San Juan County Marine Stewardship Area Plan

Prepared by the San Juan County Marine Resources Committee

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SUMMARY

The San Juan County local government is acting on a vision for the San Juan Islands. This vision is one of a healthy marine ecosystem with thriving populations of marine species, including salmon, seabirds, and killer whales and one with strong recreational and resource based industries, such as recreational fishing, wildlife watching and marine research. Located at the convergence of Puget Sound and Georgia Basin, the San Juan archipelago is characterized by a rich diversity of marine life that draws hundreds of thousands of visitors each year. Yet, the ecological systems that support these species and industries are threatened. Human activities resulting in habitat loss, toxins in the water and marine life, climate change, chronic small oil spills, and numerous other stresses to the marine system are becoming increasingly prevalent as the human population in Puget Sound grows and expands to rural areas. In order to achieve their vision for the San Juans and protect the archipelagos' rich marine diversity, the San Juan Board of County Commissioners designated the county a Marine Stewardship Area.

Established in January 2004, the Marine Stewardship Area set a course for the Marine Resources Committee (MRC) to identify the key action steps toward a healthier and more sustainable island marine ecosystem for the natural resources and the benefit of the people who live, work and recreate there. To accomplish this, the MRC brought in partners from the Northwest Straits Initiative, The Nature Conservancy and SeaDoc Society to develop a planning process that would identify key strategic actions incorporating scientific knowledge and human-based priorities, such as our desires to fish and to paddle.

The partnership selected a conservation action planning process developed by the Nature Conservancy; otherwise known as the "5-S Framework". It is named 5-S for the five-step process it entails. For the first step or "S" for "system", the Committee convened a panel of scientists to identify a set of stewardship "targets": species, major groupings of species, ecological communities and/or systems that, taken together collectively represent the range of marine biodiversity of the San Juan ecosystem. In the following two "S" steps (stresses and sources), MRC members met with marine managers and local stakeholders for two days to identify and rank the stresses affecting the targets and the upstream sources of those stresses in order to yield a threat assessment for the marine ecosystem. Next, the MRC developed broad action paths, named "strategies", for the 4^{th} "S", to mitigate the threats causing harm to the system. During a key intermediate step, the MRC established measurable benchmarks, identifying what the Committee and planning partners hope to achieve with the implementation of the plan. These Benchmarks form the foundation of the final "S" step, which is "success" in achieving the desired conservation goals for the Marine Stewardship Area. Measuring success is also incorporated into the process through the identification of key indicators that will be measured over time, forming the bases of a long term monitoring plan.

As an example, through the planning process, the MRC selected seabirds as a stewardship target. One of the indicators for the health of this target is number of nesting pairs of black oystercatchers, a seabird that resides on shorelines of the San Islands year-round. Based on this indicator, the MRC developed the benchmark for maintaining stable or increasing numbers of nesting pairs of black oystercatchers based on 2006 levels. As the plan is implemented, this MRC will track numbers for this benchmark to help evaluate success. All the information collected throughout this process on the targets, the background information for assessing the viability of these targets, the threat assessment and strategy development is captured in an electronic workbook. The workbook is a spreadsheet-based decision support tool created by TNC. It will be used to incorporate new information as it becomes available and to monitor success in achieving the benchmarks.

Through the Nature Conservancy planning process and with the help of many partner organizations, stakeholders, managers, and local citizens, the MRC identified over 35 priority strategies under the Marine Stewardship Area plan. These strategies were presented to citizens throughout the county and other key stakeholder groups through a series of presentations and public meetings on all the ferry serviced islands.

MSA Strategies
November 15, 2006

Education:

- Communicate a clear, inspiring stewardship message to the public and develop a comprehensive communication strategy.
- Education & outreach on the benefits of "softshore" alternatives for shoreline armoring.
- Education & outreach on the importance of eelgrass and the benefits of best marine use/shoreline development practices.
- Promote public awareness of the status of and threats to rockfish, lingcod, and greenling so that the public is involved, understands, and takes ownership over the problem and action toward a solution.
- Promote water quality protection through best management practices to help ensure that locally-harvested marine species pose insignificant risks to human health.

Community Stewardship:

- Foster projects that engage the public (seasonal and year-round residents) in marine stewardship.
- Work with stakeholders to develop and implement a strategy for identifying and engaging key partners as active marine stewards.
- Promote concept of the county doing its part to reduce greenhouse gas emissions (think globally, act locally).
- Minimize chronic pollution from land and marine sources (includes medium spills and chronic events like bilge pumping).
- Reduce nitrogen inputs from human sources to improve water quality for eelgrass.
- Minimize new armored shoreline.
- Remove shoreline armoring where appropriate (refer to FRIENDS soft shore blueprint).
- Increase prey base in order to restore herring spawning to all historic areas.
- Protect and restore herring spawning habitat.
- Reduce bycatch of depleted species of bottomfish.
- Reduce disturbance of seabirds.
- Support efforts to reduce risk and improve response to oil spills.
- Reduce impacts of derelict fishing gear to seabirds.
- Support efforts to reduce bioaccumulative toxins in order to help restore local populations of killer whales.

Management & Planning:

- Draw attention to and work to include marine issues (stormwater, wastewater, etc) within watershed management plans and programs.
- Work to ensure that fisheries management supports a local fishing economy.
- Work to ensure that species restoration/recovery is to a level that allows sustainable fishing.
- Suspend direct harvest of select species of bottomfish until recovery goals are met.
- Implement the local salmon recovery plan.

- Increase salmon (considering their size and the season) to support restored marine mammal populations.
- Recommend that the County plan for sea level rise and other climate change implications.
- Recommend that County policies & regulations are directed toward achieving a scenic, functional and natural marine environment that is available for human enjoyment.
- Determine the scope and nature of the water quality problem and develop an implementation plan.

