarized as follows: In essence, one is able to access information on *where* the resource is, *who* has *what* rights to the resource, and how the information can be provided to decision makers (whomever these may be) [Ng'ang'a and Nichols, 2002].

From the oceanographic survey (tidal flushing patterns analysis), the OMG concluded that pollutants and contaminants located outside the proposed external boundary might find their way into the estuary. OMG had recommended that a buffer zone might be appropriate to mitigate these circumstances. When presented with this information, local community and MAC members were interested in the buffer zone recommendations for three reasons: (1) lobster fishermen were interested in the effect of the buffer zone proposal on their rights of access to the fishery located at the mouth of the estuary; (2) MAC members were interested in how the tidal flushing patterns could be used to extend the MPA boundary; and, (3) local community members were interested in determining how this information could be used to restrict other future marine activities e.g., aquaculture site location outside the MPA.

Additionally, there was a lack of conclusive evidence to support a claim that a scallop habitat existed within the proposed scallop-fishing zone [Byrne et al., 2002]. The MAC and community members overlooked this scientific information and the original delimitation of the boundary was upheld. Two reasons were articulated: (1) scientific data can be inconclusive and should not be the sole authoritative source of boundary location information; and, (2) in the hierarchy of boundary evidence, there are several instances where local knowledge can be used instead of scientific evidence. This latter point is important as community members felt that this specific example endorsed the validity of local knowledge. This is because scallop fishing was a fact at that location regardless of the lack of scientific evidence.

The OMG suggested an external “fuzzy” boundary consisting of the original straight-line limit and a buffer zone. However, even this definition provided a particular

delineation challenge: namely, how does one determine the width of the buffer zone? In the end, it was more convenient to propose an estimated buffer size extending one kilometre from the straight-line boundary. The general consensus of the Musquash Advisory Committee (MAC) was that a more precise delineation would entail an in-depth study of the tidal models at the mouth of the estuary. This was considered unacceptable because it would inevitably delay the MPA establishment process [Thompson, 2003; Buzeta, 2003].

7.1.3.2 Delimiting the High Water Mark Boundary

The role of stakeholders in delimiting the high water mark boundary can be summarised as twofold: (1) providing knowledge of the high water mark options, and (2) analysing various high water mark boundary options. For example, UNB students were involved in a topographic survey of Black Beach area (in the Musquash) in order to identify the location of the ordinary high water mark boundary. This was important for two primary reasons: (1) the original boundaries of the Musquash MPA included a reference to the ordinary high water mark as one of the delimiters of this spatial extent; and, (2) there were several sources of information that could be used to identify the high water mark boundary.

The focus of the topographic survey was to provide the legal interpretation of the physical location of the boundary. However, there was also provincial mapping of the ordinary high water mark available in the coastal lands database. This latter high water mark was referred to in some programs. For example, the original New Brunswick coastal zone policy restricted new development within 30 meters of coastal features identified in the coastal lands database. These features had been identified as above or

below the high water mark.[5] However, the delimitation of the features, as well as the high water mark, was based on interpretation of orthophoto imagery.[6]

This high water mark was also compared against real property boundary information in the registry. The written descriptions of parcels, as well as supporting graphical information, were retrieved to determine the spatial extent of parcels within the Musquash MPA. Additionally, the Province of New Brunswick also considers some lands below the ordinary high water mark as provincial crown lands and information is recorded in a submerged lands registry.[7] These and other tenure issues are shown in Table 7.3.

Table 7.3: Table summarising the tenure issues in the Musquash MPA and their implication on the ordinary high water mark boundary.

Location	Associated tenure, including impact on high water mark boundary
Musquash Bay (Five Fathom Hole to the estuary mouth)	Provincial crown owns property below the high water mark. Although the limit of upland private property ownership usually extends to the ordinary high water mark, there are several grants to private individuals below the high water mark in this area.
Hepburn Basin	There are some explicitly mentioned parcels below the high water mark in, which are considered to be submerged crown lands. A Submerged Lands Registry has been proposed to provide notice of the location and ownership of these parcels.
Parcels adjacent to the Musquash River	The principle of *ad medium filum aquae* does not apply since the Musquash River is a tidal river. Ownership of the bed of this tidal river is vested in the provincial crown.
Parcels where saltmarshes are located	Fee-simple estate has been granted to Ducks Unlimited (which owns several impoundments that extend below the high water mark). These 340 acres of former agricultural dykeland (drained saltmarsh) are now privately owned fresh water marsh and ponds.

From the foregoing discussion on the high water mark delimitation, this research concludes the following:

[5] The Coastal Areas Protection Policy now refers to a sensitive zone between the Higher High Water Large Tide (HHWLT) and the Lower Low Water Large Tide (LLWLT)[see http://www.gnb.ca/0009/0371/0002/Coastal-E.pdf].
[6] A large coastal mapping project carried out by the Province of New Brunswick [Nichols and Monahan, 1999].
[7] Submerged lands are currently registered as provincial crown lands in county registries. Legislation is being developed that will see all lands covered by a central registry [Canada, 1997b].

a) **It is important to be "precise" in boundary definition.** Whereas the boundary objective was to protect the Musquash estuary, and that the high water mark would suffice as a boundary definition, uncertainty in accomplishing this objective arose from not specifying the nature of the high water mark. In Canada, this high water mark may be interpreted as the Higher High Water Large Tides (HHWLT) / Higher High Water Mean Tides (HHWMT) from the Hydrographic Tidal Manual or the Ordinary High Water Mark (OHWM) from surveying practice.

b) **There are several options available for boundary delineation of the high water mark.** From the foregoing definitions, there are several interpretations available for the high water mark. These depend on several information sources including, the nautical chart, the surveyor's knowledge and interpretation, the coastal mapping interpretation, and the tidal datum interpretation (including the local tide gauges). All these represent different abilities to accomplish the MPA conservation objective.

c) **Boundary demarcation using coastal monuments deserves consideration.** In the Musquash MPA, the physical land-water interface (although ambulatory) was indicative of the boundary location. The overall intent was to provide visual evidence of the boundary location. However, there were two other criteria that were important. First, the legal appropriateness of the boundary. For example, if the purpose is to consider the extent of real property rights, it might be more prudent to use a legal interpretation of the boundary as provided by a surveyor. Second, the methodology used to provide notice about the boundary. For example, if the purpose is to provide digital or hardcopy notice of boundary location, then a coastal map or nautical chart of the area can be used.

7.1.3.3 Social Capital and the Boundary Delimitation Process

The scientific surveys carried out in the Musquash MPA provided an opportunity to include stakeholders. In Chapter 5, this research has hypothesised that an interactive scientific data collection process, that facilitates scientists interacting with the stakeholders involved in MPA establishment, allows one to gauge participation in MPA establishment. This is considered an important social indicator of the effectiveness of the MPA establishment process. This was tested in the boundary delimitation process for the Musquash MPA. Stakeholders involved in MPA establishment were observed during data management (collection, analysis, dissemination) that supported decision-making regarding the MPA spatial extent.

Stakeholders can be involved in scientific surveys during the planning and implementation stages. This is macro-scale involvement since it focuses on project management procedures. However, there are specific tasks (micro-scale involvement) that stakeholders can be involved in e.g., data collection, analysis, and dissemination. In the Musquash MPA, the hydrographic survey data management process was used to evaluate, (1) the local community stakeholders' capacity to participate in data management processes, and (2) the *macro* and *micro* scale level of participation. Table 7.4 outlines the local community participation at the *macro* and *micro* scales. Table 7.4 also captures the more specific roles of stakeholders in the hydrographic and oceanographic survey. For example, the local community was a data source for the following information: locations of uncharted hazards, areas of particular interest, navigation lanes, and some tidal information.

Table 7.4: Local community participation in the hydrographic survey data management process

Participation	Description of the participation in the Hydrographic survey
Macro Scale *Project Planning*	Lobster fishing season and times Ideal areas for locating tide gauges Uncharted hazards in the area Shoal areas that may be a hazard to navigation Best navigation lanes at high and low tide. Best time for wharf use.
Macro Scale *Project Implementation*	Providing access to Five Fathom Hole wharf to dock. Providing assistance in installing tide gauges. Providing access through private properties for various activities. Providing data processing facilities.
Micro Scale *Data Collection*	Background reports produced in conjunction with the local community prior to the hydrographic survey, important in providing information regarding human activities within the estuary waters. Also see *project planning* above.
Micro Scale *Data Analysis*	How tidal flushing patterns correlated with local knowledge of tides. How tide gauge results correlated with local knowledge of the tides. Whether local knowledge from long-time observations (e.g. dumping grounds, fisheries habitat etc) could be validated by the hydrographic data that was collected.
Micro Scale *Data Dissemination*	Participation in Town-hall style meetings Participation in MAC

Two primary observations arose from the town-hall-style meetings carried out to provide community members with the results of preliminary hydrographic and oceanographic data analysis. First, community members were interested in determining whether their long time observations (e.g. dumping grounds, fisheries habitat etc) could be validated by the data that was collected. Second, community members used the information to support other agendas e.g., the *Lorneville Recreation Community* was proposing a coastal park on lands adjacent to the Musquash estuary. These two observations are further discussed in the next section.

7.1.3.4 A Summary of the Role of Stakeholders

Observation of stakeholders as they participated in the hydrographic and oceanographic data management process provided insight into how stakeholders affect identification of information requirements, and the use of information, in determining the spatial extent. This is best represented by trend outlined in Figure 7.7. In this trend, the tenure information that was identified prior to, and during, the scientific research went through several stages as the community interacted with the various information types. For the Musquash MPA, this trend resulted in community members deciding on acceptable changes to the proposed MPA spatial extent.

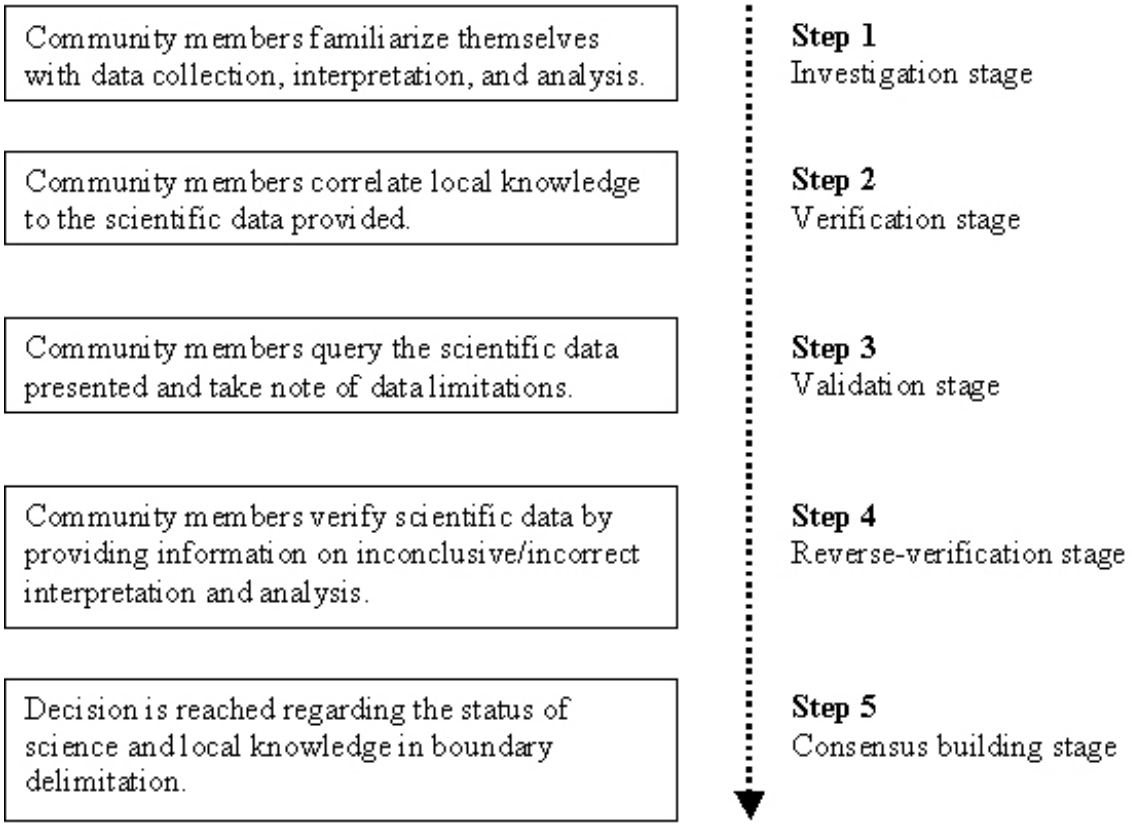

Figure 7.7: Progression in community participation during the hydrographic survey data management process

Although the trend in Figure 7.7 represents local community interaction with scientific research data, a similar trend was observed when members of the MAC interacted with the scientific research results. This interaction provides for a noteworthy conclusion. In the Musquash MPA, consensus building on final boundary delimitation was based on the stakeholders' *hierarchy of interests*. This *hierarchy of interests* suggests that the MPA spatial extents, and associated boundaries, are based on the following:

1) **The community, cultural, and economic values.** The primary community goal is to protect group interests in the "marine commons". The boundary delimitation process is viewed as an opportunity to assert "informal" group rights and have them recognised in a formal environment represented by the MPA. These group interests are represented by various activities/uses in the Musquash MPA. Protection of the community's interests was particularly important as members felt that since they were involved in the initial campaign to designate the MPA, they had a greater vested interest in ensuring that their vision was accomplished. For example, the Fundy North Fishermen's Association (FNFA) wanted scallop fishing to be maintained in the proposed MPA. Normally, these would not be considered due to the adverse action of the scallop dragging activities on benthic habitat. However, by supporting the original proposal, the FNFA was able to ensure that its resource use rights remained unaffected within the proposed MPA.
2) **The practicality of boundary enforcement.** This suggests that communities will support boundary locations that are practical i.e., easily recognisable and familiar to the local community, over those that may be legally appropriate. Support for boundary locations is important since it can translate to success in voluntary

compliance programs, or in co-opting public enforcement support. This also implies that the boundary function of providing notice is particularly important. The primary consideration here is whether the group is able to assert their rights, and ensure that other individuals are aware of the spatial extent and nature of these rights.

3) **The accomplishment of MPA conservation objectives.** In this context, the local community views itself as the guardian of public rights in the marine commons. However, the community may view conservation objectives as representing interests shared with the "wider" community. Therefore, even though community groups will endeavour to support conservation objectives, group interests will mitigate this. For example, a buffer zone was proposed at the existing external boundary location. On presenting to the community the possible flow of contaminants into the Musquash MPA as a result of tidal flushing patterns, there was community support for a buffer zone. However, it was the clearly defined sand-wave feature lying outside the proposed external boundary of the MPA that provided the strongest argument for the buffer zone. Community members suggested that this sand wave feature represented a tangible community value of the Musquash MPA, and was a stronger case for protection.

These observations in the Musquash MPA suggest that MPA establishment is primarily viewed as a group tenure recognition exercise. The observations in the Musquash MPA suggested that three elements formalised the community group rights: (1) participation in the process; (2) participation in the data collection, interpretation, and dissemination; and, (3) decision making regarding the various MPA management plan components. The role of tenure information in this context is therefore one of

determining, (a) the group members, and (b) the group rights to be enjoyed within the MPA space. Whether this is the intent of the MPA program remains unknown.

7.2 Chapter Summary and Conclusions

This chapter has provided insight into several issues. The main points regarding the role of tenure information in determining the MPA spatial extent are summarised in Table 7.5 below.

Table 7.5: Summary of major points regarding the role of tenure information and determining the MPA Spatial Extent

Tenure information requirements for determining MPA spatial extent are: (1) an in-depth review of information used in determining MPA rationale and objectives, (2) *jurisdiction, administration, and property* rights information, (3) spatial extent of tenure, and (4) criteria for labeling tenure and its impact on the spatial extent.
The use of tenure information in determining MPA spatial extent is in: (1) identifying tenure issues; (2) identifying the location and proximity of these issues to proposed MPA boundaries; and, (3) identifying the impact of these issues on the MPA spatial extent which includes reviewing management objectives.
In the Musquash MPA, the importance of *tenure objects/space* information was in determining the uncertainty in, (a) the proposed MPA boundaries, and (b) the proposed MPA tenure.

As can be seen from the final point shown in Table 7.5, this chapter has also determined that uncertainty in tenure information characteristics propagates to the MPA spatial extent. This point is outlined in Table 7.6 below.

Table 7.6: Summary of major points regarding the role of tenure information in determining the MPA Spatial Extent uncertainty

Uncertainty in the proposed MPA boundaries depends on determining the proximity and extent of *tenure objects/spaces.* This depends on determining the effect of *tenure objects / spaces* on the location and description of proposed MPA boundaries. This involves determining how the proximity and extent of *tenure objects / spaces* impacts on the proposed MPA boundaries.
Uncertainty in the proposed tenure in an MPA depends on accurately determining the tenure within the *tenure objects/spaces.* This is dependent on the *type* characteristic. As previously mentioned, the *type* characteristic identifies *tenure object/space* values, and then distinguishes them as *resource features* and / or *legal features.*
Uncertainty in determining the cultural / community / economic values, which make up the *type* characteristic, will propagate to the proposed MPA boundary. For example, there was a difficulty in consensus regarding the value of saltmarsh resources in the Musquash MPA. Both groups agreed

on the need to protected the area, but for different reasons. This can affect the overall MPA spatial extent, or the tenure within the proposed MPA spatial extent.
The uncertainty in categorizing the *tenure objects* / *spaces* as *resource* and / or *legal* features will propagate to the proposed MPA spatial extent. In the Musquash MPA, the ability to categorize these objects was based on sources of information, or the interpretations arising from the available information. These are functions of (a) the available information systems, and (b) the groups involved in the interpretation.
Resource features contain characteristics that contribute to uncertainty in the MPA spatial extent. The physical features include: (1) ambulatory, (2) poorly defined spatially, and (3) have the potential to increase or decrease with time. Determining the MPA spatial extent based on resource boundaries is therefore risky. For example, what happens when the saltmarsh resource in the Musquash MPA grows because of conservation efforts? Does this mean that the regulated spatial extent has the possibility of change? What happens if boundaries are found to be ineffective through scientific research, do we reconsider the legislated boundaries? Should there be a clause within the MPA management plan that suggests the ability to update the MPA boundaries?
Legal features also contain characteristics that contribute to uncertainty in the MPA spatial extent. Some regulations may be ignored due to weak enforcement. Government programs may be ignored because of their specialized focus, and their inability to provide notice to a wider group of people. Does this diminish their consideration when determining the MPA spatial extent?

This chapter also demonstrated the MPA spatial extent delimitation process and the role of tenure information in various stages of this process. This is summarized in Table 7.7.

Table 7.7: Summary of Research Findings regarding the MPA Spatial Extent delimitation process

The MPA spatial extent is made up of several boundary components that may not be equally delimited. By equal delimitation, we are referring to the precision of the proposed boundary.
Within MPA spatial extents, there are several *tenure objects* and *spaces* to be found. Not all of them have the same characteristics. Not all of them have the same impact on the MPA spatial extent.
The process of delimiting the MPA spatial extent involves two separate issues: (1) delimiting the proposed boundaries that make up the MPA spatial extent and, (2) delimiting the *tenure objects* and *spaces* within (and adjacent to) the proposed MPA spatial extent. The location and type of *tenure objects* and *spaces* support or modify the proposed boundaries that make up the MPA spatial extent.
The process of delimiting the MPA spatial extent should accomplish two separate goals (1) accomplish general functions associated with spatial extent delimitation, and (2) accomplish specific functions associated with the MPA.
The general functions associated with spatial extent delimitation are twofold. The proposed MPA spatial extent should (1) provide notice of *tenure objects* and *spaces* and, (2) provide information on *tenure objects* and *spaces*.
Providing notice refers to digital or physical notice of *tenure objects* and *spaces* be provided by the

spatial extent. Providing information involves outlining *type* and *location* characteristics. The *type* characteristic identifies cultural, community, and economic values, and then distinguishes them as *resource features* and / or *legal features.* The *location* characteristic involves indicating the extent of *tenure objects/spaces, and / or* the proximity to proposed MPA boundaries.
There are three specific MPA functions associated with spatial extent delimitation: The proposed MPA spatial extent should (1) accomplish the MPA rationale, (2) accomplish conservation and management objectives, and (3) accomplish socio-economic and governance objectives.
From the discussions on the high water mark delimitation in Chapter 7 this research concluded that for *MPA establishment*: It may be important to have a specific ***definition*** of the high water mark. There are several options available for ***delineation*** of the high water mark. High water mark boundary ***demarcation***, using coastal-based monuments, deserves consideration. However, there are implications arising from the ambulatory nature of coastal-based monuments.
Existing and future tenure arrangements in the area may mitigate jurisdictional uncertainty and / or ensure accomplishment of MPA objectives. For the Musquash MPA these tenure arrangements were: (1) the purchase of surrounding real property and the acquisition of conservation easements by the Nature Conservancy, (2) the proposed Federal/Provincial Memorandum of Understanding on administrative responsibilities, (3) the co-designation of the area surrounding the Musquash (Loch Alva 1and II) as provincially Protected Natural Area.

This chapter also demonstrated the MPA spatial extent functions and the role of tenure information in fulfilling the functions. This is outlined in Table 7.8 and Figure 7.8.

Table 7.8: Research findings on the MPA spatial extent delimitation functions

The MPA spatial extent boundary components fulfill two categories of functions: the MPA spatial extent "criteria" functions and the "traditional" real property boundary functions.
Research findings on the spatial extent "criteria" functions have been outlined under delimitation processes. Research findings on the "traditional" real property boundary functions are discussed in the Musquash case study in Chapter 7. *The "traditional" real property boundary functions are (1) to provide notice and (2) to provide additional information.*
It was shown that providing a rationale for the MPA spatial extent was an important function of the MPA management plan. This was subsequently verified for the other case studies in Chapter 8.
It was demonstrated that there is no observable difference in data management processes used to fulfill the notice and information function. From the case studies, it was determined that data management to fulfill the *notice* function consists of collecting, retrieving and analysing scientific (or other) evidence to justify boundary location. Similarly, data management to fulfill the *information* function consists of collecting, retrieving and analysing evidence to justify boundary adequacy in accomplishing MPA objectives.
It was demonstrated that MPA spatial extent functions are influenced by stakeholder opinion. For example, section 7.1.3.1 noted the OMG suggestion of a one-kilometer buffer zone at the mouth of the Musquash estuary. This was ignored due to the perception that it would lead to a delay in the Musquash MPA establishment process (due to preparation of supporting tidal model

information). A similar scenario emerged with the lack of conclusive scientific evidence to support a claim that a scallop habitat existed within a proposed scallop-fishing zone in the Musquash MPA. In both cases, the scientific evidence was "ignored" by the local community and MPA Advisory Council for two reasons: (1) scientific data can be inconclusive and should not be the sole authoritative source of boundary location information; and, (2) there are several instances where local knowledge can be used instead of scientific evidence.

It was demonstrated that there is a trend in the way stakeholders interact with information, which affects ability to fulfill spatial extent functions. The trend was noted for the Musquash MPA, after observing stakeholders as they participated in the hydrographic and oceanographic data management process. This trend provides insight into how stakeholders affect identification of information requirements, and the use of information, in determining the spatial extent.

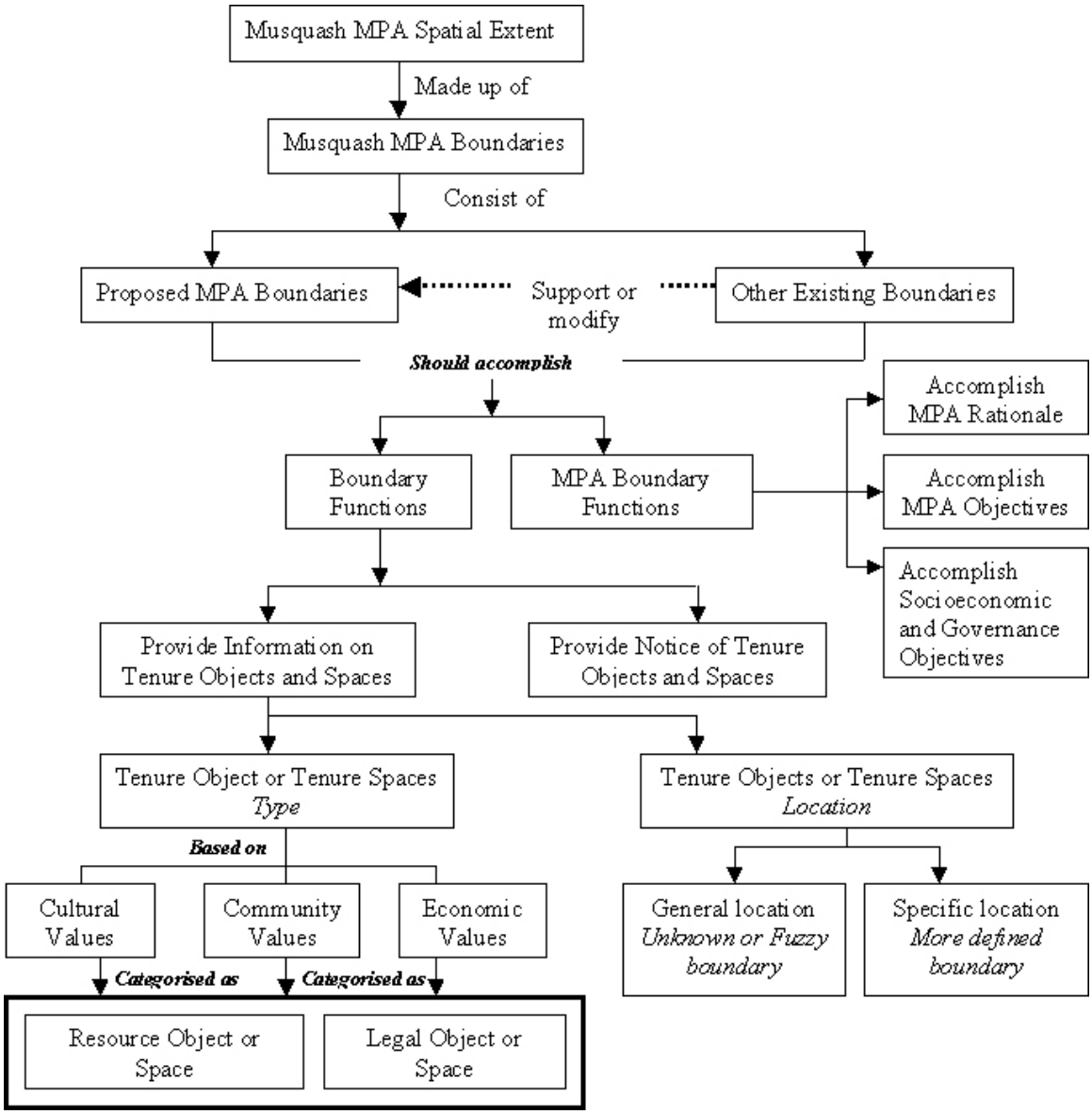

Figure 7.8: The Role of Tenure Information in determining the Musquash MPA Spatial Extent

8 CHAPTER 8: COMPARATIVE ANALYSIS AND EVALUATION OF THE ROLE OF TENURE INFORMATION IN BASIN HEAD AND GILBERT BAY MPAs

In this chapter two inshore MPAs in Atlantic Canada will be used to carry out a comparative analysis of the results obtained for Musquash MPA in Chapter 6 and 7. The comparative analysis is used to verify the conceptual framework developed in Chapter 4, and utilizes the approach developed in Chapter 5. The two inshore MPAs are Basin Head in Prince Edward Island, and Gilbert Bay in Newfoundland and Labrador. This chapter will therefore highlight how tenure information was used in the two case studies to determine, (1) the MPA rationale, (2) goals and objectives, and (3) MPA spatial extent.

8.1 The Basin Head MPA in Prince Edward Island[8]

Basin Head is located in eastern Prince Edward Island between the towns of Souris and Eastpoint. It is a small coastal lagoon feature inhabited by a diversity of organisms, most notably a unique type of Irish moss that is the focus of the proposed MPA [Canada Gazette, 2005a]. Irish moss is ranked fourth in landed weight and eighth in landed value of species in PEI [DFO, 2002a]. There is significant interest from the aquaculture community in using the productive strain of Irish moss as transplant stock for commercial operations [Therrien et al., 2000].

As shown in Figure 8.1, the watershed is relatively small (1750 hectares) with three streams entering the north face of the lagoon [DFO 2002a]. The south side is bordered by an extensive and unique sand dune system (320 hectares). Land use north of the lagoon is

[8] The work in this section is based on three primary sources of information. First, the Basin Head Draft Regulatory Management Plan prepared for the Oceans and Habitat Division, Department of Fisheries and Oceans, Gulf Region. Second, the Regulatory Impact Assessment Statement that accompanies the Basin Head Marine Protected Regulations, published in the Canada Gazette Vol. 139, No. 25— June 18, 2005.Third, personal communication with DFO personnel Isabelle Frenette and Delephina Keen of the Gulf Region.

primarily agricultural (750 hectares) and forested (600 hectares) with very little residential development (10 hectares) [DFO 2002a].

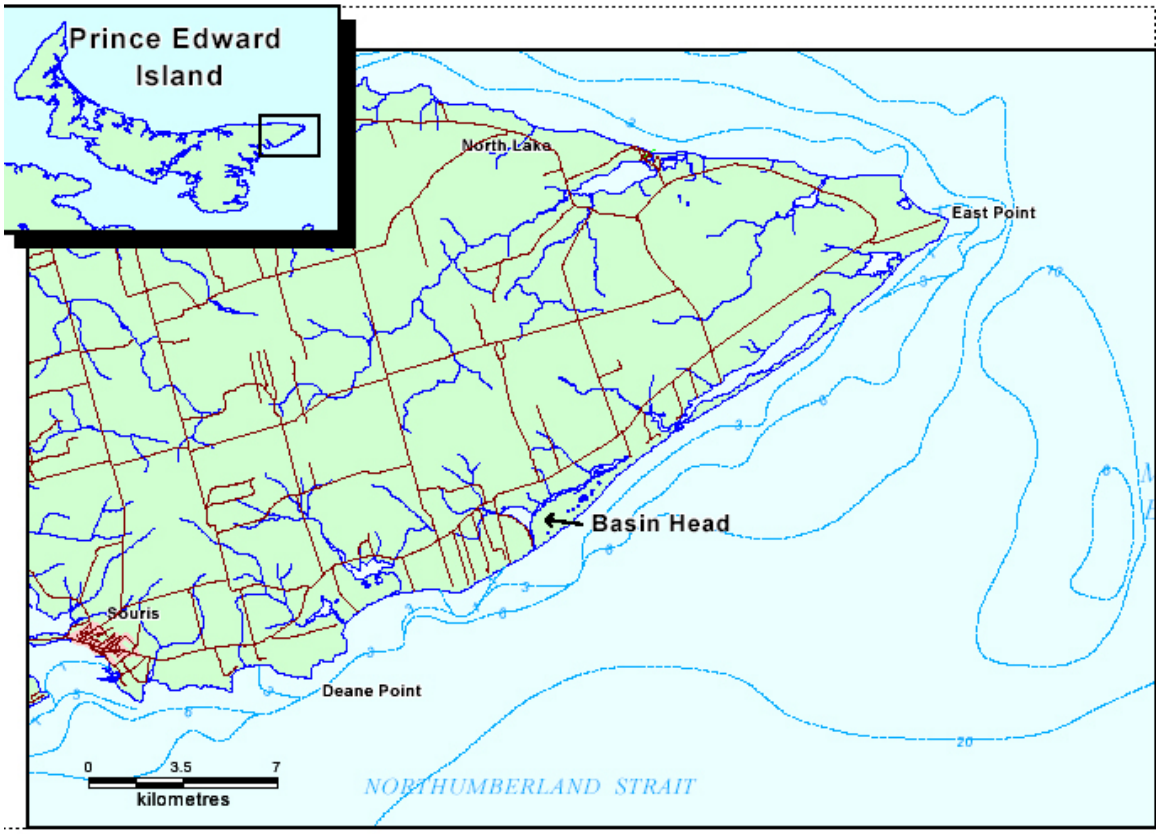

Figure 8.1: The proposed Basin Head MPA (from DFO, [2002a])

Interest in the Basin Head culminated in 1999 when the Basin Head Lagoon Ecosystem Conservation Committee (BHLECC) was formed to represent the community on conservation issues [DFO, 2002a]. Basin Head was accepted as an Area of Interest (AOI) in June 1999 and designated as a Marine Protected Area (MPA) in October 2005 [Canada Gazette, 2005a].

BHLECC consists of members of the community involved in agriculture, tourism, and fishing activities. It also includes landowners, municipal government, DFO, and the provincial Department of Fisheries, Aquaculture and Environment (DFAE). BHLECC serves as a community of interest in ensuring the maximum aesthetic, recreational, and

financial benefits are derived from the site without jeopardizing the biological integrity [Canada Gazette, 2005a].

8.1.1 Determining the MPA Rationale

Basin Head lagoon is approximately 5km in length and covers 60 hectares. The deeper section of the basin is about 0.5km in diameter (i.e., main lagoon) and is attached to a shallower channel (i.e., inner channel) about 3 km long and 200m wide [Sharp et al., 2003]. This lagoon is a site of high marine and terrestrial biodiversity but it contains a unique strain of Irish moss that is not found anywhere else in the world (see Chopin et al [1999]; Therrien et al., [2000]; Sharp et al., [2003]).

