

Local-Level Marine Resource Management in the Northwest Straits: Assessing the  
Implementation of the Proposed Dungeness Crab Stewardship Plan for  
Snohomish County

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**Abstract**

Local-Level Marine Resource Management in the Northwest Straits: Assessing the  
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Jennifer Anne Hernandez

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Northwest Straits Marine Conservation Initiative (NWSMCI) projects involve restoration, protection, education, and outreach activities throughout seven counties in the Puget Sound region. Projects are implemented through the collaboration of citizen advisory groups called Marine Resource Committees (MRCs), local governments and other interest groups. Overall, these projects aim to achieve the NWSMCI's goal of developing scientifically sound recommendations citizens can give to governmental authorities to make future management decisions on marine resources. Among the efforts currently pursued by an MRC in Snohomish County is the "Proposed Dungeness Crab Stewardship Plan for Snohomish County." This plan is intended to be a proactive, local effort to conserve the county's Dungeness crab resource, a resource that has experienced an increase in harvest over the last eight years.

The Proposed Dungeness Crab Stewardship Plan seeks to initiate projects that increase awareness of Dungeness crab issues, map and assess Dungeness crab habitat, and locate then remove derelict fishing gear. However, the stewardship plan, as construed, requires commitments by specific individuals that could make its long-term maintenance problematic. This thesis examined problems that exist as barriers to implementing the stewardship plan: issue salience, agency and volunteer commitment, and the overall plan framework. Through literature reviews, interviews and participant observation I developed: 1) a set of guidelines that provide a format for local-level

marine resource management plans that all MRCs can use to improve planning and implementation; and 2) a matrix that the Snohomish County MRC can use to evaluate their potential projects. Considering the possible barriers to implementation and the resources available to the Snohomish County MRC, I recommend the MRC consider participating in existing Dungeness crab stewardship activities that also use education to promote citizen participation and a sense of responsibility for the resource.

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## **Dedication**

To my grandparents who taught me the importance of education and my parents who allowed me to spread my wings and experience life. Your never-ending love extends into everything that I have become.

## **Chapter One – Local-Level Natural Resource Management**

### Background

Within the last decade, local-level resource management has emerged as a new approach to public involvement in natural resource management, both domestically and internationally. This new approach involves decentralized or shared decision-making, collaboration, and involvement by stakeholders (Born and Genskow, 2001). Local-level resource management is now expanding dramatically in the United States, where processes are shifting from a top-down, public hearing approach to a collaborative, bottom-up, citizen-led and citizen-organized approach (Griffin, 1999).

In the 1960s and 1970s, Congress legislated that the public should be involved in management issues, yet federal agencies still needed to determine how and when the public should be involved. Public involvement was characterized by presentations to those who attended public meetings, public comment to the agency, agency reaction to public comment, after which the proposal was then modified, presented once again, approved and implemented (Griffin, 1999). These public involvement procedures, such as those required by the National Environmental Policy Act and other laws, were not proving to be adequate for natural resource planning at the local level (Carroll and Hendrix, 1992; Griffin, 1999) because public input occurred later in the process of planning or implementing a project (Leach and Pelkey, 2001). When this happened, the public felt excluded from participating in certain projects, which then spurred legal

challenges in order to achieve more effective involvement in the public participation process (Griffin, 1999; Leach and Pelkey 2001).

Since the late 1990s the roles of government, industry, and the community have changed because of an increase in environmental and social awareness by community and industry, including their overall desire to be included in decision-making processes (Kay and Alder, 1999, PNCERS, 2002). Today, a majority of coastal management programs are attempting to create partnerships between government, private industries and the wider community, although it is with a guiding hand from the government (Kay and Alder, 1999).

#### Local-Level Resource Management Defined

Local-level resource management, also known as collaborative or community-based management, is now considered a powerful tool to address resource issues (Kay and Alder, 1999). The intent of these new approaches is to foster or induce changes in people's activities and attitudes or to effect socioeconomic changes in order to help meet resource management objectives. These new approaches also assist in integrating environmental management into the public's everyday lives. Collaborative management, as Kay and Alder (1999) define it, "involves all stakeholders in the management of resources. [T]he aim is to achieve mutual agreement among the majority of stakeholders on the available options." This approach has several characteristics:

- Stakeholders have a voice in managing a resource
- Government shares management, but usually assumes responsibility for policy and coordination

- Socioeconomic and cultural objectives are included as an important part of management.

When it comes to implementing these new programs, there is no simple, prescribed method, nor does it happen in a short period of time. Every community is unique, and requires time spent on-the-ground designing and implementing the local-level approach. After implementation, successes may not be seen for several years, and could require at least 15 years (Olsen et al. 1999, Hastings, 1997) before measurable changes in the environment can be identified. Although planning, implementing and managing this approach can be complex, there are hallmarks of “successful” local-level planning and management programs which could be applied to situations where natural resources are at risk (Born and Genskow, 2001; Olsen et al., 1999; Huntington and Sommarstrom, 2000). These hallmarks, or characteristics of successful local-level planning and management will be discussed further in Chapter Three.

#### Institutional Approaches to Local-Level Conservation Efforts

When incorporating public participation into government decision-making, it is still commonly accepted that “institutions are the primary mechanism available to mediate, soften, attenuate, structure, mold, accentuate and facilitate particular outcomes” (Agrawal and Clark, 1999). In other words, institutions provide a framework and promote stability and consistency. Agrawal and Clark (1999) also note that in order to create a more effective program, attention should focus on multiple interests and actors in the community, the processes through which participants interrelate, and the institutional arrangements that exist to organize the interactions; therefore, they advocate an

institutional approach to local-level conservation efforts. Agrawal and Clark (1999) explain that if institutions are immersed in the local community, institutions will have a greater understanding of local perceptions and needs. This collaborative arrangement creates the opportunity for communication between institutions and the stakeholders, which could increase the feasibility of implementing new policy as well as help divert costly delays or litigation (Leach and Pelkey, 2001).

### Skeptics of Local-Level Resource Management

While there is a growing literature concerning the advantages of local-level environmental management, there are also a growing number of researchers that are skeptical of such processes (Singleton, 2002; McCloskey, 1996; Kenney, 1999). Much of the literature concerning collaborative or community-based management in the United States concerns the evaluation of watershed councils, particularly in the western United States. The primary questions that the researchers ask are: “Are watershed groups effective, and are they an improvement over traditional methods of public involvement in natural resource management?” (Griffin, 1999; Kenney, 1999). Critics have argued that collaborative environmental planning represents “an abdication of government responsibility in policy areas already characterized by too much deference to local and/or producer interests; that the process through which representatives are selected excludes legitimate interests of national stakeholders; that they are forums for inaction or that they shift the definition of success from one of an improvement in environmental conditions to one of reduced social conflict” (Singleton, 2002). McCloskey (1996) also warns of the

risk in “least common denominator” decision making that can result from a consensus based process, and that such processes actually reduce the influence and effectiveness of the national environmental organizations in the policy field. Kenney (1999) notes that occasionally it is also argued that collaborative groups sometimes operate as a ruse, and that they generally favor commodity interests over conservation objectives.

#### Advocates of Top-Down and Bottom-Up Approaches

Skeptics of community-based resource planning make points that are well founded. However, these new initiatives are seeking to avoid the legislative oversight in the 1970s and 1980s that failed to engage local communities (Singleton, 2002). Singleton also mentions that even though environmental management processes are becoming more locally oriented, the problems they are trying to solve are not. In an attempt to solve large scale problems with local governments and communities, researchers are suggesting both top-down and bottom-up approaches to be one solution for resource management (Olsen et al., 1999; Singleton, 2002; Chess and Gibson, 2001; Agrawal and Clark, 1999). These approaches have traditionally been presented in opposition to one another, but experienced participants are now viewing the two approaches as working together (Singleton, 2002). Chess and Gibson (2001) have recognized this and propose that some regions are better suited for collaborative management than others. They describe that success is not obtained through more public participation, improved scientific analysis, or an integration of the two, but suggest that pre-existing conditions (social feasibility, scientific feasibility, and motivational feasibility) could instead be the key to success, and

that recognizing potential hurdles could help build a foundation by which to overcome them. In the literature on collaborative processes, there are recommendations regarding how to improve and learn from local programs through evaluation (Born and Genskow, 2001; Olsen et al., 1997, 1999; Olsen 2002; Lowry et al., 1999; Lowry, 2002).

Practitioners in local-level resource management have recognized the need for innovative arrangements in resource management, particularly in showing the value in cautious experimentation and learning-by-doing (Kenney, 1999). Considering that initiatives are increasingly required to assess their successes and failures, Kenney (1999), Singleton (2002) and Olsen et al. (1999) indicate the need to investigate how the various components of community-based groups interact with each other, with institutions, policies, and natural resources. Public participation in resource management continues to be a contentious issue since the evaluation of local-level resource management initiatives in the United States is relatively new. Assessing these innovative programs can help managers, politicians, practitioners and the public to learn what works and what does not.

What is known is that the local-level approach to natural resources management is becoming increasingly popular and is seen as a new model for reinventing government (Singleton, 2002), but it is also seen as an experiment (Kenney, 1999; Griffin, 1999) in need of being critically evaluated. The Northwest Straits Marine Conservation Initiative (NWSMCI) is an example of a local-level approach towards marine protection and restoration, which uses a citizen-based model to provide guidance to state and local management authorities in the Puget Sound region. This initiative is, in effect, an experiment in top-down and bottom-up collaborative marine resource management that



researchers and practitioners in local-level marine resource management across the United States would like to learn from.

Within the Northwest Straits Marine Conservation Initiative, projects are geared towards restoration, protection, education, and outreach activities throughout seven counties in the Puget Sound region. Projects are implemented through the collaboration of appointed Marine Resource Committees (MRCs), local governments and other interested groups. Examples of these projects include restoring beaches, planting shellfish, removing derelict gear, identifying nearshore habitat, establishing marine protected areas (MPAs), education and outreach, and proactive protection for Dungeness crab. These projects aim to achieve the NWSMCI's goal of developing scientifically sound recommendations that citizens can give to existing governmental authorities (Gordon, 2003) to make future management decisions (Beierle, 2002). Among the efforts currently pursued by a group of citizens in Snohomish County is the "Proposed Dungeness Crab Stewardship Plan for Snohomish County," which strives to be a proactive, local effort to conserve the County's Dungeness crab resource, a resource that has experienced an increase in harvest over the past eight years.

However, the proposed stewardship plan exists as a draft plan and needs to be finalized. Finalizing the stewardship plan would involve improving some of the existing sections within the plan and selecting criteria to assist the advisory group in choosing recommendations that are realistic and feasible to implement. The Dungeness crab stewardship effort also raises some theoretical questions about citizen involvement in the management of a resource. For example, how could citizen involvement in the

management of the Dungeness crab resource at the local level help to improve the management and the status of the resource, given that the resource is currently co-managed by the Washington State Department of Fish and Wildlife and the Native American Tribes?

These problems identify the need for guidelines that can aid the Snohomish County MRC in their planning process, and identify strengths and weaknesses that could enhance or inhibit a project's implementation. Based on an analysis of literature regarding local level natural resource management, participatory observation, work experience and interviews, this thesis will develop a set of elements and criteria based on watershed and coastal management evaluations that can be used by the Snohomish County MRC to formulate a final plan and an implementation strategy for Dungeness crab stewardship.

Chapter One explores the theoretical context for the use of local-level natural resource management approaches by examining both the advocates and skeptics of this type of management. Overall, practitioners and researchers in this field agree that the use of both top-down and bottom-up methods are the preferred approach to involving local citizens in resource management in the United States. But what practical difficulties impede integration of top-down and bottom-up mandates and perspectives, and how well does such integration work in practice? Because this local-level approach to natural resource management is fairly new, projects that are implemented through initiatives such as the Northwest Straits Marine Conservation Initiative should be seen as an experiment to explore the advantages and disadvantages of managing resources with local citizens.

Chapter Two describes the momentum behind creating the Northwest Straits Marine Conservation Initiative and the role that Marine Resource Committees (MRCs) hold as citizen advisory groups. The structure of the Snohomish County MRC is presented, along with a discussion of why Dungeness crab stewardship was chosen as a topic area for protection and conservation efforts by the Snohomish County MRC. The MRC created the “Proposed Dungeness Crab Stewardship Plan for Snohomish County” and a list of recommendations to implement Dungeness crab stewardship. Yet, the plan is in draft form and the recommendations need to be analyzed in order to move forward with actions for implementation. My research suggests the need for a methodology to assess individual projects and calls for a general framework or guidelines that all MRCs can use to plan or evaluate their projects.

Chapter Three presents the methodology used to plan and evaluate local-level natural resource initiatives and projects on both large and small scales. These methods originate from researchers and practitioners in the local-level natural resources management field, and point towards the many lessons learned from both watershed and integrated coastal management (ICM) initiatives. By learning from the challenges and lessons that practitioners in watershed management and ICM present, new initiatives and projects can analyze their planning process and plans and anticipate the generated impacts of their efforts.

In Chapter Four I use the methods and lessons from Chapter Three to analyze the Proposed Dungeness Crab Stewardship Plan. I present a two-part analysis that: 1) proposes a framework for a local-level marine resource management plan, and 2)

evaluates criteria that can be used by the Snohomish County MRC to measure and then choose stewardship tools to implement the stewardship plan. The framework I construct can be used to revise the design of local-level marine resource management plans and improve future planning processes.

Chapter Five concludes my analysis on the Proposed Dungeness Crab Stewardship Plan for Snohomish County. My analysis suggests that in order for the plan to be implemented, the MRC should use the elements I describe to complete a plan that is succinct and describes in detail how the recommendation(s) they choose will be implemented. The recommendations the MRC is considering are within its capabilities as an advisory group. However, some barriers exist that could create implementation difficulty. Therefore, the MRC should consider taking advantage of existing opportunities (Wondolleck and Yaffee, 2000) that promote precautionary activities. Participating in existing activities can give the MRC an early, small success by which to build awareness to the fishing public and in others whose activities affect the nearshore environment.