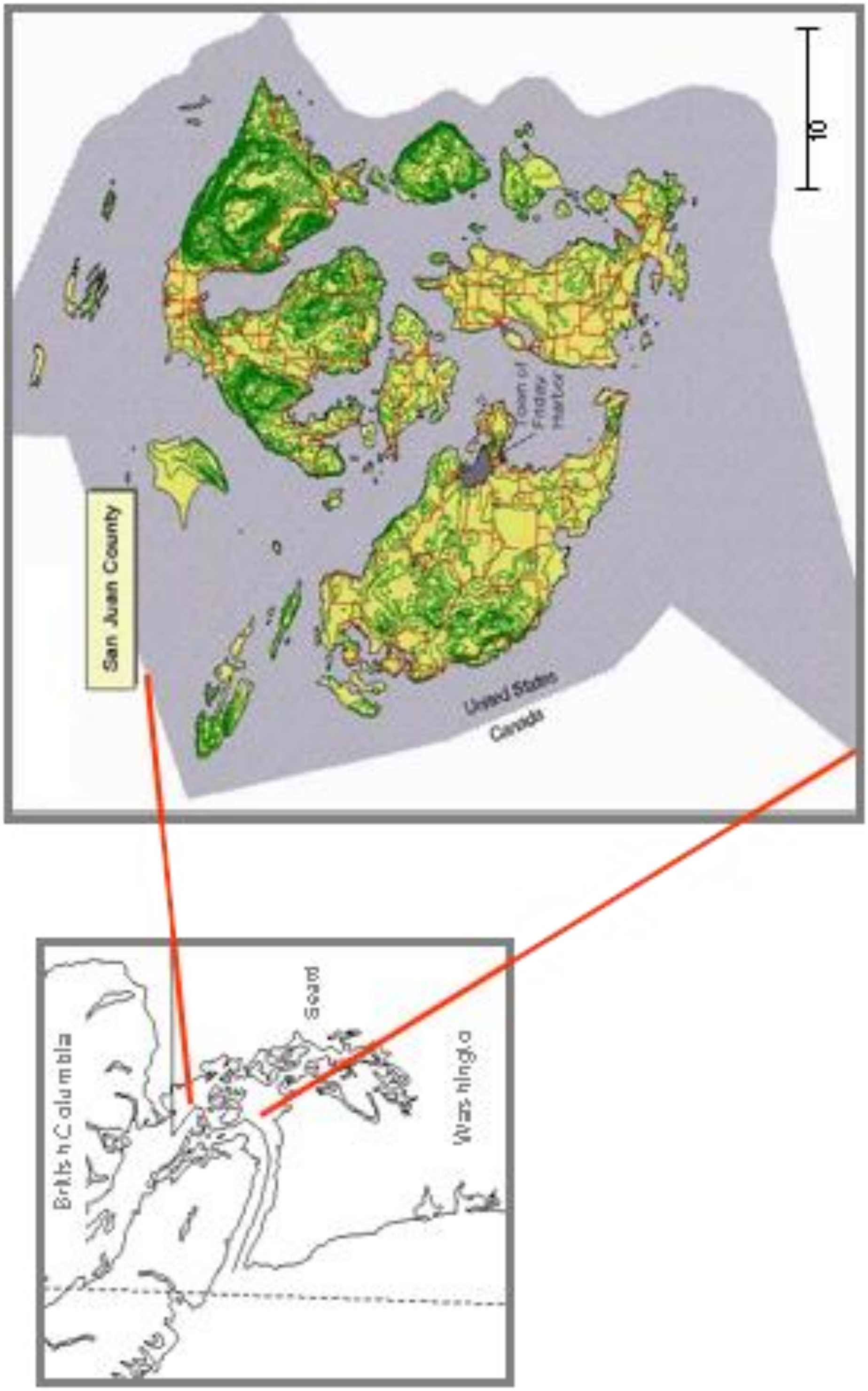
Coordination:

- Connect with regional efforts working to protect and restore salmon populations.
- Continue and build upon MRC, county and others' outreach efforts with the tribes.
- Help marine managers address the pressures on marine resources associated with increased population and demand.
- Recommend improved and coordinated policies for building, anchoring, docks, enforcement, and mitigation.
- Support others' efforts to highlight traditional marine practices.
- Work with county and port districts to develop criteria for facility (such as barge landings) sighting, operation and maintenance.

Research:

- Support research to inform the MRC, managers, and decision makers on the trends and conditions of marine communities in the San Juans.
- Monitor the effectiveness of marine management and stewardship measures to better inform the MRC, managers, and decision makers.

The Marine Stewardship Area Plan aims to protect and restore the entire marine system in the San Juans. Recognizing that much of this plan is beyond the scope and capacity of the MRC, the Committee is counting on our friends, partners and community members to implement this plan along with us.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I. BACKGROUND

Faced with the declining health of marine life in the San Juan Islands along with increasing human pressures, the San Juan Board of County Commissioners designated the County a Marine Stewardship Area with the stated objective: "to facilitate the protection and preservation of our natural marine environment for the tribes and other historic users, current and future residents, and visitors."[1] With this resolution, the board tasked the Marine Resources Committee (MRC)[2] with delivering the results of a formal study with detailed recommendations for achieving this goal. As a result, the Committee began collecting available marine resources data and placing this data on maps in order to get a better picture of the county's marine life and the potential measures that would help to protect it and the human activities that depend on it.

During the first year following the designation of the stewardship area, the MRC compiled marine resources data, mapped them and developed the concept for a county-wide zone scheme (Slocomb 2004). The zone scheme proposed special use areas along county shorelines where resources were found to be especially abundant. The proposal included multiple use and restricted use areas, proposing voluntary protection measures such as no anchoring in eelgrass beds. Simultaneously, Committee members and staff conducted extensive community outreach, giving presentations to communities and stakeholder groups on San Juan, Shaw, Waldron, and Orcas islands to gather input in the development of new marine protection measures (see appendix B.1). The Committee also presented their work on the MSA to the first Marine Managers' Work Session for San Juan County. Organized by the Northwest Straits Commission, this two-day meeting brought marine site managers together from federal and state agencies, tribes, land conservancies, and MRC members to identify opportunities to improve management strategies to protect marine species and habitats in the San Juans.

The outcome of the managers work session, the spatial analysis and the public outreach meetings was identifying the need to 1) involve local planners, the science community and marine managers, including tribes, in order to better understand what actions were needed to address threats to the marine environment; and 2) return to community members with a more concrete proposal for them to respond to. Recognizing this, the MRC developed a partnership with the Washington Chapter of the Nature Conservancy and the Northwest Straits Commission and SeaDoc Society to develop the best planning process for engaging scientists, managers, citizens and stakeholders in the development of strategic actions. The planning process selected was The Nature Conservancy's site-based conservation action planning approach. The bases for the plan were the MRC's vision and goals developed originally in 2001 and then revised in 2003. This statement (see Appendix A) clearly defined the Committee's vision to protect both the natural marine resources as well as the human activities connected to them.

II. PLANNING PROCESS

To further develop the Marine Stewardship Area, the MRC applied a conservation planning methodology developed by The Nature Conservancy called the Five-S Framework for Site Conservation, also known as "Conservation Action Planning" (TNC 2003a, Low 2004). This approach involves the selection of a limited set of ecosystem elements (called 'focal conservation targets') to serve as the focus of the conservation effort. The focal conservation targets are selected so

[1] San Juan County Resolution No. 8-2004. January 2004.
[2] The MRC, created in 1996, is a citizens' advisory committee to the local county government on issues pertaining to the marine environment.

that they collectively encompass the range of biodiversity at the site through their dependence upon important ecological and physical processes that benefit other species not represented among the focal targets. The information generated during the planning process was managed using the Conservation Action Planning Workbook (TNC 2005), a spreadsheet-based decision support tool created by TNC.