Designation of the Basin Head MPA is primarily based on a scientific rationale. The strain of Irish moss found at this site had first been identified by the local community as unique; this was verified by a biological survey carried out in later years.[9] The survey focused on environmental conditions and ecological characteristics, e.g., key species distribution and critical habitats [Therrien et al., 2000]. Scientific data collection consisted of: Irish moss, stability of shorelines, diversity of habitats, characteristics and area of habitat components, structure of the basin, sand dune instability, flow rates, bathymetry, bottom types, water quality, habitats and dynamics of the basin [DFO, 2002a]. Data retrieval also consisted of reviewing historical and current scientific reports.

8.1.1.1 Tenure Information Requirements to determine the MPA Rationale

In order to determine tenure information requirements for the MPA rationale, the Basin Head Lagoon Ecosystem Conservation Committee (BHLECC) members carried

[9] It was not until the 1960s that researchers "discovered" the unique strain of Irish moss at Basin Head, a fact long known by area residents. Since then, several initiatives, most of them unsuccessful, have been discussed to protect and conserve Basin Head. Among them, there was discussion of creating a national park in the late 1960s [Canada Gazette, 2005].

out a preliminary review of restrictions provided by various legislation and programs. For example, they noted that 96 hectares of the sand dunes surrounding Basin Head were designated under the provincial statutory authority of the *Natural Areas Protection Act* [1988]. This was however a fraction of the total acreage of 320 hectares and represented a provincial initiative. BHLECC determined that the restrictions in this *Act* did not cover all the lands adjacent to the proposed MPA, the waters in the lagoon, nor comprehensively address protection issues proposed under the MPA program [DFO 2002a].

The PEI government responsibility for the surrounding MPA areas is captured in the *Tourism Product Development Strategy for Eastern Kings* [MYRS and MRS&A, 2000]. This strategy recommends establishing Basin Head as a regional "nature-based attraction icon" for eastern PEI. This program suggests an ecotourism focus for the Basin Head area with the Fisheries Museum, sand dunes, beach, and MPA initiative as the building blocks [DFO, 2002a]. This represents a complementary program in the vicinity of the proposed MPA, and provides a social *rationale* for the MPA.

Other tenure information providing a social *rationale* included historical information describing protection initiatives. For example, the Canadian Committee for the International Biological Programme had recommended Basin Head as an area worth protecting in a 1974 report on *Ecological Reserves in the Maritimes* [Sharp et al., 2003]. Basin Head was also included on a 1991 list of sites for the *Provincial Significant Environmental Areas Program* [Canada Gazette, 2005a]. This historical tenure information, describing the responsibilities to protect the MPA, was important in obtaining support for protecting the area.

8.1.1.2 The Supportive Role of BHLECC/Local Community in articulating the MPA Rationale

In comparison to the Musquash MPA, a distinct stakeholder group did not lead the Basin Head MPA proposal. The proposal was driven by the BHLECC, which was formed in the fall of 1998 when the PEI Department of Technology and Environment and the DFO held a public meeting in the Basin Head area [Canada Gazette, 2005]. However, support for the MPA proposal also benefited from the endorsement by the aboriginal groups that had historically set up seasonal fishing and hunting camps in the area.

As previously mentioned in section 8.1, the BHLECC consists of individuals, formal and informal groups, as well as public and private institutions. BHLECC members have been instrumental in advancing the case for the MPA. Therefore, identification of group members, and their stakeholding, was an instrumental part of determining the MPA rationale. Support for the MPA proposal from BHLECC members, as well as other community members, indicates that the proposed MPA enjoys widespread support [DFO, 2002a; Canada Gazette, 2005a].

For example, presentations were made to the Abegweit and Lennox Island First Nations, the Mi'kmaq Confederacy of Prince Edward Island and the Prince Edward Island Native Council [Canada Gazette, 2005a]. These groups were important in supporting the MPA rationale especially given the historical tenure arrangements in Basin Head. These arrangements had noted that aboriginal groups had historically set up seasonal fishing and hunting camps in the Basin Head area [DFO, 2002a].

8.1.1.3 Using Tenure Information to support dissemination of the MPA Rationale

Section 8.1.1.1 has highlighted the importance of tenure information in articulating the *social rationale*. Combined with observations in section 8.1.1.2, the *social rationale*

may be important in determining, (a) whether the MPA program is the most appropriate option, and (b) whether support has been obtained from individuals who have an important stake.

The first point is important since a review of tenure information used to describe the *social rationale* identifies the shortcomings of existing, or previously proposed, protection initiatives. For example, the *social rationale* of the Basin Head MPA program was complemented by providing (*historical, present, and future*) responsibilities outlined in various legislation and programs.

The second point is important since it assures the validity of support for the MPA program. For example, historical aboriginal activities in the Basin Head area were deemed to be indicative of a particularly important stakeholder. In the case of Basin Head, these activities complemented the scientific MPA rationale by indicating that there were "broader" reasons for MPA establishment.

These two points also highlight the importance of stakeholders in determining the *social MPA rationale*. For example, provincial government representatives in the BHLECC were able to provide information regarding the restrictions provided by legislation e.g., PEI *Planning Act* [1988], and responsibilities arising from programs e.g., PEI Aquaculture zoning system. This facilitated an evaluation of the adequacy of these programs and legislation, and the results from this evaluation strengthened the rationale for the MPA program. BHLECC members were able to provide a preliminary assessment of tenure information regarding: (1) the identity and location of real property and resources; (2) rights, restraints, and responsibilities associated with the real property and resources; and, (3) the holders of these interests.

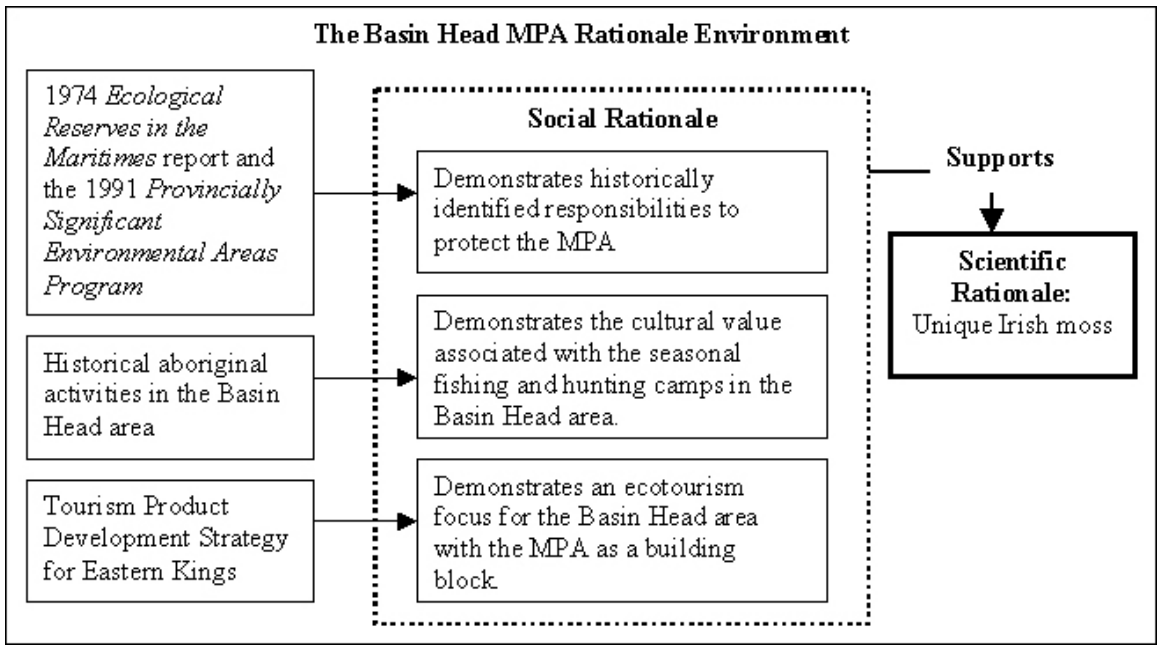

Figure 8.2: The Role of Tenure Information in supporting the Basin Head MPA scientific rationale

The discussions in the previous paragraphs are summarized in Figure 8.2 above. This Figure describes how tenure information was used to highlight the *social rationale* for the Basin Head MPA. This *social rationale* is used support the primary scientific rationale, which is to protect the unique strain of Irish moss.

8.1.2 Determining MPA Objectives

The Basin Head MPA proposal outlined a vision statement and several conservation objectives. The main goal and objectives are outlined in Table 8.1. The objectives in Table 8.1 focus primarily on *habitat and resource* conservation. However, some of these objectives have a broader focus. For example, in Table 8.1 there is reference to "conserving and protecting the lagoon ecosystem through ongoing management including use of regulations" and "providing for the multiple use of the ecosystem with activities that meet the ecological objectives". These objectives indicate that there are other

"broader" information categories that must be considered. These are outlined in the next section.

Table 8.1: The Basin Head MPA goal and supporting objectives (after DFO [2002a])

Main Goal	Objectives
The conservation and protection of the Basin Head Lagoon ecosystem including the unique form of Irish moss currently present, and to maintain and enhance the ecosystem, which may provide future economic benefits to the region.	To maintain and enhance the quality of Basin Head ecosystem. To maintain a viable population of the Basin Head strain of Irish moss. Provide the public with an understanding of Irish moss and ecosystem of Basin Head. To ensure that any potential economic benefit offered by this plant is not lost by destruction of this small unique ecosystem. To conserve and protect the lagoon ecosystem through ongoing management including use of regulations. To provide for the "multiple use" of the ecosystem with activities that meet ecological objectives.

8.1.2.1 Tenure Information Requirements to determine MPA Objectives

The "broader" objectives mentioned in the previous section can be more clearly understood from the studies that were undertaken to assess the Basin Head MPA proposal. The reports from these studies were intended to collectively contribute to the future development of the MPA management plan, and further enhance support for designation as an MPA. These reports are outlined in Appendix IV.1.

Although majority of the reports focus on conservation, a report on *Community use of the Basin Head Lagoon* describes (past and present) uses in Basin Head and the surrounding lands [Island Nature Trust, 2002]. This document represents an important cultural and community perspective and suggests that there are other values to be associated with the MPA. For example, this document describes the seasonal fishing and hunting camps historically set up in the area by the Mi'kmaq people. The document points to the Mi'kmaq artifacts gathered in this area and displayed at the Basin Head

Fisheries museum [DFO, 2002a; Canada Gazette, 2005a]. This cultural perspective provides one of several non-ecological values associated with the Basin Head MPA proposal.

In this same report, there is reference to cultural, economic and community values in the Basin Head MPA [Island Nature Trust, 2002]. These are reflected in the past/present activities and uses, as well as the stakeholders, and their interests. From a review of this and other Basin Head MPA documentation, this research notes that there is a dual role for tenure information in determining MPA objectives. These roles are: (1) identifying the cultural, economic, and community values; and, (2) determining whether the activities and interests making up these values are compatible with the *habitat and resource* conservation values. Some of the Basin Head MPA cultural, economic, and community values are outlined in Table 8.2.

Table 8.2: A summary of Basin Head MPA values and the tenure information used to define the MPA values (after DFO [2002a])

Value	Description
Economic/ Community value	Residential land use adjacent to the lagoon is very minimal. Agriculture use of the lands north of the lagoon is primarily potato production. Remaining watershed lands are residential and forested. The lands directly adjacent to the lagoon are relatively undeveloped, with significant provincial ownership of the dune complex.
Community/ Economic value	Small commercial and recreational fisheries (clams and eel) within the lagoon. Adjacent coastal waters have a spring lobster fishery, a fall fishery and scallop fishing. Other commercial species in the waters off Basin Head are white hake, Atlantic Mackerel, winter flounder, American plaice, dogfish and rock crab.
Community/ Economic value	Locals and visitors use the area for recreational activities such as canoeing in the lagoon, some hunting of waterfowl and trapping of muskrat, beaver and mink, cycling and hiking in nearby trails, and birdwatching. The basin supports a significant number of blue herons and other waterfowl.
Economic/ Community value	The beach and museum are popular tourist destination in PEI tourism activities.
Cultural/ Heritage value	The Mi'kmaq people crossed the Northumberland Strait to set up seasonal camps while fishing and hunting in the area. Many Mi'kmaq artifacts have been gathered from around the lagoon and displayed at the Basin Head Fisheries Museum.

As can be seen from Table 8.2, MPA objectives are also associated with other "broader" values. Therefore, this research proposes that within MPA objectives there are two sub-categories: conservation and value-based objectives. The former objectives reflect a *habitat and resource* conservation focus and primarily depend on scientific information. The latter objectives reflect a focus on cultural, economic and community values and depend on tenure information.

Both categories of objectives are accomplished through the management of activities uses and interests. This is further outlined in the next section.

8.1.2.2 Using Tenure Information for Management Objectives

The observations in the Basin Head MPA suggest that value-based objectives have an important role in the overall MPA objectives. Both conservation and value-based objectives are used to outline *management objectives*, which are subsequently addressed through management actions.

For the Basin Head MPA, the *management objectives* were addressed using regulatory, voluntary, research, and education-oriented actions. These management actions depend on descriptions of activities, uses, and interests; and resulted in proposed activities, uses, and interests. Therefore, this research suggests that management actions use and simultaneously produce tenure information. For example, management actions in the Basin Head MPA depended on knowing about pre-existing voluntary stewardship programs involving the Irish moss. Individuals involved in this program recommended that restrictions on Irish moss removal needed to be formalized [DFO, 2002a]. This suggestion resulted in Irish moss removal being specifically regulated within the MPA legislation.

For the Basin Head MPA, five *management objectives* were outlined [DFO, 2002a]: (1) maintain and enhance environmental quality and health of ecosystem; (2) protect unique strain of Irish moss; (3) education and awareness; (4) understanding Basin Head; and, (5) long term management of Basin Head. The tenure focus of each *management objective* is summarized in Figure 8.3.

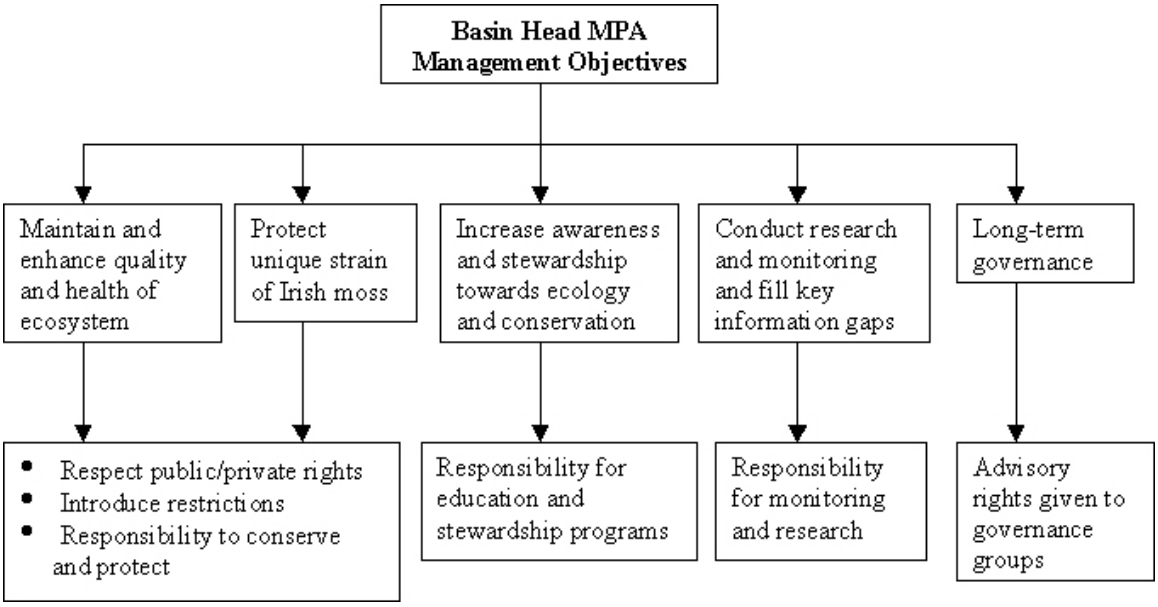

Figure 8.3: Basin Head MPA Management Objectives from a Tenure Perspective

In the Basin Head MPA, tenure information was used to provide options that can be used to accomplish the *management objectives*. For example, in order to protect the unique strain of Irish moss (objective 2), human activities that could lead to degradation/loss of habitat had to be identified and the existing regulatory management framework highlighted. The adequacy of regulatory management was then assessed, and proposed management actions outlined. This is shown in Figure 8.4.

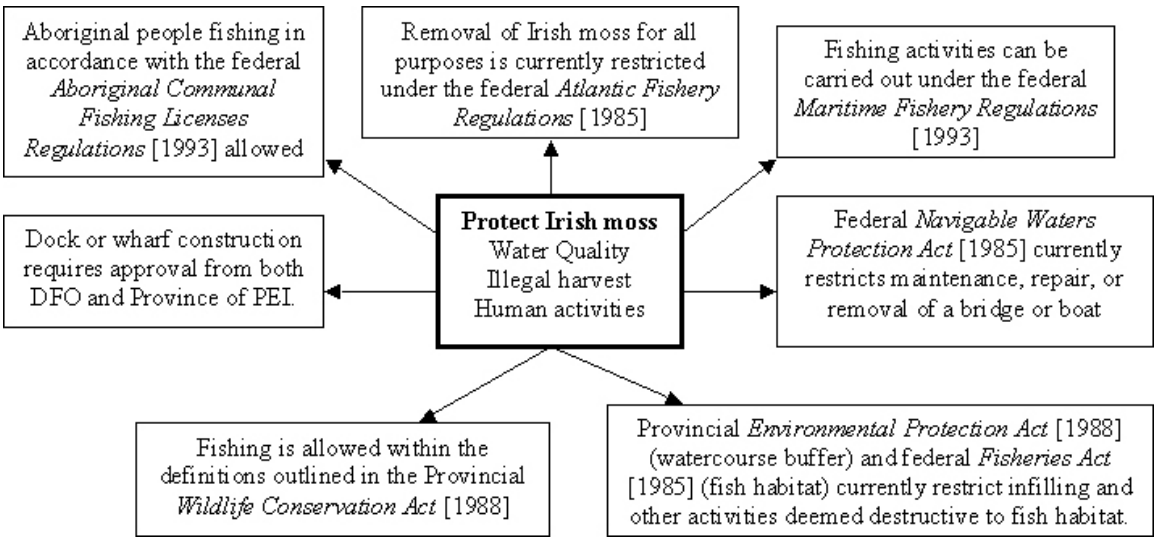

Figure 8.4: An example showing how the adequacy of existing tenure arrangements is evaluated against the accomplishment of Basin Head MPA management objectives

Similar management actions were designed for each of the Basin Head MPA *management objectives* outlined in the previous paragraphs. From a review of the Basin Head MPA *management objectives*, this research concludes that each relies on different types of tenure information. Additionally, each *management objective* results in management actions that describe the proposed tenure in the MPA.

8.1.2.3 The Role of BHLECC/Local Community in determining MPA Objectives

The collaborative nature of the MPA establishment process provides for participation by individuals and groups in determining the MPA objectives. Since 1998, there have been six public meetings held in the Basin Head area [Canada Gazette, 2005a].[10] During these public meetings, presentations were given by DFO and other BHLECC members on ongoing research, proposed management objectives, and proposed regulations [DFO, 2002a].

[10] One public meeting in 1998, two in 1999, one in 2000, one in 2001 and one in June 2002 [Canada Gazette, 2005a].

Some of these presentations were carried out to determine MPA objectives. This means that BHLECC members had an opportunity to influence identification of these objectives. The members begun by outlining a list of MPA objectives in part based on a description of the tenure information used to determine community, economic and cultural values. An informal ranking system was then defined, based on negotiation between individuals and groups that participated in the public meetings [Frenette, 2005]. For example, although there was a concerted effort to prohibit commercial clam and recreational eel spearing due to the fragile nature of the northeast channel, fishermen members of the BHLECC ensured that this continued within the MPA area [Canada Gazette, 2005a]. Since the fishermen came from the immediate community, they were able to relate the importance of eel fishing to the wider community and economic values.

The foregoing demonstrates that (1) BHLECC membership was important in determining MPA objectives, (2) participation in public meetings is an opportunity to influence MPA objectives, (3) aligning individual/group values with wider community values may affect the informal MPA objectives ranking process. This is summarized in Figure 8.5.

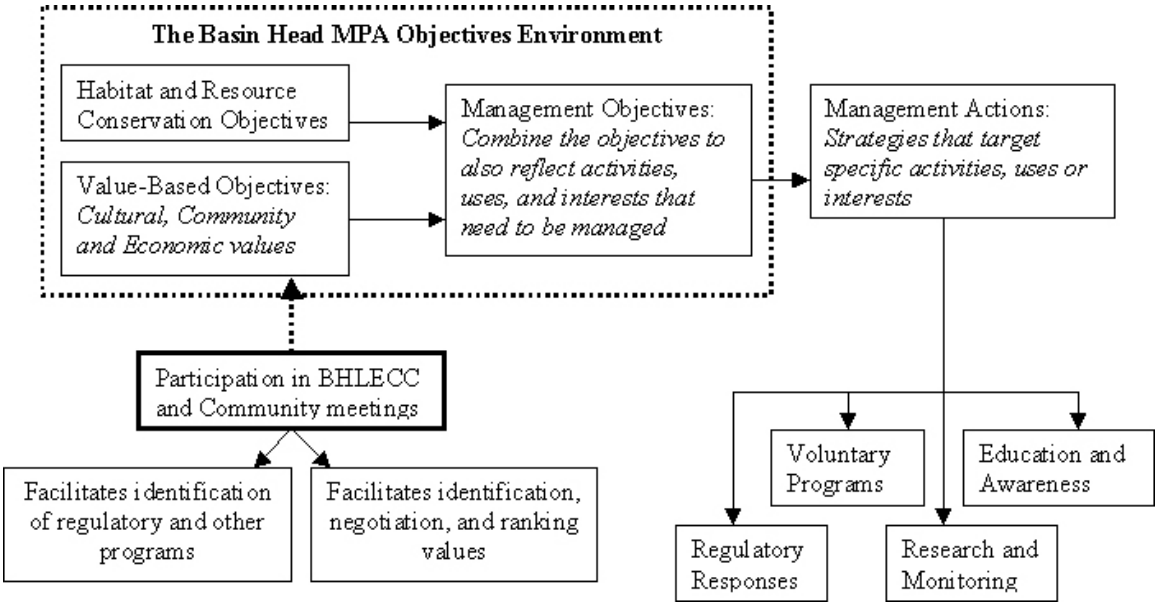

Figure 8.5: Tenure information is used to determine Basin Head MPA Objectives, and is produced as proposed management actions

8.1.3 Determining the MPA Spatial Extent

The original spatial extent of the Basin Head MPA had been proposed as consisting of an inner channel, main lagoon, and the outer coast. These general boundary descriptions are described in Table 8.3 and later shown in Figure 8.6.

Table 8.3: Basin Head MPA spatial extent component descriptions (after DFO [2002a])

Spatial Extent Component	Description
Inner channel	Also shown as Zone 1 in Figure 8.6. Comprising of the area from the lagoons eastern end to the main lagoon, including water up to the high water mark.
Main lagoon	Also shown as Zone 2 in Figure 8.6. An area from the lagoon to the outer channel, including waters up to the high water mark.
Outer coast	Also shown as Zone 3 in Figure 8.6. An area extending from the coastal high water mark out to one nautical mile, and covering the oceanic area between Red Point and Elliot Beach.

Figure 8.6: Diagram of the Basin Head MPA Spatial Extent

As can be seen in Table 8.3, the terminology used to describe the spatial extent components reflects community values. For example, the reference to an inner channel, main lagoon and outer coast reflects the local terminology used in describing various areas of the lagoon. The overall spatial extent delimitation challenge is therefore one of interpreting these general descriptions accurately.

The boundary descriptions in Table 8.3 were based on a preliminary review (*and background knowledge*) of tenure information. For example, one of the descriptions refers to the high water mark as the internal limit. Clearly this may infringe on private property rights that may extend beyond this mark. Therefore, this description did not reflect research on real property rights in the area [Frenette, 2005].

Similar to the Musquash MPA, the management plan requirements for the Basin Head MPA spatial extent are more rigorous. They contain a greater expectation regarding the rationale for every spatial extent component. This expectation is partially met by an in-depth review of tenure information. This is elaborated in the next section.

8.1.3.1 Tenure Information Requirements for determining the MPA Spatial Extent

As mentioned in the previous section, the MPA spatial extent is much more rigorously defined in the MPA management plan. A rationale for each MPA spatial extent component must be provided. This research suggests that in order to provide this rationale, four criteria (in the form of questions) had to be fulfilled in order to determine the Basin Head MPA spatial extent.

The first question involves determining whether the MPA spatial extent accomplishes the conservation objectives. As previously outlined, this question was answered by several scientific studies that were used to describe the spatial extent of the Irish moss ecosystem [Frenette, 2006].

The second question involves determining whether the MPA spatial extent accomplishes the management objectives. As previously mentioned in section 8.1.1.2, tenure information was used to outline the community, cultural, and economic values; and to propose management actions to accomplish management objectives.

The third question involves determining the legal status of the spatial extent. For the Basin Head MPA this involved determining whether the MPA spatial extent components were legally adequate. For example, the high water mark was not a legally adequate delimiter of the MPA spatial extent as it may encroach on private property rights.

The fourth question involves determining whether there is a consensus regarding the location and description of various MPA spatial extent components. For example, First Nations groups involved in the MPA establishment process were supportive of the concept of an MPA at Basin Head, provided that a good balance could be achieved between conservation, future economic possibilities, and treaty rights [DFO, 2002a]. The group's concerns suggested that the proposed MPA spatial extent may be reviewed at a later date as a result of enforcing treaty rights, or pursuing economic activities such as aquaculture.

This last point is important because it addresses the elements of boundary *precision* and *accuracy*. In the example in the previous paragraph, *precision* is considered to be secondary to the *accuracy*. In other words, there are some groups whose rights are encapsulated within the proposed MPA that are less interested in the *precision* of the MPA boundary and more interested in the possibility of an ambulatory MPA spatial extent (and by extension the boundary *accurately* reflecting this possibility). This research suggests that, although the MPA spatial extent may be fixed at the time of passing the associated MPA regulations, there are stakeholders who perceive it as ambulatory, as a result of the nature of tenure within that spatial extent.

8.1.3.2 Using Tenure Information to determine the MPA Spatial Extent

The previous section has suggested that a rationale for each MPA spatial extent component must be provided. Four criteria (in the form of questions) have been used to evaluate each Basin Head MPA spatial extent component. The four criteria have been shown to depend on tenure information.

There are several examples outlined in DFO [2002a] and the Canada Gazette [2005a] that describe the relationship between tenure information management and the MPA spatial extent. For example, the Samuel Holland surveys of 1765 have a bearing on the limit of provincial jurisdiction. The whole of Lot 47 and part of Lot 46 became what is now known as Eastern Kings, which is the location of the Basin Head MPA. The Province later obtained the rights to these lots, including access to water bodies [Bolger, 1991]. Lot 47 descriptions were crucial in determining what had originally been granted, and therefore, what constraints were placed on the proposed MPA spatial extent components. This also suggests that the precision of MPA spatial extent components (e.g., high water mark limit) may be dependent on access to tenure information.

The tenure information from the MPA rationale and objectives are also important in determining the MPA spatial extent. For example, they provide insight into the justification for the MPA spatial extent components, and assist in determining whether these components assist in accomplishing MPA objectives. Section 8.1.1.2 has provided an in-depth discussion of the role of tenure information in determining MPA objectives.

Within the review in the previous paragraph, there is a task of delimiting *objects*/*spaces.* This involves three primary activities: (1) identifying and delimiting the extent of cultural/ economic/ community value *objects/spaces*; (2) identifying and (where possible) delimiting the space where rights, restrictions, and responsibilities exist; and, (3) evaluating the effect of the first two activities on the MPA spatial extent.

The first activity involves identifying *objects/spaces* that have cultural/ economic/ community value. These values have previously been summarized in Table 8.2 in section 8.1.2.1. In the Basin Head MPA, some spatial extents of these *objects/spaces* were

possible to delimit while others were not. For example, identifying the spatial extent of recreational fisheries is not easy as different individuals carry this out in different areas of the lagoon. In contrast, tourism activities are largely confined to the beach and museum.

The second activity involves identifying and delimiting the space where rights, restrictions, and responsibilities exist. A review of the Basin Head MPA suggests that this was carried out for programs and legislation [DFO, 2002a]. For example, the PEI aquaculture zoning program does not allow aquaculture activities in this area due to the presence of marine plants. Additionally, the official plan of Eastern Kings municipality has zoned some of the lands surrounding Basin Head MPA are as "scenic" under the provincial *Lands Act* [1988]. Finally, the 200-hectare sand dune system that surrounds the Basin Head MPA is considered a provincially *Significant Environmental Area* i.e., it is considered to be a protection priority [Canada Gazette, 2005a]. However, only 96 hectares corresponding to provincial ownership have been protected under the *Natural Areas Protection Act* [1988] that enforces this provincial designation. This *Act* prohibits development while allowing for scientific, educational and recreational uses [DFO, 2002a].

The third activity involves evaluating the effect of the first two activities on the MPA spatial extent. For example, there is substantial provincial real property ownership of land adjacent to the waters of the lagoon [DFO, 2002a]. This may mitigate the uncertainty of using the high/low watermark as the internal limit of the MPA spatial extent. This is because private claims beyond the high water mark may effectively be reduced by this ownership pattern. This is important since existing ownership arrangements adjacent to the MPA may explain why the *precision* of an internal MPA limit remains unresolved.

This latter point suggests that other dispute resolution approaches may be used to mitigate MPA spatial extent constraints highlighted by tenure information. This observation is supported by a proposal to develop a memorandum of agreement between DFO and the PEI after the Basin Head MPA [DFO, 2002a; Canada Gazette, 2005a]. This memorandum is intended to clarify and define management responsibilities of each government level with respect to the MPA. This can be interpreted as a remedial dispute resolution approach, in the event that there emerge jurisdictional issues that may affect the MPA spatial extent.

From the foregoing discussion, this research suggests that the three tenure related criteria used to evaluate each Basin Head MPA spatial extent component, were addressed by four tenure information management tasks. The first task involved an investigation of PEI tenure issues (*jurisdiction, administration, and property*). The second task involved a more in-depth review of the tenure information used in determining MPA rationale and objectives. The third task involved associating spatial extents with tenure issues and tenure information. The fourth task involved two sub-tasks, (1) the assessment of tenure issues/information and (2) the subsequent labelling of tenure as constraints/justification for the MPA spatial extent components. This is outlined in Figure 8.7.

8.1.3.3 The Role of BHLECC/Local Community in determining the MPA Spatial Extent

The importance of stakeholders and the partnerships of various groups was important in determining the MPA spatial extent. For example, the previous section has noted the substantial provincial real property ownership adjacent to the Basin Head MPA and the proposed DFO/PEI memorandum of agreement on management responsibilities. These two examples have an effect on the MPA spatial extent. First, they suggest that *precision*

of the MPA spatial extent components may not be as important. Second, they imply that dispute resolution strategies may mitigate uncertainty in spatial extent *precision*.

The process of delimiting the MPA spatial extent also provides an important insight into the importance of individuals/groups. First, while the delimitation process may be considered a technical process where scientific data is collected to ensure the accomplishment of conservation objectives, this is only one part of the process. As outlined in the previous sections, this is one of four criteria used to evaluate the MPA spatial extent. The delimitation process also involves reviewing *management objectives*, legal adequacy of the MPA spatial extent components, and consensus in the MPA spatial extent.

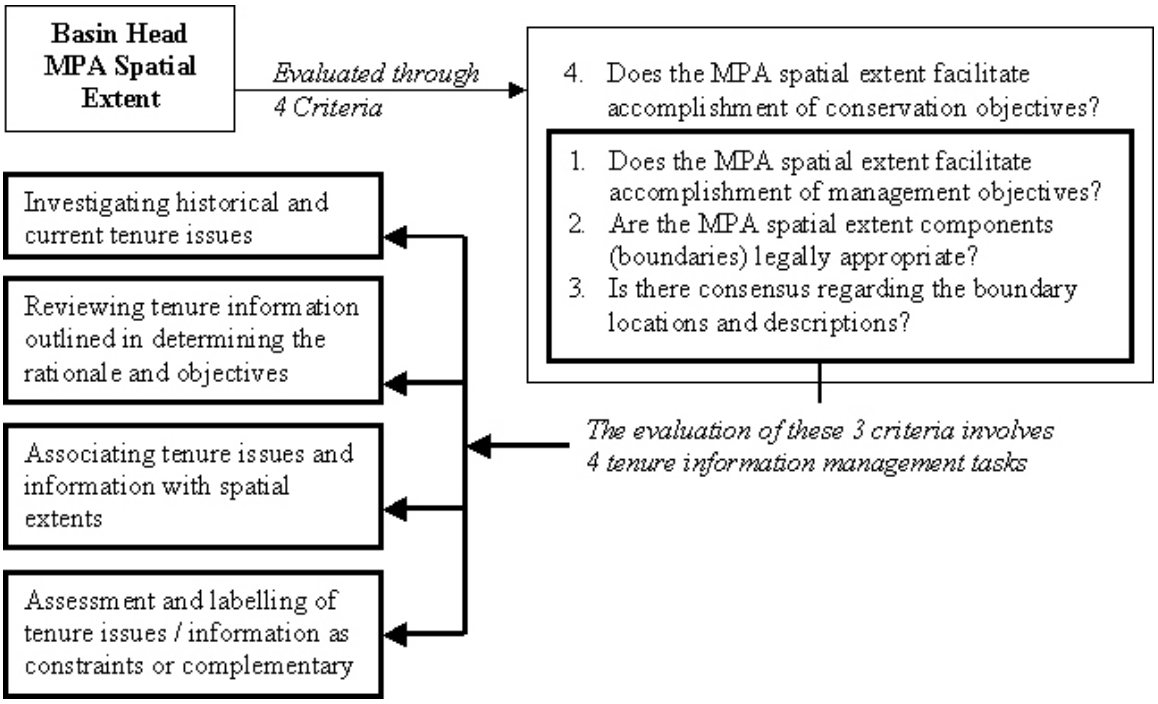

Figure 8.7: The criteria used to evaluate the Basin Head MPA Spatial Extent

As previously outlined *management objectives* are addressed through management actions. These management actions depend on identifying individual/group interests, activities, and uses. For the Basin Head MPA this identification was carried out in formal

settings such as the BHLECC or publicly organized meetings, or in informal meetings involving individuals/groups from the local community. Participation in these meetings ensured that opinions were taken into consideration and cultural / community / economic values were ranked. This socio-political process is the vehicle that produces the final MPA spatial extent.