## **Chapter Two – Local-Level Marine Resource Management in the Northwest Straits**

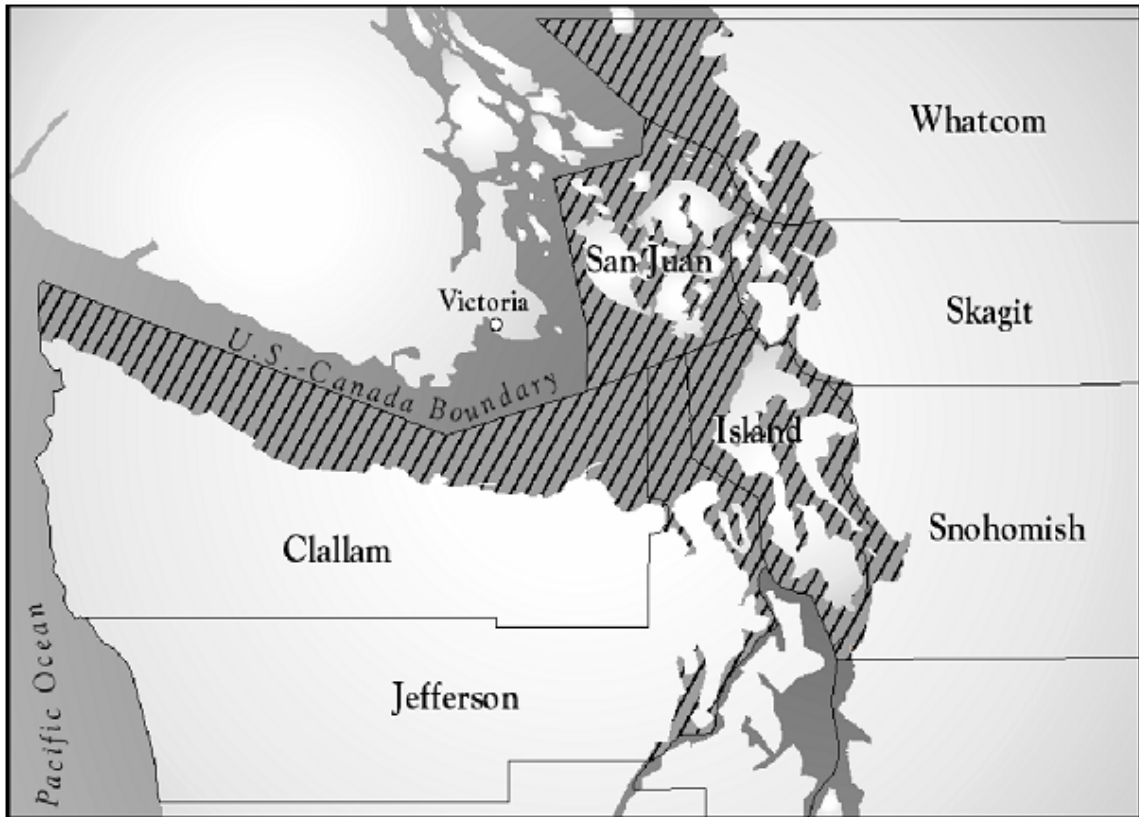
In this chapter, I present the Northwest Straits Marine Conservation Initiative as an example of local-level marine resource management and why it has become an experimental model of management in the Northwest Straits. I also discuss the formation and basic structure of Marine Resource Committees (MRCs), which are an example of citizen advisory groups. Next, I introduce the Snohomish County MRC and why it chose to focus on Dungeness crab stewardship as one of its topic areas. I include a description of the stewardship plan it produced, and why it has the potential to be a proactive initiative in protecting and conserving Dungeness crab. Finally, I summarize problems that the MRC has encountered as it developed the stewardship plan and present the objectives of my assessment of their planning effort.

### The Northwest Straits

The Northwest Straits includes the marine waters, shoreline, and nearshore areas of northern Puget Sound and the Strait of Juan de Fuca from the Canadian border to the south end of Whidbey Island (Figure 1). Marine areas of seven counties (Whatcom, San Juan, Skagit, Island, Snohomish, Clallam and Jefferson) are included within the Northwest Straits.

Increasing population growth in the region is likely to contribute to habitat loss and degradation, thereby necessitating careful management to sustain the uses of Puget Sound's resources (PSAT, 2002). Barriers to providing effective remedies include overlapping jurisdiction over marine resources, which makes it difficult to regulate

harmful activities and implement protective measures in order to slow or reverse the trends of resource decline (Murray-Metcalf Commission, 1998).



**Figure 1. The Northwest Straits Marine Conservation Initiative Area.**

The National Marine Sanctuary Proposal – Impetus for Local Level Marine Resource Management in the Northwest Straits

A National Marine Sanctuary (NMS) designation for the inland waters of northwest Washington was proposed in 1983 by the National Oceanic and Atmospheric Administration (NOAA) under the 1972 Marine Protection, Research and Sanctuaries Act (48 FR 35568). The public meetings concerning sanctuary establishment generated both support and opposition among the local communities. Citizens in support of the

proposed sanctuary were part of a coalition organized by several environmental organizations in the region, while opposition among local citizens was generated because they felt that the sanctuary was a federal power grab over their local waters (Smuckler, 2001; Winger, 2001). As citizen opposition grew, San Juan County developed a resolution of opposition to the sanctuary, which was signed by the San Juan County Board of Commissioners (Smuckler, 2001). In March 1996, in response to the proposed Sanctuary, the San Juan County Board of County Commissioners (BOCC) established a Marine Resources Committee (MRC) to advise the BOCC on priority marine resource concerns (Winger, 2001). The NMS designation was lobbied by both sides in Washington D.C. After listening to both viewpoints of concerned citizens, U.S. Senator Patty Murray (Democrat) and U.S. Representative Jack Metcalf (Republican) negotiated alternatives to the sanctuary designation process. Together, Senator Murray and Representative Metcalf formulated an independent Citizen's Advisory Commission (CAC), comprised of 15 members representing local governments, tribes, resource users, ports, environmentalists and two facilitators. The CAC reached consensus on eleven points, all focusing on the need to develop coordinated science and "bottom up" consensus building. The points include the need to: 1) reverse the declining trends in marine ecosystem health while maintaining the economic viability of the region, 2) involve local citizens including the tribes and, 3) use sound science in monitoring, research, and education (Murray-Metcalf Commission, 1998). In August 1998, the Report to the Convenors was complete. It recommended the creation of a federally-funded, regional, voluntary, bottom-up program for the seven counties adjacent to the waters of the Northwest Straits. The CAC

recommended that a sanctuary not be established and also proposed that no new regulatory authority be created or introduced (64 FR 50061). The CAC also stated that the new process would compel local and state authorities to make changes in the environment through a bottom-up and consensus-based process, yet it would not add another layer of bureaucracy (Murray-Metcalf Commission, 1998).

#### Structure of the Northwest Straits Marine Conservation Initiative (NWSMCI)

In 1998, the Murray-Metcalf Citizen Advisory Committee (CAC) determined that the Northwest Straits needed a federally funded but locally directed program to identify and deal with current marine resource concerns. The CAC concluded that a system of Marine Resource Committees (MRCs), modeled after the San Juan County MRC, could provide the desired amount of community involvement and sound science. The Northwest Straits Marine Conservation Initiative requested federal support to expand the bottom-up approach used by the San Juan County MRC to six other counties with jurisdiction in the Northwest Straits region. In 1998, the Northwest Straits Marine Conservation Initiative Act was adopted by Congress as a rider to H.R. 3461. It authorized the establishment of the Northwest Straits Commission (NWSC) and seven county MRCs in the Northwest Straits Marine Conservation Initiative Act (P.L. 105-384). The structure of both the MRCs and the Commission followed the recommendations made by the Murray-Metcalf CAC, representing specific areas and diverse viewpoints on marine issues in the Northwest Straits (Murray-Metcalf Commission, 1998).



A 13-member Northwest Straits Commission (Commission)<sup>1</sup> was formed to help guide scientific, technical, and financial support to the MRCs, and coordinates efforts to help regulatory authorities make more informed decisions about the Northwest Straits (Murray-Metcalf Commission, 1998; P.L. 105-384). To complete the establishment of the Northwest Straits Commission, the remaining six county governments (Whatcom, Skagit, Island, Snohomish, Clallam and Jefferson) were given the opportunity to establish MRCs. All of the MRCs are both voluntary and advisory, and make decisions by voting or by consensus; however, the MRCs have no direct authority over marine resources. By January 2000, all seven counties had formed MRCs and had designated representatives to the Northwest Straits Commission. In November 1999, the Commission began monthly meetings with the county representatives and some of the Governor-appointees.

MRCs include representatives of Native American tribal groups, scientists, local government officials (both elected and appointed), those with economic, recreational, environmental and conservation interests and other community members. Each MRC is challenged with assessing their marine resources, coordinating with government agencies, tribes and other entities, while working closely with local government to implement local marine conservation and restoration initiatives (Murray-Metcalf Commission, 1998).

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<sup>1</sup> The NWSC is comprised of five Governor appointees, a tribal appointment made by the Secretary of the Interior, and a representative from each of the MRCs.

### Accountability and Evaluation

The Northwest Straits Marine Conservation Initiative Act included a sunset clause that will terminate the initiative in 2004 if it is not reauthorized. In order for Congress to determine whether or not the initiative should be reauthorized, the Commission and the MRCs are required to measure their progress. Eight performance benchmarks were recommended by the CAC to guide the activities of the Commission and MRCs. In effect the MRCs become responsible for producing substantive and detectable results in marine resource restoration and protection. The CAC understood that it could take decades before the initiative generates substantive, detectable changes in the marine environment. Therefore, the CAC stated in the *Report to Convenors* that, "...many of the measures [s]hould be of the input or procedural type..." in order to promote early, substantial actions towards achieving the benchmarks. The benchmarks were considered by the CAC to be central to the success of the initiative. If the initiative fails to meet the benchmarks, it might not be reauthorized.

**Table 1. Benchmarks for Performance (Murray-Metcalf Commission, 1998).**

1. Local Participation: Obtain broad county participation in the MRCs.
2. Marine Protected Areas: Achieve a science-based, regional system of marine protected areas.
3. Habitat: Demonstrate a net gain in highly ecologically productive nearshore, intertidal and estuarine habitat in the Northwest Straits, with no significant loss of existing, high-value habitat. Improve state, tribal and local tools to map, assess and protect nearshore habitat. Prevent harm from upland activities.
4. Shellfish: Show a net reduction in shellfish harvest areas closed due to contamination.
5. Bottomfish: Exhibit measurable increases in factors supporting recovery of bottomfish (such as rockfish) – including numbers of fish of broodstock size and age, average fish size and abundance of prey species – as well as sufficient amounts and quality of protected habitat.
6. Marine Indicator Species: Demonstrate increases in other key marine indicator species.
7. Scientific Data: Initiate coordination of scientific data, including a scientific baseline, common protocols, unified GIS, and sharing of ecosystem assessments and research.
8. Outreach and Education: Coordinate with Puget Sound Action Team and other entities on an effective outreach and education effort with measurements of the numbers of people contacted as well as changes in behavior.

The MRCs serve as nonpartisan advisory groups that aid in the decision-making process on issues that focus primarily on protection, restoration, education, and outreach (Gordon, 2003). Each MRC has its own organization, process, and the means by which it achieves the benchmarks (Cowan, pers. comm., 2003), but in many cases, the success of one MRC has enhanced the activities and successes of other MRCs (Gordon, 2003)<sup>2</sup>. The

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<sup>2</sup> The Northwest Straits Commission contributes to MRC efforts through monthly meetings, staff support, and financial support in the form of Action Grants (up to \$70,000/year) for each MRC and has also coordinated its own region-wide projects (NWSMCI, 2000; NWSMCI, 2001; Gordon, 2003). In addition to Action Grants received by the Commission, MRCs also apply for outside funding and have received funds from: the Washington State Salmon Recovery Funding Board, Washington State Coastal Zone

Snohomish County MRC is an example of an advisory group that has benefited from the lessons learned by other MRCs, and could offer the initiative a new outlook on how a citizen-led group can organize an effort that is proactive in marine restoration and protection.

### The Mission and Structure of the Snohomish County Marine Resources Advisory Committee

The mission of the Snohomish County MRC is to advise the County Council and Executive regarding the status and protection of marine resources and build local awareness of the issues and support for actions. With administrative support and staffing from Snohomish County, the MRC holds monthly, open public meetings with a membership that is currently comprised of a recreational boater, active representatives from two tribes, city planners, and non-governmental organization and education interests<sup>3</sup>. Members can make decisions when there is a quorum (majority of MRC members present at the meeting), and use a “modified consensus” model for decision-making. This model ensures that all efforts will be made in order for the members to come to consensus, meaning that all members are willing to accept the decision made by the group. If consensus cannot be met, the chairperson calls for the issue to be put to a vote.

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Management Program, University of California (Davis) Marine Ecosystem Health Program, National Fish and Wildlife Fund, Bullitt Foundation and the Marjorie Mosher Schmidt Foundation.

<sup>3</sup> The MRC also created an *ex officio* MRC member, who is a representative of the county, to improve coordination between the county and the MRC. This representative fully participates in MRC meetings, but is not allowed to participate in MRC decisions.

Through research, discussions with experts, and public outreach, the Snohomish County MRC decided to focus on four main topic areas: vegetation, physical habitat, forage fish (surf smelt, sand lance and herring) and Dungeness crab. For vegetation, physical habitat and forage fish topic areas, the MRC is pursuing projects that gather, map and analyze scientific data, enhance nearshore habitat and coordinate volunteer forage fish surveys. For the topic focusing on Dungeness crab, the MRC met with biologists, including co-managers (Washington State Department of Fish and Wildlife and the tribes), recreational fishers, and researchers who provided the MRC with information on the current issues concerning Dungeness crab. They were also educated on Dungeness crab life history, habitat and management. The MRC created an *ad hoc* work group (referred to as the subcommittee), to complete a Dungeness Crab Stewardship Plan by February 28, 2003. To develop the plan, the subcommittee met bi-monthly over a period of 15 months<sup>4</sup>, and consisted of three MRC members and one concerned citizen. Decisions at the subcommittee meetings were made by consensus, but ultimately, final decisions concerning the recommendations in the stewardship plan rest with the entire Snohomish County MRC.