The Five-S Framework five main steps:

1. Systems (Targets): Systems are the elements of conservation concern: the natural resources and the natural processes that maintain them. These natural resources become the focus of management action. This step has 3 parts: a) identifying a set of five to eight focal ecological systems, species groupings or specific species to serve as the focal targets, b) ranking the 'viability' of each target based on the health of the key ecological factors and processes upon which it depends, and c) using these ranks to assess the overall "biodiversity health" of the site.
2. Stresses: Stresses cause destruction or impairment of a system (e.g., water pollution). This step involves identifying the stresses affecting each of the focal targets identified in Step 1 and then ranking the stressors, based on the best available info and judgment.
3. Sources: Sources are the activity(ies) that produce a stress. Together, the sources and the stresses comprise the Threats to our systems. This step has several parts. First, the team identifies the sources of the stresses identified in Step 2 and then ranks them by their degree of contribution to the stress and the irreversibility of the stress caused by that source. "Irreversibility" refers to the ability of the system/attribute to recover if the source of stress was removed. Next, that information is combined with the stress rankings to generate a list of critical threats using the Conservation Action Planning Workbook. The critical threats are then ranked to generate a prioritized list of the 16 greatest threats.
4. Strategies: These are the actions taken to conserve priority systems. These actions are most often focused on abating threats and maintaining the health of our systems (within the context of the assessed situation).This step involves brainstorming a variety of specific strategies (management actions) that could be used to abate each threat identified in Step 3. A "situation assessment" compiling information on the human communities and the socio-economic drivers behind the various sources identified in step 4 is done and used to develop and assess strategies. The strategies are then ranked based on a cost: benefit assessment, feasibility and probability of success and an action plan is made.
5. Measures of success: In this step, performance measures are set against which the effectiveness of stewardship actions will be assessed. Measures may be related to the status of the targets and/or the threats to be abated and involve science-based indicators.

The MRC made two major modifications to the Five-S Site Conservation Planning methodology, one related to project governance and the other related to the integration of socio-cultural values. In a typical Five-S Site Conservation Planning project, TNC would be the lead organization, or might lead jointly with partner organizations. In this case, a stakeholder group – the MRC – served as the lead decision-maker. A Core Planning Team made day to day decisions about the project and essentially staffed the MRC on this project. The Core Planning Team membership included several MRC members, a marine ecologist from TNC, a wildlife veterinarian, and the manager of a TNC refuge island. MRC and TNC staff and a part-time project coordinator jointly staffed the project on a daily basis. The MRC reviewed and signed off on all major steps of the process.

The second major modification related to the integration of socio-cultural values into the planning process. A typical Five-S Site Conservation Planning project incorporates information on the human context of the planning area principally through the situation assessments. In accordance with current practices in marine resource planning and conservation (e.g. the use of socio-economic operating principles alongside biophysical operating principles in the Great Barrier Reef management plan development), the MRC decided to expand the scope of the project to include a set of socio-cultural focal targets in addition to traditional biodiversity targets. This decision reflected several factors. The goals adopted by the MRC for the Marine Stewardship Area (see Appendix A) explicitly include the protection of direct use benefits for marine resources. Second, the participants at a technical workshop held by the MRC to obtain scientific input into the selection of focal targets recommended that human uses of the marine environment be included as a focal target for the planning process.

While the Five-S Framework has been adapted for use in protection of physical cultural heritage resources (TNC 2003b), few TNC site conservation planning efforts have incorporated socio-cultural values as targets. Thus, the MRC adapted the Five-S planning methodology for socio-cultural values as they went along. The target selection, viability analysis and preliminary threat assessment phases were done separately for each set of targets. The results of the threat assessments were then combined to develop joint planning objectives. Since the most proximate sources of stress affecting the socio-cultural targets differed from those affecting the marine biodiversity targets, the socio-cultural targets were housed in a separate copy of the Conservation Action Planning workbook.

III. OUTCOMES

The MRC implemented the planning process using a combination of formal workshops to involve larger numbers of scientific experts and stakeholders and smaller planning work sessions of the Core Planning Team and/or MRC. The MRC served as the lead organization developing and implementing the project. A Core Project Team composed of representatives from the MRC, TNC, Northwest Straits Commission and SeaDoc Society was formed to manage the project. Additional stakeholders were included in some of these smaller work sessions. Technical experts participated in additional meetings to assist the MRC with the viability and stress-source analyses. Appendix B.2 includes a list of all meetings, workshops and work sessions held. A more detailed discussion of the process used to complete each phase of the planning process is included in the discussion of each step.

Finally, given the limited information available and significant interpretation required to make assessments of indicator status and stress/source magnitudes, the MRC elected to commission an outside technical review of the results of the viability and threat assessments for the marine biodiversity targets. Two reviewers were identified for each target and asked to review the viability and threat assessments. Ten out of 14 reviewers submitted comments; these comments were compiled and submitted to the Core Team for consideration (See Appendix D).

A. SAN JUAN MARINE SYSTEMS

Focal Target Selection

The Five-S Framework calls for the identification of a set of 5-8 focal conservation targets that collectively encompass the range of biodiversity of the site, represent a range of biological organization from species to ecological communities to ecological systems and other important natural resources, and occur a range of scales from local (<10 km^2) to regional (>10,000 km^2). The restriction of the number of focal conservation targets to no more than eight targets is predicated on the idea that for each focal target, there are numerous species and other features of the system that are dependent upon the same ecological and physical processes as the focal target and will benefit from the strategies adopted to protect the broader focal targets. Species that fall into this category are considered particularly important biologically and culturally may be called out as “nested targets” for the focal target with which they are associated.

Through an iterative process involving formal and informal consultation with scientific and technical experts and review by a broader group of stakeholders, the MRC selected the following marine biodiversity-related targets:

- Rocky intertidal communities
- Rocky subtidal communities
- Nearshore sand, mud and gravel communities
- Rockfish, lingcod and greenling
- Seabirds
- Marine mammals
- Pacific salmon

Short descriptions of the focal targets, the rationale for their selection, and the nested targets identified for each follow. These targets were selected to encompass the range of marine biodiversity within San Juan County and also to include species using different realms of the marine environment.

In consultation with stakeholders, the MRC also developed three socio-cultural targets related to human uses of the marine environment:

- Enjoyment of the marine environment
- Thriving marine-based livelihoods
- Cultural traditions: ceremonial, subsistence, sustenance and spiritual uses and aspects

<u>Description of Focal Targets</u>

Rocky intertidal communities – This focal target includes a highly diverse assemblage of marine algae and animals that inhabit the rocky shores of the San Juans, along with dynamic physical and biological processes that are a feature of this environment. It extends from the interface between terrestrial vegetation and the upper splash zone to the depth of the lowest tides. In addition to its ecological importance as a producer of organic material and as a foraging area for both terrestrial and marine animals, the rocky intertidal is the dominant shoreline type in the MSA and is an important recreational area for humans. This target was recommended by participants at the scientific workshop and the stakeholder workshop. The nested targets include characteristic species include barnacles, limpets, rockweed (*Fucus spp.*) and other seaweeds, seagrass (*Phyllospadix*), chitons, crabs and many other invertebrates, as well as black oystercatchers.

Rocky subtidal communities – This focal target represents the benthic communities found on rocky substrate from just below the lowest tides to a depth of 30 m. The nested targets include characteristic species such as canopy-forming kelps and numerous species of red and brown seaweeds, invertebrates such as sea urchins, sponges and crab, and fish species such as juvenile rockfish and perhaps juvenile salmon. This target plays an important ecological role in the San Juans marine ecosystem by serving as a nursery area for many fish species, a foraging area for fish, birds and mammals, and an area of primary production that feeds deeper water habitats.