8.2 The Gilbert Bay MPA in Labrador[11]

Gilbert Bay is located on Labrador's southeast coast, approximately 30km from Happy Valley-Goose Bay. The bay is 20 km in length with narrow openings to the Labrador Sea, including one at William's Harbour Run [DFO, 2002b; Canada Gazette, 2005b].

In January 1999, representatives from the communities of Port Hope Simpson and Williams Harbour submitted a proposal to DFO to consider Gilbert Bay as an Area of Interest (AOI) under the MPA Program. Both the local community and scientists had recognized that the Bay was populated by a different group of Atlantic cod than those caught on traditional fishing grounds along the Labrador coast [Canada Gazette, 2005b]. Scientists identified Gilbert Bay cod as a resident population, genetically distinct from other northern cod.[12] In October 2000, the Minister of Fisheries and Oceans announced Gilbert Bay as the first AOI in the Newfoundland and Labrador Region. In November

[11] The work in this section is based on three primary sources of information. First, the Gilbert Bay Draft Regulatory Management Plan prepared for the Oceans Program Division, Department of Fisheries and Oceans, Newfoundland and Labrador Region. Second, the Regulatory Impact Assessment Statement that accompanies the Gilbert Bay Marine Protected Regulations published in the Canada Gazette Vol. 139, No. 25—June 18, 2005.Third, personal communication with DFO personnel Nadine Wells and Jason Simms of the Newfoundland and Labrador Region, and Wayne Russell the Gilbert Bay MPA Community Coordinator.

[12] During the 1970's people living near Gilbert Bay recognized that this particular bay was populated by a different group of Atlantic cod than those caught on traditional fishing grounds along the Labrador coast [DFO, 2002b]. Since 1996, scientists from Memorial University of Newfoundland (MUN) have studied and verified the assertion about the cod [Canada Gazette, 2005b].

2001, the Gilbert Bay Steering Committee (GBSC) was established as part of the Gilbert Bay MPA initiative [DFO, 2002b; Canada Gazette, 2005b].

The GBSC is made up of representatives from local fishing communities, aquaculture groups, Labrador Métis Nation (LMN), Memorial University of Newfoundland (MUN), the Provincial Department of Fisheries and Aquaculture (DFA) and DFO. The GBSC mandate is to evaluate the proposal, responsibility for bi-lateral and public consultations on the MPA initiative, and advising DFO on the feasibility of establishing a MPA [Canada Gazette, 2005b].

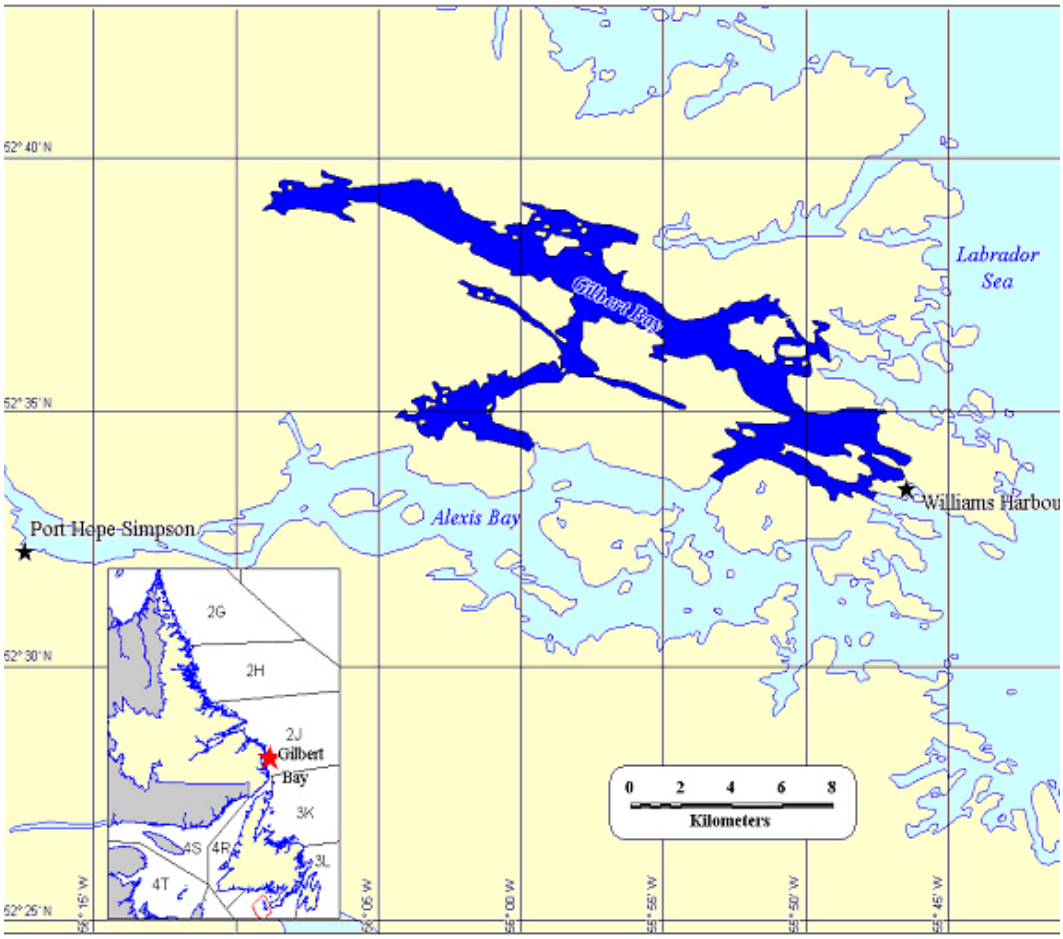

Figure 8.8: General Location of Gilbert Bay MPA (after DFO [2002b])

8.2.1 Determining the MPA Rationale

The Gilbert Bay MPA is primarily based on a scientific rationale. Research from Memorial University of Newfoundland (MUN) had supported the belief that the "bay cod" was unique (see Ruzzante et al. [2000]; Beacham et al. [2000]; Green and Wroblewski [2000]). Scientific research suggests that the Atlantic cod population in Gilbert Bay has a range of only 60 km^2. This corresponds to the physical extent of the Bay [DFO, 2002b].

The physical characteristics of Gilbert Bay and the surrounding ecosystem are considered to play an important role in the establishment and continued support of the local cod population found there. Within Gilbert Bay, specific areas have been identified as important spawning areas and nursery habitats (see Green and Wroblewski [2000]; Morris et al [2003]). The relative abundance of cod in the Bay meant that fishermen targeted this population with the re-opening of the commercial northern cod fishery in 1998. Therefore, local area residents were concerned about over fishing of this population [DFO, 2002b].

8.2.1.1 Tenure Information Requirements to determine the MPA Rationale

The distinctiveness of the Gilbert Bay cod had first been identified by the local community, and later verified by scientists. While scientific information had been important in verifying the genetic distinctiveness of the cod and their habitat, tenure information was important in several roles.

First, tenure information was important in determining the individuals who depended on this "unique" resource. These individuals were able to provide local knowledge of the cod habitat and characteristics. For example, a single-family enterprise fished cod commercially in Gilbert Bay from the late 1970s until 1992 when a moratorium was

place on northern cod [DFO, 2005b]. Based on their historical fishing rights, this group was in a position to provide significant information on the cod population (see Morris et al [2002b]).

Second, tenure information was important in demonstrating support for protective measures. For example, the communities of Port Hope Simpson and Williams Harbour had obtained support from local fish harvesters when they first approached DFO to implement protective measures in 1998. In September 1998, DFO issued a *Notice to Fishers* closing a large portion of Gilbert Bay to commercial cod fishing [Canada Gazette, 2005b]. A fisheries variation order[13] was issued in 2001 and has since provided a level of interim protection for the Gilbert Bay cod, effectively closing >70% of the bay to recreational fishing [DFO 2002b]. These arrangements suggest that there is pre-existing support for the MPA scientific rationale.

These two examples suggest that tenure information requirements for determining the MPA rationale also include, (1) historical and current tenure arrangements, and (2) the legal and policy instruments (if available) that describe these tenure arrangements. Pre-existing regulatory and other tenure arrangements (e.g., stewardship initiatives) indicate support for the scientific MPA rationale. Legal and policy instruments indicate the type of "tenure" support e.g., fishery variation orders indicate pre-existing legislative support (in the form of restrictions) for the MPA rationale.

[13] The *Fishery (General) Regulations* [1993] are made under the authority of the *Fisheries Act* [1985] and include provisions of general application to all fisheries across Canada. In particular, the Regulations provide for the making of orders to vary close times, fishing quotas and the size and weight limits of fish that have been previously set out in other *Fisheries Act* regulations (e.g., the *Maritime Provinces Fishery Regulations* [1993]). These variation orders allow for fishing restrictions to be adjusted quickly when necessary for the conservation of fish stocks [Canada Gazette, 2003].

The Gilbert Bay MPA targets a resource that is not only exclusively located in the water-filled space, but is also intertwined with the cultural identity of the Province of Newfoundland and Labrador [Simms, 2006]. Historical observations on this cultural identity may therefore be used to support the scientific MPA rationale. This tenure information, on the responsibility to protect the cod stocks because of historical and cultural reasons, was important in conveying the overall Gilbert Bay MPA message [Russell, 2006].

8.2.1.2 The Supportive Role of GBSC/Local Community in articulating the MPA Rationale

The communities of Port Hope Simpson and Williams Harbour drove the Gilbert Bay MPA proposal, with support from local fish harvesters. The role of these groups was to articulate the community and economic values associated with the Gilbert Bay cod [Simms, 2006]. In November 2001, there was a transition from these informal groups to a formal group referred to as the Gilbert Bay Steering Committee (GBSC) [DFO 2002b; Canada Gazette, 2005b; Simms, 2006].

GBSC representatives included local fishing communities, aquaculture interests, Labrador Métis Nation (LMN), Memorial University of Newfoundland (MUN), the Provincial Department of Fisheries and Aquaculture (DFA) and federal Department of Fisheries and Oceans (DFO) [Canada Gazette, 2005b]. Membership in the GBSC was important in defining the MPA rationale. For example, MUN provided the scientific rationale to support the local knowledge regarding the distinctness of the Gilbert Bay cod. Similarly, the Labrador Métis Nation support provided a cultural rationale for the MPA proposal [Simms, 2006].

8.2.1.3 Using Tenure Information to support dissemination of the MPA Rationale

Recall that the changing nature of recreational and commercial cod fishing in the area had been formally captured by tenure instruments like the *Notice to Fishers, Variation Order*, and moratorium that had been placed in 1998, 2001, and 2003 respectively [DFO 2002b; Canada Gazette, 2005b]. This tenure information was used to provide a *social rationale* for the Gilbert Bay MPA by showing that communities were already dealing with restrictions in cod fishing. Additionally, it demonstrated that the socio-economic impact of MPA establishment would be minimal [DFO, 2002b; Simms, 2006].

Another example of tenure information used to support the scientific MPA rationale includes plans and programs to promote economic development in the area. For example, the *Zone 4 Tourism Development Plan* and the *Destination Labrador* initiatives were used to support the Gilbert Bay MPA program.[14] The former suggests that there is a local responsibility to maintain and pursue viable socio-economic initiatives in the area. The latter suggests that these responsibilities are also part of a larger initiative to improve the socio-economic well being of the area. This is shown in Figure 8.9.

From the examples outlined previously, this research concludes that tenure information was used in the Gilbert Bay MPA to determine (a) stakeholder support for the program, and (b) complementary plans/programs that could be used to support the scientific MPA rationale.

[14] Zone 4 comprises of eleven permanent communities along the Southeast coast of Labrador. The Southeastern Aurora Development Corporation is responsible for preparing plans for economic development in the area. Destination Labrador is a regional product development and marketing group, recently re-formed to address specific tourism development issues in the Labrador region. It recently oversaw the preparation of a Tourism Destination Development Plan for Labrador.

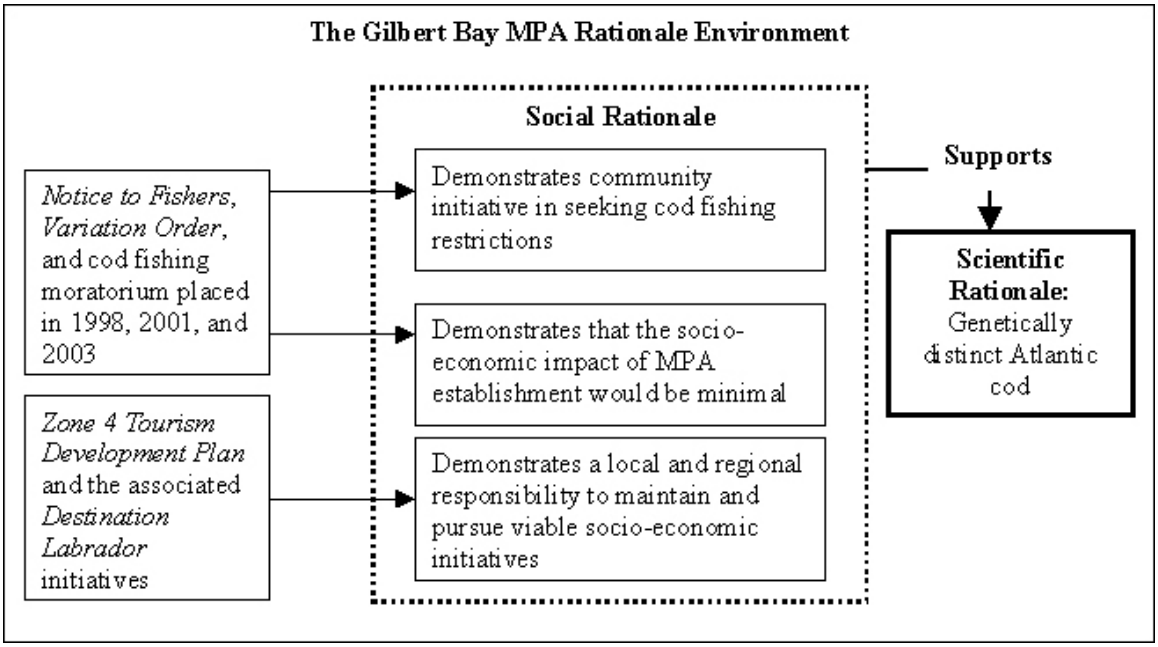

Figure 8.9: The Role of Tenure Information in supporting the Gilbert Bay MPA Scientific Rationale

8.2.2 Determining the MPA Objectives

The Gilbert Bay proposal outlined a vision statement and several conservation objectives. The main goal and objectives are outlined in Table 8.4.

Table 8.4: The Gilbert Bay MPA goal and supporting objectives (after DFO [2002b])

Main Goal	Objectives
To sustainably manage the marine ecosystem, habitats, and species of Gilbert Bay as a community united by its people, culture and mutual desire to share with future generations.	To promote sustainable use of the marine resources of Gilbert Bay To promote conservation and protection of the ecosystem with special consideration for the Gilbert Bay cod populations and its habitats. To promote scientific research, monitoring, and related activities on the marine ecosystem of Gilbert Bay. To promote public awareness and education at Gilbert Bay MPA.

A review of Table 8.4 suggests that the MPA focus is broader than *habitat and resource* conservation. For example, the main goal in Table 8.4 refers to Gilbert Bay as a "…community united by its people, culture and mutual desire to share with future

generations". This suggests that there is a focus on the people, their culture, and their mutual desire to carry out *habitat* and *resource* conservation. Because of this unique dynamic, Simms [2006] suggested there existed a balance between conservation and value-based objectives outlined in the MPA goal. This is further reviewed in the next section.

8.2.2.1 Tenure Information Requirements to determine MPA Objectives

As mentioned in the previous section, the Gilbert Bay MPA goal outlined in Table 8.4 suggests that cultural, economic and community values are as important as *habitat* and *resource* conservation objectives. A number of studies have been undertaken to identify some of these values and further assess the MPA proposal. These are outlined in Appendix IV.2.

The values depend on tenure information such as (1) activities and uses, (2) identity of stakeholders, and (3) stakeholder interests in the Gilbert Bay MPA (see Davis [2002], Canada Gazette [2005b]). This tenure information was formally collected in the study *Overview of Commercial Fishing in Gilbert Bay*, which identified (active and retired) fish harvesters and processors, and described their local knowledge and biological observations regarding the fishery [Morris et al., 2002]. It was also collected as part of *Socioeconomic Overview of Gilbert Bay*, which described the history, activities, users and uses of resources of the area in an effort to illustrate the social, economic and cultural values within Gilbert Bay [Murphy et al., 2002]. Additionally, tenure information (e.g. activities, uses, stakeholder identity and interests) was locally known by community members of Williams Harbour and Port Hope Simpson.

On reviewing the use of tenure information in determining the MPA objectives, this research noted two primary uses. First, tenure information was used for identifying the cultural, economic, and community values. Second, tenure information was used for determining whether the activities and interests that make up these values, are compatible with the *habitat and resource* conservation objectives. Examples of the types of Gilbert Bay MPA cultural, economic, and community values are outlined in Table 8.5.

The Gilbert Bay MPA observations in Table 8.5 resemble those from Basin Head and Musquash MPA. However, Gilbert Bay MPA community, economic, cultural values play an important role in outlining the overall MPA objectives. This is because they are explicitly acknowledged in the MPA goal. These values define what has previously been referred to as value-based objectives. Combined with *habitat and resource* conservation objectives, these make up the complete set of Gilbert Bay MPA objectives.

Table 8.5: A summary of Gilbert Bay MPA values and the tenure information used to define the values (after DFO [2002b]

Value	Description
Community value	Commercial fishery employs a high percentage of the populations of Port Hope Simpson and Williams Harbour. Scallop and cod are the primary commercial species in the Bay.
Community/ Economic value	The Icelandic scallop fishery became important after the northern cod moratorium in 1992. Residents of the area have emphasized that this fishery must remain open as it is an important source of income in the absence of the cod fishery.
Community value	Residents and non-residents use the area for sport fishing for Atlantic salmon, sea run brook trout and Arctic charr. A recreational trout net fishery is also popular with residents of Williams Harbour and Port Hope Simpson.
Economic value	A number of cabins exist along the bay shoreline, and more recently local residents have expressed interest in building additional trapper cabins. During winter months the surrounding area is an important link for snowmobile trails.
Cultural / Heritage value	Labrador Mėtis Nations guardians are involved in the monitoring and enforcement of recreational fishing activities. They represent the majority of the people in the southeast Labrador coast and use Gilbert Bay for subsistence, recreational, ceremonial and economic purposes. Mėtis cultural and spiritual value is an important component of Gilbert Bay.
Economic value	Although the area has been the site for several aquaculture research projects, involving cod and scallop, no commercial operations have been established. Cod grow-out operations are potentially viable.

Economic Value	Forestry is historically important in the Port Hope Simpson area where logging operations have been ongoing since the 1930s. No plans to begin forestry activities in the immediate watershed.
Economic value	No exploration of other mines but with the opening of the Trans-Labrador Highway it is anticipated that mining exploration may increase. There is exploration activity in the offshore that could lead to offshore oil and gas development. Current estimates of oil and gas development in the Gilbert Bay MPA area is 10-15years. Supporting infrastructure may be needed in areas surrounding Gilbert Bay MPA.
Community/ Economic Value	MUN, DFO, DFA and the Fish and Allied Workers Union have supported a variety of research projects in Gilbert Bay. This has had a positive economic impact on area establishments e.g., convenience stores, accommodation, gas bars, businesses in service industry.

8.2.2.2 Using Tenure Information for Management Objectives

As previously noted for other MPAs, managing activities, uses, and interests accomplishes the MPA objectives. These are referred to as *management goals/objectives* and are in turn accomplished through a specific set of management actions. In the Gilbert Bay MPA, there were four primary *management goals* and several *management actions* that were proposed. The four *management goals* were [DFO, 2002b] (Figure 8.10): (1) promote sustainable use of the marine resources; (2) promote conservation and protection of the ecosystem with special consideration for the cod populations and its habitats; (3) promote scientific research, monitoring, and related activities on the marine ecosystem; and, (4) To promote public awareness and education. Tenure information was used to identify some of the *management goals* and highlight options for accomplishing them.

A review of tenure information (as shown in Figure 8.10) facilitates the design of appropriate *management actions*. For example, the *management goal* of promoting sustainable use of marine resources depends on reviewing (*formal and informal*) programs in the Gilbert Bay MPA area as well as highlighting the restrictions and responsibilities associated with these programs.

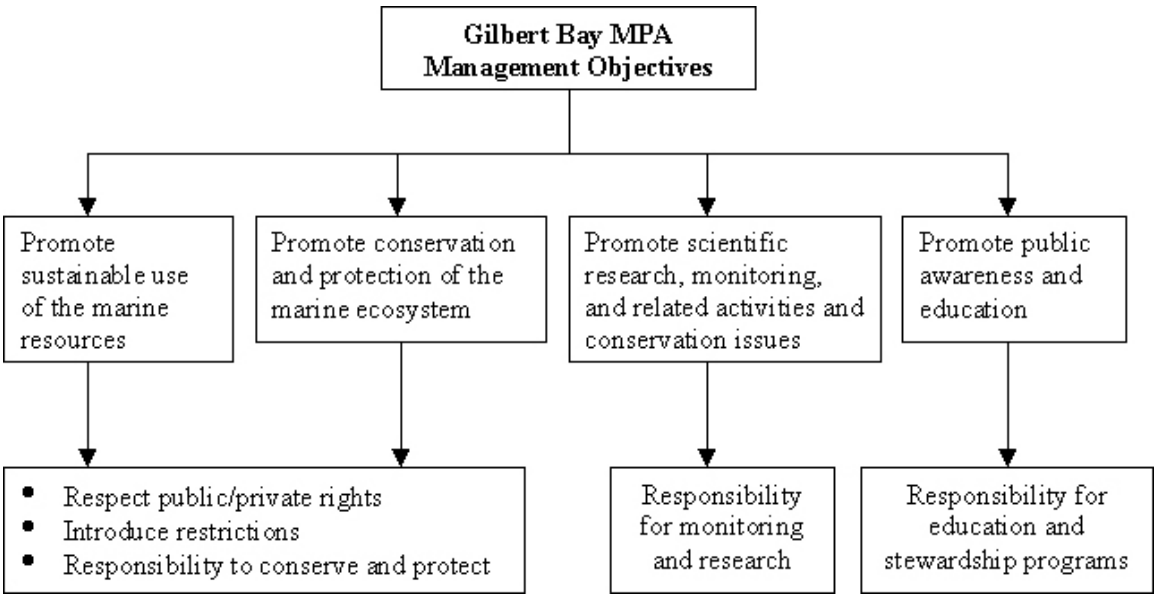

Figure 8.10 : Gilbert Bay MPA Objectives from a Tenure perspective

One such voluntary program was reflected in the community support and proactive approach for a sustainable cod fishery in Gilbert Bay [DFO, 2002b; Russell, 2005b]. However, one cannot count on this voluntary program to accomplish protection due to two reasons: (1) it is a voluntary program that depends on shared community values. Community values may change and the responsibilities for sustainable use cannot be dependent on changing community values; (2) for compliance, it depends on applying peer pressure to group members. A *voluntary* management strategy is considered impractical in the long-term.

Another example that highlights the use of tenure information is illustrated by the *management goal* of promoting conservation and protection of the ecosystem. This goal can be accomplished by managing four primary activities within and adjacent to the Gilbert Bay MPA. These activities are [DFO, 2002b]: (1) directed commercial fishing of Gilbert Bay cod; (2) habitat alteration, disruption and destruction; (3) sedimentation, nutrient enrichment, and siltation due to land use practices; and, (4) development on the

shore. In this specific case in the Gilbert Bay MPA, existing regulatory controls had to be highlighted and assessed, and proposed management actions arising from identified regulatory shortcomings outlined. This is shown in Figure 8.11.

The foregoing examples suggest that *management goals* (and their associated actions) depend on knowledge of tenure information. More specifically, *management goals* may be accomplished by reviewing pre-existing regulatory and voluntary frameworks in the area. For example, Gilbert Bay MPA *management goals* suggest that identifying existing MPA research and education programs is a vital component of determining proposed *management actions.*

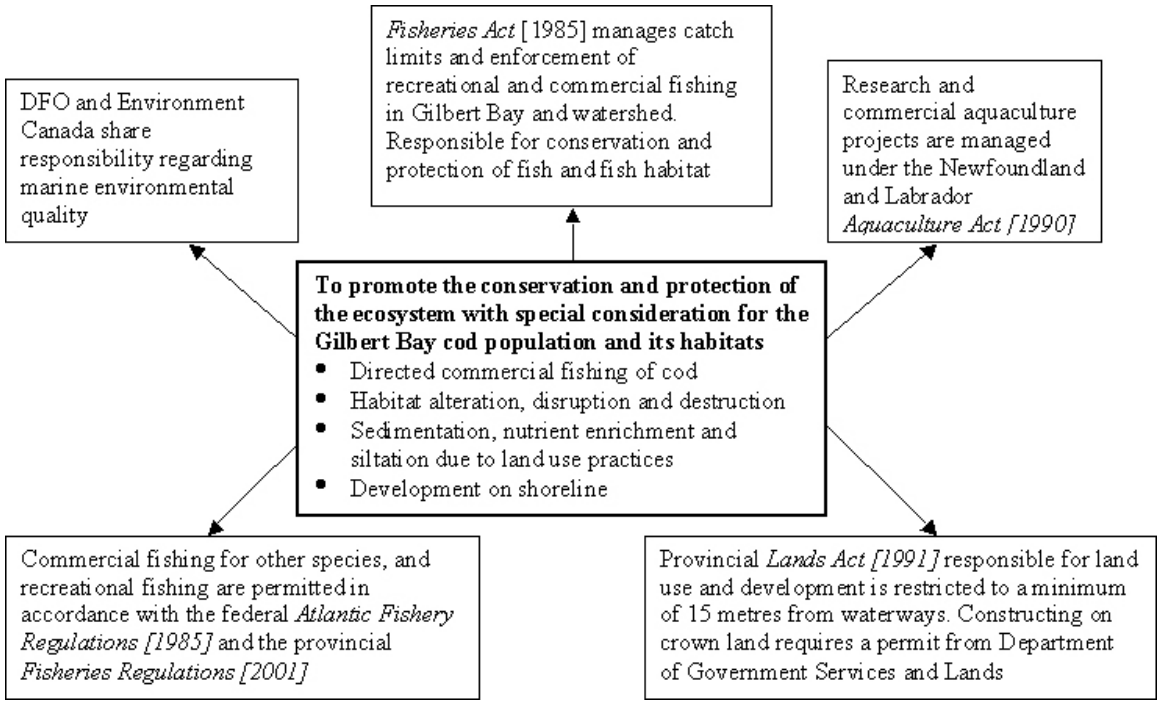

Figure 8.11: An example showing how the adequacy of existing tenure arrangements is evaluated against the accomplishment of Gilbert Bay MPA management objectives

This last example is important because it indicates that tenure information also includes community led initiatives associated with the MPA objectives. For example, the community in Williams Harbour hosts an annual Golden Cod Festival that raises

awareness about the unique cod population [Canada Gazette, 2005b]. Knowledge of the strengths and weaknesses of this initiative allows the proposal of appropriate *management actions* [Russell, 2006].

As previously mentioned, programs, policy and legislation in the Gilbert Bay MPA area were reviewed in order to highlight rights, restrictions and responsibilities associated with them. The information from this review was then used to propose *management actions* within the MPA. *Management actions* represent possible tenure arrangements. Therefore, it is possible to conclude that tenure information results from proposing *management action*s. Clearly, tenure information is used and simultaneously produced in the process of determining MPA *management goals* and associated *management actions*.

8.2.2.3 The Role of GBSC Groups in determining MPA Objectives

For the Gilbert Bay MPA, the individuals and groups that were part of the GBSC benefited from regular meetings carried out to consult on MPA objectives [Russell, 2006; Simms, 2006]. There were also several public meetings to engage the public in the process. Since 1998, there have been fifteen public meetings held in the Gilbert Bay area [Canada Gazette, 2005b].[15] During these public meetings, presentations outlined ongoing research, proposed management objectives, and proposed management actions [Simms, 2006].

Participation in the GBSC, and associated public meetings, provided a forum for issue identification, discussion and resolution [Simms, 2006]. This has led to a commitment to stewardship and co-operation in the protection of this area as an MPA [Russell, 2006].

[15] There were two public meetings held in 1998, one in 1999, one in 2000, one in 2001, two in 2002, two in 2003, five in 2004 and one in 2005.

Generally speaking, this was an opportunity to "rank" community, economic and cultural values and ensure that MPA objectives were inclusive.

The issue of ranked values and their representation in the MPA objectives suggests that the participation of stakeholders is critical. For example, the World Wildlife Fund (Canada) has expressed concern with regard to scallop dragging in the MPA due to the fragile nature of the cod habitat [Canada Gazette, 2005b]. However, since the cultural values attached to scallop dragging were articulated at the onset of the MPA establishment process, the community was not willing to compromise on this issue [DFO, 2002b]. This shows the importance of GBSC membership, as well as community participation, in determining (and influencing) MPA objectives. It also shows that determination of value-based objectives is dependent on the participation of individuals/groups in the MPA establishment process.

8.2.3 Determining the MPA Spatial Extent

The description of the Gilbert Bay MPA represents cultural and community values associated with the area. The spatial extent of Gilbert Bay MPA had been proposed as consisting of the Shinneys and Head of Bay, the mid section of Gilbert Bay, and the areas seaward to the three main channels of Gilbert Bay [DFO, 2002b]. This is outlined in Table 8.6.

Table 8.6: Gilbert Bay MPA boundary descriptions (after DFO [2002b])

Spatial Extent Component	General Boundary Description
Inland Waters	Comprising of two areas, Shinneys and Head of Bay, including all water up to the high water mark.
Main Arm	Mid section of Gilbert Bay, including waters up to the high water mark.
Outer Channels	Area from the coastal high water mark , seaward to the three main channels of Winnard Tickle, Williams Harbour Run, and Main Tickle.

The terminology used to describe the spatial extent components reflects community values associated with the Gilbert Bay MPA. For example, the *Main Arm* of the MPA was deemed to extend up to a line that extended from "Kelly's point to Deer park point" [Simms, 2006]. Similarly, the *Outer channel* of the MPA was said to extend to a line in Alexis Bay extending from "Blubber point to the upper end of Denbigh island" [Russell, 2006]. This reflects local terminology. The challenge is therefore to take these preliminary spatial extent descriptions and make them adequate for the MPA management plan.

As with Basin Head and Musquash MPAs, these preliminary spatial extent descriptions depend on an initial review of tenure information. For example, the reference to high water mark as a limit of the MPA does not reflect a real property rights review of land adjacent to the Gilbert Bay MPA. This is not a requirement at this point in the MPA establishment process. The tenure information requirements for the Gilbert Bay MPA spatial extent are outlined in the next section.

8.2.3.1 Tenure Information Requirements for determining the MPA Spatial Extent

Observations in Gilbert Bay MPA suggest that a set of criteria, similar to those used for the Musquash and Basin Head MPAs, were used to evaluate the MPA spatial extent. These criteria questions are: (1) Does the spatial extent assist in accomplishing the conservation objectives? (2) Does it assist in accomplishing the management objectives? (3) Are the spatial extent components (e.g., boundaries) legally appropriate? (4) Is there consensus regarding the spatial extent component locations and descriptions?

The first criterion deals with the ability to accomplish conservation objectives. This depends primarily on scientific information and evaluates whether the spatial extent

encompasses the entire range of the Gilbert Bay cod, as well as the marine ecosystem. This question was answered by (1) local fishermen observations regarding codfish catch locations, and (2) scientific sampling carried out by MUN.

Local observations regarding cod fishing indicated that the Gilbert Bay cod were rarely found in the areas outside of Winnard Tickle, Willams Harbour Run, and Maine Tickle [Morris et al., 2002b; Russell, 2006]. Additionally, a study in 2002 tagged 2453 cod with Floy t-bar tags, but none were recaptured outside Gilbert Bay [Morris and Green, 2002]. Green and Wroblewski [2000] tagged 23 Atlantic cod with ultrasonic transmitters as part of experiments to determine the movement of adult cod in the Gilbert Bay. The results suggested a strong homing tendency for individual cod, which was hypothesized as the reason for their genetic distinctiveness. Local observations and the scientific studies were used to support the external boundary location rationale. Russell [2006] suggests that dialogue between scientists and the local community, and the associated trust developed in this process, allowed the local knowledge and scientific information to be used to delimit the MPA spatial extent components.