### Why Dungeness Crab Stewardship?

#### *Understanding the Dungeness Crab Issue*

The MRC's decision to conserve and protect Dungeness crab is based on its importance as the largest commercial crustacean fishery in Puget Sound, the lack of

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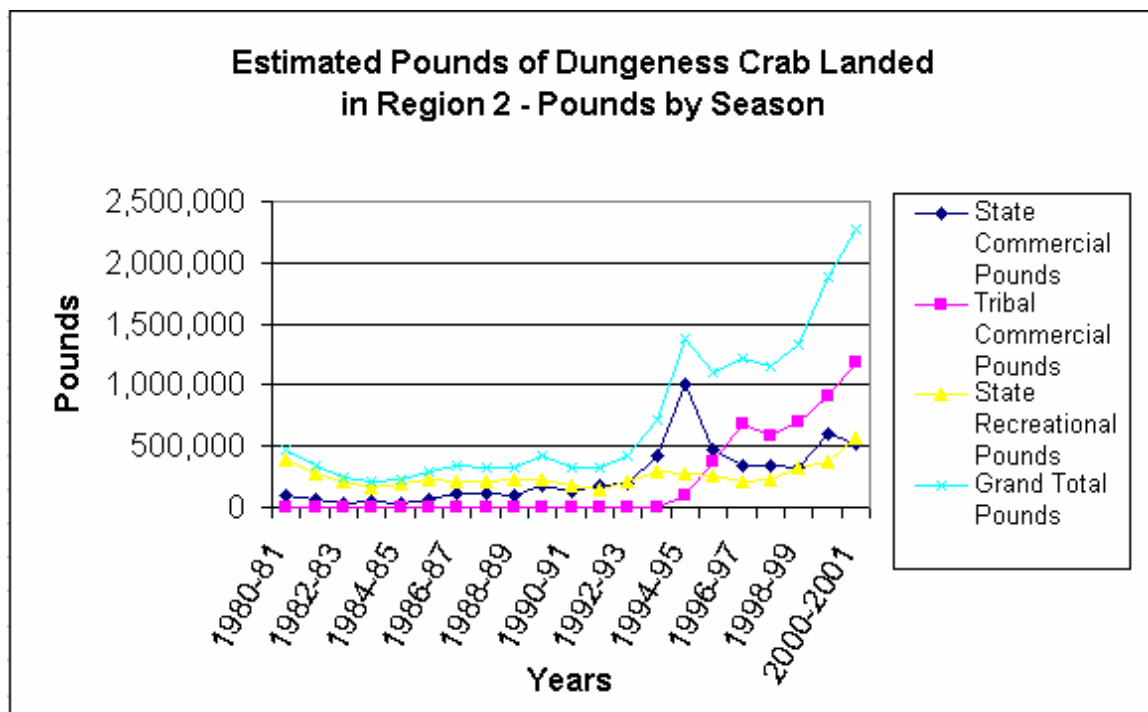
<sup>4</sup> The last nine months of planning Snohomish County provided myself as staff to the MRC.

reliable population estimates, the increased participation in the fisheries, and the increase in total annual harvest (SCMRC, 2003). To assist with researching the issue and formulating a plan, Snohomish County provided staff to a subcommittee of the MRC with partial funding from a grant from the Washington State Department of Ecology.

Over a fifteen month period, the subcommittee, with assistance from Snohomish County staff, collected data from the Washington Department of Fish and Wildlife (WDFW) to help the MRC determine whether the harvest of Dungeness crab in Snohomish County was increasing. Harvest data collected from WDFW indicated that over twenty years, the total annual Dungeness crab harvested by recreational, commercial and tribal fishers in waters surrounding Snohomish County increased from 478,640 pounds in 1980-1981 to 2,273,082 pounds in 2000-2001<sup>5</sup>. Figure 2 is a graph that the subcommittee used to indicate the increase in harvest, pounds by season, in all sectors of the industry in Snohomish County.

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<sup>5</sup> This information from WDFW data obtained in 2001.



**Figure 2. Region 2 Dungeness Crab Fishery - State Commercial, State Recreational and Tribal Commercial Components (adapted from WDFW data).**

There could be many explanations for this increase, but several possibilities for the increase are notable:

- 1) Since the Rafeedie decision in 1994, the state and the tribes co-manage the Dungeness crab fishery in a 50/50 share. Since then, participation by tribal commercial crab fishermen has increased within Puget Sound thereby raising the entire number of fishermen participating in the fishery.
- 2) There could be a short-term increase in the number of harvestable crab.
- 3) The increase in harvest could be due to fishers seeking alternatives to the declining opportunities for bottomfish and salmon.

Many managers believe that before the Rafeedie decision in 1994, the Dungeness crab resource was not harvested to its fullest potential. At the same time, they are

considering that the overall effort today could be approaching its full potential<sup>6</sup>. Even in the face of an increase in the harvest, WDFW can not say whether or not the increase in harvest is due to an increase in the resource itself (Velasques, pers. comm., 2003). So for now, most managers and policy makers feel that the current management strategy they are employing (size, sex, and season regulations) is working well, and that there are currently no benefits to spending more funds on determining meaningful population estimates.

In general though, the increase in harvest has raised interest by the co-managers and those interested in the sustainability of the resource<sup>7</sup>. Along with the co-managers, there are other interests such as the Puget Sound Water Quality Action Team (PSAT), as well as fisheries interests that have expressed concern regarding the increased crab harvest. WDFW has recently included Dungeness crab in the WDFW “Catch Record Card” system, instituted in the 2000-2001 license year, and includes almost all licensed recreational harvesters of crab<sup>8</sup>. The PSAT has also mimicked the Snohomish County MRC’s “Dungeness Crab Fact Sheet,” and has placed it on their website to educate the public about the Dungeness crab resource (See Appendix A).

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<sup>6</sup> For example, the 2001-2002 season quota for Region 2E (which comprises most of Snohomish County waters) was not harvested despite the best efforts of the commercial fishers in that region.

<sup>7</sup> The MRC specifically noted in their plan that blame should not be placed on any one sector of the industry, emphasizing that the increase in harvest is not well understood.

<sup>8</sup> Licensed recreational fishers before the 2000-2001 season were not required to complete Catch Record Cards. Before then, recreational catch was recorded by voluntary phone surveys by WDFW. Compliance by recreational fishers 2000-2001 was low, therefore the data obtained by WDFW was thrown out. It was kept by the subcommittee because it was felt that the new data was a better indication of recreational harvest than data recorded in the past.



The subcommittee began work on writing a *management* plan for Dungeness crab. Soon afterwards, the subcommittee changed the focus of the plan and decided to promote Dungeness crab *stewardship*, based on the fact that the resource is already managed by the state and the tribes, and that stewardship could be seen as a way for all users of the resource to participate in making decisions for the long-term use and health of Dungeness crab. For this reason, the stewardship plan provides a good opportunity to study the integration of top-down and bottom-down methods in marine resource management.

#### *The Goal and Objectives of the Stewardship Plan*

From December 2001 to June 2002, the subcommittee of the MRC formulated their overall goal and objectives of the stewardship plan<sup>9</sup>. The overall goal of the stewardship plan is to provide a healthy and sustainable Dungeness crab resource for current and future generations of fishers, and for marine life including fish and shorebirds. In addition to their goal, the MRC adopted six objectives meant to guide stewardship activities or projects aimed at monitoring, outreach, regulation and restoration:

1. Prevent overharvest
2. Achieve compatible and equitable stewardship measures among jurisdictions throughout the fishery stewardship groups
3. Facilitate cooperative research, monitoring, and law enforcement

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<sup>9</sup> The subcommittee formulated the goal and objectives without assistance by Snohomish County staff. Once the goal and objectives were formulated, the entire Snohomish County MRC came to consensus on the goal and objectives presented by the subcommittee.

4. Identify critical habitats and environmental factors that limit long-term Dungeness crab productivity
5. Adopt and promote environmental quality guidelines necessary for the long-term Dungeness crab maintenance and productivity in Snohomish County and throughout their range
6. Establish standards and procedures for implementing the Plan and criteria for determining Plan compliance (SCMRC, 2003)

### *Stewardship Defined*

The subcommittee's idea of stewardship evolved from their recognition that stewardship could be seen as a way for all users of the resource to participate in making decisions for the long-term use and continued health of Dungeness crab. Stewardship could also provide for proactive activities such as habitat preservation, resource conservation, and public education, which could be less costly and easier to achieve than species recovery and habitat restoration (SCMRC, 2003). Therefore, the subcommittee needed to describe what they meant by stewardship, which was adapted from a definition used by Peter Block, (1999). "Stewardship" in the context of their plan is: "Active participation by the stakeholders who, considering both current and future needs, help manage the resource with the best interests for all" (SCMRC, 2003). In addition to their definition of stewardship, the subcommittee also defined the term stakeholder, which they take to mean: "Any person or entity affected in any way by Dungeness crab... [t]his includes the harvesters, consumers, regulators and a diverse collection of other parties concerned with the role of the crab in the marine ecosystem."

The subcommittee notes that although the stewardship plan is specific to Snohomish County, they recognize that the stewardship plan could have applications to the entire Puget Sound region. The subcommittee stresses that stewardship is primarily carried out through local stakeholders such as co-managers, agencies, recreational fishers and NGOs, who have knowledge of the resource. Nevertheless, local entities cannot act alone to obtain the resources (such as staffing and funding) required to achieve stewardship (Ack et al., 2001). Therefore, the challenges brought by stewardship at the local-level eventually create the need to transcend to regional, state, or national involvement in stewardship efforts, while at the same being enhanced by on-the-ground efforts of local entities working out the specific details of a stewardship plan (Ack et al. 2001).

#### *Completion and Current Status of the Dungeness Crab Stewardship Plan*

From July 2002 to February 2003, the remainder of the subcommittee's effort was to complete the Stewardship Plan, which was modeled after a horseshoe crab management plan from the east coast of the United States. The goal of the horseshoe crab plan was similar to the goal of the Dungeness crab plan, in that it addressed a resource with multiple users and interests with multiple jurisdictions. On the other hand, the two plans also differed from each other; the horseshoe plan addressed a depleted resource and the Dungeness crab plan addresses a rather healthy resource. Included in the Dungeness crab stewardship plan are sections pertaining to:

- Dungeness crab life history and habitat requirements
- The history and status of Dungeness crab

- Issues and concerns about the resource
- The concept of stewardship
- Stewardship activities
- Stewardship program implementation and evaluation

In December 2002 and January 2003, the stewardship plan received six independent reviews from managers, researchers, and a recreational fisher. After incorporating some of the comments, the subcommittee presented a draft plan to the Snohomish County MRC for approval in February of 2003. During the MRC's monthly meeting in February, the MRC and Snohomish County decided that the stewardship plan was not final, citing that the plan should: 1) have the ability to evolve, 2) have substantive, understandable recommendations, and 3) be written in a condensed and simplified manner. To allow for modifications to occur, the MRC changed the name of the "Dungeness Crab Stewardship Plan for Snohomish County" to "Proposed Dungeness Crab Stewardship Plan for Snohomish County." Although the stewardship plan was not final, it was produced with the new title and placed on the Snohomish County MRC website.

In the proposed stewardship plan, the subcommittee did not have a set of clear findings and recommendations that the Snohomish County Council and other authorities like WDFW were to use to make future management decisions regarding Dungeness crab. Rather, the subcommittee listed a set of "Issues and Concerns" (SCMRC, 2003). In order for the MRC to be more explicit in their recommendations to the Snohomish County Council, the MRC formulated a list of findings and recommendations that were adapted from their "Issues and Concerns" section. The findings and recommendations

were placed in a separate document and given to the Snohomish County Council<sup>10</sup>. One of the recommendations for Dungeness crab stewardship is to support a project that is already established within the NWSMCI, while other recommendations suggest new actions for public education and outreach and improving existing knowledge of Dungeness crab habitat (Table 2). These recommendations will be discussed further in Chapter Four.

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<sup>10</sup> The findings and recommendations in this separate document were voted on consensus by the MRC. They can be found at: <http://www.co.snohomish.wa.us/publicwk/swm/mrc/admin/2002AnnualReport.htm> (October 2, 2003).

**Table 2. Findings and Recommendations Given to the Snohomish County Council for Dungeness Crab Stewardship**

<p>1. Implement the Stewardship Plan</p> <ul style="list-style-type: none"> <li>• Finding - Harvesting of Dungeness crab in Snohomish County has increased by a factor of five over the past decade, but co-managers (state and tribes) do not know what level of harvest is sustainable or the ecological role of Dungeness crab in the marine ecosystem.</li> <li>• Recommendation - Support the MRC's proactive response to these uncertainties by implementing the Proposed Dungeness Crab Stewardship Plan for Snohomish County, including the production of a Dungeness crab stewardship handbook.</li> </ul> <p>2. Map Gravid Female and Nursery Habitat</p> <ul style="list-style-type: none"> <li>• Finding - Gravid (egg-carrying) female crabs aggregate in specific areas during the winter months. In Snohomish County, we know that the outer shelf of the Snohomish River delta is heavily utilized by gravid female crabs. The amount of nearshore nursery habitat may limit Dungeness crab abundance. First-year crabs settle and reside in intertidal eelgrass beds and mid-intertidal gravel substrate. These habitats provide food and shelter for juvenile crabs until they are large enough to survive in the offshore environment. The extent and condition of gravid female and juvenile crab nursery habitat is not known. This information is needed for effective local stewardship of Dungeness crab.</li> <li>• Recommendation - Assess and map the extent and condition of Dungeness crab gravid female and juvenile nursery habitats.</li> </ul> <p>3. Locate and Remove Derelict Fishing Gear</p> <ul style="list-style-type: none"> <li>• Finding - The extent and impact of unmarked and derelict fishing gear on local Dungeness crab stocks is not known. Derelict crab pots may cause significant losses of Dungeness crab. Lost gill nets have been shown to be damaging to crabs because they trap crabs that are attracted to dead fish ensnared in the nets.</li> <li>• Recommendation - Investigate the extent and impact of derelict fishing gear on local Dungeness crab stocks and participate in the Northwest Straits regional derelict fishing gear removal program.</li> </ul> <p>4. Increase Public Awareness</p> <ul style="list-style-type: none"> <li>• Finding - Throughout Snohomish County there is little or no information on recreational harvesting of crab and shellfish posted at public shoreline access locations.</li> <li>• Recommendation - Increase public awareness of crab and shellfish harvesting issues by posting new or existing public education materials at public shoreline access locations.</li> </ul> <p>5. Decrease Poaching</p> <ul style="list-style-type: none"> <li>• Finding - The reproductive potential of female crabs is protected by not harvesting females and by establishing a minimum legal harvest size for male crabs. Poaching of females and sub-legal males might eventually take a toll on the mating efficiency and egg production by the females. In addition, harvesting crab while they have soft shells damages many crabs that are returned to the water.</li> <li>• Recommendation - Initiate discussion with co-managers about local actions that could be taken to increase compliance with sex, size, bag, and seasonal limitations on harvest of Dungeness crab.</li> </ul>
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At the time this thesis was written, the Snohomish County MRC was in the process of deciding which recommendations it should implement with a \$10,000 grant from the Marjorie Mosher Schmidt Foundation. It should be noted that there are other sources of funding allotted for the Snohomish County MRC, which could be used for MRC projects. For instance, the Snohomish County MRC receives an Action Grant each year from the Northwest Straits Commission, which can reach up to \$70,000 per year, and Snohomish County has an annual budget of about \$100,000 for marine resource projects. In addition to this funding, the MRC also has the ability to apply for other outside funding.