Nearshore sand, mud and gravel communities – This focal target describes the ecological communities found in soft-bottom habitats, which typically occur along beaches with lower wave and current energy and embayments, from the intertidal to a depth of 30 m. Characteristic species include eelgrass (*Zostera marina*) and other submerged aquatic vegetation, clams, and forage fish (herring, sand lance, and surf smelt), along with the shoreline processes that maintain the sediments.

Rockfish, lingcod and greenlings – This focal target represents an assemblage of relatively sedentary bottom-dwelling fish species common to rocky habitats in the MSA that are also targeted by recreational fisheries. Recovery of rockfish populations has long been a goal of the MRC and the Northwest Straits Commission. The characteristic species include quillback, copper and Puget Sound rockfishes, lingcod, kelp greenlings. This target also includes several "nested targets", which are other species that co-occur with rockfish and are thought to benefit from actions taken to protect rockfish, such as species in deep water rocky reef communities, adult spot prawns, and adult Dungeness crab. This target was recommended by participants at the scientific workshop and the stakeholder workshop.

Seabirds – This focal target represents marine birds with significant feeding aggregations or nesting sites within the MSA, including sea ducks and shorebirds. Principal species include: rhinoceros auklets, hooded mergansers, pelagic cormorants, harlequin ducks, bufflehead ducks, goldeneyes, pigeon guillemots, and glaucous-winged gulls. This target was recommended by participants at the scientific workshop and the stakeholder workshop.

Marine mammals – This focal target includes the whale, dolphin, porpoise and seal species commonly found in the MSA, such as killer whales (*Orcinus orca*), minke whales, grey whales, harbor porpoises, harbor seals, sea lions and river otters. In addition to playing potentially important roles in structuring the marine ecosystem as predators, these species have great cultural importance for residents and visitors to the MSA. This target was recommended by participants at the scientific workshop and the stakeholder workshop.

Pacific salmon – This focal target includes juvenile salmon species that use marine habitats of the MSA as they migrate through the MSA towards the open ocean, the resident population of adult Chinook (a.k.a. "blackmouth"), and adult salmon species that pass through the MSA en route to their natal streams. This target was not one of the original targets recommended by the Scientific Workshop participants but was added by the MRC because of its cultural importance as well as the desirability of integrating the MRC's role in salmon recovery efforts with this broader ecosystem-focused effort. As salmon are a migratory species, this focal target has the added benefit of tying in freshwater systems.

Enjoyment of the marine environment – This focal target includes the numerous ways in which residents and visitors enjoy the marine environment and the different values we obtain from it. This includes having a diversity of marine recreation opportunities as well as spiritual resources and is a fundamental component of our sense of place. Some of the important characteristics of this target are the existence of abundant populations of marine wildlife for people to enjoy viewing, locally-caught and raised high quality seafood available for consumption, opportunities to engage in diverse recreational activities and particularly boating, public access to beaches and shorelines, unspoiled views, and the enjoyment and respect of historical and present-day marine cultural sites and traditions.

Thriving marine-based livelihoods – This focal target describes the residents' desire to support livelihoods and make a living in ways that use the marine environment of the San Juans, recognizing that the ability to do so is dependent upon having healthy and abundant marine wildlife populations and our ability to understand the ecosystem that supports them. This includes having local food security, whether via sustenance harvests or the ability to purchase local seafood, having various marine transportation options available to serve the many islands (some of which do not have ferry service), and being able to make a living in diverse ways related to the marine environment.

Cultural traditions: ceremonial, subsistence, sustenance and spiritual uses and aspects – This focal target encompasses a range of values related to the marine environment other than purely recreational or commercial values, that include intangible benefits such as spiritual values and fulfillment and tangible benefits such as personal harvest for sustenance purposes and stewardship. This target encompasses physical marine cultural sites, historical and modern marine-related cultural practices, opportunities to harvest for tribal ceremonial, subsistence and sustenance purposes, and recognition and appreciation of tribal treaty rights to marine resources. Sustenance uses differ from subsistence uses in that subsistence uses fill a critical need for physical and/or cultural survival, while sustenance uses refer to personal harvest for dietary purposes. Sustenance harvests may have a spiritual or ethical component when an individual chooses not to harvest a particular species as an act of stewardship of their environment.

Viability Analysis

The viability assessment methodology used in the Five-S Framework relies upon the identification of a set of "key ecological attributes" for each target and then identification of indicators to assess the status of these key ecological attributes. Key ecological attributes are "pivotal aspects of the focal target that distinguish it from others, shape its natural variation over time and space, and strongly influence other characteristics of the target and its long-term persistence and function" (TNC 2004). They can include biological characteristics, ecological processes, and biotic interactions with the physical environment, along with the critical causal links among them. Once the set of key ecological attributes is identified, one or more indicators must be developed to evaluate the status of the key ecological attribute. Finally, for each indicator, criteria must be developed to state whether it is in poor, fair, good or very good status. The indicator ratings are combined to yield a status assessment for each attribute, which in turn can be used to develop an overall assessment of the status of each target. The Five-S Framework defines viability as the likelihood that a target will persist long-term (usually 100 years). The rating categories are:

- Very Good = optimal: the factor is functioning at an ecologically sustainable level, and requires little or no human intervention to ensure long-term (100 years) viability.
- Good = acceptable: the factor is functioning within its range of natural variation; it may require some human intervention to ensure long-term (100 years) viability.
- Fair = unacceptable: the factor is outside the range of natural variation and requires human intervention. If unchecked, the attribute will be vulnerable to serious degradation.
- Poor = extreme danger: the factor is well outside the natural range of variation, and allowing this condition to persist for an extended period will make restoration practically impossible. (Adapted from Low 2004).

As is apparent from the category descriptions, improving the status of the attributes that are rated as being in poor or fair condition becomes a top priority in the strategy phase.

Preliminary work on the viability assessment phase began at the June 14th, 2005 Scientific Workshop and continued over several months. Following the Scientific Workshop, the Project Core Team held numerous individual and small group meetings with technical experts to identify key ecological attributes and indicators for the marine biological diversity-related targets and solicit information, in the form of data or best professional judgment, on the current status of those indicators. Once the viability analysis was largely complete, the MRC commissioned an outside technical review of the viability analysis for the marine biodiversity targets. Technical contributors are recognized on page 4 and summarized comments are Appendix D.

The viability analysis for the socio-cultural targets followed a similar approach. Key attributes – rather than key ecological attributes – were identified for each socio-cultural target, and indicators were identified to assess the status of key attributes. An ad-hoc subcommittee of MRC members was formed to assist the Core Team in developing and implementing a viability analysis for the socio-cultural targets. This group consulted with additional stakeholders, including representatives from the San Juan Visitors Bureau, Port of Friday Harbor and others, in an all-day work session to review a set of indicators and define what the desired future condition (i.e., "good" or "very good" condition) would be for each indicator. Participants also identified, evaluated and ranked a list of 31 possible stresses affecting these targets, and identified the top sources contributing to the highest ranked stresses.