The second criterion used to evaluate the MPA spatial extent deals with the ability to accomplish *management objectives*. For example, there was a sewage outfall located at Williams Harbour that was of concern to the GBSC [DFO, 2002b]. DFO personnel visited the location in summer of 2005 to ascertain the extent of the outfall, its overlap with the MPA boundaries, and its effect on the proposed MPA [The Golden Cod, 2005]. The general idea was to determine whether further restraints on the sewage outfall needed to be imposed in order to accomplish the MPA *management objectives*. However, the sewage outfall was ascertained not to be a threat to the proposed MPA but that continued

monitoring was a prerequisite for ensuring that it continue to pose negligible threat [DFO, 2002b; The Golden Cod, 2005]. In other words, a responsibility to monitor the sewage outfall would have to be part of the Gilbert Bay MPA tenure.

The third criterion used to evaluate the MPA spatial extent deals with the legality of its boundary components. For example, reference to the high water mark in Table 8.6 was modified after reviewing information on provincial/federal jurisdiction, and property rights in the area [Simms, 2006]. This suggests that jurisdiction and real property *tenure spaces* within (and adjacent) to the MPA spatial extent may have an effect on the legality of the MPA spatial extent boundary components. Furthermore, dispute resolution strategies that may mitigate legal issues that arise may be as important as the legal issues. This point is further elaborated in section 8.2.3.2.

The fourth criterion deals with consensus, within the GBSC and local community, regarding the MPA spatial extent. This depends on the stakeholder groups involved in the MPA establishment process, shared stakeholder values, and the ranking of stakeholder values. For example, the provincial Department of Transportation and Works in Newfoundland and Labrador requested that the MPA spatial extent be adjusted in order to allow for the construction of a road to link Williams Harbour with the Trans Labrador Highway (TLH) [Canada Gazette, 2005b]. This was declined on the basis that there would be potential MPA impact regardless of whether the road was constructed within or adjacent to the MPA spatial extent [DFO 2002b].

However, because there would be economic benefit for Williams Harbour community to be connected through the TLH, an exception was created in the MPA legislation for construction of causeways and bridges [Canada Gazette, 2005b]. However, this was

subject to authorizations under the *Fisheries Act* [1985] and the *Navigable Waters Protection Act* [1985]. This example suggests that the negotiation process is an important part of MPA spatial extent delimitation.

8.2.3.2 Using Tenure Information to determine the MPA Spatial Extent

The latter three criteria outlined in the previous section provide insight into the uses of tenure information in determining the Gilbert Bay MPA spatial extent. To recap, these three criteria dealt with whether the MPA spatial extent was (1) sufficient in facilitating the accomplishment of management objectives, (2) legally appropriate, and (3) consensus-based.

As in the Basin Head and Musquash MPA, it is possible to summarize the procedure used to answer the criteria questions using four tasks. This tasks are: (1) investigating existing (*jurisdiction, administration, and property*) tenure issues, (2) revisiting the tenure information used in determining MPA rationale and objectives, (3) associating spatial extents with tenure issues/information, (4) labelling tenure issues/information as MPA spatial extent constraints or justification.

In accomplishing the first task, historical tenure issues in Newfoundland and Labrador were reviewed [Simms, 2006]. Newfoundland's jurisdiction over its resources, coastline and coastal waters was a major issue in the 19th century. In 1910, the Hague Tribunal (the international court) awarded control of bays to Newfoundland.[16] When Newfoundland joined Confederation in 1949, its boundary in Labrador was confirmed in the Terms of Union (now the *Newfoundland Act* [1949]), which is now enshrined in the

[16] Newfoundland traced its claim of ownership to the commission issued to Governor Thomas Graves in 1763, which extended his jurisdiction to the "Coasts of Labrador." The 1927 Labrador boundary decision of the Judicial Committee of the Privy Council (JCPC), laid down the modern boundary between Labrador and Quebec [McEwen, 1982].

Constitution Act [1982]. However, public harbours, wharves, breakwaters, and aids to navigation were transferred to Canada.

Gilbert Bay is not a public harbour and the existence of a federal MPA is not meant to suggest that it is under federal jurisdiction. Simms [2006] noted that this jurisdictional issue was deliberately left unresolved in discussions regarding the Gilbert Bay MPA. The focus was on protection for the cod, and therefore a decision to overlook the jurisdiction issue was agreed upon by DFO and provincial government representatives [Simms, 2006]. The decision was made so that there would be no further delay with regard to the MPA establishment process.[17] This example demonstrates, (1) the importance of historical tenure arrangements in determining the jurisdiction within the MPA spatial extent, and (2) the decision to overlook uncertainty in tenure arising from tenure arrangements.

The second and third tasks dealt with revisiting the tenure information used in determining MPA rationale and objectives, and associating spatial extents with tenure issues/information. These tasks focused on identifying voluntary, education based, and regulatory programs within and adjacent to the Gilbert Bay MPA. At the same time, it was necessary to associate some sort of spatial extent with these tenure arrangements in order to be able to identify their impact on the MPA spatial extent.

For example, regulatory management of cabin developments in areas adjacent to the Gilbert Bay MPA provided information on the spatial extent of existing land use development controls. Development is currently restricted within 15 metres of a (marine or freshwater) waterway by the provincial *Lands Act* [1991]. Additionally, building

[17] Federal/provincial representatives emphasized that this was unique case involving this MPA. Therefore, the decision to designate Gilbert Bay as a federal MPA could not be used as a precedent that the federal government had jurisdiction over bays in the Newfoundland and Labrador region [Simms, 2006].

construction on crown land requires a permit from provincial Department of Government Services and Lands.

This example also shows how the fourth task was accomplished. This task deals with labelling identified tenure arrangements as constraints/complementary to the MPA spatial extent. For example, the 15-metre development buffer previously mentioned can be used to complement MPA protection. In fact, the *precision* of the watercourse edge (e.g. high or low water mark) can be low (an uncertainty of up to 15m) and still manage to be sufficient for some *management objectives*. In this specific case, the legislated 15m buffer restraints will mitigate concerns regarding the boundary precision. This restraint on adjacent lands may also be complementary to fulfillment of MPA *management objectives*.

From this example, it is clear that evaluating the MPA spatial extent also involves evaluating (1) the extent of *tenure spaces* within and surrounding Gilbert Bay MPA, (2) the overlap between these *tenure spaces* and the proposed Gilbert Bay MPA boundaries, (3) the complementary/conflicting nature of existing tenure on proposed management actions.

The delimitation of *tenure objects / spaces* in Gilbert Bay MPA is of particular interest. Some *tenure spaces* had well determined boundaries. For example, the 1998 *Notice to Fishers* closed commercial cod fishing in an area of approximately 43km^2 within Gilbert Bay. The boundaries of this *tenure space* were well outlined and its complementary effect on the proposed MPA boundaries could be more easily evaluated. This was also the case for the April 2003 commercial cod fishery moratorium placed by DFO in NAFO Division 2J [DFO, 2002b].

What was unique about *tenure spaces* in the Gilbert Bay MPA was that there were some future considerations that were important. For example, the Committee on the Status of Wildlife in Canada (COSEWIC) recommended in 2003 that certain populations of Atlantic cod be listed as endangered [DFO, 2002b]. The Canada Gazette [2005b] notes that the Minister of Fisheries and Oceans may accept the northern cod listing and request a recovery strategy under the *Species at Risk Act (SARA)* [2003]. This is important because it suggests that there may be future legislated tenure arrangements within (or adjacent to) the Gilbert Bay MPA.

These future tenure arrangements may be complemented by future programs that outline further responsibilities. For example, it is possible that there will be a *Recovery of Nationally Endangered Wildlife Program* (*RENEW*)[18] to support *SARA*. This may be complemented by a *Habitat Stewardship Program* (*HSP*)[19] focusing on partnerships among organizations interested in the recovery of species at risk.

The *SARA* legislative tenure arrangements, and the *RENEW* and *HSP* programs that support it, have an important role to play in determining the MPA spatial extent. It is possible to suggest that higher precision in the MPA spatial extents is not necessary as these future *tenure spaces* may mitigate concerns regarding the ability to accomplish management objectives. For example, it is possible to argue that the external boundaries at Winnard Tickle, Main Tickle, and Williams Harbour do not have to be precisely delimited. This is because the uncertainty in delimiting the spatial extent may be

[18]RENEW brings together 16 federal, provincial and territorial departments, and more than a hundred recovery teams of governmental and non-governmental members (see http://www.speciesatrisk.gc.ca/recovery/default_e.cfm)
[19] HSP provides funding to "stewards" for implementing activities that protect or conserve habitats for species. These activities must take place on private lands, provincial Crown lands, Aboriginal lands, or in aquatic and marine areas across Canada (see http://www.cws-scf.ec.gc.ca/hsp-pih/).

mitigated by future *SARA* programs, thus accomplishing some of the articulated management objectives.

The foregoing paragraphs have outlined how tenure information is used in determining the Gilbert Bay MPA spatial extent. As outlined in previous sections, this process depends on reviewing tenure information used in determining the MPA objectives. MPA management objectives depend on values, which are described by activities, uses and interests. Management objectives are then accomplished by management actions, which depend on an assessment of the adequacy of existing tenure arrangements. Legal appropriateness depends on evaluating tenure, its spatial extent, and any mitigating circumstances. Finally, a consensus on boundaries depends on ranking of community/economic/cultural values, which depends on knowledge of activities, uses, and interests in the area.

8.2.3.3 The Role of GBSC Groups in determining the MPA Spatial Extent

Observations in the Gilbert Bay MPA suggest that GBSC members, and the local community, were able to affect the MPA spatial extent. For example, the previous section outlined how the provincial Department of Transportation and Works requested that the MPA spatial extent be adjusted in order to allow for the construction of a road to link Williams Harbour with the Trans Labrador Highway (TLH) [DFO, 2002b]. The request to adjust the MPA spatial extent was turned down due to habitat protection reasons.

This suggests that although the TLH had economic value to the communities surrounding the Gilbert Bay MPA, the negotiation process did not necessitate changes to the MPA spatial extent. It is important to note that this same argument had resulted in the modification of the MPA objectives, and the proposed management actions included

allowing construction of causeways and bridges [DFO, 2002b; Simms, 2006]. It is therefore possible to hypothesize that community/ economic/ cultural values may have a greater impact on particular MPA management plan components. In this example, they affect MPA objectives more than they affect the MPA spatial extent.

The role of the Labrador Métis Nation (LMN) in monitoring and enforcement of fishing activities in the Gilbert Bay area seems to also affect the proposed MPA spatial extent. For example, LMN guardians are funded through the federal Aboriginal Fishery Strategy Program [Canada Gazette, 2005b]. They make boat patrols within and adjacent to Gilbert Bay in order to enforce the regulations under the LMN communal fishing license. DFO sometimes conducts joint patrols with the LMN guardians and the provincial conservation officers [DFO, 2002b]. This partnership may possibly be formalized through MPA designation [Simms, 2006]. It is possible that issues surrounding imprecise boundary delimitation may be mitigated by this relationship. This is important because it suggest that partnerships and arrangements on the ground may be mitigating factors for legal disputes arising from imprecise delimitation.

The Gilbert Bay example complements the list of factors that mitigate imprecise boundary delimitation identified in other case studies. Recall in the Basin Head MPA that these factors consisted of substantial provincial real property ownership, and memorandum of agreement on management responsibilities. These strategies address legal issues that may arise from boundary uncertainty and suggest lesser legal implications.

8.3 Chapter Summary and Conclusions

This chapter has provided a comparative analysis of the role of tenure information in Atlantic Canada inshore MPAs. This has been accomplished by identifying the role of tenure in determining three management plan components i.e., the MPA rationale, objectives, and spatial extent. More specifically, this chapter has; (1) identified the tenure information requirements for each MPA; (2) identified the use of tenure information; (3) identified the tenure information management groups, and (4) identified the roles of individuals and groups in determining tenure information requirements and using tenure information. The major research findings are summarised in the following Tables.

Table 8.7: Summary of major research findings on tenure information management and determination of the Basin Head/Gilbert Bay MPA Social Rationale

Basin Head MPA
Basin Head Lagoon Ecosystem Conservation Committee (BHLECC) members carried out a preliminary review of restrictions provided by various legislation and programs. They determined that restrictions in various Acts did not comprehensively address protection issues proposed under the MPA program.
The PEI government responsibility for the surrounding MPA areas is captured in the *Tourism Product Development Strategy for Eastern Kings.* This is a complementary program which proposes an ecotourism focus for the Basin Head area with the Fisheries Museum, sand dunes, beach, and MPA initiative as the building blocks
Other tenure information providing a social *rationale* included historical information describing protection initiatives. Basin Head was identified in a 1974 report on *Ecological Reserves in the Maritimes* and *included* on a 1991 list of sites for the *Provincial Significant Environmental Areas Program.*
Gilbert Bay MPA
Stakeholders were able to provide information on, (1) historical and current tenure arrangements, and (2) the legal and policy instruments (if available) that describe these tenure arrangements. Pre-existing regulatory and other tenure arrangements (e.g., stewardship initiatives) indicate support for the scientific MPA rationale. Legal and policy instruments indicate the type of "tenure" support e.g., fishery variation orders indicate pre-existing legislative support (in the form of restrictions) for the MPA rationale.
Stakeholders were able to provide local knowledge of the cod habitat and characteristics. For example, a single-family enterprise fished cod commercially in Gilbert Bay from the late 1970s until 1992 when a moratorium was place on northern cod [DFO, 2002b]. Based on their historical fishing rights, this group was in a position to provide significant information on the cod population characteristics.

The communities of Port Hope Simpson and Williams Harbour had obtained support from local fish harvesters when they first approached DFO to implement protective measures in 1998. In September 1998, DFO issued a *Notice to Fishers* closing a large portion of Gilbert Bay to commercial cod fishing [Canada Gazette, 2005b]. A fisheries variation order was issued in 2001 and has since provided a level of interim protection for the Gilbert Bay cod, effectively closing >70% of the bay to recreational fishing [DFO 2002b]. These arrangements suggest that there is pre-existing support for the MPA scientific rationale.

Table 8.8: Summary of major research findings on tenure information management and determination of Basin Head/Gilbert Bay MPA Objectives

Basin Head
Some Basin Head MPA objectives suggest a broader focus than *habitat* and *resource* conservation. These include, "conserving and protecting the lagoon ecosystem through ongoing management including use of regulations" and "providing for the multiple use of the ecosystem with activities that meet the ecological objectives".
The report by the Island Nature Trust on *Community use of the Basin Head Lagoon* describes (past and present) uses in Basin Head and the surrounding lands. This document represents an important cultural and community perspective and suggests that there are other values to be associated with the MPA.
Cultural, economic and community values in the Basin Head MPA are reflected in the past/present activities and uses, as well as the stakeholders and their interests.
Gilbert Bay
The main MPA goal refers to Gilbert Bay as a "…community united by its people, culture and mutual desire to share with future generations". This suggests that there is a focus on the people, their culture, and their mutual desire to carry out *habitat* and *resource* conservation.
The report on an *Overview of Commercial Fishing in Gilbert Bay* identified (active and retired) fish harvesters and processors, and described their local knowledge and biological observations regarding the cod fishery. The report on a *Socioeconomic Overview of Gilbert Bay* described the history, activities, users and uses of resources of the area in an effort to illustrate the social, economic and cultural values within Gilbert Bay.
Gilbert Bay MPA community, economic, cultural values play an important role in outlining the overall MPA objectives. These value-based objectives are explicitly acknowledged in the MPA goal. Because of this, Simms [2006] suggested that there exists a balance between conservation and value-based objectives.

Table 8.9: Research findings on the role of tenure information in MPA Spatial Extent delimitation process

There are four criteria in the case studies used to refine the MPA spatial extent components (Sections 8.1.3.1, and 8.2.3.1): Accomplishment of conservation objectives. Accomplishment of management objectives. Legal appropriateness. Consensus in delimiting the spatial extent component.
From a review of information requirements for the four criteria, this research concludes that

the latter three criteria depend more on tenure information. The first criterion depends primarily on scientific information and evaluates whether the spatial extent encompasses the entire range of the habitat/resource. The second criterion depends on information used to fulfill *management objectives*. This information is primarily used to determine whether additional (legislated) restraints are needed in order to accomplish MPA *management objectives*. The third criterion depends on determining the legality of the spatial extent components. Information on historical and current tenure arrangements, as well as dispute resolution strategies that may mitigate boundary legality issues, are important. The fourth criterion deals with stakeholder consensus regarding the MPA spatial extent components. This depends on information that highlights stakeholders involved in the MPA establishment process, shared stakeholder values, and the ranking of stakeholder values.
It is possible to summarize the procedure used to answer the latter three criteria questions using four tasks: Investigating existing (*jurisdiction, administration, and property*) tenure issues. Revisiting the tenure information used in determining MPA rationale and objectives. Associating spatial extents with tenure issues/information. Labelling tenure issues/information as MPA spatial extent constraints or justification.
The first and second tasks strongly depend on knowledge of historical tenure issues in the coastal area, particularly those dealing with jurisdiction over resources, coastline and coastal waters. It is important to be familiar with the specific terms of Confederation for the province where an MPA is proposed, including how these terms impact on tenure in coastal areas. As was shown for all three case studies, most MPAs are being proposed in areas not located in public harbours, or other areas that may fall under federal jurisdiction. The existence of a federal MPA does not suggest that the area falls under federal jurisdiction. As noted in the case studies, the MPA jurisdictional uncertainty was deliberately left unresolved to ensure that the MPA was not delayed by attempts to resolve this issue.
The third and fourth tasks focused on identifying voluntary, education based, and regulatory programs within and adjacent to the MPAs and then associating (where possible) a spatial extent with tenure arrangements in order to identify the impact on the MPA spatial extent. This involves the delimitation of *tenure objects*/*spaces*. *Tenure objects* refer to natural and man-made features that can be associated with activities and interests. *Tenure spaces* refer to areas associated with certain rights, and / or restrictions, and / or responsibilities that had poorly defined spatial extents.

Table 8.10: Research findings on the effect of tenure arrangements and the MPA spatial extent

For each case study, *this research has demonstrated that the MPA delimitation process can be conceptually split into two steps: determining the original MPA spatial extent proposal, and refining this proposal.* The role of tenure information in this process is facilitating these two steps.
The objective of these two steps is to take the preliminary spatial extent descriptions (which reflect community and cultural values, as well as local terminology) and make them adequate for the MPA management plan (sections 8.1.3,and 8.2.3). The original spatial extent descriptions are summarized in Tables 8.3, and 8.6.

Existing and future tenure arrangements in the area may mitigate jurisdictional uncertainty and / or ensure accomplishment of MPA objectives. For the Basin Head MPA these tenure arrangements were: (1) substantial provincial real property ownership adjacent to the Basin Head MPA, (2) the proposed DFO/PEI memorandum of agreement on management responsibilities. For the Gilbert Bay MPA these tenure arrangements were: (1) the informal relationship involving monitoring and enforcing fishing activities between Federal/Provincial/First Nations representatives, (2) future considerations under the *Species at Risk Act (SARA)* [2003], (3) future programs to support SARA such as the *Recovery of Nationally Endangered Wildlife Program* (*RENEW*) and *Habitat Stewardship Program* (*HSP*).
Tenure arrangements can mitigate the uncertainty in precision of the spatial extent components. For example, administrative agreements between Federal/Provincial governments, which are outlined as part of the MPA establishment process, may overcome uncertainty in precisely defining the spatial extent components.
The precision of the MPA spatial extent components might not be as important as previously thought by some scientific communities (e.g. the geomatics community). This is because some tenure arrangements arising from MPA establishment also incorporate dispute resolution strategies that may mitigate uncertainty in spatial extent *precision*.

9 CHAPTER 9: CONCLUSIONS AND RECOMMENDATIONS

This chapter summarizes the results of verifying the conceptual framework developed in Chapter 4, and those from testing the approach developed in Chapter 5. Conclusions are drawn and recommendations made regarding application of this framework to Canadian marine space management.

9.1 Research Overview

Overall, the conceptual framework was useful for appreciating, understanding, identifying, modeling and analyzing administration of marine activities and interests. This is because of the following components: (1) the theoretical background of the conceptual framework developed in Chapters, 2,3,4; (2) the testing approach developed in Chapter 5 and applied in Chapters 6,7,8; and (3) the comparative analysis developed in Chapter 5 and applied in Chapter 8.

In general, this research provides insight into several challenges in MPA tenure information management. Although there are similarities across the three inshore MPAs, each case study has a unique set of social, cultural and political issues. The general observation is that social, cultural and political considerations will have a strong influence on testing this framework across Canadian MPAs.

9.1.1 Research Strengths

The primary strength of the framework is in the ***rigour*** of the solution proposed, which is based on a "***systems view"*** of marine environmental management. Chapter 2 defined a system as an organized set of processes designed to accomplish certain objectives. This research has drawn a parallel from land management to marine environmental management where the latter consists of several processes including

administration of marine tenure. Within these processes, there are several activities including tenure information management.

Chapter 2 has demonstrated that the system view allows a better understanding of the processes, functions, activities and tasks involved in administration of marine tenure. This leads to a ***better understanding*** of the problems and a ***more complete design*** of the necessary responses. The problem, as mentioned in Chapter 1, is that policy and program responses do not comprehensively deal with the legacy of fractured and incomplete sets of data that are the basis of decision-making regarding coastal and marine resources. This research has shown that this is addressed by designing an MPA-based framework that: (1) articulates the importance of rights (*and / or interests*) in coastal and ocean management; (2) describes the information requirements for defining these rights; and, (3) demonstrates how an integrated inventory of information on "*who has what rights to use which resources*" is used in coastal and ocean management.

Another strength of the conceptual framework is in ***verifying the research premise*** by first establishing its validity. The research premise was that there was a role for tenure information in MPA management and that a conceptual framework could be designed based on this. This research premise was identified from an extensive literature research in Chapters 2, 3, and 4, then verified in the Musquash, Basin Head and Gilbert Bay MPA case studies in Chapters 6, 7 and 8.

A third strength of this research is in the ***outcome-based approach*** that is adopted to test the conceptual framework. This provides a ***testing focus*** by relating the approach to the *MPA establishment* process. The focus is less on tenure information inputs and outputs and more on the preferred outcome of an MPA management plan. The approach

developed is based on the idea that the inputs-outputs-outcomes technique can be used to describe the role of tenure information in *MPA establishment*.

A fourth strength of the research is in the ***"grounding"*** of the conceptual framework to the *Canadian MPA establishment framework.* In this way, the conceptual framework is ***relevant*** because it reflects the processes, activities and tasks that are in this framework. The testing (of the conceptual framework on the case studies) was modified to reflect the reality that three management plan components are usually determined within the first three stages of the *Canadian MPA establishment framework*. Therefore, the testing was carried out primarily in the determination of these three management plan components; namely, MPA rationale, goals and objectives, and spatial extent.

The fifth strength of this research is in its recognition that ***people play a major role*** in tenure information management. The research explicitly recognizes this by placing people at the heart of the conceptual framework. This is reflected in the tenure information management activity "the role of tenure information management groups". This is important because decisions regarding marine space are increasingly being made by collaboration and (some) consensus. Therefore, marine policies, programs, and legislation have to be socially and politically justified. This research has shown that this is made easier by improved tenure information management. Specifically, this is shown to be true when there is an improved understanding of the role of tenure information management in *MPA establishment*.

9.1.2 Reviewing the Thesis Questions and Objectives

In order to guide the research in developing a framework for evaluating the role of tenure information in MPAs and to evaluate research completion, four research questions

and three objectives were identified in Chapter 1. The research findings are summarised in Table 9.1. The research also identified specific questions regarding the use of tenure information in the MPA establishment process in Chapter 1. The research findings are summarised in Table 9.2.

Table 9.1: Research findings on the thesis questions identified in Chapter 1

Thesis Questions	Research Contributions
What frameworks exist for studying tenure information requirements for marine space?	A review of the overall significance of tenure information in marine environmental management. This is accomplished by drawing a parallel with land management processes and land administration activities. A review of the approaches for managing MPAs in Canada, including a focus on the national approach to oceans and coastal management. This also involves highlighting the specific information requirements. A review of various MPA information management frameworks including how they incorporate tenure information into broader governance and socio-economic information categories. A review of the general criteria for selecting and managing MPAs worldwide with a specific focus on MPA goals, objectives and indicators.
How are tenure information requirements determined for MPAs?	Tenure information requirements are generally inferred from broader governance and socio-economic information categories. This research used this inference to determine the research premise that there is a role for tenure information in MPA establishment. This research premise was further verified through the in-depth literature review in Chapters 2, 3, and 4.The conceptual framework was designed based on this premise.
Can boundary delimitation concepts be applied successfully in MPAs? If so, what type of information is required and what is it used for?	Boundary delimitation concepts are successfully applied in the MPA case studies in this research. Chapter 5 suggests an approach for testing the conceptual framework developed in Chapter 4 by focusing on the MPA management plan. One of the MPA management plan components is the MPA spatial extent, which includes boundaries. This research investigated the delimitation of the MPA spatial extents under two headings: namely, the boundary delimitation process and the boundary functions. Tenure information is a critical component in both.
How can the challenges in tenure information management be identified and modelled for an	The primary MPA objective in the case studies is to develop an MPA management plan. This research has focussed on three processes involved in preparing this plan. These include determining the (1) MPA rationale, (2) objectives, and (3) spatial extent. Tenure information challenges for each of these processes are highlighted. Each process consists of three activities: (1) determining MPA tenure

inshore Marine Protected Area in New Brunswick?	information requirements, (2) determining the role of MPA tenure information management groups, and (3) determining MPA tenure information use. Each activity involves several tasks. In this research the tasks are represented by a series of questions. The tasks are intended to further clarify the role of tenure information management in *MPA establishment*. For the first activity, the task involves answering the following question: what tenure data management processes are involved in identifying, (1) resource use patterns and boundaries, (2) rights and rules involving marine resources, and, (3) formal legislation? For the second activity, there are two tasks described by the following questions: (1) Are community organizations, as well as MPA decision-making and management organizations involved in marine tenure information management? (2) What is the role of marine tenure information management groups in determining marine tenure information requirements and use? For the third activity, there are four tasks described by the following questions: (1) Can the highlighted tenure information uses be verified? (2) Does MPA tenure information use depend on the characteristics of MPA tenure information management groups? (3) Does MPA tenure information use affect MPA tenure information requirements? (4) Is scientific data used to validate MPA tenure information?

Table 9.2: The case study questions identified in Chapter 1 and the research findings

Case Study Questions	Research findings / Lessons learnt
Can MPA tenure information management processes be shown to support coastal communities and government in public decision-making?	The definition of the tenure information management process in this research includes data collection, information retrieval, analysis and dissemination. This process was shown to be supportive of decision making in the following manner: Stakeholders influence the scientific MPA rationale by also providing a *social rationale* for the MPA. *Social rationale* is a term used to reflect the shared community support needed to advance the MPA proposal. Stakeholders influence the identification of community, cultural and economic values. Stakeholders influence the subsequent ranking of these values within the MPA objectives. Stakeholders will also assist in identifying existing regulatory, voluntary, educational and research tenure arrangements in the area. Stakeholders affect identification of information requirements, and the use of information, in determining the spatial extent.
Can MPA tenure information management processes be shown to	Observation of Musquash MPA stakeholders as they participated in the hydrographic and oceanographic data management process provided insight into how stakeholders affect identification of

encourage coastal communities to participate in public decision-making?	information requirements, and the use of information, in developing the MPA management plan.
Can MPA tenure information management processes be used to overcome communication barriers between different marine space stakeholders?	There was no conclusive evidence that tenure information management processes can assist in overcoming communication barriers among stakeholders. These barriers are based on complex and dynamic social, political and cultural factors. It was observed that tenure discussions among Musquash MPA stakeholders (i.e., regarding what rights, restrictions and responsibilities were most appropriate for the MPA) seemed to generate greater and more inclusive discussion. This observation was verified for the other case studies.
Can a tenure information management system be useful for inshore Marine Protected Areas in Atlantic Canada?	The comparative analysis of MPAs in Chapter 8 addressed this question. It showed that inshore MPAs, having similar functional characteristics, could be shown to SIGNIFICANTLY depend on tenure information in the development of their MPA management plans. From the case studies, improved tenure information management would facilitate: Supporting the scientific MPA rationale. Capturing the value –based objectives. Analysis of possible management actions. Recommendation of MPA spatial extent.

9.2 Research Conclusions

The research goal was to identify and design a framework for highlighting the role of tenure information in Canadian MPAs. The research premise was that tenure information management is an important process in "marine administration", which in turn is an important process in marine environmental management. To this end the research developed a conceptual framework that highlights the role of tenure information in developing an MPA management plan.

9.2.1 Research Findings on Tenure Information Management Activities

The conceptual framework designed was based on the premise that there is a role for tenure information in MPA establishment. This premise was verified in the Musquash, Basin Head and Gilbert Bay MPA case studies and a framework for identifying MPA

tenure information management activities was developed. The activities have specific tasks (in the form of questions) associated with them, which are used to clarify the role of tenure information in MPA establishment. Research findings on the activities and associated tasks are outlined in the following sections.

9.2.1.1 Determining MPA Tenure Information Requirements

From a review of MPA governance/socioeconomic criteria frameworks in Chapter 4, ***this research has shown that MPA tenure information requirements are clarified by a single task.*** The research findings on this task are further described in Table 9.3.

Table 9.3: Research findings on determining MPA tenure information requirements

Task Question	Research Findings
What tenure data management processes are involved in identifying Resource use patterns and boundaries? Rights and rules involving marine resources? Formal legislation?	There were several processes that focused on identifying voluntary, education based, and regulatory programs within and adjacent to the MPA area. Activities, interests and uses that were encapsulated as programs, policy and legislation were referred to as *tenure objects*/*spaces*. The previously mentioned processes involved trying to associate (where possible) a spatial extent with *tenure objects / spaces* in order to be able to identify their impact on the MPA management plan components. It was important to distinguish two *tenure objects / spaces* characteristics i.e., *type* and *location*. The *location* characteristic provides information on the *tenure object*/*space* extent, and / or location within the proposed MPA boundaries. The *type* characteristic provides information on the cultural/ economic/ community value of the *tenure object*/*space*. The impacts of *tenure objects / spaces* on the MPA are twofold: (1) the effect on location and description of boundaries; and, (2) effect on proposed rights, restrictions, and responsibilities. Uncertainty in both contexts affects tenure data management and *MPA establishment*.

9.2.1.2 Determining MPA Tenure Information Use

From the review of MPA governance/socioeconomic criteria, ***this research showed that tenure data collection/information retrieval should be complemented by***

dissemination to the stakeholder community. A better understanding of how tenure information is used is clarified by four tasks (in the form of questions). The research findings on these questions/tasks are further outlined in Table 9.4.

Table 9.4: Research findings on determining MPA tenure information use

Task Questions	Research Findings
Can the following tenure information uses be verified? To explain impact of human activities on environment To visualize how rights to resources are impacted by MPAs To determine non market and non-use MPA values To bring a degree of social equity in social groups To determine the locations and types of other cultural resources.	The tenure uses can be verified. This is outlined below. Conservation and value-based objectives are used to outline *management objectives*, which are subsequently addressed through management actions. These management actions depend on descriptions of activities, uses, and interests. Tenure information was used to visualise how the MPA rationale, objectives and spatial extent are impacted. Cultural and community values were used to support the social MPA rationale, modify the MPA objectives, and determine the MPA spatial extent. Participation of the community in data collection, analysis and management was able to provide (a) a sense of ownership of the process, (b) validation of local knowledge, (c) a sense of value to the community. Local knowledge is important in determining the possible location of these cultural resources. Scientific data can be able to pinpoint the location and spatial extent of these resources.
Does MPA tenure information use depend on the characteristics of MPA tenure information management groups?	Stakeholders (e.g., local community, Govt departments) are involved, in various capacities, in various aspects of tenure data management. These capacities include tenure information dissemination. Therefore, one can conclude that the use of tenure information is directly related to the participation of stakeholders groups. All three case studies provided multiple examples of this during the preparation of MPA management plan components. For example, the participation of aboriginal groups in Basin Head and Gilbert Bay in the MPA establishment process significantly affected the way tenure information was used.
Does MPA tenure information use affect MPA tenure information requirements?	As outlined in response to the previous question, stakeholders are involved in determining (1) tenure information requirements, and (2) tenure information use. Since stakeholders influence the decision making, they ensure that certain types of information are identified. All three case studies reported that several stakeholders were involved in the determination of the MPA rationale and objectives because they wanted their "interests" to be identified

	and officially recognised during MPA management plan preparation.
Is scientific data used to validate MPA tenure information?	Scientific data may be used to validate tenure information and vice versa. This is best represented by trend outlined in Chapter 7, Figure 7.7. In this trend, the tenure information that was identified prior to, and during, the scientific research went through several stages as the community interacted with the various information types. However, there are several factors that may influence this e.g., social and political pressure. The Musquash MPA case study provided an example where, in the presence of "significant" tidal flushing patterns evidence, a political decision was made to ignore this scientific data.

9.2.1.3 Determining the Role of Tenure Information Management Groups

This research has demonstrated the following stakeholders roles: (1) determining tenure information requirements, and (2) determining tenure information use. This may be affected by: (1) stakeholder tenure data management objectives and, (2) tenure data management abilities.

A better understanding of how tenure information is managed is clarified by two tasks (in the form questions). Research findings on the tasks are outlined in Table 9.5.

Table 9.5: Research findings on determining MPA tenure information management groups

Task Questions	Research Findings
Are community organizations, as well as MPA decision-making and management organizations involved in marine tenure information management?	The research determined that there is a role for all these groups in MPA tenure information management. This depends on several factors such as: The available human, technical, financial and social capital resources; The nature of the partnerships formed to advance the MPA establishment process; The social, political and cultural dynamics of groups that advance the original MPA proposal.
What is the role of marine tenure information management groups in determining marine tenure	The roles vary during the determination of various management plan components. They can be summarised as follows: In terms of data management, this role includes planning and participating in data collection, retrieval, analysis and dissemination.

information requirements and use?	Planning and participation allows these groups to influence tenure information requirements from a technical and management perspective. *Technical perspective*: these groups affect the identification of tenure data sources, tenure data quality (including formats and accuracy) and tenure data types. *Management perspective*: these groups affect the identification of tenure data custody, retrieval mechanisms, and distribution / dissemination. Planning and participation allows these groups to influence tenure information use in MPA decision-making, specifically, in the determination of the MPA rationale, objectives and spatial extent.