#### Problem Statement and Purpose of the Study

In fifteen months, the Snohomish County MRC has formulated a plan that attempts to be proactive in the local-level marine resource management for Dungeness crab. However, the plan is still in draft form and needs to be finalized. There are disadvantages to not finalizing the plan. A plan in draft form, especially if it is in print or placed on a website, can seem final, and people can feel it cannot be changed (Kay and Alder, 1999). In addition to this, if stakeholders are not involved in the final draft of the plan, a sense of ownership and commitment to the plan could be lost, and could affect whether or not the plan will be implemented (Kay and Alder, 1999).

Creating a final plan and making recommendations are necessary but not sufficient to implement a plan, since the creation of the final plan and recommendations can be viewed as the end of the planning process rather than the beginning of

implementation (Kay and Alder, 1999). Naturally there can be down-time in productivity and motivation by a citizen's advisory group whenever a draft or final plan is complete. Therefore, one challenge the MRC faces is its ability to gain the motivation to instigate actions that are realistic and feasible to implement within its means as a citizen's advisory group. Other challenges have also surfaced. Attempting to initiate a proactive plan can be difficult when collaboration may be viewed by some of those involved as a waste of time and resources (Wondolleck and Yaffee, 2000), especially if the resource is not in any immediate danger or harm. For example, would citizen involvement in Dungeness crab stewardship help to improve the management of the resource, given that the resource is currently co-managed by the state and the tribes?

The questions presented in this section indicate that there is a need for a guide that can aid MRCs in their planning process, and identify strengths and weaknesses that could enhance or inhibit a project's implementation. Based on an analysis of literature regarding local level natural resource management, participatory observation, and interviews, this thesis will develop a set of elements and criteria based on watershed and coastal management evaluations the MRC can use to improve the stewardship plan. In addition, I suggest changes that help the MRC address the benchmarks and formulate an implementation strategy for Dungeness crab stewardship.



## **Chapter Three - Methodology**

The problem presented in Chapter Two indicates that there is a need for broad guidelines that the Snohomish County MRC can use when considering the contents of their final Dungeness Crab Stewardship Plan, as well as a methodology for choosing which recommendations to implement. In this chapter, I discuss the methods that will be used in Chapter Four to evaluate the stewardship plan's contents, process and recommendations. A complete description of methods can be found in Kay and Alder (1999), Olsen et al. (1999), and Born and Genskow (2000, 2001).

In the past decade, literature within local-level natural resources management has created "lessons learned" and manuals which local-level initiatives can use in project design and evaluation (Olsen et al., 1999; Olsen, 2003; Born and Genskow, 2000, 2001; Huntington and Sommarstrom 2000). The experiences discussed by these researchers and practitioners on watershed initiatives and integrated coastal management have applicability to local-level marine resource initiatives like the NWSMCI. In this chapter, I discuss: 1) data collection methods, 2) the classification of coastal management plans, 3) lessons learned from watershed initiatives and integrated coastal management, and 4) a coastal management framework on which future projects and initiatives can base their design, process and evaluations. The results are not meant to be prescriptive. The practitioner or researcher selects what relevant guidelines to use based on their detailed knowledge of the initiative (Olsen et al., 1999).

### Data Collection

Primary source data for this thesis were obtained through participant observation, MRC and subcommittee meeting minutes, unstructured interviews and a review of the Proposed Dungeness Crab Stewardship Plan<sup>11</sup>. Secondary source data include a review of literature on coastal management plans and local-level natural resource management, particularly within watershed management and integrated coastal management. These approaches to local-level resource management were chosen because they comprise a substantial amount of information on evaluating local-level initiatives, and are collectively considered to have a general evaluation methodology by which to plan and assess local-level natural resource management initiatives.

### Classifying Coastal Management Plans

In general, coastal management plans can be used to provide information about program scale, focus, and the degree of integration (Kay and Alder, 1999). More specifically, plans can indicate why a resource needs to be managed, what actions need to be taken to manage the resource, and how management will occur. Coastal management plans can also be strategic or operational in focus. Strategic plans tend to be broad, aim for long-term objectives, and do not give a step-by-step account of how to achieve the objectives. Operational plans are more concerned with day-to-day management of the

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<sup>11</sup> Participant observation is a data collection method that combines direct participation with informants and careful observation of their behaviors with introspective reflection on the possible meanings of their activities (Spradley, 1980). An unstructured interview is an interview based on a plan characterized by minimum control over informants responses, used in situations in which you have lots of time, and allows considerable freedom in the questioning procedure (Bernard, 1988).

resource, and describe the infrastructure and human capacity needed to meet specific objectives (Kay and Alder, 1999). Which level of planning to employ is determined by the issue, geographic scale, and the level of future planning and management a community wishes to undertake<sup>12</sup>.

Over the past two decades, researchers in the field of local-level natural resource management have compiled a set of key elements that could be incorporated into coastal management plans to design activities and evaluate programs or projects (Kay and Alder, 1999; Olsen et al., 1999; Born and Genskow, 2000; Adler et al., 2000). These key elements, along with those elements indicated by researchers in watershed management and integrated coastal management, will be discussed further in the following sections and in Chapter Four.

### Watershed Management

Although managing natural resources within a watershed is not a new idea within the United States, interest has increased in the “watershed ideal” over the past decade (Coughlin et al., 1999), particularly in the western United States. This progressive approach in environmental management seeks to form collaborative partnerships that are comprised of a diverse group of stakeholders working together to address environmental issues through interagency and intergovernmental coordination and linking related governmental programs (Born and Genskow, 2000). One example of this type of

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<sup>12</sup> A complete description of the various classifications of coastal management plans can be found in Kay and Alder (1999). General frameworks for coastal management plans can also be adapted from Born and Genskow (2001) and Olsen et al. (1999).

collaborative partnership is watershed councils, which were formed in response to the public's dissatisfaction on natural resource management issues, and the public's desire for increased, direct involvement in decision making (Kenney, 1999; Griffin, 1999; Coughlin et al., 1999; Corner and Moote, 1999). The term "watershed council" is used to describe a group of people who participate in collaborative, water-based partnerships in an effort to:

- Use the watershed approach in managing their natural resources
- Create collaborative partnerships between private and public sectors
- Represent a diverse interest of stakeholders
- Use consensus as their means for decision-making
- Use science-based and information-driven assessments, plans and decisions
- Include action-oriented planning and management to reflect new knowledge from monitoring and evaluation (Sommarstrom, 1999; Born and Genskow, 2000)

Although the framework listed above is rarely fulfilled by each watershed initiative (Kenney, 1999; Sommarstrom, 1999; Born and Genskow, 2000, 2001), it represents what the watershed approach strives to accomplish. Griffin (1999) states that, "Watershed councils are just one manifestation of a massive power shift away from centralized, bureaucratic management of public resources towards more community-level involvement." Hence, watershed councils have evolved to incorporate more public involvement than past approaches in water management (Kenney, 1999) and encourage increased citizen deliberation in decision-making (Griffin, 1999).

As noted in Chapter One, watershed councils have both advocates and critics (Huntington, 1999; Kenney, 1999; Griffin, 1999; Adler et al., 2000; Chess and Gibson 2001), but given the increasing reliance on watershed councils to effectively advise on the management of their natural resources, the government suggests assessing their work

in order to evaluate how effective these “new” programs are. Organizations such as the National Academy of Public Administration have published literature pertaining to the evaluation of watershed initiatives and councils (Born and Genskow, 2000 and 2001; Hungtington and Sommarstrom, 2000; Adler et al., 2000). Each claims to have their own lessons learned and methodology that aim to explore how watershed initiatives and councils have succeeded or failed in the watershed process and measuring on-the-ground environmental outcomes. Born and Genskow (2001) describe a set of lessons learned that may be used to guide and design watershed initiatives, but the lessons they suggest could be applicable to many local-level natural resource initiatives:

1. Establishing a common vocabulary can aid in clarifying disparate notions of watershed initiatives held by NGOs, agencies and policy makers
2. There is a need for a multi-dimensional evaluation framework that can identify various levels of accomplishment or success at various levels of organizational maturity
3. Good planning processes lead to better recommendations
4. Top-down and bottom-up processes working in concert are integral to successful partnerships but should not replace regulation
5. The context in which initiatives develop greatly influences scopes, goals, characteristics, and accomplishments (Born and Genskow, 2001: 20)

In addition to the lessons that Born and Genskow describe above, they have also generated a general framework by which to measure an initiative’s progress across multiple dimensions over time (Table 3). This is not employed as part of my evaluation, but the framework could be used to determine the appropriate measures to assess environmental outcomes, as well as social, economic and institutional processes.

**Table 3. Elements of a Multi-Dimensional Evaluation Framework for Watershed Initiatives (Born and Genskow, 2001).**

Dimension	Measures
Social capacity-development and generally less-tangible accomplishments	Process measures, trust-building, educational efforts and awareness-building, enhanced coordination, dispute resolution, and strengthened local problem-solving networks.
Institutional changes	Changes in existing institutions (e.g., changes in budgets, regulations, permit review processes, consistency provisions) and/or creation of new organizations (e.g., land trusts).
Economic outputs	Economic gains related to: hydropower; flood protection; riparian property values (including valuation increases from urban riverside redevelopment); recreation; fisheries; water supply; and wastewater treatment.
Intermediate environmental outputs	Resource-level biophysical changes such as measurable changes in land management practices, habitat rehabilitation, land acquisition, and improvements to wastewater treatment.
Environmental outcomes	Measurable and attributable resource improvements. Depending on the environmental goals, these could include land conservation, water conservation, improvements in water quality, and other measures of ecological health.

Born and Genskow (2001) note that evaluating watershed initiatives will involve a more expanded approach than the general framework for evaluation presented in Table 3. The authors admit that conducting an evaluation based on these multi-dimensional elements poses numerous challenges, citing the need for a mix of both qualitative and quantitative methods that require an inordinate amount of staffing and funding. For these reasons it is easy to see why watershed initiatives need an expanded methodology for evaluating their local-level resource management initiatives. The methodology presented by practitioners in integrated coastal management could have application to creating expanded evaluation approaches. Integrated coastal management presents an approach that could help to design initiatives, or to evaluate both progress and environmental outcomes as a series of intermediate steps.

## Integrated Coastal Management

The evaluation of coastal management programs is still a relatively new field (Kay and Alder, 1999). However, researchers in integrated coastal management (ICM), which is primarily focused on international coastal management issues, have generated a list of lessons learned, including an evaluation methodology which could be applied to United States local-level marine resource management initiatives.

ICM focuses on the watershed approach, and how it can be used to address the connections and implications of development, human activities, biological processes, inland areas, as well as coastal lands and offshore waters (Gleason et al., 2000). The purpose of the ICM approach is to provide a structure for local-level management through community-based and collaborative approaches while meeting national standards (Gleason et al., 2000). Because of the large amount of resources and funds provided to international ICM initiatives, donors indicated the need to discern whether or not the initiatives were having an impact on the environment and communities.

The need for a common methodology was specified in 1996 in a meeting of the International Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) (Olsen et al., 1999). Since this meeting, the experiences of practitioners in coastal management worldwide were formulated in a manual<sup>13</sup> that could be used to assess progress towards coastal management goals and learn what works well and what does not work well in coastal management.

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<sup>13</sup> For more information on this manual, see Olsen et al. (1999), "The Common Methodology for Learning: A Manual for Assessing Progress in Coastal Management."

ICM researchers and practitioners strive to design initiatives that are sustainable over long periods of time (decades), are capable of being adapted, and provide a means to encourage certain types of resource use and collaboration between institutions and user groups (Olsen, 2003). The manual produced by Olsen et al. (1999) provides:

- a framework by which future projects can base their design and self assessments
- assistance in tracking progress
- learning and transfer of knowledge, which could increase the replication of good coastal management practices
- a way to make the evaluation process promote learning for staff, funders and the people who the project affects

The framework presented in the manual and in Table 4 follows a series of actions and steps that characterize a project's design and process at a given point in time. The steps can be taken in different order (Olsen et al., 1999).