Findings[3]

The overall viability rating for five of the seven biodiversity targets was "fair", which means that these targets lie outside the range of natural variation and require human intervention or the target may be vulnerable to serious degradation, as shown in Table 1 below. The MRC was unable to identify overall viability rankings for the remaining two targets, rocky intertidal habitats and rocky subtidal habitats, due to insufficient data. All three of the socio-cultural targets were rated as "fair".

The overall viability rankings were calculated from the viability ratings for each key ecological attribute (key attribute in the case of the socio-cultural targets), which were in turn derived from the indicator ratings for each attribute. All calculations were performed using algorithms contained within the Conservation Action Planning workbook decision-support tool (TNC 2005).

Table 1. Focal Targets and Overall Target Status for the San Juan Islands Marine Stewardship Area.

Target	*Overall Viability*
Marine biodiversity targets:	
1. Rockfish, lingcod and greenling	Fair
2. Pacific salmon	Fair
3. Marine mammals	Fair
4. Seabirds	Fair
5. Rocky intertidal communities	Unknown
6. Rocky subtidal communities	Unknown
7. Nearshore sand, mud and gravel communities	Fair
Socio-cultural targets:	
1. Enjoyment of the marine environment	Fair
2. Thriving marine-based livelihoods	Fair
3. Cultural traditions	Fair

Of the more than 40 attributes identified for the marine biological diversity-related targets, one key ecological attribute, *Population abundance of rockfish, lingcod, and greenling* was rated as being in "poor" condition. Sixteen key ecological attributes were found to be in "fair" condition:

- Areal coverage of wetlands associated with the shoreline in embayments
- Substrate structure and characteristics in embayments
- Water column characteristics in embayments
- Native aquatic vegetative canopy in nearshore sand, mud and gravel communities
- Age structure of the rockfish population
- Rockfish species richness
- Abundance of prey items for juvenile salmon (of up to 100 mm)
- Juvenile salmon habitat abundance along beaches
- Juvenile salmon habitat abundance in embayments

[3] Note: This section reports the results of the viability analysis *prior to* the external technical review commissioned by the MRC.

- Prey abundance for resident Chinook
- Resident Chinook salmon ("blackmouth") population abundance
- Seabird nesting success
- Seabird food resource availability
- Population size of selected seabird species
- Seabird food resource availability and quality
- Population size and structure of resident killer whales

Finally, the Core Project Team was unable to determine viability ratings for any of the attributes for the Rocky Intertidal Communities target and for most of the Rocky Subtidal Communities target, as well as assorted indicators for other targets. Collecting data to determine the viability ratings for these targets should be included among the priority action items in the final MSA Plan.

B. THREAT ASSESSMENT: STRESSES AND SOURCES

The threat assessment phase of the Five-S Framework has two main steps:

1. Stresses: This step involves identifying the stresses affecting each of the focal targets identified in Step 1 and then ranking the stressors, based on the best available information and judgment.
2. Sources: This step has several parts. First, the team must identify the most proximate sources of the stresses developed in Step 2 and then rank them by their degree of contribution to the stress and the irreversibility of the stress caused by that source. Then, that information is combined with the stress rankings to generate a list of critical threats via TNC's Conservation Action Planning workbook. The critical threats are then ranked to generate a list of the 16 most critical threats.

An additional "Situation Assessment" step may also be performed at this stage, using a participatory methodology developed by the Wildlife Conservation Society (WCS) to build causal chain diagrams of the human activities and underlying social, economic and cultural factors that create the sources of stress (WCS 2004). See Appendix F for an example.

The Project Core Team adopted a multi-pronged approach to the threat assessment phase. First, in addition to reviewing the focal target list and developing the socio-cultural focal targets, participants at the 50+ person stakeholders Threat Assessment Workshop in October 2005 were asked to identify and rank the top stresses and sources affecting each focal target and construct a situation diagram using the WCS Situation Assessment methodology. Given the variable results from the workshop and the MRC's desire to fully document the scientific basis and assumptions underlying the identification of top threats, the Project Core Team then conducted a more detailed threat analysis following the Five-S Framework and using the Conservation Action Planning workbook.

The ad-hoc subcommittee of MRC members that was formed to assist the Core Team with the socio-cultural targets also developed a threat assessment for the socio-cultural targets. In an all-day work session held in May 2006, this group plus additional stakeholders, including representatives from the San Juan Visitors Bureau, Port of Friday Harbor and others, identified, evaluated and ranked a list of 31 possible stresses affecting these targets, identified the top sources contributing to the highest ranked stresses, and generated situation assessment diagrams for some key stresses. The MRC has not yet combined this information into an overall threat assessment using the Conservation Action Planning workbook as was done for the biodiversity targets. This is because the sources of stress for the socio-cultural targets do not overlap across targets and can have different impacts to the system depending on the target. For example, a stress to human enjoyment, such as "marine views impaired by buildings" has a difference impact on the target, marine-based livelihoods, making it difficult to identify and rank common sources of this stress for both targets.

Findings: Top threats to marine biodiversity targets

The top threats to the marine biodiversity targets, and hence the marine environment of the San Juans, are listed in order of priority in Table 2.

Table 2. Top threats affecting all marine biodiversity targets in the San Juan County Marine Stewardship Area as of 8/31/06. *designates tied ranking.

Rank	Threat	Overall Threat Rank
1	Large oil spills	**High**
2	Climate change	**High**
3	Shoreline modification due to docks, shoreline armoring, boat ramps, jetties, etc.	**High**
4	Non-local sources of salmon decline	**High**
5	Invasive species	**Medium**
6	Persistent organic pollutants from current industrial and historical sources	**Medium**
7	Polluted stormwater runoff	**Medium**
8	Septic systems and wastewater discharge	**Medium**
9	Predation by marine mammals	**Medium**
10	Historical harvest of rockfish, lingcod & greenling until 1999.	**Medium**
11*	Disturbance by other wildlife	**Medium**
12*	Fishing/harvesting activities	**Medium**
13	Derelict fishing gear	**Medium**
14	Small chronic fuel and oil spills	**Medium**
15	Human disturbance on shore	**Low**
16	Sediment loading resulting from upland construction activities, logging, clearing and livestock	**Low**
	Overall Threat Status for MSA	**High**

The overall threat ranks were calculated from the rating of how significant an impact each threat has on each target, following the decision rules specified by the Five-S Framework and using the Conservation Action Planning workbook: The threat-to-system rank is at least the highest rank given to any threat associated with a particular source of stress and is adjusted upwards as follows: three High rankings equal a Very High; five Medium rankings equal a High; seven Low rankings equal a Medium (TNC 2005). A table showing the threat ranks for each target is included in Appendix E along with a note about assumptions made concerning contaminants.

Threat definitions

These are the operating definitions used by the Core Planning Team in conducting the stress-source analyses for the biodiversity targets.

- *Large oil spills* – Catastrophic and/or significant oil spills occurring within the San Juan MSA or close enough to the MSA that wind and/or currents distribute the oil over a significant portion of the MSA. A specific size of vessel or volume of oil spilled was not designated.
- *Climate change* – Refers to the impacts of global climate change due to global warming on the marine environment of the MSA. Key impacts are thought to include a rise in sea level due to thermal expansion, increases in water temperature and changes in water circulation patterns and related consequences for marine food chains.