9.2.2 Research Findings on determining MPA Management Plan Components

The activity-driven framework was implemented in a case study setting using the outcome-based approach developed in Chapter 5. The approach demonstrated that during *MPA establishment,* a focus on the tenure information outcome was more appropriate than on tenure information inputs and outputs. The approach advocated for a focus on outcome-based results as opposed to documenting the number of inputs and outputs utilized in *MPA establishment*: with the preferred outcome being the MPA management plan. The approach involved investigating the tenure information management challenges in determining the components of the MPA management plan.

In testing the conceptual framework on the primary case study, three management plan components were determined during the first three stages of the *Canadian framework for establishing and managing MPAs* [see Canada, 1997a; 1998; 2002c]. Therefore, it was concluded that tenure information management should be investigated during the determination of these three management plan components; namely, MPA rationale, goals and objectives, and spatial extent. Research findings for the management plan components are as follows:

There are two roles for tenure information in determining the MPA rationale: (1) to strengthen the scientific rationale for the MPA, and (2) stakeholder identification.

MPA *management objectives* are addressed using regulatory, voluntary, research, and education-oriented management actions; which depend on, and produce, descriptions of activities, uses. Tenure information is simultaneously used and produced during the determination of MPA objectives.

The role of tenure information in boundary delimitation is better appreciated by focusing on two elements: the delimitation process and functions.

This research investigated the **processes** involved in the determination of the MPA spatial extent and came to the following conclusions:

The MPA delimitation process can be conceptually split into two steps: determining the original MPA spatial extent proposal, and refining this proposal.

The objective of these two steps is to take the preliminary spatial extent descriptions (which reflect community and cultural values, as well as local terminology) and make them adequate for the MPA management plan. This determines the accuracy of the MPA spatial extent.

This research investigated the **functions** of the MPA spatial extent and came to the following conclusions:

The primary function of the MPA spatial extent is to provide information, specifically, a rationale for the location and type of spatial extent.

The MPA spatial extent fulfills two categories of functions: the MPA spatial extent “criteria” functions and the “traditional” real property boundary functions.

The “traditional” real property boundary functions are (1) to provide notice and (2) to provide additional information. There is no observable difference in data management processes used to fulfill the notice and information function.

MPA spatial extent functions are influenced by stakeholder opinion.

There is an observable trend in the way stakeholders interact with tenure information. This affects the identification of tenure information requirements and the use of tenure information in decision-making.

From the case studies, this research has demonstrated that there are **four criteria “functions” used to refine the MPA spatial extent**. These are: (1) Accomplishment of conservation objectives; (2) Accomplishment of management objectives;(3) Legal appropriateness; and, (4) Consensus in delimiting the spatial extent component. The research investigated the **information requirements necessary to fulfill the four criteria** and came to the following conclusions:

The latter three criteria depend more on tenure information. These criteria can be answered by four tenure information management tasks: (1) Investigating existing (*jurisdiction, administration, and property*) tenure issues; (2) Revisiting the tenure information used in determining MPA rationale and objectives; (3) Associating spatial extents with tenure issues/information; and, (4) Labeling tenure issues/information as MPA spatial extent constraints or justification.

The first and second tasks strongly depend on knowledge of historical tenure issues in the coastal area, particularly those dealing with jurisdiction over resources, coastline and coastal waters.

The third and fourth tasks focus on identifying voluntary, education based, and regulatory programs within and adjacent to the MPAs and then associating (where possible) a spatial extent with tenure arrangements in order to identify the impact on the MPA spatial extent.

This research has also drawn conclusions regarding **the effect of past, existing, and future tenure arrangements on the MPA spatial extent.** These are as follows:

Existing and future tenure arrangements in the area may mitigate jurisdictional uncertainty and / or ensure accomplishment of MPA objectives.

Tenure arrangements can mitigate the uncertainty in precision of the spatial extent components.

The precision of the MPA spatial extent components might not be as important as previously thought by some scientific communities (e.g. the geomatics community).

9.2.3 Research Contributions

There are several research contributions. First, this research provides clarity on the role of tenure information in MPA management. This is important since MPA management frameworks in Canada do not emphasize tenure issues in MPAs nor do they incorporate the approach proposed herein. When this research began in 2000, there was very little appreciation among the scientific community at DFO of the importance of tenure issues in marine space management. This culture has slowly been changed and the community has slowly begun to incorporate the language of tenure (especially concepts like jurisdiction and property rights) in coastal and offshore management. For example, the Eastern Scotian Shelf Integrated Management Plan (ESSIM-P) explicitly recognizes

this by incorporating *human use objectives* in addition to *ecosystem objectives* (ESSIM Planning Office, 2005].

Second, this work makes a significant contribution in the development of MPA spatial extent (and specifically boundaries) delimitation concepts. In particular, the case studies have demonstrated that boundary delimitation processes in marine space are significantly different and that a different way of thinking may be appropriate. Further, this work has shown how the presence of *tenure objects* and *spaces* affects the spatial extent. The relationship between boundary functions and characteristics, and the final location of the boundary, has been demonstrated in the case studies. Sources of boundary uncertainty and the subsequent resolution of complex (tenure-related) issues surrounding decision-making in MPAs have also been addressed. A clearer understanding about the nature, location and extent of the boundaries in an MPA, and its relationship to access and availability of tenure information, has been shown to be an important component of MPA decision-making.

Third, the proposed framework has an immediate impact of providing managers of the MPA process with a "template" for use in the construction of an MPA management plan. The template can also be used as an aid to evaluating proposed MPA regulations and to propose changes to regulations (i.e., the Regulations Impact Assessment process). This is in line with the "learning by doing" approach advocated in the MPA program policy.

Fourth, the prototype that was developed demonstrated that there is utility in applying new spatial modeling technologies to promote discussion on issues surrounding: (1) virtually integrating datasets in order to visualize a comprehensive picture of marine

interests on an "as needed" basis; and, (2) the use of this visual approach in MPA decision making. This represents further support for collaborative (or participatory) use of spatial technologies in decision-making.

Fifth, this research extends the work that was funded under the GEOIDE Oceans Governance Project mentioned previously. This work uses the lessons learnt from that project as a starting point to advance scientific research into prototype development and implementation. The research continuum is described in Table 9.6.

Table 9.6: An outline of how the research extends the original GEOIDE NCE project.

GEOIDE NCE project	Thesis Research
Legal model of a proposed marine cadastre – effect of law in the marine cadastre	Tenure dataset identification workflow model - Also identifies which datasets can be used in decision making
No implementation of the legal model	Template that can be used in the Regulations Impact Assessment
Pre-identified data to be used. i.e. orthophoto imagery, bathymetry, parcel data, some ecological data	Data location model-identifies custody of the data
A model describing general data categories	Metadata model
Some qualitative uncertainty indicators	Recommendations on data sharing and access to MPA managers
Integration of data using Spatial Fusion only and viewing data in 2D	Discussion on qualitative uncertainty indicators including their implications on accuracy and precision.
	Integration of data by customizing Spatial Fusion software

Other specific research contributions involving the hydrographic and oceanographic data management process include the following:

1) This research shows that scientific data can be a source of tenure information by assisting in identifying the location and spatial extent of *tenure objects*. The use of data in this manner highlights how natural and anthropogenic phenomena affect tenure in marine space and how, as a consequence, this knowledge impacts on decision-making. In the Musquash MPA case study, this data was used to outline the

options for establishment of boundaries; how the results impacted on the local community's perception of tenure; and the conclusions (*and decisions*) drawn from the experience.

2) This research has demonstrated that the hydrographic data collection and management process can support social capital and facilitate *MPA establishment*. The Musquash MPA case study has demonstrated that this process builds bridges that link science to local knowledge. Although hydrographic survey data collection provides opportunities to work closely with local communities, participation at the data analysis and dissemination level allows community to participate more fully, thus enhancing a sense of contribution and value.
3) Hydrographic survey (and other science-based) data collection agencies involved in *MPA establishment* can learn from the collaborative approach in the Musquash MPA case study research. This approach allowed scientists to interact with the local community before, during and after data collection. If the idea of *MPA implementation* is to ensure that citizens stay involved then there needs to be change at the scientific data analysis and dissemination level. As has been observed in this case study, there must be an element of openness regarding access to data and a concerted effort to make the data understandable. This might mean that the onus of responsibility is on Government to ensure that all the data collected is made available, interpreted into "citizen friendly" format, and the decision making trail arising from data collection well documented.
4) This research notes the importance of including a social capital indicator to measure a community's involvement in the *Canadian MPA establishment* process. This will

allow “social capital” benchmarks to be established which would encourage community participation in *MPA establishment* and *management*.

9.2.4 Research Limitations and Recommendations

This research has noted that one of its strengths is its recognition that ***people play a major role*** in tenure information management. This is also a weakness because the social, economic, political and cultural well being of the community affects the outcome of the MPA establishment process. For example, the inclusive scientific research process in the Musquash MPA **encouraged public participation** in decision-making but it could not **sustain community engagement** in the MPA process. Seven years have passed from the 1998 AOI announcement to the 2005 publication of the MPA regulations in the Canada Gazette. Interest in the Musquash MPA has diminished due to the duration it has taken for the MPA to be designated - leaving many doubtful and many more disillusioned regarding the process. This has implications for MPA policy reform: outlining a very strong case for Government to review how social capital is not only created but also nurtured in MPAs. **Further research is recommended on how to nurture stakeholder support over the long period of MPA establishment.**

A limitation of this research is that it deals with tenure, which involves complex and dynamic human relationships. This will affect the ability to demonstrate similar findings for offshore MPAs and for other MPA programs run by national departments such as Environment Canada and Parks Canada. This will also exist for repeating the findings in other MPAs found within the same geographical and demographical structure. As Rakai [2004] and Nkwae [2006] have both pointed out, tenure research contains dynamic and varying perceptions of the world and research findings may not be readily repeatable as

required by conventional scientific enquiries. Therefore, while it may be possible to repeat the findings for some MPAs, the reality is that a change in the political, social, economic and cultural structure of a geographical area will affect the findings. In such a case, the emphasis should be on the retraceability of this research process. **Further research is recommended to investigate situations when repeatability vs. retraceability of the research process is appropriate.**

Another limitation of the research was the lack of comparable data for the secondary case studies. The MPA establishment process extends over a long period of time. Seven years seems to be the norm for inshore MPAs, from MPA recommendation to publishing of MPA regulations. There is therefore a lot of time, effort and emotion involved in this process and many stakeholders are wary of inquiries regarding the MPA status. In both secondary case studies, some stakeholders were hostile to outside "interference" assuming that any external process (including research to fulfill academic requirements) would further "delay" the MPA establishment process. Additionally, both case studies were located in other Atlantic provinces and travel costs were prohibitive. This meant relying on telephone interviews and email correspondence instead of participation in public meetings and one-on-one interviews with stakeholders. **It is recommended that future research incorporate empirical evidence from all case studies, which may lead to a more complete portrayal and understanding of the role of tenure information in MPA establishment.**

This research developed a conceptual framework that was then tested in three case studies. The framework was meant to analyse problems surrounding tenure information management in MPA establishment. This conceptual model was not implemented using

modern spatial modeling and design technologies. The development of the prototype was purely for stimulating discussion among stakeholders in the Musquash Advisory Committee (MAC) regarding the tenure information categories and characteristics. **Further research is recommended on simulating the conceptual model using a prototype for retrieving and managing tenure information.**

This research has not addressed the possibility of other subsystems that may exist in the administration of marine activities and interests. The research has alluded to these subsystems in Chapter 2, after drawing a parallel between land and marine administration functions. The relationship between tenure information management and these other subsystems is unclear from this research. There are implicit references in the case studies regarding this relationship but there aren't any explicit references available. **Further research is recommended on explicitly describing the existence and nature of these relationships.**

9.2.5 Future Research Directions

This research benefits the scientific community by advancing the discussion on the concept and uses of a "marine cadastre". This research proposes that the vision of a "marine cadastre" be focused on the primary function of providing an inventory of (legal and other) interests that exist; location and spatial extent of the interests in several dimensions; and the holders of those interests. ***Future research directions should include implementing such an information system in marine space.***

This research has focused on the activity of tenure information management in the marine tenure administration process. From the MPA case studies, this research has proposed some benefits arising from improved tenure information management. For

example, the Musquash MPA case study has shown that improved tenure information management leads to identification and prevention of potential conflicts and overlaps especially as new interests are granted in marine space. ***Future research directions should include validating these (and other) benefits for improved tenure information management on marine tenure administration.***

This research complements other marine cadastre research being done internationally. Projects and programs associated with the "marine cadastre" are ongoing in the USA, Australia, New Zealand and Indonesia. The preliminary work of this research (under the Oceans Governance Project) generated a lot of international interest, was the focus of a number of international publications, and has been used as a reference when discussions regarding the "marine cadastre" concept arise. This work is seen as transcending local, provincial, national and international borders and provides the international community with an additional model that can be used in marine resource management. ***Further research on harmonizing the concept of a "marine cadastre" across jurisdictions is needed.***

9.3 Concluding Remarks

The conceptual framework provided here, with its emphasis on tenure information management, and the focus on improving administration of activities and interests in marine space, is an innovative alternative to frameworks that may currently exist. The framework has the advantage of focusing on tenure in marine space, and has highlighted the specific role of tenure information management in *MPA establishment* by demonstrating its utility in determining management plan components. This research has adopted an outcome-based approach as an initial process of testing the framework in a

case study setting, although a more rigorous testing and examination of the approach is recommended. The next step may be to test (1) whether the verified role of tenure information in *MPA establishment* is part of other inshore MPAs across Canada, (2) the utility of the framework and approach in offshore MPAs, and (3) the application of the lessons of this dissertation in the broader context of marine environmental management.

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Appendix I: Perspectives on Marine Management

Appendix 1 - 1: The five-stage marine environmental management process described by the United Nations Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (after GESAMP [1996])

Management Process	Brief description	Major topics
Issue identification/ assessment	Compiling, integrating and prioritizing information that defines the environmental social and institutional context within which management will proceed.	Assessment of: ▪ Coastal systems conditions, ▪ Policy and institutional context, and ▪ Development context.
Program preparation	Consultative and planning process resulting in a management plan.	▪ The characteristics and conditions of coastal systems that cause concern ▪ The governance process itself, i.e., the decision-making process, compliance with voluntary or regulatory controls on various practices and / or behaviour ▪ The factors and processes that regulate these characteristics and conditions.
Formal adoption and funding	Political process including the consideration and adoption of budgets.	▪ Cost/benefit and decision analysis ▪ Discussions over whether the proposed actions can produce expected results
Implementation	Establishing institutional arrangements, monitoring systems, controls regulations, and incentives.	▪ Conflict resolution ▪ Public education ▪ Inter-agency coordination ▪ Training of management/ enforcement personnel ▪ Infrastructure construction ▪ Planning and research on new areas or problems ▪ Development actions;
Evaluation	Research, monitoring, and assessment against baseline data.	What have proceeding generations of programs learnt and how does this affect future management?

Appendix 1 - 2: The six-stage marine environmental management process described by Cicin-Sain and Knecht [1998].

Management process	Management goals in the process
Setting the stage	Developing political will, facilitating public participation and consensus building, as well as choosing top down or bottom up governance approaches.
Infrastructure considerations	Intergovernmental, institutional, legal and financial considerations.
Information management	Developing the science basis for management, determining the data and information requirements, and choosing the preferred methodologies, technology and analytical tools.
Program formulation	Identifying problems, issues, and opportunities; formulating goals, objectives and strategies; establishing boundaries of management areas; assessing capacity for ICM; and designing a coordinating mechanism.
Program implementation and operation	Securing legal, legislative and regulatory mandate; obtaining the necessary institutional arrangements and resources; selecting the appropriate management tools and techniques e.g. zoning; selecting dispute resolution and conflict management approaches; management of public participation)
Program evaluation	Selecting and implementing the methods for performance monitoring and program accountability.

Appendix 1 - 3: Methodologies for Evaluating Management Effectiveness (after Wells and Dahl-Taconi [2006])

METHODOLOGY	CHARACTERISTICS	STRENGTHS	ISSUES TO CONSIDER
World Heritage Management Effectiveness Workbook (http://www.enhancingheritage.net)	Broad-scale Contains worksheets on context, planning, inputs, processes, and outcomes Qualitative and semi-quantitative	Incorporates a wide range of views from internal and external participants on all elements of management	Designed for World Heritage sites, so some adaptation may be needed for other protected areas Funding is necessary for workshops, and possibly for a consultant if MPA managers are not available Pilot assessments have taken 6-12 months on average to conduct
Workbook for the Western Indian Ocean (http://www.wiomsa.org/default.asp?groupid=2004121144044139)	Based on World Heritage method Broad-scale, but with simpler worksheets than World Heritage method Qualitative and semi-quantitative	Incorporates a wide range of views from internal and external participants on all elements of management	Funding is necessary for workshops, and possibly for a consultant if MPA managers are not available Requires 2-3 months to conduct and the capacity to facilitate workshops and surveys
How Is Your MPA Doing? (http://effectiveMPA.noaa.gov)	Fine scale Focuses on individual indicators, selectable from a generic list Offers a variety of methods for data collection and analyses of a wide range of indicators Qualitative and quantitative	Provides guidance on linking objectives with indicators Offers good coverage of biophysical and socioeconomic outcomes Gives detailed instructions for collecting and processing data	Most useful for mature management arrangements (manual advises that it be used for MPAs in existence for 2 years, with a management plan in place) May be time-consuming, and technically and financially demanding Requires clear management objectives as basis for selecting indicators
The Nature Conservancy 5-S framework	Fine scale Provides criteria, questions,	Focuses on threat reduction, with direct relevance to immediate management decisions	Focuses on outcomes only Provides indications for overall

(http://nature.org/summit/files/five_s_eng.pdf)	and scoring systems to assess status and changes in threats and ecological integrity Qualitative	Supports strategic planning by gauging ecological integrity Can be used to compare sites and strategies	systems, not specifics for each species or threat Designed for small-scale and short-term conservation initiatives
World Bank Scorecard to Assess Progress (http://www.MPAscorecard.net)	- Scorecard initially aimed at MPAs supported by Global Environment Facility projects Questionnaire addresses context, planning, inputs, processes, outputs, and outcomes Qualitative and semi-quantitative	-Is quick, simple, and inexpensive Allows comparisons across sites if used consistently Incorporates some site-specific objectives and challenges into scoring	Quality and relevance of results are based entirely on knowledge and perspectives of respondent(s) at one point in time Method designed primarily for self-assessment by MPA staff (does not involve other stakeholders)
MPA Report Guide and Rating System (http://www.coast.ph/text/MPA%20Report%20Guide%20Local.doc)	Contains a survey developed for use as part of a national rating system for Philippine MPAs -Survey addresses mostly context, processes, and outputs Qualitative and semi-quantitative	Is quick and simple Allows comparisons across sites if used consistently	May need to be adapted for use by MPAs elsewhere

Appendix 1 - 4: Perspectives of the marine cadastre concept (also in Nichols et al. [2006]).

Marine cadastre concept	The marine cadastre is viewed as:
System for interest management	A system for managing the complex array of political, social, environmental and commercial interests in the marine environment (an Australian perspective advanced by Fraser [2001]; Williamson et al. [2001]).
Cadastral information system	An information system encompassing both the nature and spatial extent of interests in property, value, and use of marine areas (a USA perspective advanced by Fowler and Treml (2001)).
Tool for managing property rights in marine zones	Has the following qualities: (1) deals with multiple types of interests;(2) has participation from many stakeholders and from many levels of Government;(3) is based on an Information Custodian Model and will need a champion; (4) not wait until all marine claims/issues are settled; (5) is a central part of any Marine Geospatial Infrastructure;(6) is built on "good base data" and use visualization tools;(7) is rights-driven rather than boundary driven (a Canadian perspective advanced by Monahan and Nichols [2003]).
Visual information system	An information system that facilitates the visualisation of the effect of a jurisdiction's public laws on the marine environment e.g. spatial extents and their associated rights, responsibilities, restrictions, and administration (a Canadian perspective advanced by Ng'ang'a et al. [2004]).
Registration system	A means of recording the various rights and responsibilities of those with an interest in the marine jurisdiction (a New Zealand perspective advanced by Hoogsteden and Robertson [1998]; Hirst and Robertson [2001]).
Authoritative data portal	A data portal where land surveyors, lawyers, or researchers can obtain clear information on the location of these rights and interests and their impact on other proposed developments (a Canadian perspective advanced by Stewart and Stewart and Hartley [2003]).
Integrated Information system	An integrated rights and information system that has land information focus rather than a land development focus (a Canadian perspective advanced by Tétreault [2001] and Gagnon [2003]).
Depending on spatial information requirements	A work in progress requiring an appreciation of legal regimes as well as business practices associated with the exploration, exploitation, conservation, and management of the maritime environment (an Australian perspective advanced by Todd [2001]).
Information infrastructure	A working Pilot Cooperative Ocean Information Infrastructure that will link users of ocean information to the sources (a Canadian perspective advanced by Kucera [2004]).
Industry specific	A tool for managing the wide range of data that is currently being maintained within the oil and gas industry (a Canadian perspective advanced by Thomas [2004]).

Appendix 1 - 5: Notes regarding Marine Administration Functions and Processes

Administration Function	Administration Processes	Example of this process in marine space
Property rights transfer	Creation of interests	UNCLOS can be considered to be the framework for international recognition of rights of coastal states. Recognition of indigenous rights in marine space can also be considered as a creation of interests.
	Allocation of interests	Auction of oil and gas leases are perhaps the most publicly visible example. Aquaculture leases are also an example.
	Transfer of property rights between individuals	Formal transfer (e.g., especially purchase and exchange of ITQs) Informal transfer (e.g., inheritance of fishing weirs)
	Reversion of interest back to state	In the case of some traditional fish trapping practices e.g., fishing weirs, interests have been known to revert back to the State with abandonment of these weirs.
	Reallocation of property holdings	Increasingly dominant corporate interests are using transfer of property rights in fisheries to gradually marginalize small scale and part-time fishermen by purchasing their ITQs.
	Financing property rights transactions	Property rights in ITQs can be used as collateral for loans.
Adjudication	Parcel delimitation	Making decisions on the status of jurisdictional and administrative parcel limits still an issue. Some ownership parcels are also delimited. In general, parcel delimitation is done for different sectors.
	Dispute resolution	Resolution of conflicts and uncertainties involving international boundaries well established. Jurisdictional uncertainty still being debated in some national contexts e.g., involving federal-provincial rights. Formal confirmation of existing indigenous tenure now widely implemented.
Revenue Generation	Valuation	Potential value or existing resource value e.g. fish or hydrocarbon deposits, is important before sale of rights to resources.
	Taxation	The purchase of marine interests from the state, and payment of rents or percentage of resource value, is a significant source of State revenue. Fees are also collected for registration of interests and in the provision of information.

Common Property Management		The areas managed in marine space are usually large and are held jointly by individuals, groups, and governments.
Regulation of Property Rights	Marine tenure regulation	Implementing policies and laws affecting land use and ownership. Monitoring land-related activities.
Marine Tenure Information Management	Marine property registration	Available in written and graphical form for certain marine sectors. While traditional ecological knowledge is a focus, it is generally accepted that customary and informal tenure information not widely available.

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Appendix II : MPA Communities and Canadian Information Systems

Appendix 2 - 1: Description of the geographic communities living in areas adjacent to the proposed Musquash MPA (after Thompson [2001,p. 5]).

Community	Population Characteristics
Musquash	This is a bedroom community of 450 scattered around the marshes and uplands at the head of the estuary. The population distribution consists of a small subdivision consisting of 45 homes and a primary sewage treatment lagoon and several other scattered homes. Most Musquash residents commute to Saint John to work or are retired. A five-megawatt capacity hydro generating station owned by the New Brunswick Department of Natural Resources and Energy is located on the East Branch of the Musquash River at the head of tide. This hydro station has been automated and provides only one local job.
South Musquash	This is a community of 75 located on uplands adjacent to the salt marshes that are on the western edge of the upper Musquash Estuary. Most residents are retired while the remainder work in the woods, fish, or commute to Saint John for employment.
Prince of Wales	This is a population of 200 located on the eastern upland overlooking the Musquash Estuary. Most residents commute to Saint John for employment or are retired. There is a small propeller repair shop, which also provides recreational fishing supplies, and a truck repair garage providing employment in the community.
Five Fathom Hole	This is a small community of five homes on an eastern hillside above the Musquash Estuary. Residents are retired, self-employed, or commute to Saint John for work. A Fisheries and Oceans Canada (DFO) Small Craft Harbour fishing wharf is located at the bottom on the hill and is regularly used by seven fishing vessels. The fishermen who operate from Five Fathom Hole live in Lorneville and other communities east of Musquash. A junkyard, gravel pit and a storage area for petroleum-contaminated soil are located in the immediate vicinity of the community.
Lorneville	This is a community of 750 located 3 miles east of the estuary. The area has now become a bedroom community for the city of Saint John. Nevertheless, several fishermen continue to operate from the community.
Chance Harbour	This is a community of 250 located a few miles from the estuary. Thirty-five fishing vessels operate out of Chance and Dipper Harbour. Most of the residents earn their living from fishing, fish processing or fishery support work. The remaining residents commute to Saint John for employment, work nearby at NB Power's Point Lepreau Generating Station, or are employed in seasonal tourism. Chance Harbour has a small convenience store, an inn, seasonal cottages and a craft shop.
Dipper Harbour	This is a community of 250 located a few miles west of Chance Harbour and very similar in size and structure to it. It is also a typical coastal fishing village whose employment structure is virtually identical to Chance Harbour. In addition, Dipper Harbour has a restaurant and a small motel.

Appendix 2 - 2: Information requirements for each step in the framework for establishing and managing MPAs under the Oceans Act [1996] (after [Canada, 1998]).

Step in MPA Framework	Information Requirements
Identification of AOIs	Need for systematic approach to identifying a network of MPAs that reflects all the purposes identified in the *Oceans Act* [1996] by using ecosystem overviews which includes information on [Canada, 1998,p.12]: Existing and proposed MPAs. Existing and planned uses (fishing activities, resource extraction, recreation). Environmental conditions. Ecological characteristics such as key species distribution and critical habitats.
Initial screening of AOIs	From Canada [1998, p.13] Location of proposed AOI. An outline of purposes and rationale for establishing an MPA in this location and how these relate to section 35 of the *Oceans Act* [1996]. A brief biophysical description and socioeconomic profile of the AOI and surrounding areas. The types of management measures and regulations that might apply to the area. The suggested involvement of stakeholders or sponsors in the future management of the area. Contact person, group, and agency leading or facilitating the MPA process. Additional information if required.
AOI Evaluation and Recommendation	From Appendix 1: Checklist for AOI information [Canada, 1998, p.25] The proposing organisation/agency and its contact information. A statement of significance which indicates: Why the proposed area merits MPA status; How it meets the purposes set out in *Oceans Act* [1996]; and, How it meets purposes of other MPA legislation, if applicable. Suggested location, boundaries and current status of the area (including/involving) an analysis of federal, provincial, international, and Aboriginal jurisdictions. Environmental and ecological information such as: Significant species present, their status, and ecological requirements; Important ecosystem and habitat characteristics, including environmental status and known stressors and threats;

	Special features (e.g. upwellings, rivers and estuaries, land-based runoff, and nutrient areas; Important abiotic processes (e.g. physical, chemical, climatic and geological processes). Social and economic characteristics within and near the area such as Present and historic uses; Human activities with actual and potential impacts on the area such as oil and gas activities, shipping, aquaculture, tourism, recreation, and food gathering; Past and present commercial, recreational and aboriginal fishing activities and opportunities; Presence of any aboriginal land claims; Potential socio economic impacts. Alternatives to MPA protection such as: Protection mechanisms already in place in the AOI; Other types of designation e.g. park, conservation area, ecological reserve, wildlife management area; Other types of regulation or conservation measure e.g. fisheries closure. A list of groups and individuals interested in the development of the MPA, including proposed partnering arrangements. Proposed management strategies and regulations inside the MPA and associated rationale for each such as: Suggested management objectives, zoning and other controls; Suggestions or arrangements for research and monitoring, surveillance and enforcement; Suggestions for marking, signage and public awareness.
Development of a management plan for candidate MPA site	From Appendix 2: Checklist for MPA management plan content [Canada, 1998, p.27] Purpose and scope of plan Background and history of site Location and boundaries of area and surroundings. Descriptive information such as: Physical, biological, social and cultural resources; Existing activities and uses in or near the MPA; Existing and potential threats to the MPA and how these might affect the MPA and its management; Existing legal and management framework. Management goals and objectives. Interpretation of regulations (e.g. details on zoning and activity prohibitions). Core and special use zones management. Buffer areas and management of surrounding areas.

	Resource studies plans (inventory, research and monitoring). Awareness, interpretation, education Markers, signs, buoys and charting. Surveillance and enforcement Resource enhancement or restoration proposals. Resource harvesting and use management. Visitor management. Continuing traditional aboriginal or community uses. Participation, including advisory committees. Partnering arrangements. Administration (staffing, training, facilities and equipment, budget). Evaluation cycles and procedures for assessing MPA effectiveness and benefits. Planning cycles and update procedures.
Designation of MPA	Partnering or co-management agreements, and Memoranda of Understanding between DFO and partnering governments and organisations [Canada, p.22].
Management of MPA	MPAs will be managed using [Canada, 1998,p.22]: Existing information. On-going research. Traditional ecological information.

Appendix 2 - 3: Marine information systems taxonomy based ondatabase categories (after Lalwani and Stojanovic [1999]).

Database	Description
Oceanographic	The primary purpose is prediction and pure science arising from collection of parameters concerning the sea surface and water column. The output is computer modelling of current systems and heat exchange.
Biological	The primary purpose is the requirements of fishery research, although some records are obtained from pure oceanographic research. The outputs are models that are used for coordinating fisheries.
Seabed	These are of 2 kinds; hydrographic and physical characteristics of seabed. The main purpose for hydrographic databases is general navigation, naval navigation requirements, laying submarine cables, and offshore natural resource exploitation. The main purpose for databases highlighting the physical characteristics of the seabed is anchoring and operation of fishing gear, offshore oil, aggregate and telecommunications industry operations, coastal engineering, and harbour works.
Meteorological and climatic	The primary purpose of data acquisition is weather forecasting. A key output is computer models of atmosphere and weather systems.

Appendix 2 - 4: Marine information systems taxonomy based on use categories (after Nichols [1981]).

Use Category	Sub categories	Purpose
Natural Resources Management	Geology and Geomorphology	To determine areas of environmental instability and future intense development.
	Meteorology	To determine areas affected by extreme climactic conditions and to determine prevailing winds for pollution spread.
	Renewable resources	To determine areas that may be deteriorating, which are critical to the ecological system.
	General environmental quality	To determine existence and sources of pollution.
	Topography and Hydrography	To identify areas of instability as well as ecological and aesthetic significance.
	Bathymetry	To determine navigational hazards.
	Hydrology	To determine environmentally sensitive areas.
Socio Economic inventory and resource use	Human settlements	To determine areas of over development and congestion.
	Other land uses	To determine critical conflicts in resource use.

Appendix 2 - 5: A historical review of Canadian Marine Information Systems (after Butler et al., [1986])

Information System	Year	Description
Coastal Resource Inventory Mapping	1975	Databases of physical, biological, economic and social of coastal lands and near shore waters. Output was a series of maps and explanatory texts.
Atlantic Coastal Zone Fisheries Atlas	1981	A proposal that was not funded since it was supposed to be a consolidation of existing coastal fisheries and fisheries activities material.
Coastal/ Marine Environmental Information System	1981	Another proposal that was not funded because it relied on existing information to build an interdepartmental coastal and marine information system.
Thematic Atlases	From 1980s	Provided resource and environmental overviews. Examples include Environmental Protection Services Coastal Sensitivity Atlases, Nova Scotia Fisheries Atlases etc that were available as far back as the 1980's.
Computer Interactive Systems	From 1981	Canadian Marine Data Inventory and the Climate Information Service are examples of interactive systems in existence as far back as 1981.
Passamaquoddy Marine Resource Pilot Project	1982	Integrated marine resource information from a variety of resources by means of a GIS.
Marine Resource Information System	1983	Provided an interface for selected marine resource and environmental databases.
Integrated Fisheries Information System	1984	Focused on providing fisheries habitat information for the DFO, Fish Habitat Division.