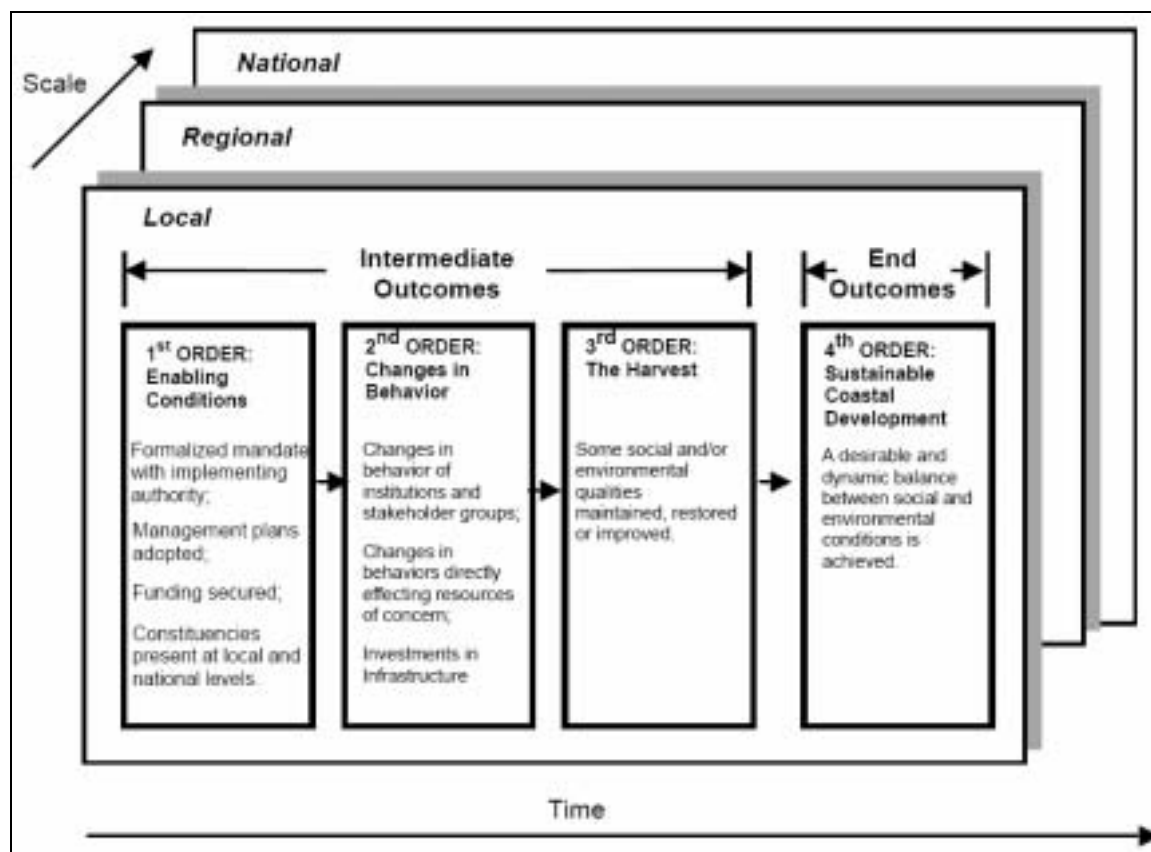


**Table 4. Actions Associated Within the Steps of Coastal Management (Olsen et al., 1999).**

<b>Step</b>	<b>Priority Actions</b>
One: Issue Identification and Assessment	Assess the principal environmental, social and institutional issues and their implications. Identify the major stakeholders and their interests. Invite review and response to the assessment. Select the issues upon which the management initiative will focus its efforts. Define the goals of the management initiative.
Two: Preparation of the Plan	Conduct scientific research targeted at selected management questions. Document baseline conditions. Conduct a public education program and involve stakeholders in the planning process. Develop the management plan and the institutional framework by which it will be implemented. Create staff and institutional capacity for implementation. Test implementation strategies at a pilot scale.
Three: Formal Adoption and Funding	Obtain governmental mandate for a planning and policy formulation process. Obtain formal endorsement of policies/plan and the authorities necessary for their implementation. Obtain the funding required for program implementation.
Four: Implementation	Modify the strategies of the program as needed. Promote compliance with program policies. Strengthen institutional frameworks and legal authority for management. Implement mechanisms for interagency coordination. Strengthen program staffs' technical and administrative capacity. Catalyze the construction and maintenance of necessary physical infrastructure. Sustain participation of major stakeholder groups. Implement conflict resolution procedures. Maintain the program's priority on the public agenda. Monitor performance and societal/ecosystem trends.
Five: Evaluation	Assess the program's impacts on the management issues being addressed. Adapt the program to its own experience and to changing social and environmental conditions. Conduct external evaluations at major junctures in the program's evolution.

The manual produced by Olsen et al. (1999) is also useful for differentiating between the various types of outcomes associated with an ongoing project. For example, first and second order outcomes can provide a means to measure progress towards a project's final goals, since goals may not be realized until decades after a project has been

completed. Third and fourth order outcomes measure the targeted changes and long-term sustainability of the initiative (Figure 3)<sup>14</sup>.



**Figure 3. The Sequence of Coastal Management Outcomes (Olsen, 2003).**

The authors note that the priority actions and sequence of outcomes should be used as a guide and not as a strict design to be adhered to. Selecting what relevant guidelines to follow is up to the researcher or practitioner, and should be based on their detailed knowledge of the initiative (Olsen et al., 1999).

<sup>14</sup> For more information on the four orders of coastal outcomes, see Olsen et al. (2003).

## Discussion

The information provided in this chapter establishes the theoretical support for applying the various elements of local-level natural resource management evaluation methodology to the analysis of the contents and process of the Proposed Dungeness Crab Stewardship Plan. By learning from the challenges and lessons that practitioners in watershed management and ICM present, it is hoped that new initiatives will be more successful by being able to analyze their planning process and plans, and to anticipate the generated impacts of their efforts, whether it be on a large or small scale.

In Chapter Four, I apply the methodology presented in Chapter Three to assess the problems of finalizing the Proposed Dungeness Crab Stewardship Plan and assessing its recommendations. I also employ policy analysis to identify evaluative criteria that the Snohomish County MRC can use to analyze their recommendations. The criteria can assist the MRC in creating a strategy they can use to implement the recommendation(s) of their choice.

## **Chapter Four – Analysis of the Plan and its Recommendations**

In Chapter Four I present a two-part analysis that: 1) proposes a framework for a local-level marine resource management plan, and 2) evaluates criteria that can be used by the Snohomish County MRC to evaluate and then choose stewardship tools to implement their Dungeness Crab Stewardship Plan. The first part of this chapter uses watershed management and ICM methodology described in Chapter Three to assess the key contents of a local-level marine resource management plan. The framework I present can be used to revise the design of the local-level marine resource management plans and improve future planning processes. In the first section I make recommendations for improvements in the Dungeness crab stewardship plan. In the second part of this chapter I apply policy analysis to select evaluative criteria by which the MRC can qualitatively measure the recommendations presented in the stewardship plan.

### Section One: Key Elements of Local-Level Natural Resource Management Plans

As mentioned in Chapter Three, strategic plans tend to be broad, aim for long-term objectives, and usually do not give a step-by-step account of how to achieve specific objectives. Operational plans are more closely concerned with day-to-day management of the resource, and describe the infrastructure and human capacity needed to meet specific objectives (Kay and Alder, 1999)<sup>15</sup>. For example, the Report to Convenors (Murray-Metcalf Commission, 1998) can be considered a strategic plan, because it is geographically and objectively broad in scope, refers to time frames of more than five

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<sup>15</sup> A complete description of definitions and methods used to create coastal management plans can be found in: Kay and Alder (1999).

years, and provides a context within which additional detailed plans can be written. The Snohomish County MRC Proposed Dungeness Crab Stewardship Plan is a plan that strives to be strategic, in that the plan cites long-term goals and time frames and does not explicitly state its recommendations (refer to Chapter Two). On the other hand, the stewardship plan also exhibits characteristics of an operational plan, in that the plan describes what issues have arisen<sup>16</sup> given the information compiled thus far and provides a framework for implementation. Therefore, the subcommittee has created a sort of “hybrid” plan that contains characteristics of both strategic and operational plans. This approach seems consistent with the MRC’s intent to change citizen behavior and engage them in becoming active participants in the long-term sustainability of the Dungeness crab resource. Having this strategic vision does not disqualify the MRC from producing a strategic plan (Kay and Alder, 1999). But stewardship is inherently local and relies on individuals to contribute information, knowledge and energy (Ack, et al., 2001) to the planning and management process. Therefore a “hybrid” plan recognizes the necessity of being long-term (strategic) but also is inherently local (operational) in order to accomplish specific tasks.

As mentioned in Chapter Two, the Snohomish County MRC would like the final stewardship plan to be written in a simple, condensed manner that also allows for the stewardship plan to evolve over time. Therefore the MRC should retain strategic elements in the plan, but should also consider: 1) how on-the-ground actions will be

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<sup>16</sup> To reiterate, the subcommittee states a set of “Issues and Concerns” in the proposed stewardship plan. After the plan was produced, the set of issues and concerns were produced in a separate document as a list of “Findings and Recommendations” (Table 2).

realized and 2) that the NWSMCI is an initiative that may or may not be reauthorized for another six years. Given that the MRC's actions could possibly occur on short time frames rather than on the long time frames, the MRC should consider including the elements of an operational plan, which could assist in defining the elements needed to implement their recommendations (Kay and Alder, 1999).

Table 5 contains the suggested contents of a local-level marine resource management plan. The table presents a description of each section, based on the literature of coastal management plans and local-level natural resource management. The table also indicates the status of the various sections of the stewardship plan as perceived by the Snohomish County MRC. In comparison, the same sections of the stewardship plan are evaluated based upon the literature review in Chapter Three. Within the "Status as Indicated by Evaluation" column, sections that receive an "X" are those sections that need substantial improvements or are not in the plan at all. Sections indicated with a "✓" are those sections that need minimal changes or are complete. In the sections following Table 5, I analyze the contents in the stewardship plan and suggest improvements for the final plan that can aid the MRC in explicitly communicating how the plan can contribute to the stewardship of Dungeness crab.

**Table 5. Suggested Contents of a Local-Level Marine Resource Management Plan (Olsen et al., 1999; Born and Genskow, 2001; Kay and Alder, 1999)**

<b>Plan Section</b>	<b>Section Description</b>	<b>MRC Perceived Completion Status</b>	<b>Status as Indicated by Evaluation</b>
Introduction – State the problem	<ul style="list-style-type: none"> <li>• State the need for the plan</li> <li>• State the steps in plan development</li> </ul>	✓	✓
Description of the Environment and the Resource	<ul style="list-style-type: none"> <li>• Habitat requirements</li> <li>• Life-history</li> </ul>	✓	✓
Collect and Analyze the Social, Cultural, and Economic Information or other Issues	<ul style="list-style-type: none"> <li>• Management history</li> <li>• Economic resources</li> <li>• Document baseline conditions and data gaps</li> <li>• Define potential threats to the resource</li> </ul>	✓	✓
Goals and Objectives	<ul style="list-style-type: none"> <li>• Define clear goals and objectives</li> <li>• Where were the goals and objectives derived from?</li> <li>• How will progress be measured towards the goals listed?</li> </ul>	✓	X
Analyze the Options	<ul style="list-style-type: none"> <li>• What options are being considered for implementation?</li> <li>• Analyze the options, considering authority, resources, existing plans and policies, and general feasibility of implementation</li> </ul>	X	X
Recommendations	<ul style="list-style-type: none"> <li>• Select the preferred option(s) upon which the initiative will focus its efforts</li> <li>• Discuss the option(s) and why they were chosen</li> </ul>	X	X
Implementation	<ul style="list-style-type: none"> <li>• Explain on-the-ground integration of the recommendations and who should implement them</li> </ul>	✓	X
Monitoring and Evaluation	<ul style="list-style-type: none"> <li>• Set monitoring and evaluation criteria and procedures for recommended projects</li> <li>• Provide timeframe for plan review from main stakeholder groups</li> </ul>	✓	X

**State the problem.** In coastal management, many projects are initiated in response to the deterioration of a resource or habitat (Olsen et al., 1999; Wondolleck and Yaffee, 2000). In the case of Dungeness crab, the Snohomish County MRC became interested in the resource when WDFW managers indicated that the resource was experiencing an increased harvest. As mentioned earlier, this increase in harvest could have many explanations, and it is not known whether this increase in harvest will have deleterious effects on the resource in the future. This uncertainty associated with the resource has presented a barrier to implementing the plan, because of a perceived lack of issue salience. Issue salience, or issue immediacy, is a variable that is crucial for the initiation and success of a collaborative plan (Born and Genskow, 2000; 2001). “Without sufficiently broad salience, it seems unlikely that partnerships can generate enough enthusiasm to form and function.” (Born and Genskow, 2001).

Conserving Dungeness crab may not be seen by the greater public as an issue of high immediacy. However, Born and Genskow (2001) suggest that issue salience could be a factor that the MRC could influence by communicating with the co-managers about the concerns and priorities with the resource, and conveying those concerns to the public through education and outreach. For example, one of the recommendations the Snohomish County MRC is considering is the creation of a “Dungeness Crab Stewardship Handbook,” that aims to educate the public on harvest regulations, and will most likely include ways that the public could participate in activities that protect and conserve Dungeness crab.



**Describe the environment and the resource.** The subcommittee collected information on the life history, habitat, population status, and other issues associated with the resource. Through data collection<sup>17</sup>, interviews and discussions with managers, they learned that there are gaps in information that could improve the management of the resource, such as identifying nearshore nursery habitat and updating population assessments. Since there is a possibility that the management of Dungeness crab could change in the future, the Snohomish County MRC should strive to keep information in the stewardship plan up-to-date. This would require the MRC to continue to communicate with and collect information from resource managers in order to update the stewardship plan. By keeping abreast of new issues associated with the resource, the MRC could use the new information to help the project gain momentum and more participation (Born and Genskow, 2001). In addition, collecting new information from WDFW could be used to document baseline information and data gaps, as well as define potential threats to the resource.

**Collect and analyze information.** With assistance from Snohomish County staff and WDFW, the subcommittee determined issue areas to focus their efforts on. They concluded that several issues could jeopardize the sustainability of the resource, such as the loss of eelgrass habitat, lack of adherence to harvest regulations, and derelict fishing gear. Initiating projects to address these issues and other projects within the NWSMCI requires the MRC to document change. These changes could represent changes in the resource, or management and policy process, and should be documented to identify

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<sup>17</sup> Much of the information was provided by crab biologists and WDFW.

baseline conditions and data gaps prior to the completion of the plan. (Adler et al., 2000; Kay and Alder, 1999; Pauley, 1995). For instance, participating in the derelict fishing gear removal project entails identifying the location of derelict gear through underwater surveys.