- *Shoreline modification due to docks, shoreline armoring, boat ramps, jetties, etc*. –Alteration of shorelines and shoreline habitats due to a variety of physical structures plus shoreline and habitat impacts due to barge landings. Threat ratings generally reflect shoreline modification within the MSA, though shoreline modification in other areas has the potential to affect marine resources of the MSA

- *Non-local sources of salmon decline* - Refers to multiple sources of salmon decline originating outside the MSA. Includes impacts of hatcheries located outside the MSA, degradation of salmon spawning habitat, and salmon harvest activities outside the MSA (including ocean harvests). Impacts of persistent organic pollutants were considered separately.

- *Invasive species* – Refers to the impacts of non-indigenous species on marine habitats of the MSA. Does not include potential effects of invasions of non-indigenous species occurring outside the MSA that may influence marine resources within the MSA. Also does not include blooms of harmful microalgae.

- *Persistent organic pollutants from current industrial and historical sources* – Refers to a variety of persistent organic pollutants (POPs) that bioaccumulate in marine organisms and have adverse effects on the organisms' health, such as PCBs. Includes impacts of POPs originating outside the MSA that are found in marine organisms in the MSA as well as POPs that may be present in sediments within the MSA. Does not consider human health impacts. See discussion of assumptions made regarding contaminants in Appendix E.

- *Polluted stormwater runoff* – Non-POP contaminants originating from terrestrial sources and having adverse effects on marine organisms, such as metals, pesticides and polyaromatic hydrocarbons, which typically enter the marine system via stormwater. Includes those contaminants originating from terrestrial sources located within the MSA plus those originating from terrestrial sources outside the MSA that reach the MSA due to currents. Does not include sediments or turbidity, or human health impacts. See discussion of assumptions made regarding contaminants in Appendix E.

- *Septic systems and wastewater discharge* – Refers to the impacts of wastewater and greywater entering the marine environment from wastewater treatment facilities, septic systems, and vessels, including impacts from nutrients (e.g., nitrogen and phosphate), pathogens and viruses (e.g. fecal coliform bacteria), and endocrine-disrupting compounds. Includes sources located within the MSA as well as those originating outside the MSA that may impact the resources of the MSA via currents (e.g. Victoria wastewater outfall). Does not consider human health impacts. See discussion of assumptions made regarding contaminants in Appendix E.

- *Predation by marine mammals* – Refers to the impacts of marine mammal predation on marine resources of the MSA. The scope of this threat generally refers to predation occurring within or near the MSA, depending on the spatial extent of the prey species population (e.g., North Sound rockfish population). Reflects a sentiment that marine mammal predation has increased due to changes in the relative abundance of predators and prey.

- *Historical harvest of rockfish, lingcod & greenling until 1999* – Refers to the impacts of harvesting activities directed at rockfish, lingcod and greenling species prior to 1999 within the MSA. Reflects a sentiment that the magnitude of harvest was formerly much greater than today, and the population characteristics of the species targeted continue to show the effects of greater harvest rates in the past.

- *Disturbance by other wildlife* – Refers to the effects of other species on MSA targets, particularly eagles and other predators of seabirds, occurring within the MSA.

- *Fishing/harvesting activities* - Refers to the impacts of fishing and harvesting activities occurring within the MSA over the last 5-6 years on target and non-target species (e.g., bycatch, habitat impacts). Does not include the effects of lost or derelict gear. Was formerly divided into several threats depending on species targeted.
- *Derelict fishing gear* – Refers to the impacts of lost or derelict fishing gear within the MSA on MSA resources.
- *Small chronic fuel and oil spills* –Small and/or chronic sources of polyaromatic hydrocarbons originating within the MSA from vessels and marinas, but not those entering the marine environment via stormwater. A specific size or volume of oil spilled was not designated. Does not consider human health impacts. See discussion of assumptions made regarding contaminants in Appendix E.
- *Human disturbance on shore* – Disturbance and/or damage to marine organisms due to human recreational activities along the shorelines of the MSA, such as walking, landing small boats and kayaks etc. Does not include barge landings or disturbance of animals due to vessels. Includes direct damage (e.g. trampling) as well as disruption of animal behavior (e.g. flushing birds).
- *Sediment loading resulting from upland construction activities, logging, clearing and livestock* – Reflects all sources of sediments entering marine waters due to human activities within watersheds, both activities occurring within the MSA as well as those occurring outside the MSA but may influence the MSA via currents (e.g. Fraser River). Does not include the effects of removal of shoreline vegetation (marine riparian vegetation) or other contaminants.
- *Human disturbance on water* –Disturbance of marine animals due to human activities, such as boating and boater behavior, occurring within the MSA. Does not include the impacts of boat wakes, anchoring and/or mooring buoys.
- *Removal of riparian terrestrial vegetation along shore* – Refers to the impacts of the removal of shoreline vegetation within the MSA, such as loss of shading, increased sheet flow runoff. Does not include contaminants or effects of removal of shoreline vegetation outside the MSA that may impact fish species within the MSA.
- *Boat wakes* – Refers to the impacts of boat wakes occurring within the MSA on shoreline characteristics and marine communities
- *Local freshwater diversions and withdrawals* – Refers to the impacts of diversion and withdrawal from surface and subsurface freshwater resources within the MSA on marine resources of the MSA.
- *Harmful algal blooms* – Refers to the impacts of blooms of microalgal species with adverse impacts on marine organisms. Does not consider human health impacts.
- *Boating activities* (anchoring, mooring buoys) – Refers to the impacts of anchoring and mooring of vessels within the MSA on marine resources. Does not include impacts of boat wakes, boater behavior (e.g. disturbance of seabirds) or vessel discharges while anchored.
- *Loss of eelgrass* – Refers to the impacts of the loss of eelgrass beds within the MSA on other species, specifically Pacific salmon. In accordance with the Five-S Framework, this should not be considered a "source" in the stress-source analysis and should be replaced by the various human activities causing the loss of eelgrass. Since this could be a long list of sources, much of which is conjecture, it was left as is.

Findings: Top threats affecting socio-cultural targets

As discussed above, despite many attempts, we were unable to generate a threat assessment summary that evaluated the impacts of threats across all of the socio-cultural targets, due to the fact that there was little overlap between the most proximate source(s) causing each stress across stresses and across targets, and because it was more difficult to distinguish between sources and stresses for these targets – one target's stress may be another target's source and vice-versa. In lieu of a threat summary, we developed a ranked list of the top stresses affecting the socio-cultural targets (shown in Table 3), and listings of the top sources contributing to the highest ranked stresses. The key sources contributing to these stresses were identified using situation assessments prepared in the social targets work session and will be further identified in the strategy development component.

Table 3. Top stresses affecting the MSA socio-cultural targets.