Appendix 2 - 6: Examples of some of Canada's Marine Information Systems

System	Developed by	Function
Marine Environmental Data Service System (MEDS)	MEDS, a branch of Ocean Science Section, Dept. of Fisheries and Oceans Canada	National ocean data centre for Canada and the data management focus of Ocean Sciences Branch.
Canadian Marine Data Inventory	MEDS	Inventory of data holdings in government, industry, and universities.
Canadian Sea Ice Information System	Centre for Cold Ocean Resources Engineering (C-CORE), Memorial University of Newfoundland	Provision of sea ice information for marine users.
Canadian Hydrographic Service System (CHS)	CHS, a branch of Ocean Science Section, Dept. of Fisheries and Oceans Canada	Provision of navigational information to marine users.
Climatological Ice Data Archival System (CIDAS)	Dept. of Environment Canada, Atmospheric Environmental Service	Archival data storage for Arctic and East coast ice data.
Canadian Oil and Gas Lands Administration System (COGLA)	Legal Surveys Division of Dept of Natural Resources, Canada	Information on administration of oil and gas activities in federal lands.
Climate Research in Ice Software Package (CRISP)	Dept. of Environment Canada, Atmospheric Environmental Service	Manipulation of ice information taken from archived AES weekly ice charts
Environmental Database System (EDBS)	Petro-Canada Exploration limited	Provision of on-line environmental data for the Labrador Shelf, the Grand Banks, and the Scotian Shelf
Shipboard Ice Navigation Support System (SINSS)	Transport Canada and North Water Navigation	Integration of shipboard, satellite, and airborne remotely sensed data in support of historical ice/climatology studies

Arctec Canada Macintosh system	Arctec Canada	Modelling and statistical analysis of oceanographic data
Institute of Ocean Sciences System (ODIS)	Institute of Ocean Sciences, DFO Canada, Sydney, B.C.	Physical, chemical and biological oceanography in support of ocean research
Fisheries Information Network System (FINS)	DFO Canada, Gulf Region, Moncton, N.B.	To facilitate the coordination, access, and flow of oceans and fisheries related data among user groups.
Geophysical database of the Atlantic Geoscience Centre	Atlantic Geoscience Centre, Bedford Institute of Oceanography, Dartmouth, N.S.	Provision of geophysical data for marine areas
Department of Fisheries and Oceans GeoPortal	Canadian Hydrographic Services in partnership with other marine organizations and GeoConnections	Enabler to make it easier to access and share geospatial information associated with marine space.
Atlas of Coastal Habitats and Fishery Resources	Fish Habitat Management Program, Quebec Region	Framework data layers such as the coastline, the outline of watercourses and roads, etc. Thematic data layers describing the spatio-temporal distribution of the main essential habitats of invertebrates, fish and marine mammals. Metadata
Fisheries Information Summary System	Fisheries and Oceans Canada and BC Ministry of Sustainable Resource Management	The system consists of fish and fish habitat, macro-reach and lake classification databases, overlaid on a 1:50,000 digital stream network of British Columbia and Yukon Territory.
The Fisheries Project Registry (FPR)	Fisheries and Oceans Canada and Government of BC	Tracks minimum data about the existence, general nature, location and key contacts for specific categories of fisheries-related projects. These projects include: inventory and biophysical surveys, stock assessment, stewardship, resource planning, restoration and enhancement and economic development.
COINPacific	Land Information British Columbia	Provides access to data provided by COINPacific partners and stakeholders including federal and provincial agencies.

Traditional Fisheries Knowledge Internet Mapping Application.	Department of Fisheries and Oceans, Gulf Region	Provides quick and easy access to geographic knowledge of fisheries resources for the Southern Gulf of St. Lawrence.
National Atlas of Canada	Natural Resources Canada	
Discovery Portal	GeoConnections	Gateway to geospatial data products. Allows one to browse metadata records or search by subject, coverage or product type.
Water Survey of Canada	Environment Canada	National Water Quantity Survey Program
The Community Mapping Network (CMN)		Collects and integrates natural resource information, maps and mapping information,

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APPENDIX III: IDENTIFYING CANADIAN MARINE TENURE INFORMATION MANAGEMENT ISSUES: AN EVALUATION OF THE CANADIAN OIL AND GAS MANAGEMENT FRAMEWORK

One of the challenges in coastal and oceans management is finding a uniform way of describing where different uses are located within a spatial framework and visualizing how current or future activities within a spatial extent impinge on other interests. An artificial framework superimposed over a spatial extent might provide an alternative. This approach is not new as many countries have opted to maintain a grid-based offshore information system based on petroleum exploration and exploitation, mining, construction of public utilities, aquaculture etc. The spatial extent of tenure in these grid-based information systems is usually in the form of licenses or leases, defining the resources being exploited and containing explicitly stated rights, restrictions and responsibilities. More specifically, the grid-based "parcels" in these information systems represent a homogenous bundle of rights associated with the use rights of a particular resource.

Out of the artificial framework options in Canada, this appendix looks at the oil and gas grid framework. It is important to note that there exist other systems based on mining, construction of public utilities, aquaculture etc that also provide valid examples. The oil and gas framework example is evaluated here because it utilises a systematic and expansive artificial framework to collect information on property rights. The appendix begins with a review of interests in marine space.

3.1 Interests in Marine Space

To understand what interests are held in marine space one has to begin by determining who holds what quantity/quality of rights i.e. a definition of who has ownership, jurisdiction or administration in marine space. Nichols et al., [2001] offer the tenure definitions in Table 3.1.

Table 3.1: Tenure terms and their definitions

Tenure term	Description in Canadian context
Jurisdiction	Viewed as the right to govern or legislate. Canada is a federation of provincial, territorial and federal governments. These levels of government have different spheres of authority to legislate, as outlined in the *British North American Act* [1867].
Administration	Viewed as the rights assumed when some jurisdiction is delegated, such as the right to legislate and / or enforce. The appropriate level of government will delegate specific powers to a defined body.
Ownership	Based on the quantity and quality of rights held. Only the Crown (*provincial or federal*) may have absolute ownership. With ownership it is possible to grant property rights to other individuals.

The terms in Table 3.1 can be used to describe tenure in Canadian marine space (*in general*) and the oil and gas management framework (*in particular*). To provide a context for this description, the next section will provide a general description of the international legislative tenure framework of United Nations Convention on Law of the Sea (UNCLOS), and then link it to the national tenure framework in Canada.

3.1.1 From the International to the National Marine Tenure Context

UNCLOS describes the international legal framework that recognises Nations' rights to the marine space. The legislated tenure framework in UNCLOS recognises nations as juridical persons, and provides a public registration system for disseminating information on rights, restrictions and responsibilities. This is similar to land registration, with nations able to provide notice to other countries regarding the location of their boundaries, and general acceptance as to what rights a nation enjoys within these boundaries. More importantly there is a legal framework underlying a nations enforcements of its UNCLOS recognized rights.[1]

[1] For example, the nation may control navigation over of its territorial sea and contiguous waters to prevent infringement of certain laws e.g. customs, sanitary laws etc but other nations have the right of innocent passage.

Canada has ratified[2] UNCLOS and has followed its guidelines to delineate territorial boundaries. It is therefore internationally recognised as having jurisdiction within each of the zones in the UNCLOS framework: namely, Territorial waters, Contiguous Zone, Exclusive Economic Zone, and Juridical continental shelf.

3.1.2 Tenure in the Canadian National Context

Because of the Canadian governance structure, the nation has acknowledged, shared and / or delegated rights in marine space. However, Canada still retains jurisdiction over specific uses (e.g., navigation, customs, etc.) through various statutes. This is demonstrated in Table 3.2.

Table 3.2: An overview of Canadian tenure arrangements

Tenure Arrangement	Description
Shared jurisdiction and ownership	Shared jurisdiction with aboriginal people to offshore resources. In some cases, aboriginal people have ownership of certain lands.
Shared jurisdiction	Shared jurisdiction with provinces, for example the resource management and revenue sharing arrangements made at Federal-provincial level as the Canada–Nova Scotia and Canada-Newfoundland Offshore Petroleum Boards.
Administrative arrangements	Jurisdiction is delegated to provinces in the administering of certain federal laws dealing with certain resources.
Administrative Arrangements	Jurisdiction is delegated to provinces in the administering of certain resources. An example is the Memorandum Of Understanding (MOU) used to transfer administration of Aquaculture from the federal government to a province.

The marine tenure arrangements in Table 3.2 suggest that the Canadian government shares responsibility and ownership with others. This means that coastal and offshore management is also shared with others. The ownership of marine space becomes important in management because it determines who can grant rights and who, as a consequence, can make decisions regarding marine space.

[2] Some countries haven't ratified the convention but have claimed the marine space according to UNCLOS guidelines.

With ownership comes the right to convey property rights to individuals. These may be conveyed in the form of instruments that might convey use rights to individuals, subject to overriding rights of the Crown or First Nation group. Some of these instruments are very explicit in describing the nature of rights conveyed e.g., rights to security and (in some cases) exclusive use [Nichols et al., 1997]. Examples include aquaculture, mineral, dumpsite leases, and fishing licenses.

These tenure instruments have the ability to modify interests by their (implicit or explicit) conditions [Nichols et al., 1997]. However, it is important to note that there is a hierarchy of rights that exists. For example, rights of navigation and access are considered paramount. Other interests e.g. environmental interests, may also be ranked higher than rights that might be conveyed to individuals.

This brings about an interesting observation, that tenure characteristics are important in understanding coastal and oceans management. Tenure can have "temporal"[3] and "paramount" characteristics that will affect other rights granted in marine spaces. For example, paramount rights supersede private rights that may be conveyed. In the specific case of navigation, the main concern is that rights conveyed could produce hazards to navigation. The legislative framework that ensures the dominance of navigation rights is encapsulated in the federal *Navigable Waters Protection Act* [1985].

Tenure also varies with proximity to the coast. Real property conveyance in coastal areas is much more advanced than in offshore areas. The coast provides for ownership rights in waterlots that might have been granted with rights to the upland property. Traditionally, there have been private rights granted or claimed through possession below

[3] Temporal rights vary with space and time, and are encapsulated in the form of privately held licenses and leases (such as fishing licenses or oil and gas leases).

the ordinary high water mark. These include traditional waterlots for wharves and piers, for gathering kelp and seaweed, and for accessing the water by boat [Nichols and Monahan, 1999]. In Canada, this leads to situations where individuals have rights to submerged lands, and can therefore restrict certain public rights in this marine space. In certain jurisdictions, waterlot rights may even be in the form of a heterogeneous bundle of rights (captured as riparian rights) or in the form of a homogeneous bundle of rights (captured as specific use rights such as easements).

3.2 A Review of Tenure Information Management Associated with a Specific Resource

The previous section has outlined several important points regarding the tenure framework in marine space. These are: (1) The international legislative tenure framework is described by UNCLOS; (2) the national marine tenure framework in Canada follows UNCLOS; (3) the national marine tenure framework within Canada consists of recognised, shared, and delegated jurisdiction; (4) marine tenure in Canada is in some cases captured by instruments such as licences, leases, and grants to waterlots; (5) Canadian marine tenure varies with proximity to the coast; (6) understanding Canadian marine tenure is enhanced by two tenure characteristics (hierarchy of rights and temporal nature of rights).

The following section reviews the impact of these observations on the oil and gas tenure information management framework in Canada. The section begins by reviewing the framework.

3.2.1 The Oil and Gas Management Framework in Canada[4]

[4] This discussion in this section is also found in Nichols et al. [2001].

The *Canada Oil and Gas Land Regulations (COGLR)* provide for the division of the offshore for the purpose of administering and disposing of oil and gas rights. This division is based on North American Datum of 1927 (NAD27) and extends up to the Exclusive Economic Zone of Canada. The offshore[5] is first divided into grid areas which are 15'/10' latitude in width and 10' longitude in breadth. Each grid area is then divided into 60, 80 or 100 sections based on the latitude. Each section further subdivided into 16 units per section, which extend 450 square metres as shown in Figure 3.1.

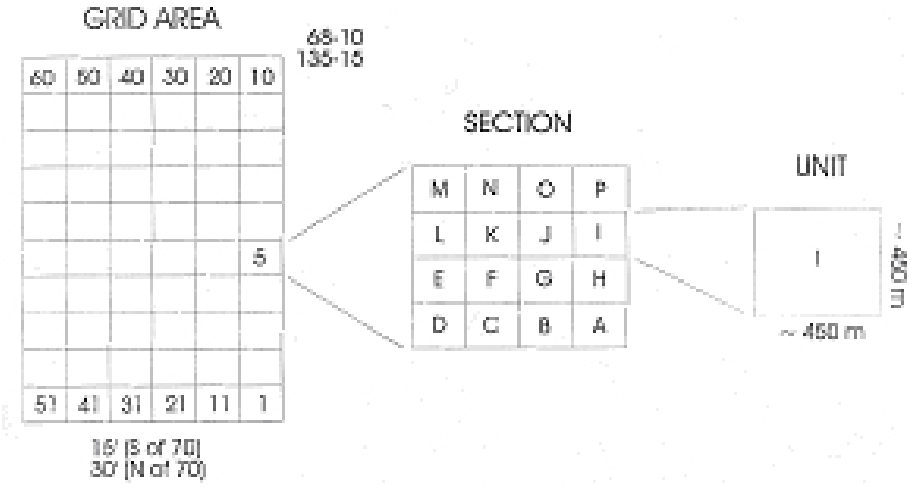

Figure 3.1: Division of Offshore Canada Lands for Oil and Gas (after Canada Oil and Gas Land Regulations)

The width of the Grid area depends on the latitude at which the grid area is located. This is due to the North-South expanse of Canada, which extends to the North Pole. Since the East-West boundary of the Grid area is a meridian (a converging line that meets at the pole), the southern boundary of a Grid area will be longer than the northern boundary as one moves towards the North pole. Therefore, if no correction is introduced, then the Grid areas will be significantly smaller in size as one moves towards the North Pole. Therefore, the spatial area of the grids, sections, and units is dependent upon

[5] The COGLR uses the term "Canada Lands".

latitudes due to the convergence of meridians of longitude as they approach the North Pole. This is shown in Table 3.3.

Table 3.3: The Spatial Reference System for Offshore Oil and Gas Rights [after Nichols et al., 2001]

Division	Boundaries	Reference	Description
Grid Area	North & South boundary are straight lines, joining intersection of parallels of latitude and meridians East/West Boundaries are Meridians	Referred to by latitude and longitude of the North East corner	North of latitude 70 North: East & West boundary – Meridians 30' apart North & South boundary - straight lines, joining intersection of parallels of latitude and meridians, 10' apart. South of latitude 70 North: East & West boundary – Meridians 15' apart North & South boundary - straight lines, joining intersection of parallels of latitude and meridians, 10' apart.
Section	Bounded by straight lines parallel to North and South Boundaries of Grid area	Referred to by section number	Between latitudes 40 -60 and 70 -75 , 100 sections to a grid area Between latitudes 60 -68 and 75 -78 , 80 sections to a grid area Between latitudes 68 -70 and 78 -85 , 60 sections to a grid area
Unit	Bounded by straight lines parallel to North and South Boundaries of section	Every unit referred to by a letter A-P	Each section is divided into 16 units

3.2.2 Regimes in the Oil and Gas Management Framework

From the descriptions in the previous section one can argue that management in marine space, in general, and the oil and gas management framework, specifically, are described by legal, tenure, and information management regimes. This is elaborated for the oil and gas framework in the following subsections.

3.2.2.1 Legal Regime

The exploration and exploitation of offshore oil and gas resources lies with federal government jurisdiction. At the time of federation, the *British North America Act* [1867] assigned to the two levels of government different spheres of authority within which to legislate. Thus, each level of government, federal and provincial, is said to have jurisdiction over different areas of activity. As examples, S. 91(10) gave the federal government jurisdiction over the areas of navigation and shipping, while S. 92(13) gave the provincial governments jurisdiction over property and civil rights in the province.

However, through a series of court cases and agreements, co-governance structures such as the Canada Nova Scotia Offshore Petroleum Board (CNSOPB) and Canada Newfoundland Offshore Petroleum Board (CNOPB), which outline resource management and revenue sharing agreements between federal and provincial governments, have evolved. While the federal government still has jurisdiction[6], these administrative bodies regulate activities and enforce decisions within their areas.

3.2.2.2 Tenure Regime

The federal government outlines a licensing system that is used to reference oil and gas property rights in offshore lands that it confers to individuals. The *COGLR* forms the legislative base for this grid licensing system.

Because of co-governance arrangements that exist between Federal and some Provincial governments, Legal Surveys Division (LSD) [7] runs this system in partnership with CNSOPB and CNOPB. Since LSD has the legislative mandate for the *COGLR*, its responsibility is to define and maintain the grid framework. The boards are responsible for issuing and administering petroleum rights by calling for bids from, and issuing

[6] There is acceptance in the Accords of the federal licensing scheme, administrative system and management regime for the offshore by the provincial governments.
[7] Department of Natural Resources, Canada

exploration licenses to, petroleum companies. These rights are given by legislative mandate to the two Boards through sections 60(1) and 57(1) of the *Canada-Nova Scotia Offshore Petroleum Resources* and *Canada-Newfoundland Atlantic Accords* respectively. The rights that are given out include: exploration (section 65), significant discovery (section 72), production (section 80 (1)) and subsurface storage licenses (section 86).

3.2.2.3 Tenure Information Management Regime

The information about the licenses and leases is registered with the boards. To illustrate this issue further we take the example of Newfoundland and CNOPB. Section 102 of the *Canada-Newfoundland Atlantic Accord* gives CNOPB the legislative power to designate a Registrar who is responsible for the public register of all interests and instruments as described in section 105(1). The only documents that can be registered are interests and instruments (a security notice[8], full/partial discharge/ postponement of a security notice, and transfer/ assignment of a security interest). The Registrar is also responsible for examining the documents that are to be registered.

3.3 Sources of Tenure Uncertainty in the Framework

There are several sources of tenure uncertainty that are identified from a review of the regimes in the oil and gas framework. These are summarised in the following sections.

3.3.1 Uncertainty in Spatial Extent Definitions

Between 1968 and 1971, oil and gas exploratory permits were issued, pursuant to the *Canada Oil and Gas Land Regulations (COGLR)* made under the *Territorial Lands Act (TLA)* [1985]. The *COGLR* was replaced in March 1982 by *Canada Oil and Gas Operations Act (COGOA)* [1985] which provided that the permits be renegotiated into

[8] A notice of a charge or right to an interest – with the exception of an operators lien.

exploration agreements. *COGOA* was then replaced in February 1987 by the *Canadian Petroleum Resources Act (CPRA)* [1985]. Upon proclamation of the *CPRA*, exploration agreements issued under *COGOA* became exploration licences subject to the terms of the new legislation [Canada Gazette, 1998]. [9] Legal surveys associated with these Acts are done under the authority of the *Canada Lands Surveys Act (CLSA)* [1985]. Therefore, the legislative framework for oil and gas management consists of five primary statutes: namely, *CPRA*, *TLA*, *COGOA*, *CLSA*, and *COGLR*.

There are three types of spatial extents defined in the legislative frameworks. *CPRA* is the enabling legislation of *COGLR* and it regulates interests in petroleum in relation to ***Frontier Lands***. *COGLR* regulations also implement *TLA*, which regulates interests in ***Territorial Lands***. COGOA refers to regulating interests in ***Canada Lands*** and the surveys associated with these are done under the authority of the *CLSA*. Each area definition associated with legislation is outlined in Table 3.4.

Table 3.4: Spatial Extent of the Oil and Gas Cadastral Framework

Act / Regulation	Area Definition	Marine Area Legal Description
Canada Oil and Gas Land Regulations	Canada lands	*(a) territorial lands as defined in the Territorial Lands Act [1985], and* *(b) public lands as defined in the Public Lands Grants Act for the sale, lease or other disposition of which there is no provision in the law,* *…and includes land under water; (terres du Canada)*
Canada Petroleum Resources Act [1985]	Frontier Lands	*(b) submarine areas, not within a province, in the internal waters of Canada, the territorial sea of Canada or the continental shelf of Canada,* *but does not include the adjoining area, as defined in section 2 of the Yukon Act;"*
Canada Lands Surveys Act [1985]	Canada Lands	*(b) any lands under water belonging to Her Majesty in right of Canada or in respect of any rights in which the Government of Canada has power to dispose.*
Territorial Lands Act [1985]	Territorial Lands	*"territorial lands" means lands, or any interest in lands, in the Northwest Territories or Nunavut that are vested in*

[9] See http://canadagazette.gc.ca/partII/1998/19980708/html/sor349-e.html#a.

		the Crown or of which the Government of Canada has power to dispose

From the legal descriptions outlined in Table 3.4, one can see that there are several definitions of the spatial extent over which legislation is effective. This lack of harmony over the descriptions means that there exists some uncertainty regarding the spatial extent of the oil and gas framework.

3.3.2 Uncertainty due to determining Provincial Jurisdiction

Nichols et al., [2001] have noted that there may be sources of uncertainty in the spatial extent of the framework arising from determining Federal/Provincial jurisdiction. Prominent researchers such as LaForest [1973] have indicated that there may be contentions arising out the *vague jurisdictional description* of the phrase "under all lands forming part of Canada ***BUT NOT WITHIN ANY PROVINCE***" (emphasis added). This is because Federal and Provincial governments have different opinions regarding how to distinguish water-covered lands that are within a province. This may not be important until a particular issues arises, in which case several Canadian Supreme Court decisions have partly addressed jurisdiction over offshore lands (see for example, *Re: Seabed and Subsoil of the Continental Shelf Offshore Newfoundland* [1984]).

The Supreme Court cases have not only made determinations regarding jurisdiction but have also made specific determinations regarding the extent of federal government ownership. For example, a Supreme Court decision addressed federal government ownership of the bed of the British Columbia offshore by extending it from the low water mark to the outer limit of the territorial sea, excluding inland waters (see for example, *Re: Offshore Mineral Rights of British Columbia* [1967] and *Re: Ownership of the Bed of the Strait of Georgia and Related Areas* [1984]).

Supreme Court decisions are affected by the claims that provinces may bring before the court. LaForest [1973, p. 464] argues that individual provinces could probably sustain claims to ownership of internal waters based on its ownership of those waters prior to the province joining Canada. This is a major source of jurisdictional uncertainty especially in areas where a court decision has not been pursued yet.

Apart from Supreme Court decisions, there also exist alternative solutions, in dealing with Federal/Provincial jurisdiction. These exist in the form of accords or Memorandums of Understanding (MOUs) and are referred to in some literature as cooperative federalism. These have been adopted in order to circumvent the issue of jurisdiction in offshore waters (see for example, *Canada-Newfoundland Atlantic Accord Implementation Act* [1987] and *Canada-Nova Scotia Agreement on Joint Management and Revenue Sharing* [1988]). The uncertainty brought about by the unsystematic adjudication of jurisdiction in the offshore is outlined in Table 3.5.

Table 3.5: Uncertainty in the coverage of the Oil and Gas information network [after Nichols et al., 2001]

Area of Uncertainty	Rationale	Status Quo
Public Harbours and the outer limits of harbours whether under federal or provincial ownership and control;	LaForest [1969, pp. 49-68] discussed the physical and use requirements which the courts have considered when addressing the issue of whether or not a specific harbour had been transferred at the time of a province joining Canada. The federal interest in harbours is a property one - it involves ownership of the bed. LaForest indicated that the physical extent of the various harbours was not addressed by the *British North America (BNA) Act* and thus is the subject of doubt.	The *BNA Act* provided that on confederation, all public harbours were to be transferred to the Federal Government. Many harbours in Canada considered to be owned by the federal government and fall under the definition of Canada Lands
Historical Bays (e.g., Bay of Fundy, Baie de Chaleur, Hudson;s Bay) and their outer limits;	*LaForest [1973, p. 464] stated that with specific reference to the internal waters off the Atlantic provinces* *"... Historic claims could be made that all bays in these provinces, including in particular the large bays, Chaleurs, Conception, Fundy and Miramichi, were inland bays."*	
Territorial Seas around the Atlantic Provinces and Quebec that may have existed at Confederation (three or twelve nautical miles);	After reviewing the issue of the ownership of the territorial sea, LaForest [1973 at p. 468] concluded that the issue could not be considered as settled in Atlantic Canada; at least in as far as the first three nautical miles are concerned. LaForest pointed out that under international law at the time of Confederation, the territorial sea would have only extended three nautical miles from low water and therefore, any provincial claim would probably be limited to that extent.	In *Re: Newfoundland Continental Shelf.* (1984), 1 S.C.R. 86, the Supreme Court found for Canada when asked to answer whether Newfoundland had the right to explore and exploit natural minerals and resources on the continental shelf. The limitation of the case to the Hibernia area, however, excluded "consideration of the territorial sea, i.e. waters adjacent to Newfoundland within formerly three, now twelve, nautical miles thereof." This question has yet to be resolved in the Supreme Court, although the Newfoundland Court of Appeal has

		issued an opinion that Newfoundland owns the three-mile-wide belt adjacent to it.
Areas such as the Bay of Fundy and Northumberland Strait where provincial boundaries were defined as midlines before Confederation;	Sookbir [1998] did address the situation of the Northumberland Strait between New Brunswick and Prince Edward Island, where he argued that the stronger case was that those waters are Canada Lands.	Northumberland strait is viewed as Canada lands. Bay of Fundy is also considered Canada lands although certain activities, such as aquaculture, are under provincial jurisdiction[10].
Internal Waters enclosed by straight baselines that may be claimed by provinces as "part of the land".	LaForest [1973, p. 464] stated that the internal waters off the Atlantic provinces before Confederation... "included ... all bays and straits, or parts thereof, capable of being enclosed by lines of six marine miles from shore to shore.." He further argued that the individual provinces could probably sustain claims to ownership of those internal waters today.	A pair of Supreme Court of Canada cases [*Reference re Offshore Mineral Rights of British Columbia [1967] S.C.R. 792*, and *Re; Ownership of the Bed of the Straight of Georgia, [1984] 1 S.C.R. 388*] determined that the federal government owns the bed of the offshore extending from the low water mark excluding inland waters to the outer limit of the territorial sea, and the provincial government owns the bed of Juan de Fuca, the Strait of Georgia, Johnstone Strait and Queen Charlotte Strait.

[10] British Columbia, New Brunswick, Nova Scotia, Prince Edward Island and Newfoundland all regulate the aquaculture industry. There is the outstanding question of the status of the lands on which the provinces are granting aquaculture leases or other rights. If these lands are Canada Lands, then the grants will be ineffective because the provincial governments have no interest to grant.

3.3.3 Uncertainty due to Outstanding Interests of First Nations in Canada

The Provincial, Territorial and Federal governments are acknowledging that there may be rights existing in the offshore that may be vested in First Nations. These are affecting the nature and extent of tenure arrangement in marine space. Cases such as *R. v. Marshall* [1999] indicate the importance of First Nations rights to harvest resources in marine space. The decision made it clear that the Supreme Court judges believed that First Nations' right extended beyond fishing for eels to other ocean resources. However, First Nations were obliged to operate within the framework of federal government rules.

To demonstrate how the Marshall case may bring about uncertainty in property rights in the offshore, the following points are noted about the Marshall case ruling [Coates, 2000]:

1) The Court declared that the federal government, as the steward of ocean resources, could 'within its proper limits' regulate the coastal fishery, including Aboriginal fishing activity. Regional fishers and governments worried in their interventions before the Supreme Court that an unregulated right would give First Nations effective control over the fishery.
2) In addition, the Court held that any regulations limiting Aboriginal fishing rights had to be fully justified, explained, and reasonable. These limits had to respect the federal government's fiduciary, or trust, relationship with First Nations. Infringement of fishing rights would, in normal circumstances, involve compensation.
3) It is important to note that a clarification to the ruling also followed, indicating that justices had not heard evidence and arguments relating to such issues as logging, mining, and offshore natural gas. The door was not barred on these issues, but a clear burden of proof was established.

3.4 Specific Issues Surrounding Tenure Information Availability and Access

The previous sections have described information availability challenges that arise from uncertainty in determining the spatial extent of the oil and gas framework. However, there are other shortcomings that limit the effectiveness of the framework in decision support. Specifically, these shortcomings deal with tenure information availability and access. These are outlined in the following subsections.

3.4.1 Fragmented Tenure Information

The procedure for defining the oil and gas licenses and leases is described in the *COGLR*. Since the COGLR refers to Canada Lands, surveys of oil and gas leases are done under the *Canada Lands Surveys Act* [1985].[11] Survey plans have to be submitted to the Surveyor General indicating: position, direction and length of the boundaries of grid areas in offshore Canada Lands; positions of existing wells; nature and position of monuments; and rights of way.

It is important to note that the survey identified here is only for the purpose of confirming the location of wells at structure surface and not to confer any legal rights. Therefore, even though the Surveyor General might approve a legal survey plan showing the location of a well, this does not indicate that legal rights to place other works on the surveyed position have been granted. In effect, the rights to explore, develop and produce oil and gas are granted without the need for a legal survey.

Information about directional drilling or subsea structures such as pipelines is usually considered proprietary and not disclosed. In Canada, some of this information is submitted to the administrative boards (such as CNSOPB and CNOPB) but may not be

[11] This Act not only sets out the powers and duties of Canada Lands surveyors, but also describes the jurisdiction within which they work. This is described as "…the territories and Nunavut; reserves and Indian lands; and generally lands under water that are outside any province, owned or administered by the federal government".

accessible or available to other users of marine space and the general public [Nichols et al., 2002]. ***Therefore, the first information management challenge is that information about the framework is fragmented: namely, (1) geotechnical, seismic, multibeam surveys information is in the custody of individual companies; (2) well location survey plans are in the custody of the Surveyor General; (3) leases and licences information is in the registry run by LSD/CNSOPB/CNOPB.***

3.4.2 Missing Tenure Information

Where licenses and leases have been allocated, there will essentially be little (or no) additional tenure information available for these locations. Part of the problem is outlined in the previous section, that is, the custody of tenure and other information is fragmented over several agencies, departments and institutions. Unfortunately, this gives the (wrong) impression that there are no other resources or rights present in a lease location. One is rarely able to determine whether rights granted with the leases or licenses are to the exclusion of other use rights. ***Therefore, the second information management challenge is that other tenure information that may exist within a lease location is not accessible within the oil and gas information management framework.***

3.4.3 Impact of Legal Complexity on Tenure Information Availability

The oil and gas tenure information management regime does not facilitate visualising of how Licenses and leases affect existing rights such as navigation and fishing. This also goes for any other rights that might exist as a result of the oil and gas lease (e.g., pipeline rights of way or easements). For example, the development of an oil or gas lease involves interaction with the seabed where cables and pipelines are located. These other uses are

directed by different legal regimes and their tenure information regimes are also significantly different.

Lets take the example of telecommunications cables to illustrate the legal complexity arising from multiple human use of marine space. In Canada, if there is an international cable that is laid in an area where an oil and gas license or lease has not been previously granted, it is done under a permit issued by Industry Canada under the *Telecommunications Act* [1993] and the *International Submarine Cable Licence Regulations* [1998]. When applying for a domestic cable one needs to apply under the *Navigable Waters Protection Act, Canadian Environmental Assessment Act, Canadian Environmental Protection Act,* and *Fisheries Act*[12][Coffen-Smout and Herbert, 2000].

The previous example demonstrates the third information management challenge, which is that legal complexity (and associated requirements) contributes to tenure information management complexity.

3.4.4 Poor Enforcement of Tenure Information Improvement Guidelines

The survey of pipelines on (onshore) Canada Lands usually allows the pipeline operator to obtain an easement along the pipeline. This provides some control or protection from unauthorized access into the pipeline corridor. If a similar approach to offshore lands were to be adopted, two primary questions would have to be addressed: (1) how wide the easements should be, and (2) what kinds of rights and restrictions should be imposed on them.

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[12] According to Coffen-Smout and Herbert [2000], the *Navigable Waters Act* [1985] is triggered if the construction affects navigation; the Canadian Environmental Assessment Act allows for consideration of socio economic impacts arising from the perceived change in the environment (i.e. how fishing might be affected); the ocean dumping provisions of the Canadian Environmental Protection Act are triggered in case of cable burial; and, the Fisheries Act is triggered in case there is alteration of fish habitat.

To address both issues would require regulations that would also enforce registration of rights. This latter point is important, as the characteristics of information would have to be defined. For example, evidence of the location of the pipeline, its deflection points and any other intermediate points, would have to be provided so that there is an element of providing public notice. The *Addendum to Surveying Offshore Canada Lands for Mineral Resources Development* already recommends that data collected about the final position of the pipeline relative to control, its position relative to other structures, the depth of the cover, and sea bottom conditions should be presented on a plan to be submitted to the Surveyor General. However, this is not being necessarily followed. ***Therefore, the fourth information management challenge is that there are guidelines proposed to improve tenure information but there is limited legislative mandate and enforcement mechanisms available.***

3.4.5 (Reduced) Legal Liability from Poor Tenure Information

Coffen-Smout and Herbert [2000] point out that interaction between cable operations and other ocean activities, after a submarine cable is laid, is not controlled by legislation. They also indicate that legal remedy available in cases of damage to submarine cables is through civil liability with respect to private property. For example, in the event where there is cable damage caused by external aggression, legal action in civil court (claim for damages) seems to be the preferred approach. In most cases, it is meant to have two objectives; to discourage intentional or negligent acts that may disrupt cable communications; and to provide compensation to cable owners for damages incurred when a cable is damaged [Wagner, 1995].