**Define goals and objectives, analyze the options, and then choose the preferred recommendation(s).** In general, goals are usually formulated as abstract ideas, and objectives (or criteria) can be used to measure the progress towards achieving a goal (Weimer and Vining, 1999). When scoping goals and objectives of a project or initiative, it is important to select those that are appropriate to the capacity of the partners involved, as well as to communicate them in a manner that avoids misinterpretation and confusion (Hinchcliff and Hinkey, 2003; Olsen et al., 1999). In the stewardship plan the subcommittee states vague goals and objectives. In addition to this, the means by which they intend to reach those goals may not be appropriate to the capacity of the MRC and Snohomish County staff. For example, one objective of the stewardship plan is to prevent overharvest. This is an objective that the MRC can strive for in the long-term, but preventing overharvest will require an inordinate amount of time and resources from the MRC<sup>18</sup>. It also illustrates that not all objectives should be used as criteria to place measurement towards a goal (Weimer and Vining, 1999), since attributing a change in stock status due to a management regime is difficult over the short term. This means that the objectives that the MRC has chosen should be restated to reflect its abilities as a

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<sup>18</sup> Time and resources could include extensive monitoring and research, which is normally undertaken by the co-managers.

citizen's advisory group. The objectives should therefore define how the main goal will be met, which calls for objectives to provide the specific end points of a project or measurable outcomes. In addition, the objectives should be useful for MRC members and county staff to select and design the methods by which a project can be implemented and measured (Hinchcliff and Hinkey, 2003; Olsen et al., 1999).

Analyzing the options and then selecting what project to implement is at the heart of the decision-making process, and should involve a discussion of each possible recommendation (or option) the group is considering (Kay and Alder, 1999). This section should not only aim to describe how the recommendations could impact resources, but it should also generally describe how feasible a recommendation is, based on existing plans and policies. Further analysis of the recommendations that the Snohomish County MRC wishes to implement requires an application of policy analysis, and will be discussed in more detail in the second part of this chapter.

**Explain how implementation will occur.** The MRC describes how their stewardship plan is to be implemented, which will happen through: 1) local leaders who guide stewardship activities; 2) maintenance of the plan; and 3) preparing annual work plans. But what are the other specifics of implementation? After the MRC selects which recommendation(s) will best achieve their goal of contributing to the sustainability of the Dungeness crab resource, the MRC needs to specifically explain the on-the-ground implementation of the recommendation and who should carry the actions out. Weimer and Vining (1999) and Olsen et al. (1999) explain that there are three general factors that influence the likelihood of successful implementation: 1) the logic of the

recommendation, 2) the nature of cooperation, and 3) the availability of knowledgeable people who are committed to the implementation of the management strategy.

A recommendation could be considered illogical if the MRC cannot specify a credible set of behaviors that lead to the desired outcomes (Weimer and Vining, 1999). For example, one recommendation the MRC suggests is to identify and map female and juvenile Dungeness crab habitat. It assumes that the habitat has not been mapped; that impacts to these habitat areas (once they are identified) are made subject to regulation; that the information compiled is sufficient to inform decision-makers; and that identification of habitat will promote citizens to protect the areas. Identifying these assumptions underlying a recommendation could aid the MRC in identifying future implementation problems (Olsen et al., 1999).

In addition to the logic of a recommendation, “[i]t should also be valid, that is the degree to which the recommendation is based on an adequate, technical understanding of the causal linkages among the human activities and adverse conditions in the resource” (Olsen et al., 1999). For instance, if habitat loss in a particular area is identified, a technical understanding of why that habitat was lost should be sought, since it may be attributed to natural occurrences and not human activity.

It is also important to look at the actors involved in cooperation in order to determine if the recommendation is feasible to implement. For instance, Weimer and Vining (1999) and Olsen et al. (1999) identified several questions to consider when implementing a recommendation:

- What elements are needed to implement the recommendation, and who controls these elements?
- Do any conflicts arise with existing programs, laws or jurisdictions?
- What is the potential motivation of the actors who will be involved?

Probably one of the most important characteristics of a successful initiative is having access to knowledgeable individuals who are committed to the management strategy (Wondolleck and Yaffee, 2000). Based on the literature (Wondolleck and Yaffee, 2000, Olsen et al., 1999; Weimer and Vining, 1999; Born and Genskow, 2001; Kay and Alder, 1999) and on personal experience, it appears that local initiatives in the Northwest Straits should be led by both top-down and bottom-up representatives, or managers and local leaders. Local leaders push the effort forward by involving other participants and make the effort to spend time, energy and resources to see an initiative implemented. At the same time, responsibility for implementing the initiative relies on government staff that provides the rest of the elements needed (Weimer and Vining, 1999) such as funding and administration. It is important that both groups of people see the recommendation as one that they believe is important. If either group views the recommendation as undesirable, they might devote less energy and organizational resources to the initiative which could make implementation unlikely.

**Set monitoring and evaluation procedures.** The stewardship plan explains how the MRC will monitor its projects, but some of the components it describes<sup>19</sup> could be

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<sup>19</sup> The stewardship plan specifies that environmental monitoring will be divided into four programs: 1) conduct biological sampling on Dungeness crab and species that are dependent on Dungeness crab, 2) conduct sampling on factors that affect larval distribution, such as currents, temperature and salinity, 3)

very expensive and therefore not feasible. In addition, the plan is not specific on how it will be evaluated. As described in Chapter Two, the Northwest Straits Marine Conservation Initiative could terminate if the MRCs fail to show progress towards eight performance benchmarks. A coastal management evaluation should be treated as an adaptive and iterative process (Olsen et al., 1999). Therefore the benchmarks could be seen as a way for managers and practitioners to learn from each other and improve future initiatives and projects.

The benchmarks were considered by the Murray-Metcalf Citizen's Advisory Committee (CAC) to be central to the success of the *overall* initiative; each MRC does not have to reach every benchmark (Cowan, pers. comm., 2003). In the case of the stewardship plan, three of the eight benchmarks (Table 1) are relevant to the overall evaluation of a Dungeness crab stewardship project:

- Habitat – Demonstrate a net gain in productive nearshore, intertidal and estuarine habitat, with no significant loss of existing high-value habitat.
- Scientific Data – Initiate coordination of data, including baseline information, common protocols, GIS, as well as ecosystem assessments and research.
- Outreach and Education – Coordinate with PSAT and other entities on an effective outreach and education effort with measurements of the numbers of people contacted as well as changed behavior.

The other benchmarks are not appropriate performance measures for the stewardship plan, for the following reasons:

- Local Participation – This benchmarks only relates to obtaining broad county participation in the MRCs, not participation in projects.

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conduct chemical sampling on nutrients or contaminants that are important or detrimental to crab health, and 4) conduct geological sampling to track the substrate crab use.

- Marine Protected Areas (MPAs) – There is currently no scientific evidence that justifies the need for MPAs for Dungeness crab. Crab habitat already has the potential to be “protected” through WDFW’s hydraulic project application process.
- Bottomfish – This benchmark only pertains to measuring increases in the factors supporting the recovery of bottomfish.
- Shellfish – Dungeness crab are crustaceans, and are managed separately from shellfish by WDFW. The CAC intended this benchmark to only include bivalves.
- Marine Indicator Species – Although Dungeness crab could be used an indicator species, this benchmark specifies the need to demonstrate an increase in the species. The co-managers do not know the current population of Dungeness crab, therefore an increase would be difficult and costly to detect.

The benchmarks I have chosen for the MRC should be used with additional criteria in order to measure the Proposed Dungeness Crab Stewardship Plan. These additional criteria will be analyzed in the second section of this chapter.

### *Section One Summary and Discussion*

My analysis of the contents of local-level marine resource management plans shows that the Snohomish County MRC needs to make additions, improvements and changes to their stewardship plan. Below I list the plan sections and explain each section’s link to an implementation strategy that aims to meet the MRC’s goal of promoting a healthy and sustainable Dungeness crab resource:

1. **State the Problem** – Ensure that the issue is salient to the general public or the co-managers.
2. **Describe the Environment and the Resource** – Continue communication with the co-managers in order to revise this section accordingly.

3. **Collect and Analyze Information** - Collect baseline information by which to measure stewardship efforts.
4. **Goals and Objectives** - Rewrite objectives that reflect the capacity of the MRC.
5. **Analyze the Options** – Discuss how each option could impact resources and society.
6. **Recommendations** – Discuss in detail why the recommendation(s) was chosen.
7. **Monitoring and Evaluation** - Choose appropriate criteria by which to compare recommendations; for example, use objectives, appropriate benchmarks, and other criteria important to the group
8. **Implementation** – Discuss in detail the implementation feasibility of the recommendations in the plan.

The actions mentioned above can be taken in a different order and could be used to guide and assess future stewardship efforts. In the second part of this chapter, I will apply a process of policy analysis to: 1) choose appropriate criteria to evaluate the recommendations of the MRC; and 2) rewrite the recommendations that reflect the capacity of the MRC.

### Section Two: Analysis of the Dungeness Crab Stewardship Plan Recommendations

In this section I use the policy analysis methods developed by Weimer and Vining (1999) to develop a simple matrix that the MRC can use to evaluate its recommendations. First, I propose a specific set of criteria that the MRC can use to evaluate the recommendations. Next, I analyze the recommendations' ability to reach the MRC's goal of providing long-term sustainability of the resource, but I do not suggest a particular recommendation since the final decision will be made by the MRC.



Goals, objectives or criteria and recommendations can be used to create a structure or matrix that can be used for a policy analysis (Weimer and Vining, 1999). In general, goals and objectives should be formulated as abstract ideas, and recommendations should attempt to be as specific as possible (Weimer and Vining, 1999). Objectives, which can also be stated as criteria, are the means used to evaluate the goals. In policy analysis, developing criteria should be the first step in identifying which recommendation or strategy to choose in order to progress towards an overall goal. A criterion does not need to be quantifiable; in some instances it may be better to use a criterion to qualitatively measure progress towards the achievement of a goal (Weimer and Vining, 1999).

#### *Choosing Criteria for Evaluation*

As mentioned in my analysis of the stewardship plan, the subcommittee states overarching goals and objectives that may not be appropriate to the capacity of the MRC and Snohomish County staff (Hinchcliff and Hinkey, 2003; Olsen et al., 1999). Therefore, all aspects of an objective may not be equally appropriate to translate into criteria when evaluating recommendations to implement (Weimer and Vining, 1999).

The MRC's objectives and the NWSMCI's benchmarks have common characteristics in their ability to evaluate their recommendations. Because of this overlap, several of the MRC's and the NWSMCI's criteria can be written as a single criterion that measures progress towards their goal. For example, the MRC would like to achieve stewardship measures among the co-managers and ensure that the implementation of a

recommendation involves the cooperation of research, monitoring and enforcement sectors. At the same time, the “scientific data” benchmark aims to initiate similar activities such as coordination of data, baseline information, common protocols, and research. Altogether, these individual criteria can be written as one single criterion: “promote coordination of research and data.”

Additional criteria besides those listed by the MRC and the NWSMCI could be used to provide a more comprehensive way to measure the recommendations’ ability to reach their goal of providing a sustainable Dungeness crab resource (Weimer and Vining, 1999). In Table 6, I list the criteria the MRC could use to evaluate the recommendations, including the NWSMCI criteria (benchmarks) and a new criterion suggested by Weimer and Vining (1999) and Olsen et al. (1999). Following the table, I formulate a condensed set of criteria using Table 6. In writing the new criteria I try to maintain the MRC’s original ideas and beliefs, but I also attempt to restate the criteria based upon the MRC’s capacity as an advisory group. The MRC can use the new criteria to evaluate the recommendations in the stewardship plan.

**Table 6. Possible Objectives for Evaluating the Recommendations in the Dungeness Crab Stewardship Plan.**

<p><b>MRC Objective:</b> Prevent overharvest</p> <p><b>MRC Objective:</b> Achieve compatible and equitable stewardship measures among jurisdictions throughout the fishery stewardship groups</p> <p><b>MRC Objective:</b> Facilitate cooperative research, monitoring and law enforcement</p> <p><b>MRC Objective:</b> Adopt and promote environmental quality guidelines necessary for the long-term Dungeness crab maintenance and productivity in Snohomish County and throughout their range</p> <p><b>MRC Objective:</b> Identify critical habitats and environmental factors that could limit long-term Dungeness crab productivity</p> <p><b>Benchmark:</b> Habitat – Demonstrate a net gain in productive nearshore, intertidal and estuarine habitat, with no significant loss of existing high-value habitat</p> <p><b>Benchmark:</b> Scientific Data – Initiate coordination of data, including baseline information, common protocols, GIS, as well as ecosystem assessments and research</p> <p><b>Benchmark:</b> Outreach and Education – Coordinate with PSAT and other entities on an effective outreach and education effort with measurements of the numbers of people contacted as well as changed behavior</p> <p><b>Weimer and Vining (1999); Olsen et al., (1999):</b> Administrative Feasibility - The recommendation is appropriate to the capacity of the local government and state agencies</p>
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In looking further down the list in Table 6, one objective points towards the involvement of the MRC in law enforcement. This is beyond the MRC's capabilities as an advisory group, since law enforcement is the responsibility of the co-managers, primarily WDFW. Instead of participating in enforcing regulations, projects initiated by the NWSC and other MRCs are able to *promote* new guidelines and regulations, as well as identify areas for protection. For example, the NWSC has coordinated with WDFW to adopt protocols to guide divers and operators in removing derelict fishing gear in order to prevent harm to the environment and people. In another example, several MRCs have identified nearshore forage fish spawning areas, which now qualifies the areas for

protection under the state's Hydraulic Protection Approval code and local government's Shoreline Master Programs (Gordon, 2003). Overall, promoting new guidelines or regulations is one crux of the NWSMCI's goal. In doing so, citizens can give recommendations to governmental authorities to make future management decisions on marine resources.

Below is a revised list of criteria that excludes the inappropriate objectives mentioned above as well as the overlap of objectives presented in the remainder of the MRC objectives and the NWSC benchmarks. I suggest that the Snohomish County MRC use the following criteria to determine a recommendation's likelihood of success, which could in turn help the MRC to choose the recommendation(s) they wish to implement.