Rank	Stress	Rating
1	Not enough fish to catch.	very high
2	Not enough opportunity for commercial fishing	very high
3	Fish contaminated with pollution	very high
4	Shellfish contaminated with pollutants	high
5	Low availability of local seafood	high
6	Not enough public access to beaches and shorelines	high
7	Marine views and/or viewsheds impaired by buildings	high
8*	Not enough access to marine views and viewsheds	high
9*	Little knowledge of historical/current marine cultural sites & traditions	high
10*	Too few cultural activities and traditions are practiced	high
11*	Not enough fish landed for local markets	high
12*	Too few local vessels involved in commercial fisheries	high
13*	Not enough local fishermen involved in the commercial fisheries	high
14*	Wages too low in marine-based livelihoods	high
15	Not enough opportunity for sustenance fishing	high
16	Reduced quality of marine recreational experiences	high
17*	Not enough big fish caught	high
18	Marine cultural sites and practices aren't respected	high
19	Not enough opportunity for recreational fishing	high
20	Not enough shellfish available to catch	high
21	Not enough access to shellfishing areas	med
22	Inadequate marine transportation infrastructure	med
23	Not enough boating facilities for residents' use	med
24	Not enough wildlife to view	med
25	Locally caught/raised seafood is too expensive	med
26	Not enough opportunities to learn about the marine environment	med
27	Little diversity in marine-based livelihoods	med
28	Not enough opportunities for marine research	low
29	Not enough boating facilities for visitors' use	low
30	Shellfish are too small	low
31	Not enough diversity of marine recreational experiences	low

* - equal value/tied with the stress above.

C. MSA BENCHMARKS

Benchmarks are a key precursor to the development of stewardship strategies and also provide the measuring stick by which the MRC and its partners will be able to evaluate their progress in protecting and restoring the marine environment of the MSA. The Five-S Framework uses two types of benchmarks: those that are related to improving the status of the target, and those that are related to abating critical threats. All benchmarks should be feasible to implement and, if achieved, leave the MRC reasonably certain that all of the targets will survive and the MSA will retain adequate ecological function. The benchmarks should also be:

- Quantitative, or at least measurable
- Effective
- Achievable
- Time limited – have a deadline for completion

The MSA Core Team identified a set of "Benchmarks" that describe the changes the MRC wants to see in the viability of the targets and which the MRC will use to report on improvements in the status of marine resources as a result of actions taken by the MRC and its partners. The priority objectives represent a short list of all the potential objectives considered by the MRC; the remaining objectives are included in the plan as "Longer-term Objectives" to be implemented down the road, or as "Findings" that fall outside of the MRC's scope of work. For a list of the long term benchmarks and findings, see Appendix C.1. As presented in the next section, the priority benchmarks are the focus of conservation strategies.

<u>Research Benchmarks</u>
A key outcome of the plan is the identification of key research priorities for the Marine Stewardship Area. Early in the planning process, it became clear that the MRC needed better data on the trends and conditions of marine communities in the San Juans. Technical advisors could not identify reliable data sources to support viability analysis for many of the marine species identified as either targets or key indicators. Such information is critical in order to develop effective management measures and measure their success. Some of the Priority Research Objectives identified at the writing of this plan (for the complete list, see Appendix C.2)

- Determine the cumulative impacts of docks and other overwater structures on habitats of interest.
- Determine the current levels of PCBs, mercury, tributyl tin, flame retardants and other bioaccumulating contaminants in fish and shellfish in the San Juans that may have biological impacts, including to human health; identify which are priority causes for concern and establish appropriate threshold amounts. Determine local levels of consumption so that the threshold for human health risks is adjusted for local consumption rates.
- Identify significant local sources of priority contaminants listed above and establish specific timelines to reduce these inputs.
- Determine a maximum allowable concentration of PAHs in sediments, water column, clams, etc.
- Determine the current abundance of sand lance and smelt in the MSA
- Determine current viability/status of rocky intertidal target within the MSA.
- Determine current viability/status of rocky subtidal within the MSA.
- Identify the current level of greenhouse gas emissions in San Juan County and a target and timeline for reduction.
- Determine number and condition of physical marine cultural sites within the MSA.
- Determine what level and frequency of fishing opportunities are needed to be considered viable.

D. STRATEGIES

Following the development of benchmarks, the Marine Resources Committee identified a comprehensive list of strategies. Strategies are management actions that will directly address the top priority threats in order to achieve the benchmarks. The MRC developed the strategies list working from proposals put forward by stakeholders and managers at the Threat Assessment Workshop and second Managers Work Session. In addition, the Core Team developed a situation analysis for each target. These are diagrams that draw out the connections between the target, the stresses to that target and the human activities that are causing the stress, providing a useful tool for identifying the most effective strategies. For an example of a situation analysis diagram, please see Appendix F. For the complete set, please see the accompanying MSA CD.

Strategies are presented by Target under the benchmark they are aiming to achieve. "B" is for biodiversity benchmarks; "T" is for threat-based benchmarks; "SC" is for Socio Cultural benchmarks. Many of the benchmarks are listed multiple times because they apply to more than one target. The relationships between the targets, benchmarks, strategies and threats are presented in a matrix format on the accompanying MSA CD.

Criteria for the strategies:

1. MRC's job: within our mission, authority, and ability; and are not being done by another group.
2. Smart: most effective/ greatest impact
3. Start-up: can occur within five years

Benchmarks and strategies presented by target

Conservation Target: Nearshore sand, mud and gravel communities

Benchmark

B-4. The regional coverage of eelgrass (Zostera marina) remains stable on beaches and increases by 10 percent in embayments over a 5-year period by 2013.

Strategies

1. Recommend improved and coordinated policies for building, anchoring, docks, enforcement, and mitigation.
2. Improve water quality relative to eelgrass needs (see T-7, strategy 1)
3. Education & outreach on the importance of eelgrass and best marine use/shoreline development practices

Benchmark

T-3. Ensure that there are enough salmon of the right sizes and species available within the MSA at the right times of year to support restored marine mammal populations.

Strategies

1. Implement local salmon recovery plan
2. Connect with regional efforts

Benchmark

T-4. Reduce the number of miles of armored shoreline by 2016.

Strategies

1. Minimize new armored shoreline
2. Remove shoreline armoring where appropriate (soft shore blueprint)

3. Education & outreach on the benefits of "softshore"

Benchmark
T-5 The probability of a catastrophic oil affecting the San Juan Islands is less than .0005 per year. Amount of chronic oil pollution is reduced by 2016.

Strategies
1. Minimize chronic pollution from land and marine sources (includes medium spills and chronic events like bilge pumping.)
2. Support efforts to reduce risk and improve response to oil spills.

Benchmark
T-6. Reduce greenhouse gas emissions from San Juan County according to the same standards adopted by Seattle.

Strategy
1. Promote concept of the county doing its part to reduce greenhouse gas emissions (think globally, act locally)

Benchmark
T-7. Nitrogen inputs from human sources do not exceed more than 10 percent of natural levels by 2017 – considering changing to capture all pollutants that we care about.

Strategy
1. Draw attention to/include marine issues (stormwater, wastewater, etc) within watershed management plans and programs

Conservation Target: Rocky intertidal and rocky subtidal communities

Benchmark
T-2 Abundance of healthy kelp habitat and community dynamics remains at current levels or increases by 2016.