Other legal issues associated with cables and pipelines are outlined in Table 3.6. ***From this, one can conclude that the fifth information management challenge is that legal responsibility arising from providing (poor) tenure information is in some cases considered to be a civil liability (and therefore has lesser consequences).***

Table 3.6: Some Issues surrounding Cables and Pipelines (after Coffen-Smout and Herbert [2000])

Sample Issues	General findings
Who is responsible when a cable gets damaged?	Article 113 of UNCLOS provides that states should make punishable offense not only to break a cable but also to engage in conduct calculated or likely to result in such breaking or injury. Article 115 requires that all states adopt laws to ensure that vessels owners who prove they sacrificed fishing gear or an anchor in order to avoid damaging a submarine cable can recover the loss against the cable owner, provided the vessel took precautionary measures beforehand [Coffen-Smout and Herbert, 2000].
How does one determine encroachment on an individual's rights?	In order to seek compensation for cable repair costs through civil litigation under private property law, the cable owner as a plaintiff has the onus to prove negligence on the part of the master of a fishing or cargo vessel snagging (and damaging) a cable. Article 113 of UNCLOS provides that states should make punishable offense not only to break a cable but also to engage in conduct calculated or likely to result in such breaking or injury. Article 115 requires that all states adopt laws to ensure that vessels owners who prove they sacrificed fishing gear or an anchor in order to avoid damaging a submarine cable can recover the loss against the cable owner, provided the vessel took precautionary measures beforehand [Coffen-Smout and Herbert, 2000].
What procedure is in place to ensure that information on the delineation of a cable route is available?	After the cable is installed (and buried in some cases) efforts are usually made to publicize the cable route. Nautical charts may be updated and appropriate "Notice to Mariners" issued. Many cable owners supplement this by distributing " cable warning charts" or "cable awareness charts". Education and awareness programs are supplemented with cable patrol and surveillance programs. Aircraft is sometime used to monitor certain portions of the seabed where there is heavy usage [Coffen-Smout and Herbert, 2000].
Are there any property rights created when a cable or pipeline is laid?	There is international interest in this issue as organisations such as the International Cable Protection Committee are now calling for the development of national legislation to establish a corridor around cables where other marine activities may be restricted. In an Atlantic Canada fishing industry publication, Teleglobe Canada went ahead and advertised an "easement" that included a 2-nm mile exclusion

	zone along cable routes for cable bottom fishing. Although there is no legal basis for this claim, there still exists legal liability for willful or negligent damage of private property. The fishing industry is particularly concerned about the loss of fishing areas where *de facto* exclusion zones were declared. The establishment of such a corridor would require a cadastral survey since property rights (in the form of rights of way) are created.

3.4.6 Fragmented Approach to Providing Tenure Information

A cable laying company may select a cable route and share construction plans with other seabed users to avoid conflicts at sea during installation. However, information about an inactive (or decommissioned) cable is rarely relayed [Coffen-Smout and Herbert, 2000]. This will cause a problem because both active and inactive cables will impact on seabed use.

A "Notice to Mariners" is issued detailing installation activities and negotiations required to cross or operate near other offshore structures [Wagner, 1995]. After the cable is installed (and buried in some cases) efforts are usually made to publicize the cable route. Nautical charts may be updated and appropriate "Notice to Mariners" issued [Coffen-Smout and Herbert, 2000]. Many cable owners supplement this by distributing " cable warning charts" or cable awareness charts" [Wagner, 1995]. ***Therefore, the sixth information management challenge is that there are several methods available for disseminating information associated with the oil and gas industry, which makes it difficult to obtain a complete picture of marine space use.***

3.4.7 Lack of a Champion to Advocate for a Unified Tenure Information Management Approach

Organizations such as the International Cable Protection Committee (ICPC) are now leading the call for improved legislative and information frameworks for oceans use management. The ICPC promotes the safeguarding of submarine telecommunications cables against man-made and natural hazards. It has recently called for the development of regulations to reduce the risk of cable damage by: establishing a corridor in which other marine activities may be restricted; setting a legal framework that entitles the cable maintenance authorities to claim for compensation in the case of cable damage; and, establishing fines or penalties for damages to cables arising from willful misconduct and / or culpable negligence [Coffen-Smout and Herbert, 2000].

The leadership role on improved tenure information management issues, demonstrated by the ICPC, needs to be reflected within national jurisdictions and across industries and uses. ***Therefore, the seventh information management challenge is that stakeholders in marine space do not seem to speak with one voice or highlight the urgent need for improved tenure information.***

3.5 Lessons Learnt from the Oil and Gas Framework

From the foregoing discussion, it is possible to highlight the following lessons learnt about tenure information management in marine space:

1) The oil and gas tenure framework is impacted by pre-existing tenure arrangements. For example, the Federal/Provincial/First Nations jurisdiction uncertainty.
2) The oil and gas tenure framework can be used to elaborate on the relationship between legal, tenure, and tenure information management regimes. A review of tenure information management regimes provides for a better understanding of information challenges.

3) The oil and gas framework highlights fundamental flaws in the tenure information management approaches as shown in the Table 3.7 below:

Table 3.7: Shortcomings of the Oil and Gas tenure information management regime

Shortcoming	Description
Incomplete tenure coverage	This framework only describes licences and leases and none of the other rights that might exist in marine space e.g. paramount rights. It provides a fractured set of data; since data on mining, construction of public utilities, aquaculture etc is cannot be retrieved using this tenure information management regime
Incomplete oil and gas tenure information coverage	Licences and leases exist only for areas where they have been granted. Vast areas do not have any tenure information associated with them in the Oil and Gas framework.
Multiple registration and information dissemination arrangements	Information on well locations and their relationship to grid framework are registered with the Surveyor General and NOT the registrar. This represents multiple tenure information dissemination methods and alternative methods for providing notice. This makes it difficult to obtain a complete picture of marine space use.
Multiple administrative arrangements	The acknowledgement, sharing and delegation of responsibility between governance structures, such as the Offshore Petroleum Boards and the Canadian government, leads to a fragmentation of data. It also leads to multiple data custodians.
Legislative complexity	Legal complexity in marine space leads to information management complexity. For example, the legislative framework for oil and gas management consists of several statutes. When combined with legislated human use of the same marine space, a clear picture of who controls what becomes very difficult to visualise.
Poor enforcement of guidelines	Guidelines for coordinated tenure information management have been proposed to address tenure information availability. Unfortunately, they are poorly enforced, as there is no legislative mandate to enforce them.
(Reduced) liability for poor tenure information	The legal consequences of providing poor tenure information (e.g., when it results in destruction of private property) fall under civil liability. Therefore, legal responsibility arising from poor tenure information is generally viewed as having lesser consequences.
Lack of a champion	Stakeholders in marine space do not seem to speak with one voice or highlight the urgent need for improved tenure information.

From the foregoing observations, this research concludes that a tenure (or property) information management model can be used to address some of the shortcomings highlighted. This will improve our understanding of how tenure information can be used for decision support in marine areas.

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Appendix IV: Basin Head MPA and Gilbert Bay MPA Objectives

Appendix 4 - 1: Information to support the Basin Head MPA objectives (after DFO [2002a])

Report	Description
Ecological Assessment of Basin Head	This study looked at the importance of Irish moss, structure of the basin, sand dune instability, flow rates, bathymetry, bottom types, water quality, habitats and dynamics of the basin.
Community use of the Basin Head Lagoon Island Nature Trust	The objective of this study was to inventory and describe the historical, present, and potential uses of Basin Head and surrounding areas.
Habitat mapping and characterization of Basin Head	The objective of this report was to gather data on biological and physical characteristics of the lagoon. The study focused on the stability of shorelines, diversity of habitats, characteristics and area of habitat components
Basin Head Stream Assessment	Ability of streams to support fish populations and other issues to be addressed in future watershed management.
Other studies	Transfer of Basin Head moss to other estuaries, sand dune stability, nutrient status and growth of sea lettuce, Irish moss stock status, potential application of water quality and circulation models to assess nutrient status. Also include validation of water quality models, development of watershed model, and development of seed stocks for the Basin Head Irish moss to other aquaculture sites on PEI.

Appendix 4 - 2: Information to support the Gilbert Bay MPA goal and objectives (after DFO [2002b])

Report	Description
Genetic Analysis of Gilbert Bay cod.	Studies by Beacham et al [2000] and Ruzzante et al [2000] identified the Gilbert Bay cod as being genetically distinct from all other northern and Atlantic cod.
Biophysical Overview of Gilbert Bay: A Proposed Marine Protected Area in Labrador	The study by Morris et al [2002a] describes physical ecosystem components such as primary production, benthic habitats including flora and fauna associated with Gilbert Bay and surrounding area. The report also summarized the current state of knowledge of the cod in Gilbert Bay.
Overview of Commercial Fishing in Gilbert Bay Labrador; Fish Harvesters Local Knowledge and Biological Observations.	The study by Morris et al [2002b] combines information collected from several fish harvesters to describe fishing activities and fishery resources in Gilbert Bay. It was based largely on the observations of commercial fish harvesters. Habitat descriptions are also included.
Socioeconomic Overview of Gilbert Bay, Labrador	The study by Murphy et al [2002] described the history, activities, users and uses of resources of the area in an effort to illustrate the social, economic and cultural values within Gilbert Bay.
Multi-beam survey of Gilbert Bay October 2002.	The study collected multi beam data on the bottom relief of Gilbert Bay. Through analysis of the data, general bottom classification has been identified (i.e., shallow sills were identified). This information was key for identifying management zones within Gilbert Bay.
Abundance of resident Atlantic cod in Gilbert Bay, Labrador.	This study by Morris et al [2003] used mark-recapture data collected from an arm of Gilbert Bay, catch per unit effort data from research sampling, and commercial tag return data to estimate the size of the resident cod population (~70 metric tonnes) from 1998-2002. This report has been key in confirming critical habitat (spawning and juvenile habitat) and population of Gilbert Bay cod resulting in management measures for the MPA.
Other Studies.	Other studies have looked at the life characteristics, local adaptations and migration patterns of the Gilbert Bay cod (e.g., Green and Wroblewski [2000]). Research has also been focused on the cod's colouration, nutritional value and cod grow out potential (e.g., Wroblewski and Hiscock [2002]). A multi-beam survey of Gilbert Bay was conducted in 2002. The analysis of which will provide the foundation for habitat mapping and hydrographic modeling.

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APPENDIX V: A REVIEW OF TENURE (PROPERTY) INFORMATION MANAGEMENT REQUIREMENTS FOR THE MUSQUASH MPA

In this appendix, tenure information management challenges in the Musquash MPA are outlined. The research begins by outlining the challenges in identifying tenure data sources, specifically, the challenge of stakeholder identification. The research then proceeds to outline the challenge in determining form, format and content of tenure information and the possible impact of this on MPA establishment.

The research then proceeds to demonstrate how a prototype that was created to aid in visualising tenure information was able to highlight tenure data accessibility/availability shortcomings and the impact of this on MPA establishment.

5.1 The Importance of Determining Tenure Stakeholders in the Musquash

For the Musquash MPA, the major stakeholders consisted of real property holders, as well as other individuals/groups that used resources or carried out activities in the Musquash area and surrounding areas. The importance of tenure stakeholders is based on the assumption that human actions (activities and use) are dependent on tenure holders. Therefore, it is necessary to identify stakeholders from several (formal and informal) data sources in order to ensure that (1) stakeholder rights are taken into consideration and, (2) stakeholders are co-opted into the MPA establishment process. The following sections outline the data sources for identifying stakeholders.

5.2 Preliminary Identification of Stakeholders in the Musquash MPA

In order to determine human actions in the Musquash MPA, a review of was carried out of several datasets that would indicate activities and uses within (and surrounding) the Musquash area. First, a preliminary analysis of census datasets was carried out. Second, an analysis of ownership, land use, and parcel descriptions datasets was carried out. The analyses are described in the following sections.

5.2.1 Stakeholder Identification from Data on Activities

Statistics Canada (census) data was used to identify human actions (activities and use) in the proposed MPA. Data was retrieved for two enumeration areas located in the Musquash Parish and City of Saint John. These two administrative areas encompass the lands surrounding the Musquash estuary.

5.2.1.1 Description of Datasets

The data used contained social and economic indicators, which provided insight into existing activities in the area. Table 5.1 describes some of the data categories that were evaluated for each enumeration area.

Table 5.1: Industry categories in the Statistics Canada dataset

Industries in an Enumeration Area
Division A - Agricultural and related service industries
Division B - Fishing and trapping industries
Division C - Logging and forestry industries
Division D - Mining (including milling), quarrying and oil well industries
Division E - Manufacturing industries
Division F - Construction industries
Division G - Transportation and storage industries
Division H - Communication and other utility industries
Division I - Wholesale trade industries
Division J - Retail trade industries
Division O - Educational service industries
Division P - Health and social service industries
Division Q - Accommodation, food and beverage service industries
Division R - Other service industries

As previously mentioned, the two administrative areas encompassing the Musquash MPA are Musquash Parish and City of Saint John. Census datasets were retrieved for enumeration areas located in these two administrative areas. Two datasets (1991 and 1996) were retrieved for each enumeration area. These were used to evaluate

employment patterns in the area adjacent to the Musquash MPA. Enumeration areas 13010261 and 13010263 are shown in Table 5.2 and 5.3 respectively.

5.2.1.2 Overview of Stakeholders in Enumeration Area 13010261

Table 5.2 notes that the major industry employer for people living in Enumeration Area 13010261 in 1991 was the manufacturing industry. Communications, health and social services and fishing and trapping industries followed. This trend changes in 1996 where the Tourism industry (represented by accommodation, food and beverage service industries) has grown substantially.

Table 5.2: Count of individuals working in industries in 1991 and 1996 (enumeration area 13010261)

Industries	Count in 1991	Count in 1996
Agricultural and related service industries	0.0	0.0
Fishing and trapping industries	35.0	35.0
Logging and forestry industries	0.0	0.0
Mining (including milling), quarrying and oil well industries	0.0	0.0
Manufacturing industries	70.0	30.0
Construction industries	20.0	10.0
Transportation and storage industries	15.0	10.0
Communication and other utility industries	45.0	40.0
Wholesale trade industries	15.0	25.0
Retail trade industries	20.0	25.0
Educational service industries	20.0	10.0
Health and social service industries	30.0	25.0
Accommodation, food and beverage service industries	10.0	55.0
Other service industries	25.0	15.0
All industries	*305*	*280*

The Tourism industry employed 45 more people living in this enumeration area. This was one of several industries that employed more people living in this area. However, there were also several industries that showed a decline in employment from this area from 1991-1996. The greatest change in employment for people living in this enumeration area was in the manufacturing industry where there was a loss of 40 jobs

over this period. The general trend from 1991 to 1996 shows a drop in 85 employment positions and an increase in 60 positions over the same period. Combined, this shows a loss in employment for 25 employees from this enumeration area over the 1991-1996 period. While there were 305 individuals in this area employed in 1991, there are only 280 employed in 1996.

5.2.1.3 Overview of Stakeholders in Enumeration Area 13010263

Table 5.3 notes that the major industry employer for people living in Enumeration Area 13010263 in 1991 was the manufacturing industry. Retail trade industries, health and social services, and communications and utilities followed. By 1996, construction was the largest employer industry.

Table 5.3: Count of individuals working in industries in 1991 and 1996 (enumeration area 13010263)

Industries	Count in 1991	Count in 1996
Agricultural and related service industries	0.0	0.0
Fishing and trapping industries	0.0	10.0
Logging and forestry industries	0.0	0.0
Mining (including milling), quarrying and oil well industries	0.0	0.0
Manufacturing industries	55.0	40.0
Construction industries	10.0	45.0
Transportation and storage industries	15.0	10.0
Communication and other utility industries	30.0	35.0
Wholesale trade industries	10.0	20.0
Retail trade industries	45.0	35.0
Educational service industries	15.0	10.0
Health and social service industries	35.0	25.0
Accommodation, food and beverage service industries	0.0	10.0
Other service industries	10.0	10.0
All industries	*225*	*250*

Several industries showed a decline in the number of employees from this enumeration area. The largest was in the manufacturing industry, which declined by 15-employee position in the period 1991 to 1996. In total, five industry categories saw a

decline of 45 employee positions in this enumeration area. There were also several industries with an increase in employees from this enumeration area. The largest increase was in construction industry with 35 more employees between 1991-1996. In total, five industry categories saw an increase in 70 employee positions in this enumeration area.

Combined, this shows an increase in employment for 25 employees from this enumeration area over the 1991-1996 period. While there were 225 individuals in this area employed in 1991, there were 250 employed in 1996.

5.2.1.4 Tenure Information from Census Information

It is clear that there is a high dependency on resource-based industries in this enumeration area. The general suggestion is that individuals in this area relate closely to the land and marine space. In fact, resource-based industry such as the fishing and trapping held steady from 1991 to 1996, for enumeration area 13010261, and grew by 10 individuals for enumeration area 13010263.

This particular industry represents a steady source of income and employment in the area and is part of the social fabric of the area. It usually consists of the same individuals (or families) enjoying recognition of rights over an extended period of time. These individuals may also be able to provide valuable historical information regarding use rights associated with this industry.

The decline in employment number for enumeration area 13010261 can be interpreted in several ways e.g., (1) voluntary loss of work through retirement, (2) involuntary loss of work due to plant closure or personal disability, (3) outward migration from enumeration area 13010261 to enumeration area 13010263. Interviews with individuals living in this area [Thompson, 2003] suggested that although all three

interpretations were valid, there was high unemployment in the area suggesting a loss of jobs in the area.

Any program that may be introduced in this area, such as the Musquash MPA, may be viewed from two perspectives i.e., (1) viewed negatively in the context of affecting the pristine nature of the area, or (2) viewed positively in the context of bringing in much needed jobs in the area. These are opposing views arising from the prevailing socio-economic structure of the area and will have to be accommodated in the MPA establishment process. The lesson learnt from this stakeholder review is that socio-economic patterns may provide insight into prevailing tenure patterns in an area.

5.2.2 Identifying Stakeholders from Musquash Parcel Data Analysis

Data on real property holders, adjacent to the Musquash MPA, was used for stakeholder identification. A 2002 Real Property Registry dataset was obtained from Service New Brunswick (SNB) in the Province of New Brunswick and analysed under four headings: Musquash ownership, Musquash land use, Musquash marshland ownership, and Musquash parcel assessment. The results are highlighted in the following subsections.

5.2.2.1 Description of Datasets

The datasets were provided as real property assessment/attribute datasets and included: (1) *A Parcel assessment file* containing information about the land use, tax status and assessed value of properties; and (2) *Parcel attribute data files* containing information about the ownership, parcel location, registered documents and plans associated with property parcels. The information on describing the structure and content of the *parcel assessment* and *parcel attribute* data files is provided in a manual provided

by SNB. This information allows one to interpret the individual fields that make up the dataset and use this knowledge to chart trends.

The *parcel assessment* dataset covers the whole province. The most complete set of assessment data may be obtained by requesting the *Regional Download* format. This format is an extract of information from the SNB Assessment Database (PATS) for all properties within an assessment region[13]. It consists of 46 data fields, shown in Table 5.4 below, and contains information such as tax authority, tax codes, and current assessment.

The primary field in the parcel assessment dataset is the Parcel Assessment Number (PAN). The PAN is an 8-digit number, which uniquely identifies each assessment property within the Province of New Brunswick. The PAN is the mechanism for indexing all assessment information in the PATS database against a specific tax assessment property. It is important to note that tax assessment properties are not necessarily coincident with property parcels, and that the PAN is *not* the primary index key for Parcel data.

Table 5.4: Fields in the parcel assessment dataset (after [SNB, 2000])

FIELD NAME	FIELD NAME	FIELD NAME	FIELD NAME	FIELD NAME
Region Code	Property Identifier 1	Volume Number: Transaction 1	Page Number: Transaction 3	Year of First Assessment
Property Account Number (PAN)	Property Identifier 2	Page Number: Transaction 1	Document Number: Transaction 3	Assessment Account Status Code
Owner Name	Property Identifier Flag Code	Document Number: Transaction 1	Transaction Date: Transaction 3	Type of Land Holding Code
Second Owner Name	Map Sheet Number	Transaction Date: Transaction 1	Registry Transaction Type Code: Transaction 3	Number of Residential Units
Owner Address Field 1	Tax Authority Code	Registry Transaction Type Code: Transaction 1	Volume Number: Transaction 2	Farm Land Identification Program Flag
Owner Address Field 2	Neighborhood Code	Responsible Assessor Code	Page Number: Transaction 2	County Code

[13] These files are generated on the second weekend of each month.

FIELD NAME	FIELD NAME	FIELD NAME	FIELD NAME	FIELD NAME
Owner Postal Code	Property Type Code	Tax Class Code	Document Number: Transaction 2	Current Net Levy
Property Location	Assessment Sequence Number	Current Assessment	Transaction Date: Transaction 2	Current BIA Tax
Property Description	Sub Unit Number	Tax Credit Code	Registry Transaction Type Code: Transaction 2	Volume Number: Transaction 3

The *parcel attribute* data files contain information concerning property parcels and document/plans registered against the property. The primary field in the parcel attribute dataset is the Parcel Identifier (PID). The PID is an 8 digit number that uniquely identities each property parcel within New Brunswick. It has been adopted as a standard for identification of land parcels and is the mechanism for indexing all attribute information regarding a parcel. It is also the linkage mechanism for attaching parcel attributes to the SNB Digital Property Maps (DPM), since the PID is used as the polygon label for properties within the DPM.

The arrangement of *parcel attribute* data files is by counties in the province. The Musquash area is covered by a dataset covering the Saint John County. This county is further divide into several SNB management zones. The dataset used for the analysis in this thesis contains over 4000 parcels falling within SNB management zones NB1101 and NB1112.

In order to relate data on assessment parcels (stored by PAN) to corresponding land parcels (stored by PID) and vice versa, a cross-reference table is created that merely contains two data fields (PID and PAN). All relationships between individual PIDs and PANs are stored within this table, which is commonly referred to as *a PID/PAN Index*. This index is embedded within the TAX file, which is part of *parcel attribute* data files.

The *parcel assessment* and *attribute* files were imported into a Microsoft Access™ database where relationships were defined, and queries constructed, in order to provide information at the appropriate resolution. The data was then exported into a Microsoft Excel™ where further analysis was carried out.

5.2.2.2 Identifying Stakeholders from Land Ownership

From the data on the ownership patterns in the Musquash MPA, it was determined that there were several large stakeholders that had to be consulted in establishing the Musquash MPA. Figure 5.1 shows the land ownership by area in the Musquash.

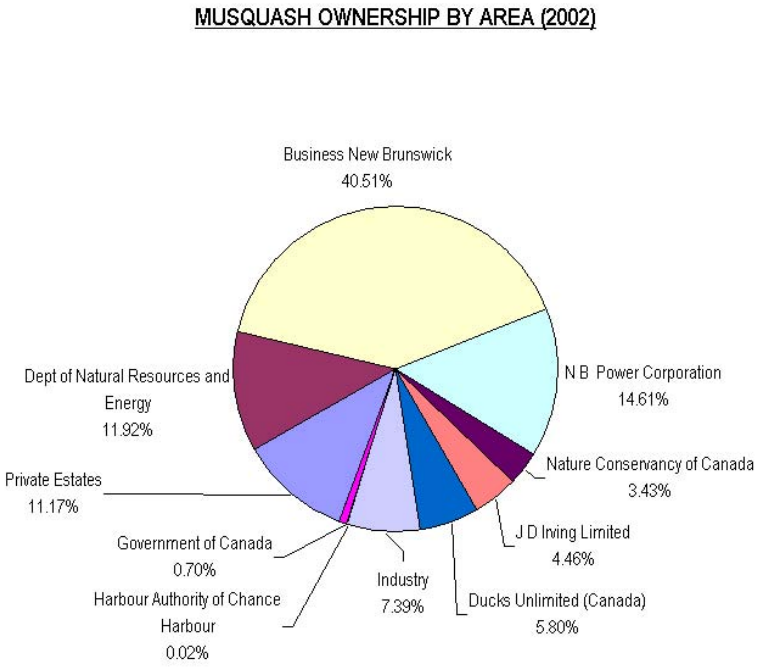

Figure 5.1: The major stakeholders in the Musquash MPA by land ownership

Three provincial government departments /agencies own majority of the land in the Musquash area with Business New Brunswick holding over 40% of the total area of 6349.37 hectares. This suggests that the listed landowners should play an important role in the establishment and overall implementation of the MPA.

Figure 5.2 reviews the percentage of number of parcels owned by each class of landowners. The Musquash MPA and surrounding areas have a total of 90 parcels. Private estates, representing 11% of the area ownership in Figure 5.1, now own 56% of the total number of parcels. Business New Brunswick, representing 40% of the area ownership in Figure 5.1, owns only 2% of the total number of parcels. Clearly a composite index, that combines ownership by area and by number of parcels, is a better representation of the stakeholding in the Musquash MPA.

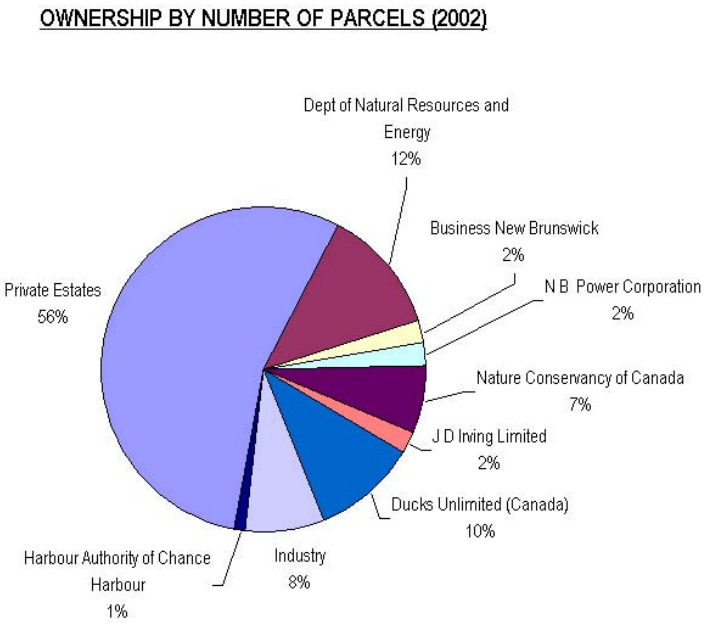

Figure 5.2: Ownership in the Musquash MPA by number of parcels

An important note on ownership regards the *Nature Conservancy*. According to Figures 5.1 and 5.2, they owned 4.3% and 7% of the total area and number of parcels in the Musquash MPA respectively. This does not represent a substantial percentage in

either category but it is part of a growth strategy to complement the protection of the MPA by purchasing real property surrounding the Musquash[14].

The conservation approach by the Nature Conservancy has transformed conservation and protection of the Musquash MPA. The Musquash MPA is viewed as part of an integrated conservation approach with the proposed Musquash MPA dealing with the waters, the Nature Conservancy dealing with properties surrounding the Waters of the MPA, and the Provincial Lock Alva Natural Protected Area dealing with the watershed.

The foregoing discussion points to two important lessons: (1) stakeholder identification by count of parcels and area may assign importance to stakeholders; (2) Only a further review of the conservation and protection objectives of individual stakeholders will provide insight to how stakeholding complements or contradicts MPA objectives.

5.2.2.3 Identifying Stakeholders from Land Use

From the data on the land use patterns in the Musquash MPA, this research noted a difference in stakeholding based on area and number of parcels. First, the land use by percentage area was analysed. This allowed land use categories to be analysed against the total area of all the parcels in the Musquash MPA. This is shown in Figure 5.3.

Figure 5.3 indicates that the highest percentage of land use is *Industrial Land-Unimproved Unserviced* at over 40% of the total area of 6349.37 hectares. Waterlots, Timberland, Marshland and Utilities follow in land use area. Of particular interest is the identification of marshland as one of the major land use.

[14] There are several ways that the Nature Conservancy acquires and preserves land: Outright purchase – where the NCC raises funds from individuals and groups to allow it to buy the land; Land donations – where private owners, both corporate and individual donate land; Conservation easements – where a legal document is signed with the landowner imposing certain restrictions on activities that would harm the environmental value of the land.

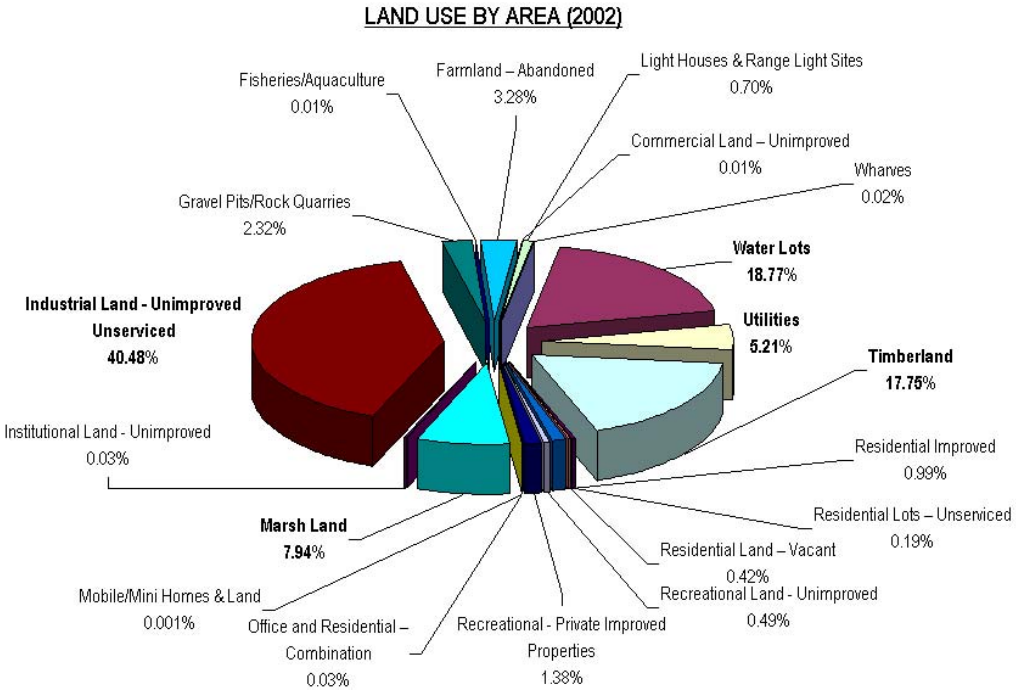

Figure 5.3: Land use by area in the Musquash MPA

Land use by number of parcels was also analysed. This allowed land use categories to be analysed against total number of parcels in the Musquash MPA (90 parcels). Figure 5.4 shows the number of parcels by land use categories. Figure 5.4 indicates that *Marshland* has the highest count of parcels associated with it. This corresponds well with the observations in Figure 5.3 on the area covered by this land use as it fits well with the objectives of Musquash MPA, which is to protect and conserve saltmarshes.

It is interesting to note that *Industrial Land-Unimproved Unserviced***,** which represented 18% of the total area in Figure 5.3, corresponds to 1% of the total number of parcels. This suggests a few parcels of land covering an expansive area. This is also the case for *Waterlots*, which represented 18% of the total area in Figure 5.3, corresponds to 4% of the total number of parcels.

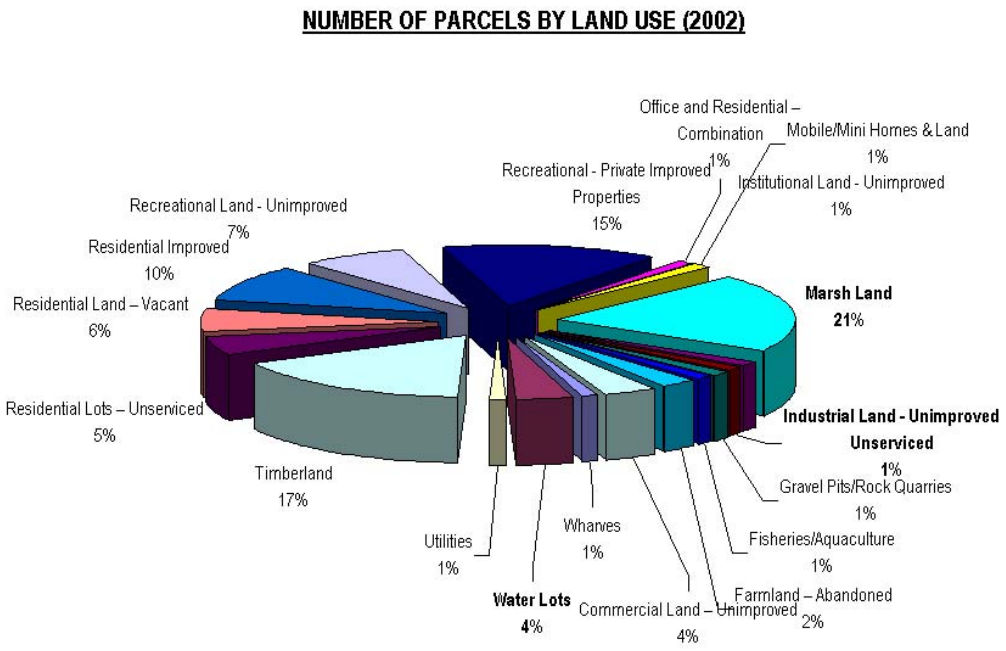

Figure 5.4: Number of parcels in each land use category in the Musquash MPA

Both land use categories are capable of affecting the spatial extent of the Musquash MPA. For example, *Industrial Land-Unimproved Unserviced* may suggest vacant lots and / or absentee ownership. This may aid in gaining and maintaining control over, and protection of, lots in the area.

5.2.2.4 Identifying Stakeholders from Marshland Ownership

From the data on land use patterns in the Musquash MPA, the ownership of the marshland was investigated in order to obtain a clearer picture of the stakeholders who were in physical control of the land on which the saltmarshes were located. This is shown in Figure 5.5.

On reviewing the ownership of the marshland in the Musquash, it was clear that the *New Brunswick government* was the largest owner both in terms of number of parcels and acreage. *Ducks Unlimited* was the second largest owner. This suggests that these two

major marshland landowners should play and important role in the Musquash MPA establishment process.