- Extent to which the recommendation promotes coordination of research and data
- Extent to which the recommendation identifies environmental factors for crab productivity and demonstrates a net gain in habitat
- Extent to which the recommendation provides for education and outreach
- Extent to which the recommendation is administratively feasible

#### *The Proposed Recommendations for Dungeness Crab Stewardship*

Choosing a recommendation is usually the last step in policy analysis. When the stewardship plan was produced, the subcommittee's recommendations were not evaluated against a specific set of criteria, although the MRC based its recommendations on information collected from the co-managers, interviews and independent reviews. The Snohomish County MRC has stated five recommendations they would like to implement

in order to reach their goal of providing a healthy and sustainable Dungeness crab resource:

1. Create a Dungeness Crab Stewardship Handbook
2. Map gravid female and juvenile Dungeness crab habitat
3. Locate and remove derelict fishing gear
4. Increase public awareness of crab harvesting issues
5. Decrease poaching by implementing local actions that increase compliance with harvest limitations

Several of the stewardship recommendations can comprise one general recommendation. Recommendations 1, 4 and 5 all strive to educate the public on Dungeness crab and on why compliance with harvest regulations is important to the sustainability of the resource. Therefore, I propose that the five recommendations be presented as three recommendations for evaluation in terms of their ability to meet the goal: 1) produce a handbook to increase awareness of crab issues, 2) map and assess female and juvenile habitat, and 3) locate and remove derelict fishing gear. I will evaluate these recommendations by listing the recommendations on one axis and the goal and criteria on the other. I will use the matrix to compare and contrast the recommendations' ability to meet the MRC's overall goal.

I use qualitative ratings of "High," "Moderate," and "Low" to assign value to the ability of each recommendation to address the evaluative criteria (Table 7). Descriptions in the cells of the matrix are predictions based upon the best available information about the resource and human behavior.

**Table 7. Ratings Used to Assign Value to the Ability of Each Recommendation to Address the Evaluative Criteria.**

<b>Rating</b>	<b>Assessment</b>
High	Recommendation can be used with few difficulties and can be easily implemented.
Moderate	The recommendation has been useful in other areas, but uncertainty about human behavior and the resource could minimize its effectiveness.
Low	The ability of the recommendation to meet the criterion is unproven, or insufficient funding and staffing could inhibit implementation.
N/A	The recommendation is not applicable to the criterion.

In the matrix that follows a description of the recommendations (Table 8), I use the rating scale in Table 7 to evaluate each recommendation's ability to reach the MRC's goal of providing a healthy and sustainable Dungeness crab resource.

**Recommendation 1. Produce a Dungeness Crab Stewardship Handbook to increase awareness of crab issues.** Under this recommendation, the MRC will initiate the development and production of a handbook that could be used to educate the public on various Dungeness crab issues. The MRC might consider a handbook that communicates the importance of protecting eelgrass habitat, compliance with harvest regulations, and where to find the latest information on the openings and closures of recreational fishing areas.

Shoreline development has been shown to cause loss of eelgrass habitat (PSAT, 2003), which serves as a nursery and refuge for juvenile Dungeness crab. The handbook could promote other initiatives within Snohomish County that are aimed at educating the

public about “softer” methods for protecting the shoreline and the detrimental effects of other “hard” alternatives such as bulkheads.

One of the largest issues affecting the management of Dungeness crab is the problem of compliance with harvest regulations by both recreational and commercial fishermen (Velasques, pers. comm., 2003). The MRC does not have the authority to enforce compliance, but the handbook could be seen as a way to educate fishers on the importance of taking only legal-sized males. The handbook could also include how to find the most up-to-date information on openings and closures of Dungeness crab recreational fishing areas. WDFW relays this information to the public through a shellfish hotline (telephone), website, and signage. In the past, the most immediate way to receive this information was through the hotline; currently the fastest way is through the internet via WDFW’s website, but the website can be difficult for some to navigate. Because the website is difficult to navigate and since the openings and closures of crab harvest areas (including regulations) can change, the handbook could provide the public the information they need in order to navigate WDFW’s website for the latest harvest information.

Although it could be difficult to measure the input of a stewardship handbook on changes in human behavior, creating one should be considered because it could have value in educating the general public, particularly fishers, about harvest regulations. Response to the handbook could be enhanced if the MRC understands who their specific audience is. Once the MRC identifies its intended audience, they need to identify the audience’s interest in the issue, needs and wants, learning styles, backgrounds, and their

ability to participate in programs relative to the issues the MRC seeks to address. (Hinchcliff and Hinkey, 2003). For example, WDFW creates various educational materials that are used to assist foreign nationals in understanding harvest regulations. For the most part, foreign nationals do not like to read signs or brochures, even if it contains their own language (Rammar, pers. comm., 2003). However, Rammar mentioned that foreign nationals prefer participating in the production of the signs, brochures and even television commercials, which eventually led to understanding the importance of harvest regulations. In Snohomish County's case, the MRC could initiate a stewardship effort by learning what fishers would like to learn about Dungeness crab. This could occur through Snohomish County's Beach Expos, an activity that the county holds in several locations every summer. The expos offer the public an opportunity to explore the nearshore and ocean environment and to learn how humans make an impact. Past activities have focused on beach processes, forage fish, and the importance of other marine life in the environment. A total of about 1,000 people attended the Beach Expos in the summers of 2000 and 2001. Using Beach Expos as a way to identify their audience could help the MRC to eliminate the trial and error process of guessing what the public would like to obtain from Dungeness crab stewardship activities, and potentially save the MRC time and money (Hinchcliff and Hinkey, 2003).

**Recommendation 2. Map and assess female and juvenile Dungeness crab habitat.** Gravid female crabs aggregate in specific areas during the winter months, and first-year crabs settle and reside in intertidal eelgrass beds and mid-intertidal gravel substrate, but the extent and condition of gravid female and juvenile crab nursery habitat



is not well known in Snohomish County. Under this alternative, these areas would be identified and guidelines to protect them from activities such as dredging and filling will be endorsed by the MRC.

In the mid-1980s, Congress legislated that the Everett Navy Homeport Project, which resulted in the dredging and disposal of bottom sediments, should not dispose dredged material where crab aggregate at more than 100 crabs per hectare (Dinnel, pers. comm., 2003). Since then, WDFW has used this condition to evaluate hydraulic project applications (HPAs) for mitigation according to RCW 75.20.100-160. WDFW has the power to apply conditions for mitigation strategies, but there are not laws or regulations in Washington that require this condition to be used for all proposed projects. Therefore, the MRC could recommend that this condition become a legal requirement so that proposed projects that impact these areas are subject to more stringent approval requirements or are required to engage in mitigation.

Mapping and assessing Dungeness crab habitat could be costly, and Snohomish County has limited resources available to gather new data (Hall, pers. comm., 2003). However, other counties in the NWSMCI have implemented and coordinated mapping programs with resources from outside their respective counties. Therefore, the Snohomish County MRC could coordinate with county, state, tribes, and other MRCs to gather existing information, identify data gaps, then pursue grants to survey nearshore habitat used by Dungeness crab. Using volunteers could be an option to identify habitat important to crab that are not identifiable by the existing data, but the limitations of the public to collect such data should be recognized. With the existing maps it would be

necessary to determine if the data are accurate and sufficient to be given to WDFW as information they could use in evaluating hydraulic permit applications.

**Recommendation 3. Locate and Remove Derelict Fishing Gear.** Derelict fishing gear is gear that is lost, abandoned, and possibly vandalized. Derelict gear includes fishing nets, crab and shrimp pots, and other commercial or recreational fishing debris. Possibly hundreds of tons of derelict gear are in the waters of Puget Sound, and continue to catch and kill marine species. The nets and fishing line are made of synthetic materials and can take decades to decompose in the water. Crab pots become “ghost pots” when they are lost, abandoned or vandalized, and continue to catch crab if the pot has bait within it. After the bait is gone, the crabs in the pot become bait and the cycle continues (Stevens, 2000). Conservation measures to protect Dungeness crab include WDFW requiring biodegradable escapement devices made of “rot cord” to prevent ghost fishing and escape holes to allow undersized crab out of traps. However, there is still usage of pots that do not have rot cord, and as a result, lost pots continue to fish for many years (June, pers. comm., 2003).

The Derelict Fishing Gear Removal Project removes derelict fishing gear in the waters of Puget Sound. The collaborators<sup>20</sup> on the project have developed a set of protocols for removing the gear, which involves locating and reporting the gear to either the Northwest Straits Commission (NWSC) or WDFW, who then coordinate with other entities for removal of the gear. In one case, a gillnet in Inati Bay on Lummi Island was

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<sup>20</sup> Collaborators include the Northwest Straits Commission, Washington Department of Fish and Wildlife, National Oceanic and Atmospheric Administration, Washington State Department of Natural Resources, Puget Sound Action Team, and Sea Grant.

removed and contained approximately 300 to 500 dead crab, 250 live crab, and around 200 dead salmon in the net. In Snohomish County, a project initiated by the Stillaguamish Tribe and facilitated by Natural Resources Consultants, Inc., surveyed 3.2 square miles of fishing grounds and identified 338 derelict crab pots<sup>21</sup>. Of those 338 pots, the divers were able to retrieve 57 commercial and recreational pots with 145 live Dungeness crab and 26 dead Dungeness crab. Of the 57 crab pots, 37 of them were still actively fishing and accounted for almost 100% of the crab retrieved. Of the 37 pots still actively fishing, 29 did not have rot cord (June, pers. comm., 2003). The use of rot cord on crab pots is essential to minimize the impact of derelict crab pots (Natural Resources Consultants, Inc., 2003).

The impact of derelict fishing gear on a larger area is hard to quantify, due to the uncertainty associated with projecting the mortality rate based on recovered derelict gear (Natural Resources Consultants, Inc., 2003). However, the consultants have been able to calculate a rough, annual mortality rate based on these assumptions: 1) a constant quantity of derelict gear (new gear lost that replaces gear that become inactive), 2) crab entrapment rates (based upon the gear removed), and 3) mortality of crab within 30 days of capture. Using these assumptions, the Natural Resources Consultants, Inc. has estimated that there could be about 440 active fishing derelict crab pots within the depth range surveyed (12 to 120 feet) in the Stillaguamish fishing grounds. Applying the mortality rate calculated from the 57 pots removed produces an overall rough annual

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<sup>21</sup> 3.2 square miles represents approximately 50% of the total Stillaguamish fishing grounds between 12 and 120 feet. The remainder of the fishing grounds were not surveyed because they extended beyond the depth range of the dive team (NRC, 2003).

mortality estimate of about 23,700 Dungeness crab in the Port Susan area (Natural Resources Consultants, Inc., 2003). The estimate could be higher since this number does not include those derelict crab pots in water deeper than 120 feet, nor does it include the fishing areas outside the Stillaguamish fishing grounds.

The impact on the Dungeness crab fishery using the estimate of crab saved each year by removing derelict gear from Port Susan may be minimal<sup>22</sup>. However, the NWSC and WDFW provide an existing framework to facilitate this project within Snohomish County, which could provide the MRC public relations and a straightforward measurement of progress towards the benchmarks.

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<sup>22</sup> In the 2000-2001 season, Snohomish County Dungeness crab fishers (recreational and commercial) harvested approximately 2,273,000 pounds of crab in all waters of Snohomish County. Given the estimated loss of 27,000 crab per year and that each crab could weigh 2 pounds, the potential loss to the fishers in the Stillaguamish fishing grounds could be almost 48,000 pounds. The estimated loss would account for only 1% of the crab caught commercially and recreationally, but at an ex-vessel value of \$2.00 per pound, the loss would be approximately \$96,000.

**Table 8. Analysis of the Recommendations in the Proposed Dungeness Crab Stewardship Plan.**

<b>GOAL</b>	<b>CRITERIA</b>	<b>Rec. 1 Produce a Handbook to Increase Awareness of Crab Issues</b>	<b>Rec. 2 Map and Assess Female and Juvenile Dungeness Crab Habitat</b>	<b>Rec. 3 Locate and Remove Derelict Fishing Gear</b>
<b>Provide a healthy and sustainable Dungeness crab resource</b>	<i>Extent to which the recommendation promotes coordination of research and collection of data</i>	Low; minimal involvement from co-managers, and the general public	Moderate to High; potential for cooperative state, tribal, and MRC efforts	Moderate; coordination through several entities to identify derelict gear for removal
	<i>Extent to which the recommendation identifies and demonstrates a net gain in habitat</i>	NA; handbook not used to identify habitat.	Moderate; if co-managers are able to use the information in regulation and enforcement	Moderate; direct removal of derelict gear could contribute to restoring habitat for crab but it is still unknown
	<i>Extent to which the recommendation provides education and outreach</i>	Moderate; need to know audience; if handbook is distributed widely, could be costly	Low; volunteer participation in survey unknown	Moderate; PR generated by project has potential to get citizens and donors involved in crab stewardship projects
	<i>Extent to which the recommendation is administratively feasible</i>	High; staff and other resources are in place for production	Moderate; staff and funding resources could be limited; other funding can be found	High; structure for implementing the project is in place by the NWSC

### *Section Two Summary and Discussion*

An important factor affecting the success of the recommendations is their ability to provide a feasible option for an advisory group and their local governing body. This is also described as administrative feasibility presented in Table 8. Because of this barrier to implementation, the MRC should consider in detail how on-the-ground implementation of the recommendations will occur. Three elements could be regarded as a set of guidelines for successful implementation (Weimer and Vining, 1999; Olsen et al., 1999): 1) who controls the elements to implementation? 2) do any conflicts arise with existing programs, laws or jurisdictions? 3) what is the potential motivation of the actors who will be involved?

Each recommendation presented by the MRC could have a role to play in a strategy designed by the MRC that could provide a sustainable and healthy Dungeness crab resource. Producing a Dungeness Crab Stewardship Handbook, if distributed widely to a specific target audience, could be effective at educating the public about harvesting regulations and protecting habitat. However, it could be difficult to identify and measure changes in behavior and could be costly. Response to the handbook could be enhanced if it is used in conjunction with other events like Beach Expos.

The extent and condition of gravid female and juvenile crab nursery habitat is not well known in Snohomish County. Mapping and assessing Dungeness crab habitat could be costly; therefore, the MRC should pursue outside funding. It would be necessary to coordinate with county, state, tribes, and other MRCs to gather existing information and

identify data gaps on habitat used by Dungeness crab. The maps that are created would need to be sufficient in order to be given to WDFW as information they could use in evaluating hydraulic permit applications.