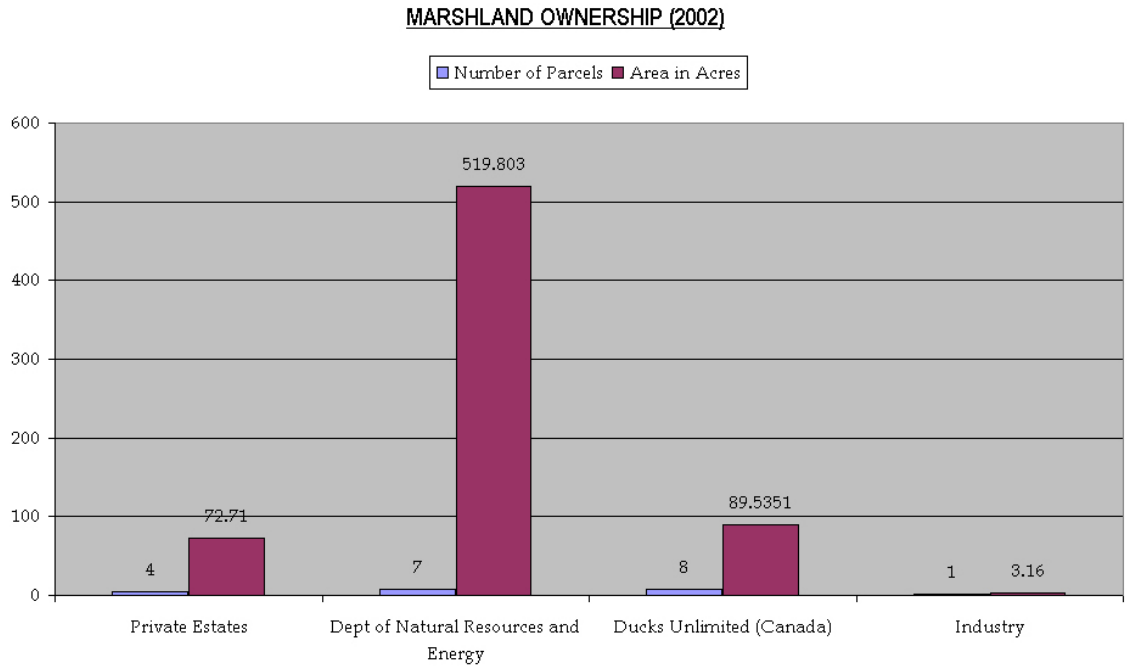

Figure 5.5: Marshland ownership in the Musquash MPA

The objective of *Ducks Unlimited* is to protect marshland as a habitat for ducks. This is compatible with the protection objective of the Musquash MPA. In a similar fashion, the New Brunswick government also mandates protection of special areas through its provincial Natural Protected Areas program. In fact, the Loch Alva watershed area, located upstream from the Musquash River, is part of this program. This suggests a willingness to support the Musquash MPA objectives. Therefore, their ownership of marshland is seen as complementary to the MPA proposal.

5.2.2.5 Identifying Stakeholders from Parcel Transactions

From the data on ownership patterns in the Musquash MPA, the stability of ownership was evaluated in order to determine the rate at which ownership changed

hands in the Musquash MPA. This would be an important indicator on the rate at which stakeholders would change during the MPA establishment process. This is shown in Figure 5.6.

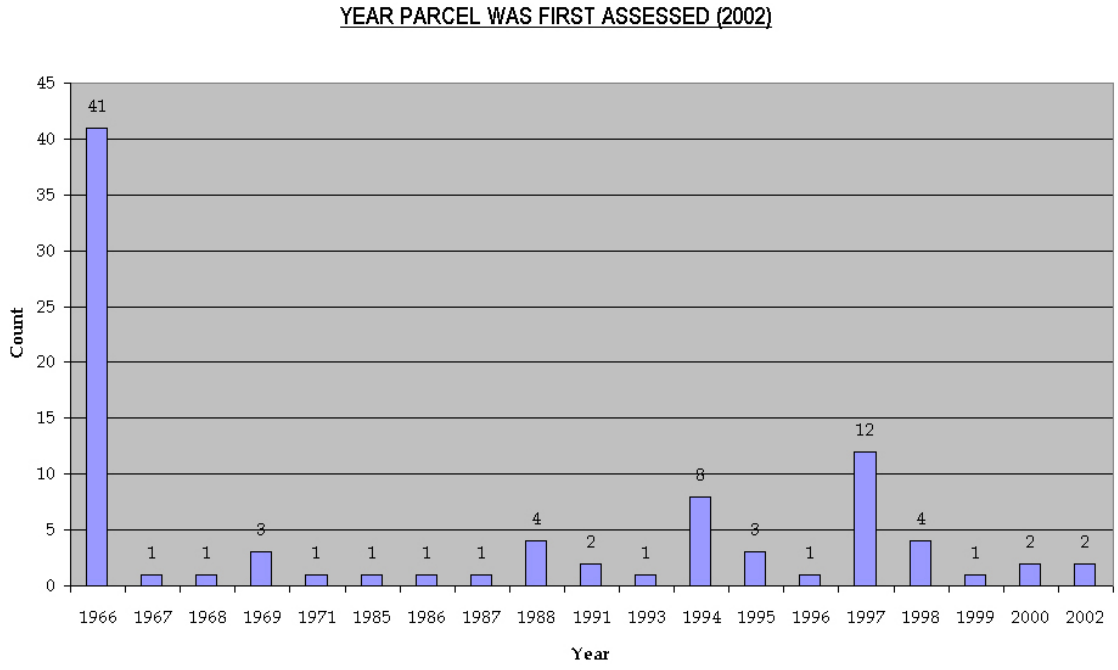

Figure 5.6: Year of first assessment for each of the 90 parcels in the Musquash MPA

From Figure 5.6, one observes that almost half of the parcels (41) have their year of first assessment as 1966. With the exception of 1994 and 1997,the average number of parcels changing ownership since 1967 is two. Generally speaking, this can be interpreted as small number of parcels changing ownership in the last two decades, and a steady ownership pattern for the Musquash area.

This suggests that stakeholders may have long term connections to the Musquash MPA and surrounding areas may associate cultural and community value to resources found in this area. The MPA program may therefore find support if it shows that it will accommodate and respect these values.

5.2.3 Stakeholder Identification from Administrative Area Descriptions

The written description of the administrative areas, in the immediate vicinity of the Musquash MPA, was reviewed in order to determine jurisdictional and administrative responsibility (*see Appendix III for the importance of this distinction*). This review demonstrated the level of uncertainty in determining the stakeholders based on spatial extent descriptions.

1. The county of Saint John, where the Musquash MPA is located, is described in Section 12 of the *Territorial Division Act* [1998] as bounded " to the South by the Bay of Fundy; west by Charlotte County; east by the line run magnetic north by Deputy Stiles, in the year one thousand eight hundred and thirty-eight, from a birch tree on the shore of the Bay of Fundy thirty chains east from the mouth of Goose River, including all the islands in the Bay of Fundy adjacent thereto; and north by a line described by a metes and bounds description". The important elements in this description are that southern county boundary is bounded by the Bay of Fundy; although there is no indication as to where on the Bay of Fundy the boundary lies.
2. Section 27 of the *Territorial Division Act* [1998] further describes the four areas that make up the County of Saint John as: City of Saint John; Musquash Parish; Saint Martins Parish and Simonds Parish.
3. The *City of Saint John* is described as "beginning at the western extremity of the eastern head of the entrance to Musquash Harbour, and thence true North on a line to its intersection with the westerly prolongation of the north line of the *County of Saint John* as defined in section 12 of the *Territorial Division Act* [1998]. "
4. *Musquash Parish* is all that part of the *County of Saint John* that is west of the *City of Saint John*. This means that all those lands described as being part of the county that

are west of the City of Saint John make up the Parish. If one looks at the description of the county, one will see reference to waters and islands, found west of the city of Saint John, as part of the Parish.

5. The internal waters of the province of New Brunswick can theoretically be argued to begin at the mouth of the Bay of Fundy. A straight line drawn across the mouth of the bay to the Saint Croix River is generally considered to be representative of these internal waters. LaForest [1963] indicates that when King James granted the colony of Nova Scotia to Sir William Alexander in 1621, the boundaries of that colony (which then included New Brunswick) were so defined as being described in part as running from Cape Sable to St. Mary's Bay, " and then towards the North by a direct line, passing the entrance or mouth of that Great Bay…. to a River commonly called by the name of St. Croix…"
6. LaForest arguments come from the observation that an 1809 Nova Scotia statute referred to Briar Island (found on the northern headland of St. Mary's Bay) as being at entrance of the Bay of Fundy. As such a straight line drawn from this point to the mouth of the St. Croix River is understood as the boundary of the Bay of Fundy internal waters.
7. LaForest also points out that the situation was not altered by the American Revolution for when New Brunswick was carved out of Nova Scotia the centre line of the Bay of Fundy became a part of the boundary between the two provinces. In LaForest opinion, these boundaries are incorporated into the constitution of Canada by section 7 of the British North America [1867], which provides that the provinces will have the same limits as at the passing of the Act. Several New Brunswick and Nova Scotia

Acts dealing with the support and maintenance of lighthouses seem to deal with the Bay as provincial territory.[15]

8. The Saint John Port Authority has been granted letters patent under the *Canada Marine Act* [2001] to have jurisdiction over certain navigable waters and management authority over federal real property found in the Musquash area and surrounding vicinity. A description of the navigable waters and federal real property can be found in the schedule at the end of the Act (see Canada Gazette Supplement, Vol. 133, No. 18 , May 1, 1999).
9. Jamieson and Levings [2001] provide an interesting observation regarding the Federal-provincial jurisdiction. They indicate that the Federal government has the mandate to protect and conserve "…habitat below the high tide that falls under federal legislation, such as recognised fish habitat or habitat in national parks, NMCAs and national wildlife areas".

From the foregoing discussion there are several conclusions that can be made:

1) The ***lands*** and ***waters*** that make up the Musquash MPA are generally recognised as within provincial limits. More specifically, the *Territorial Division Act* [1786] recognises the area where the Musquash is located as falling within the County of Saint John and THEREFORE within the Province of New Brunswick.
2) The challenge is to determine the location of the internal limit of internal waters. For the purposes of UNCLOS (*and with regard to any claim of sovereignty associated with a country's ratification of this treaty*) the internal waters are on one side of baselines while the territorial seas and other maritime zones lie on the other side of

[15] In 1835 the province of New Brunswick passed a statute (An Act relating to the navigation of the inner Bay of Passamaquoddy) that was considered to be an exercise in jurisdiction over one half of the Bay of Fundy.

these baselines. (Note: the distinction whether this applies to straight or natural baselines is not mentioned. This is important as on the other side of natural baselines is the intertidal area generally accepted as falling under exclusive provincial jurisdiction).

3) The Musquash MPA falls under two administrative regions and is administered by two different local level institutions; The City of Saint John and the Local Service District that serves the Musquash Parish. However, there are other agencies that may have jurisdiction, or exercise administrative powers over resources.

The lesson learnt is that the presence of a federal MPA does not imply federal jurisdiction, or mitigate provincial jurisdiction. Jurisdiction is NOT resolved by MPA implementation. Partnership (in MPA implementation) may the best way to mitigate jurisdictional uncertainty.

5.3 Identifying Restrictions on Tenure in the Musquash MPA

This research also reviewed the documented restrictions imposed on the Musquash MPA by existing tenure in the area. These restrictions are perceived as affecting the MPA rationale, objectives and spatial extent. In order to obtain an overview of the documented restrictions, two reviews were carried out: (1) review of written descriptions of parcels adjacent to the Musquash MPA; and, (2) a review of provincial government programs, policies and legislation. These are outlined in the following sections.

5.3.1 Identifying Restrictions on Tenure from Parcel descriptions

This research investigated the spatial extent of land-based tenure in the Musquash MPA vicinity. This was accomplished by carrying out a search in the New Brunswick Real Property Information Internet System (RPIIS) and by obtaining further information on crown lands from the Provincial Department of Natural Resources and Energy. Ownership information of the more than 50 parcels that surround the Musquash was retrieved. The following is a review of parcels adjacent to the Musquash MPA.

5.3.1.1 Parcels adjacent to the Bay of the Musquash Estuary

An inspection of written descriptions, for parcels adjacent to the bay of the Musquash estuary, indicated that only the provincial crown owns property below the high water mark. This was particularly noticeable in the Hepburn Basin area where there were several parcels that were identified as "submerged crown lands"[16]. There were no grants of title to private individuals below the high water mark. There is also an indication that there will be a Submerged Lands Registry that would soon be established to provide notice of the location and ownership of these parcels.

With the exception of the previously mentioned waterlots, there were no other privately held parcels in the Bay of the Musquash estuary. However, there were partial fishing rights that existed in the area as evidenced by abandoned fishing weirs that were present in the area. This could in turn affect tenure in the proposed MPA.

5.3.1.2 Parcels adjacent to the Musquash River

The principle of *ad medium filum aquae* does not apply in the Musquash River and the ownership of the bed of this tidal river is therefore vested in the provincial crown. This principle is a common law rule by which ownership of the bed of a non-tidal river or

[16] Clair Allen, a Land Tenure Officer from the Provincial Department of Natural Resources and Energy, indicated that these were submerged provincial crown lands.

stream belongs in equal halves to the owners of riparian land. Ownership can be rebutted either by the terms of the instrument, or circumstances surrounding the grant or conveyance indicating a different intention. An inspection of descriptions, for parcels adjacent to the river, did not find words that rebutted crown ownership.

Several privately-owned parcels are however located below the high water mark. Since the Crown has title in the Musquash river areas (where the saltmarshes are predominantly located), it has granted fee-simple estate to Ducks Unlimited (which owns several impoundments that extend below the high water mark). These estates were originally granted as agricultural dykeland (drained saltmarsh) and are now productive fresh water marsh and ponds.

There are licences, leases, and other partial rights that are present in the areas covered by the proposed Musquash MPA. However, access to the information that provides this information is restricted and in some cases unavailable.

5.3.2 Identifying Restrictions on Tenure from Programs, Policies and Legislation

This research also investigated existing (federal and provincial) government administration of resources in the Musquash MPA area. This was accomplished by obtaining an inventory of programs and policies of different government departments. Table 5.5 provides a roadmap of provincial administration of the Musquash and its environs.

Table 5.5: Provincial Programs and Policy affecting Tenure in the proposed Musquash MPA [after Canada, 1997b]

Provincial Government Department	Department / Branch and Program	Tenure Information
Department of Agriculture and		Land use location and animal manure management affecting pollution of the

Rural development		marine environment Location of dyked land
Department of Economic Development and Tourism	Beach Development Program Day Adventure Program	Location of beach improvement programs Area affected by licenses for Marine ecotourism
Department of Environment	Environmental Evaluation Branch Assessment and Approvals Branch Municipal Services Section	Freshwater aquaculture and fish waste disposal License to store dredged materials and approval for salt marsh proposals License to construct and operate municipal and private water and wastewater systems
Department of Fisheries and Aquaculture	Resource Management Team	Responsibility for site allocation and tenure administration at marine aquaculture sites and associated facilities
Service New Brunswick	Coastal Mapping Program Submerged Lands Registry	1:10000 complete digital orthophotography of province's coastal lands Future location of central submerged lands registry
Department of Health and Community Services		Permits to install septic systems and on-site sewage disposal Recreational Waters testing
Department of Municipalities, Culture and Housing	Coastal Land Use Planning Archeological Services Branch under Historic Sites Protection Act	Administration of Coastal Lands Management e.g. Coastal Land Use Policy License for archeological explorations and location of protected shipwreck sites
Department of Natural Resources and Energy	Under the Aquaculture Act Crown Lands Branch Fish and Wildlife Wetlands and Coastal Habitat Program - Parks and Recreation Branch Under Mining Act and Oil and Natural Gas Act Under the Pipeline Act and General Regulation	Responsible for other submerged land management activities e.g. previous commitments, conflicting land uses, protection of native fish, interference with riparian rights Leases, licenses or easements for permanent developments or improvements Conservation Areas and Coastal Parks: issues such as permits for gravel extraction Minerals, Oil, Natural Gas exploration and production Permits to construct and licenses to operate pipelines

Department of Transportation		Bridge rehabilitation, shore protection and related structures Operation of Ferries Operation of Wharves and Ramps

5.4 Accessing Musquash MPA Tenure Information

In order to access and visualise tenure information on the Musquash MPA, a prototype was developed using CARIS Spatial Fusion (*Spatial Fusion*). The technology is described below.

5.4.1 Description of the Technology

Spatial Fusion is a "web-mapping" technology that lets users integrate distributed data sources, in various data formats, using a web browser. It is a tool for designing the look and feel of web mapping applications quickly and easily and can be used to customize buttons, images, applets etc. [Fitzgerald, 2000]. It utilises a link between distributed services and thin customizable clients. Data is not downloaded nor processed by the web browser but is instead processed by the *Spatial Fusion* services. Not only does this keep the client thin, but also it secures the data itself by keeping it on the server [Fitzgerald, 2000].

Spatial Fusion consists of a customized Java client and a number of Fusion Data Services. On the server side, Spatial Fusion is made up of the components in Table 5.6 [Fitzgerald, 2000].

Table 5.6: Description of Spatial Fusion Components

Component	Description
Web Server	The web server is not bundled with Spatial Fusion and one must already be running on the network. For the Musquash MPA the Microsoft Personal Web Server was installed and used to run the Spatial Fusion Data Service.
ORB	This component lets the web browser and the *Spatial Fusion* data services communicate across the Internet.

Catalog Service	This service is used to list all of the available Fusion Data Services. For the Musquash MPA, this was analogous to providing an index service to the various geographical locations of the marine cadastral information identified in Table 5.5.
Fusion Data Service	These services are registered with the OrbixWeb™ Implementation Repository and contain the name used to register the service and the location of the data source.
Configuration Utilities	CARIS MapSmith™ is provided together with CARIS Spatial Fusion to help customize the display of the supported data formats. It is used to view and analyse spatial data and also to configure SAF files for ESRI,MapInfo,Caris and Autocad formats. The data is prepared into the different data layers, and can be re-projected into a different projection.

5.4.2 The Musquash MPA Spatial Fusion Application

The Musquash MPA Spatial Fusion Application was built in conjunction with Service New Brunswick and CARIS. It was meant to showcase how tenure related information could be retrieved from various locations and used for decision-making purposes. As far as the authorized user is concerned, they simply point the browser to a website and can select which datasets to view. The user also is able to select from available data sources. Figure 5.7 shows a screen capture of the Musquash Spatial Fusion application.

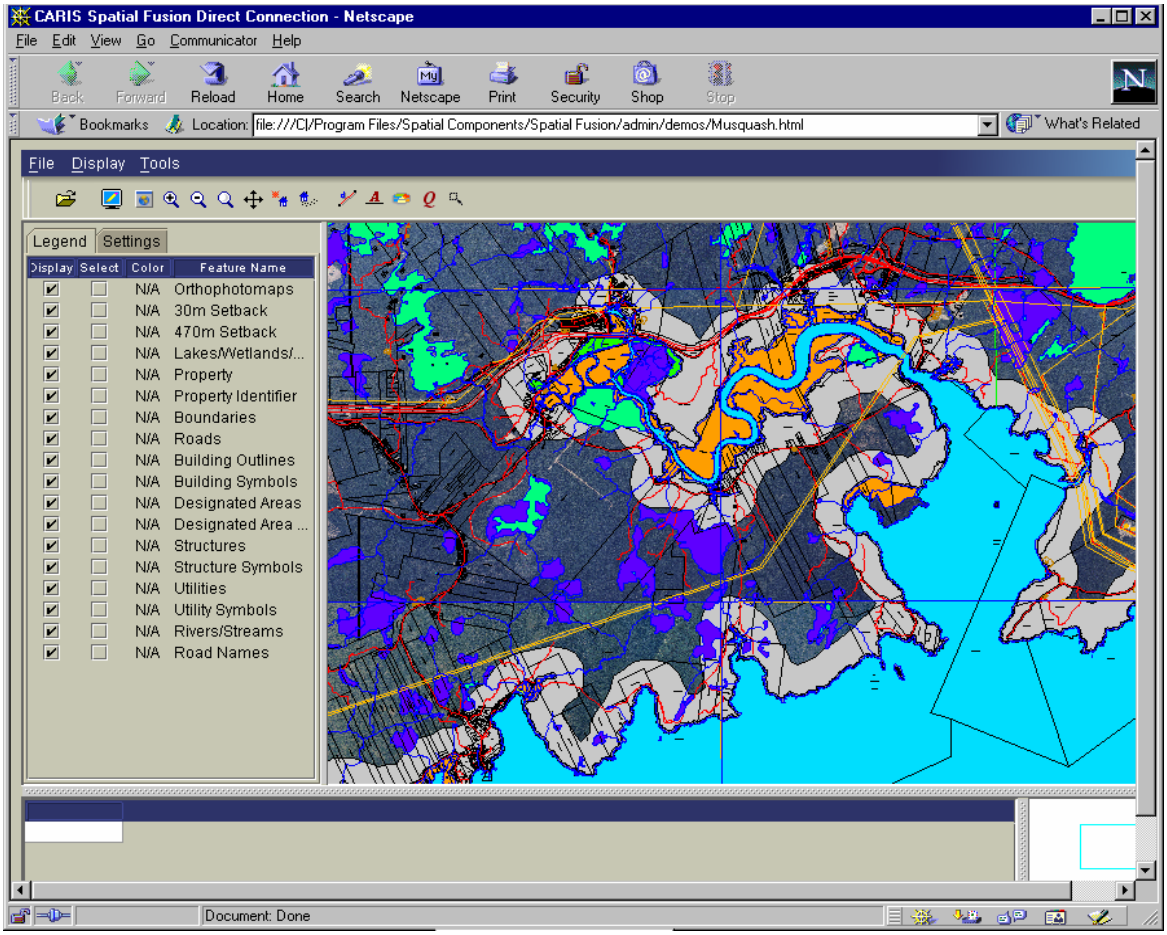

Figure 5.7: Screen Capture of Musquash MPA CARIS Spatial Fusion Application

5.4.3 Analysis of the Musquash MPA Application

The prototype in Figure 5.7 was provided to members of the Musquash MPA Planning Group (MPAPG) as a decision support tool. It was an attempt to allow stakeholders, communities and decision makers to be able to visualize the interaction of interests in marine space. On interviewing the MPAPG members, it became clear that the prototype had to be able to handle certain decision support queries. However, missing datasets and visualisation capabilities compromised its utility.

For example, Figure 5.7 shows the list of datasets that were retrieved for the Musquash MPA. From the prototype it is clear that the representation of the different

interests and boundaries in marine space is only partially appreciated by the 2D representation. This representation will not show whether particular interests refer to resources found in the water column, seabed or subsurface; or to resources that move or vary with time. Neither will they indicate the legal or other framework from which displayed interests are based on. In summary, the visual display was appealing but not useful in decision support.

From this, a tenure data management model was designed and sample data (from federal legislation) used to investigate its usefulness in decision support. This meant investigating federal government's legislation under several different headings. First, the horizontal spatial extent of federal legislation was investigated. Second, the vertical extent of legislation (water surface, water column, seabed, subsurface) was investigated. Third, the activities associated with legislation were highlighted. Fourth, the resources associated with legislation were investigated. Fifth, the interests (rights, restrictions, responsibilities) associated with legislation were investigated. Finally, the departmental responsibility for the legislation was ascertained.

5.4.3.1 The Marine Information Model

Utilising the Unified Modelling Language (UML) to visualise marine property rights, a data model was developed as shown in Figure 5.8.

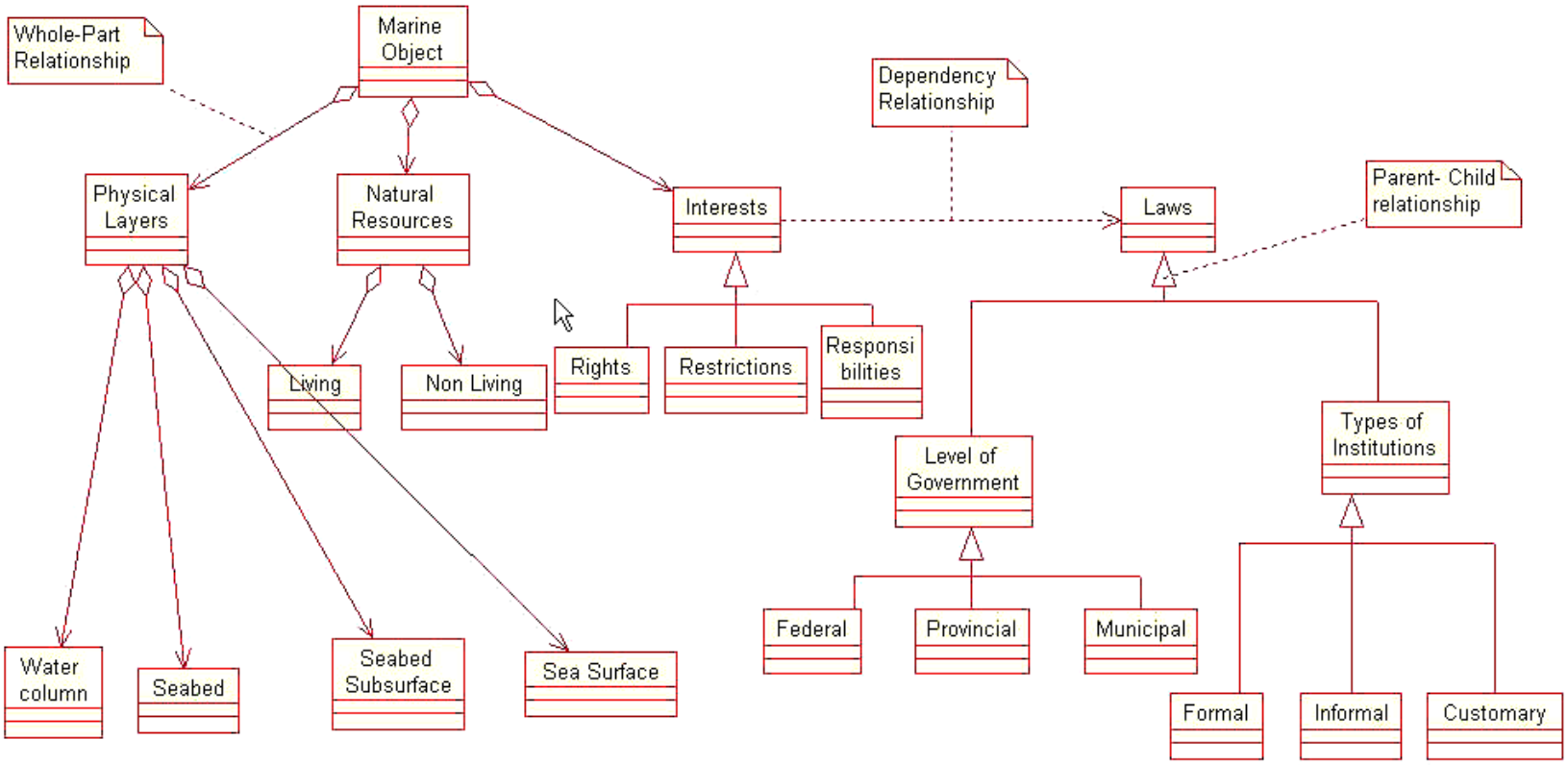

Figure 5.8: A UML class diagram of the marine tenure data model (after Ng'ang'a et al., [2004])

The model in Figure 5.9 is based on the following observations:

1) Any marine object (or space) is made up of 4 physical layers[17] i.e. water surface, water column, seabed and subsurface. For example, Canada's province of Nova Scotia enacted a *Pipeline Act* [1989] in which the province claims jurisdiction over the seabed. In this model, this is an example of a law that specifically claims jurisdiction over a physical layer of the marine object;
2) The marine object contains living and non-living resources. Living resources include benthic and pelagic species found in the marine space, while non-living resources include naturally occurring resources such as petroleum together with artificial resources such as cables and pipelines. For example, Canada's *Constitution Act* [1867] gives the federal government jurisdiction over 'public harbours'. This is an example of a law dealing specifically with non-living resources in this data model;
3) The marine parcel object has certain interests associated with it. In this model, each physical layer that makes up the marine object can have a legally recognised right, restriction or responsibility associated with it. For example, existing rights to fish certain species in the water column in a recently designated marine reserve might remain unaffected (although certain quotas might apply), while fishing activities that damage the seabed e.g. scallop dragging, might be altogether forbidden.
4) It follows then that the types of interests can be broadly classified as rights, restrictions or responsibilities that individuals have with respect to resources that are part of the a marine object. The marine object might have one or all of these interest types associated with it.

[17] Although only 4 physical layers are defined in the model, an argument could be made that the air above the sea surface could also be defined as one the physical layers.

5) Interests can also be categorised according to the type of laws that recognise their existence. For example, in Canadian jurisdiction the categories could include: laws based on the types of legal institutions i.e. formal (e.g. fishing rights in the Fisheries Act), informal (e.g. right to swim), and customary (e.g. Aboriginal fishing rights); and laws enacted according to the political structure i.e. federal (Canada's *Oceans Act*), provincial (Nova Scotia's *Pipeline Act* [1989]), or even municipal.

This model was implemented for tenure data associated with federal legislation. The results of running a query based on the data model are shown in Tables 5.7 to 5.12. Members of the MPAPG indicated that this resolution of tenure information was a better representation of the information needed for decision-making.

Table 5.7: Sample results from associating resources with Federal legislation

Resource referred to	Legislation
Granite	Territorial Quarrying Regulations
Gravel	Territorial Quarrying Regulations
Aids to navigation infrastructure	Oceans Act
Anchorage Areas	Anchorage Regulations
Areas of natural or historical significance	Department of Canadian Heritage Act
Artificial obstructions	Fishery (General) Regulations

Table 5.8: Sample results from associating activities with Federal legislation

Activity Regulated	Legislation
Anchorage	Anchorage Regulations
Access to Arctic Waters	Arctic Shipping Pollution Prevention Regulations
Deposit Waste	Arctic Waters Pollution Prevention Act
Access to Arctic Waters	Arctic Waters Pollution Prevention Regulations
Deposit Waste	Arctic Waters Pollution Prevention Regulations

Table 5.9: Sample results from associating interests with Federal legislation

Interests	Legislation
Rights to harvest certain fishing species in Canadian fisheries waters to aboriginal communities(not necessarily offshore)	Aboriginal Communal Fishing Licences Regulations
Define international boundary in the offshore	Agreement of the government of the Kingdom of Denmark and the government of Canada relating to the delimitation of the continental shelf between Greenland and Canada – 17th December 1973 (13 March 1974)
Restricts anchorage in certain prohibited waters: Schedule 2 has a written description of the prohibited areas	Anchorage Regulations
Right to issue an Arctic pollution prevention certificate	Arctic Shipping Pollution Prevention Regulations

Table 5.10: Sample results from associating Horizontal spatial extent with Federal legislation

Legislation	Horizontal Extent	Clarification on Extent	Clarification on Extent
Canada Marine Act	An Act for making the system of Canadian ports competitive, efficient and commercially oriented, providing for the establishing of port authorities and the divesting of certain harbours and ports, for the commercialization of the St. Lawrence Seaway and ferry services and other matters related to maritime trade and transport	"port facility" means a wharf, pier, breakwater, terminal, warehouse or other building or work located in, on or adjacent to navigable waters used in connection with navigation or shipping and includes all land incidental to their use	"public port" means a port designated as a public port under section 65; "public port facility" means a port facility designated as a public port facility under section 65; "Seaway" means the deep waterway between the port of Montreal and the Great Lakes.
Canada National Marine Conservation Areas Act	Marine conservation area consisting of submerged lands and waters within the internal waters, territorial sea or exclusive economic zone of Canada and any coastal lands or islands within Canada	"public lands" means lands, including submerged lands, that belong to Her Majesty in right of Canada or that the Government of Canada has the power to dispose of.	The establishment of a marine conservation area within the exclusive economic zone of Canada does not constitute a claim to any rights, jurisdiction or duties beyond those set out in section 14 of the Oceans Act.

Table 5.11: Sample results from associating vertical spatial extent with Federal legislation

Legislation	Surface	Water column	Seabed	Subsurface
Aboriginal Communal Fishing Licences Regulations	Y	Y	Y	N
Anchorage Regulations	Y	Y	Y	N
Arctic Shipping Pollution Prevention Regulations	Y	Y	Y	N
Arctic Waters Pollution Prevention Act	Y	Y	Y	N
Arctic Waters Pollution Prevention Regulations	Y	Y	N	N

Table 5.12: Sample results from associating departmental responsibility with Federal legislation

Legislation	Department Name
Aboriginal Communal Fishing Licences Regulations	Fisheries and Oceans Canada
Agreement of the government of the Kingdom of Denmark and the government of Canada relating to the delimitation of the continental shelf between Greenland and Canada – 17th December 1973 (13 March 1974)	Department of Foreign Affairs and International Trade Canada
Anchorage Regulations	Transport Canada
Arctic Shipping Pollution Prevention Regulations	Transport Canada
Arctic Waters Pollution Prevention Act	Department of Indian Affairs and Northern Development Canada
Arctic Waters Pollution Prevention Act	Natural Resources Canada
Arctic Waters Pollution Prevention Act	Transport Canada

5.4.4 Prototype Technical Challenges

Although there were several challenges that were encountered in developing the prototype, there were other challenges regarding availability and accessibility of tenure information that greatly affected use of the prototype. These are grouped under two categories as follows:

1) ***Information access vs. private data holdings:*** It became clear that there would be caveats placed on access and availability of some datasets. Some of the data provided,

notably from Government departments, was usually provided to the general public through a cost recovery model and therefore the public paid to access these datasets.

2) ***Data integration vs. data collection standards:*** The separation of responsibilities between government departments and agencies together with the independent nature of the private data collection provides challenges in the form format and content of the data collected. In the case of the Musquash there was a multitude of different marine information, in different scales, formats, accuracy, completeness and precision. Each government department and agency as well as public and private institutions were involved in data collection for various uses. The reality was that there was little to no coordination in data collection, analysis and dissemination.

Despite the challenges mentioned, several avenues were established to disseminate tenure and other information to decision makers. Presentations to members of the public were the most effective because many people did not have access or knowledge of internet technology. Limited online access to tenure data was made available to a select few members of the MPAPG.

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