Participating in the Derelict Fishing Gear Removal Project has the potential to have a small positive impact of unknown magnitude on the population of Dungeness crab, based upon the removal of a direct danger to the resource. It has good public relations value, and hence it could be seen as a stewardship tool. In addition to this, the NWSC provides an existing framework for implementing this project within Snohomish County, and provides a direct measurement of progress towards the benchmarks.

My two-part analysis on the contents and recommendations of the stewardship plan suggest that in order for the plan to continue to evolve, the MRC should use the elements I describe to complete a plan that is succinct and describes in detail how the recommendation(s) they choose will be implemented. The MRC should also consider that their actions will probably need to occur on short time frames since the NWSMCI may or may not be reauthorized. Considering this and other possible barriers to implementation, I recommend that the MRC consider participating in existing Dungeness crab stewardship activities or events. These activities should also include an educational component in order to promote citizen participation and a sense of responsibility for the resource.

## **Chapter Five – Discussion**

Marine resource management today is recognized as a system that involves the environment, organisms, and the people who are involved in the harvest, utilization and management of ocean resources (Clay and Goodwin, 1995). Some managers and practitioners view the involvement of citizens as equally important to the involvement of science (Kay and Alder, 1999; Olsen et al., 1999, Clay and Goodwin, 1995; Born and Genskow, 2001). Clay and Goodwin (1995) note that more diverse groups, such as recreational fishers, must be represented in management. The literature indicates that there is a potential for local-level natural resource management to succeed as a new form of management due to an increase in environmental and social awareness by community and industry, and their overall desire to be included in decision-making processes (Kay and Alder, 1999; PNCERS, 2002; Born and Genskow, 2001).

However, local-level natural resource management is a form of management in need of being critically investigated (Kenney, 1999). The Northwest Straits Marine Conservation Initiative and its representative projects are an example of this new form of management from which to experiment and learn. From the NWSMCI's initiation about four years ago, it was understood that the initiative would be evaluated based not only on the success of social or process change, but on measurable change in the environment as well. Hence, the Proposed Dungeness Crab Stewardship Plan for Snohomish County is one example of a project within the NWSMCI that can be learned from to see what works and what does not work in the field of local-level natural resource management.



The purpose of this research was to examine two problems that existed as barriers to implementing the Snohomish County MRC's Proposed Dungeness Crab Stewardship Plan: 1) the stewardship plan needed to be finalized; and 2) the plan needs to include feasible recommendations. Through literature reviews, interviews and personal experience, I developed: 1) a format for local-level marine resource management plans that the MRC could use to improve or make changes to the plan (Table 5); and 2) new criteria that the MRC can use to evaluate their recommendations. Overall, the recommendations the MRC has made are feasible within their abilities as a citizen advisory group, but some difficulties exist (Table 8). Once these difficulties are recognized the Snohomish County MRC can make a decision on which recommendation(s) they would like to implement.

In addition to recommendations, the Snohomish County MRC would like the stewardship plan implemented over the long term through other activities<sup>23</sup>. This could be difficult considering the amount of time and resources that would be required by volunteers to undertake such a long-term effort. Among other things, it requires Snohomish County to commit or find resources to fund projects. Because of this, the MRC should always consider their limits as a citizen's advisory group, and that there are potential barriers to implementing any project. Olsen et al. (1999) have identified a list of critical preconditions for successful implementation as it relates to coastal management. In Table 9, I identify the preconditions for implementing Dungeness crab stewardship

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<sup>23</sup> The MRC wished to implement the stewardship plan through law enforcement and an extensive environmental monitoring program.

projects in the left column. In the right column I state the abilities of the MRC to meet those preconditions, based upon the preconditions for implementation set by Olsen et al. (1999).

**Table 9. Preconditions of Implementation Success as it Pertains to Dungeness crab Stewardship (adapted from Olsen et al., 1999)**

<b>Preconditions for Successful Implementation</b>	<b>Preconditions of Implementing Dungeness Crab Stewardship Projects</b>
Sufficient jurisdiction and authority	<p>The MRC has no authority; but it can persuade changes in regulation or guidelines by resource managers or the county</p> <p>Snohomish County has authority through the Shoreline Management Act; could offer some means to prohibit development that disturbs crab habitat such as eelgrass</p> <p>The ability for the co-managers to participate in future crab stewardship projects could be low if there are time and resource constraints</p>
Good policy-relevant science	Co-managers agree that regulations are sufficient at this time for the management of crab; this could change in the future if accurate population estimates signal a decline due to harvest
Competent and committed staff	County staff can be limited by time and resources
Maintain a priority position on the public agenda	The issue is on the agenda of the NWSMCI; but the general public may not recognize this resource as being in “danger”

Some of the preconditions in Table 9 are also a general reflection of the elements I discuss in Chapter 4 and are necessary for the MRC to regard when considering implementing future Dungeness crab stewardship projects. For example, if the MRC considers a future project that entails a substantial amount of involvement from the co-managers, implementation could be unlikely because the co-managers have a limited amount of personnel and other resources to contribute to the MRC’s effort. The MRC

should therefore implement projects based on what the MRC and their local government staff are willing to contribute in time and effort towards the project. Currently the MRC, Snohomish County staff, and the co-managers have a limited amount of time and resources that they are able to give to Dungeness crab stewardship projects. Therefore, the MRC should consider taking advantage of existing programs (Wondolleck and Yaffee, 2000) or efforts that do not require any long term commitment by individuals but that do raise awareness of the issue.

Maintaining the issue as a priority on the public agenda normally entails a “problem” associated with the resource. This “problem” could be a decrease in the resource itself, management, or public outcry. At this time the co-managers and the general public do not recognize the increase in harvest as an imperative issue that needs immediate attention. Therefore, issue salience is another barrier facing the Snohomish County MRC when considering future efforts on Dungeness crab stewardship. Without salience, it is unlikely that a partnership will generate enough enthusiasm in order to function (Born and Genskow, 2001). In an attempt to overcome this barrier, Wondolleck and Yaffee (2000) suggest using the symbolic power of innovation to create salience in order to achieve more participation in a project.

Innovation as it pertains to the MRC could consist of initiating a precautionary approach that aims to address the uncertainty associated with the Dungeness crab resource. As mentioned in Chapter Two, WDFW has not determined the reason for the increase in harvest or how the harvest levels affect the resource. This uncertainty can slow the development of new management (Kay and Alder, 1999) because new

information is needed in order to fully understand the problem. Acquiring more information could also take many years and require a large amount of funding. Therefore, local-level natural resource management efforts such as the stewardship plan proposed by the Snohomish County MRC could be seen as a form of precautionary management for Dungeness crab. But would precautionary approaches initiated by the MRC benefit the resource?

My analysis of the recommendations in Chapter Four could provide answers to this question. For example, protecting habitat and removing derelict gear may be of minimal benefit, but it could promote stewardship of the crab resource through the projects' "feel good" appeal to the public. Since it is uncertain how much of these projects will actually impact the resource, a precautionary approach should be applied to implement conservation measures in the absence of adequate scientific information.

Precautionary approaches should involve using education to increase the MRC's chances in achieving the goal of providing a sustainable Dungeness crab resource. Clearly the MRC would need a strategy that reaches a large number of a particular audience. Measuring changes in behavior could be difficult. But these difficulties also occur within the field of managing non-point source pollution, where enforcement can be difficult and education is used to influence the public to change their behavior in hopes of improving the environment. Perhaps the MRC could focus on one sector of the fishery and communicate the importance of following regulations in the present so that more Dungeness crab will be available for them in the near future and in the long-term.

Even though measuring the results of Dungeness crab stewardship projects may not be easy, local-level efforts should be implemented in order to: 1) learn from this experiment in local-level marine resources management; and 2) aid the MRC in developing decision-making skills (Monroe, 1999) which could lead to more informed decisions in the future. The Snohomish County MRC has an opportunity to implement a stewardship project with a \$10,000 grant it received from the Marjorie Mosher Schmidt Foundation. In order for the MRC to implement their stewardship plan, what would be necessary for implementation success? I recommend that the MRC:

1. Make changes to the plan that warrants endorsement by the entire Snohomish County MRC and Snohomish County.
2. Build upon small steps – early, small successes can help to build trust among participants, which could lead to the group addressing more complex or controversial issues later.
3. Continue to pursue funding to implement future projects.
4. Communicate with the co-managers and the recreating public to identify mechanisms for coordination.
5. Get the issue on the public agenda, through public education and other means.

The MRC should also prepare to learn from failures and not just successes. Collaboration can be difficult, inconsistent, and even the most well-intentioned efforts do not succeed (Wondolleck and Yaffee, 2000). Therefore, the guidelines provided in this thesis could aid the MRC in their planning process and identify the strengths and weaknesses that could enhance or inhibit a project's implementation. By learning from these experiences in local-level marine resource management, citizens, managers, and academics can

continue to learn from and obtain the experience to improve their ability to identify and resolve future marine environmental issues.

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**Appendix A— Snohomish County Dungeness Crab Fact Sheet**

# dungeness crab

SNOHOMISH COUNTY MARINE FACT SHEET



For more information on this topic or to learn how you can help, please call Snohomish County Public Works, Surface Water Management at 425-388-3464 (TTY: 425-388-3700) or check [www.co.snohomish.wa.us/mrc.htm](http://www.co.snohomish.wa.us/mrc.htm)



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## Description

Dungeness crab (*Cancer magister*) are crustaceans, having an exterior skeleton or shell. The shell is purple-tinged, grayish-brown on the back, with white tipped claws. They average six to seven inches across the back. Dungeness crab are found from Alaska to Mexico. They are most abundant in Puget Sound north of Seattle, in Hood Canal, and along the coast.

## Life cycle

- **Mating and egg development (0-4 months)**—Mating occurs between hard-shelled males and newly molted, soft-shelled females from the spring to the fall. Male crabs are polygamous—each male crab may mate with more than one female crab. This may be an important factor in maintaining the reproductive viability of this species since only male crabs can be harvested. The female crab stores the sperm until her eggs are fully developed. Fertilization of the eggs occurs when the female extrudes them under her abdomen where they are carried several months until hatching. Large females can carry over 2.5 million eggs.
- **Larval stage (4-12 months)**—Crab larvae are dispersed by currents and progress through a series of stages in which their appearance changes considerably.
- **Juvenile stage (1-2 years)**—After one year the juvenile crab resembles the adult form and settles on the bottom of shallow intertidal areas and estuaries. Crabs reach an

average size of 1 3/4 inches across the back a year after the crab takes up bottom life. As they grow, they tend to move into progressively deeper water. (Small black or gray shore crabs found on the beach should not be confused with young Dungeness crabs).

- **Adult stage (3-8 years)**—Adults grow by shedding their rigid exterior skeleton (or shell). During this process (called "molting") a crab backs out of its hard shell with a new, soft shell already in place. Crabs tend to molt about seven times during the first year of bottom life and then about once a year after that. Molting periods vary within Puget Sound. In the Port Gardner and Port Susan area, crabs molt from early January to mid-April. Crabs with soft shells are vulnerable to predation, so they tend to hide in the sand or mud on the bottom. It takes about 2 months for them to form another hard shell. Crabs are sexually mature after their second year and reach legal harvest size (5 1/4 inches across the back) in about 4 years.

## Habitat

Larvae are subject to dispersal by currents. Juveniles remain in intertidal and shallow subtidal areas, hiding beneath or among plants, rocks, shell debris and eelgrass beds. Adults prefer eelgrass beds and sandy or muddy substrate. Breeding occurs in nearshore areas and females may move to deeper water to hatch eggs. Threats to crab habitat include modifications to the shoreline from development (bulkheads), disruption of eelgrass beds, and pollution.

### Food

Dungeness crab prey includes clams, snails, eggs from fish or crabs, crustaceans, marine worms, squid and fish.

### Predators

Natural predators of Dungeness crab include: octopus, halibut, other Dungeness crab, dogfish, hake, lingcod, salmon, shorebirds and waterfowl.

### Harvest

The Dungeness crab is an important commercial, recreational and tribal fishery. In Puget Sound, harvest has increased steadily from over 2 million pounds in 1992-1993 to a record 7.7 million pounds in 1999-2000. The increased harvest is due to increased numbers of recreational crabbers, easy access to crabbing areas, and the switch to crabs from dwindling fish species. Crabs are harvested using traps (crab pots), ring nets, by hand (scuba divers) or dip nets. They are also taken or harmed unintentionally when gillnetting for salmon, trawling for bottomfish, and dredging to maintain ship channels.

### Protection efforts

The Tribes and the Washington Department of Fish and Wildlife manage crab fisheries to maintain a 50/50 allocation of the harvestable crabs between tribal and non-tribal fisheries.

- **Commercial management**—Closures during the year limit harvest and protect softshell crabs during molting periods. Other conservation measures include biodegradable escapement devices to prevent derelict traps from "ghost fishing" and escape holes to allow undersized crab out of traps.



- **Recreational management**—Estimates of sustainable harvest levels are made during each season. Closures occur during molting periods and when necessary to limit catch levels. Phone surveys, voluntary catch records and buoy counts are used to estimate catch levels. Based on historical results, the average catch for recreational crabbers is 0.5 to 2.5 crab kept per trap per day.
- **Tribal management**—Tribes limit the amount of fishing and use other conservation measures to protect crab populations. Each tribe can determine the number of commercial tribal fishermen allowed to participate.
- **Local protection efforts**—The Snohomish County Marine Resources Advisory Committee (MRC) wants to protect Dungeness crab and habitat. The MRC is investigating potential crab habitat and issues related to Dungeness crab along the Snohomish County shoreline.

### Status

Along the Snohomish County shoreline, the Dungeness crab population appears to be healthy despite pressure from the fisheries described above. However, harvest pressure is likely to increase and threats to crab habitat from shoreline development and pollution are expected to continue.

### How you can get involved

The MRC was formed to recommend remedial actions to local authorities and build local awareness of the issues and support for remedies. The MRC meets on a monthly basis and welcomes public participation.

### Resources

- WDFW Shellfish Hotline: (360) 796-3215
- WDFW web site: [www.wa.gov/wdfw](http://www.wa.gov/wdfw)
- MRC web site: [www.co.snohomish.wa.us/mrc.htm](http://www.co.snohomish.wa.us/mrc.htm)

### Sources

- Washington Department of Fish and Wildlife
- Tulalip Tribes



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