Strategy
Still need to develop strategies. Research is a priority.

Benchmark
T-5 The probability of a catastrophic oil affecting the San Juan Islands is less than .0005 per year. Amount of chronic oil pollution is reduced by 2016.

Strategies
1. Minimize chronic pollution from land and marine sources (includes medium spills and chronic events like bilge pumping.)
2. Support efforts to reduce risk and improve response to oil spills.

Benchmark
T-6. Reduce greenhouse gas emissions from San Juan County according to the same standards adopted by Seattle.

Strategy
1. Promote concept of the county doing its part to reduce greenhouse gas emissions (think globally, act locally)

Conservation Target: Rockfish, lingcod and greenling

Benchmarks

B-1. Increase lingcod populations to greater than 25% of unfished spawning biomass by 2027 and increase rockfish populations to greater than 25% of unfished spawning biomass by 2037. Maintain kelp greenling populations at 2006 levels.

T-1. Impacts of harvest activities within the MSA on the rate of rockfish species recovery are within 10% of the time it will take to recover rockfish populations under zero harvest-related mortality by 2037.

Strategies

1. Reduce bycatch of select species.
2. Suspend direct harvest of select species until recovery goals are met.
3. Promote public awareness of the status of and threats to rockfish, lingcod, and greenling [objective: Public is involved, understands, and takes ownership over the problem and action toward a solution.

Benchmark

T-5 The probability of a catastrophic oil affecting the San Juan Islands is less than .0005 per year. Amount of chronic oil pollution is reduced by 2016.

Strategies

1. Minimize chronic pollution from land and marine sources (includes medium spills and chronic events like bilge pumping.)
2. Support efforts to reduce risk and improve response to oil spills.

Benchmark

T-6. Reduce greenhouse gas emissions from San Juan County according to the same standards adopted by Seattle.

Strategy

1. Promote concept of the county doing its part to reduce greenhouse gas emissions (think globally, act locally)

Benchmark

T-7. Nitrogen inputs from human sources do not exceed more than 10 percent of natural levels by 2017 – considering changing to capture all pollutants that we care about.

Strategy

1. Draw attention to/include marine issues (stormwater, wastewater, etc) within watershed management plans and programs

Conservation Target: Marine Mammals

Benchmark

B-2 Increase the resident killer whale population size to greater than 103 animals by 2020.

Strategies

1. Increase salmon (see T-3)
2. Reduce vessel disturbance
3. Support efforts to reduce bioaccumulative toxins

Benchmark

B-3. Restore herring spawning to all historic areas.

Strategies

1. Protect and restore spawning habitat
2. Support regional herring recovery efforts

Benchmark

T-3. Ensure that there are enough salmon of the right sizes and species available within the MSA at the right times of year to support restored marine mammal populations.

Strategies

1. Implement local salmon recovery plan
2. Connect with regional efforts

Benchmark

T-4. Reduce the number of miles of armored shoreline by 2016.

Strategies

1. Minimize new armored shoreline
2. Remove shoreline armoring where appropriate (soft shore blueprint)
3. Education & outreach on the benefits of "softshore"

Benchmark

T-5 The probability of a catastrophic oil affecting the San Juan Islands is less than .0005 per year. Amount of chronic oil pollution is reduced by 2016.

Strategies

1. Minimize chronic pollution from land and marine sources (includes medium spills and chronic events like bilge pumping.)
2. Support efforts to reduce risk and improve response to oil spills.

Benchmark

T-6. Reduce greenhouse gas emissions from San Juan County according to the same standards adopted by Seattle.

Strategy

1. Promote concept of the county doing its part to reduce greenhouse gas emissions (think globally, act locally)

Conservation Target: Pacific Salmon

Benchmark

B-3. Restore herring spawning to all historic areas.

Strategies

1. Protect and restore spawning habitat
2. Support regional herring recovery efforts

Benchmark

B-4. The regional coverage of eelgrass (Zostera marina) remains stable on beaches and increases by 10 percent in embayments over a 5-year period by 2013.

Strategies

1. Recommend improved and coordinated policies for building, anchoring, docks, enforcement, and mitigation.
2. Improve water quality relative to eelgrass needs (see T-7, strategy 1)
3. Education & outreach on the importance of eelgrass and best marine use/shoreline development practices

Benchmark
T-3. Ensure that there are enough salmon of the right sizes and species available within the MSA at the right times of year to support restored marine mammal populations.

Strategies
1. Implement local salmon recovery plan
2. Connect with regional efforts

Benchmark
T-4. Reduce the number of miles of armored shoreline by 2016.

Strategies
1. Minimize new armored shoreline
2. Remove shoreline armoring where appropriate (soft shore blueprint)
3. Education & outreach on the benefits of "softshore"

Benchmark
T-5 The probability of a catastrophic oil affecting the San Juan Islands is less than .0005 per year. Amount of chronic oil pollution is reduced by 2016.

Strategies
1. Minimize chronic pollution from land and marine sources (includes medium spills and chronic events like bilge pumping.)
2. Support efforts to reduce risk and improve response to oil spills.

Benchmark
T-6. Reduce greenhouse gas emissions from San Juan County according to the same standards adopted by Seattle.

Strategy
1. Promote concept of the county doing its part to reduce greenhouse gas emissions (think globally, act locally)

Benchmark
T-7. Nitrogen inputs from human sources do not exceed more than 10 percent of natural levels by 2017 – considering changing to capture all pollutants that we care about.

Strategy
1. Draw attention to/include marine issues (stormwater, wastewater, etc) within watershed management plans and programs

Conservation Target: Seabirds

Benchmark
B-3. Restore herring spawning to all historic areas.

Strategies
1. Protect and restore spawning habitat
2. Support regional herring recovery efforts

Benchmark
B-5.
a) The number of nesting pairs of black oystercatchers remains stable at the 2006 level or increases over a four year timeframe by 2017.
b) The number of nesting pairs of pelagic cormorants is stable at the 2006 level or

increasing over a four year time frame by 2022. Eagles are a threat with no strategy. Not within our goals to address this threat. Solution is to increase population levels to withstand increased predation.

Strategies

1. Reduce disturbance
2. Reduce impacts of derelict fishing gear
3. Reduce oil spill risk (see T-5)
4. Increase prey base (see B-3)

Benchmark

T-5 The probability of a catastrophic oil affecting the San Juan Islands is less than .0005 per year. Amount of chronic oil pollution is reduced by 2016.

Strategies

1. Minimize chronic pollution from land and marine sources (includes medium spills and chronic events like bilge pumping.)
2. Support efforts to reduce risk and improve response to oil spills.

Benchmark

T-6. Reduce greenhouse gas emissions from San Juan County according to the same standards adopted by Seattle.

Strategy

1. Promote concept of the county doing its part to reduce greenhouse gas emissions (think globally, act locally)

Socio-cultural target: Enjoyment of the marine environment

Benchmark

SC-1. There are viable recreational, commercial, ceremonial and sustenance fishing opportunities year-round for county residents, tribes with usual and accustomed fishing rights and visitors by 2037.

Strategies

1. Ensure that species restoration/recovery is to a level that allows sustainable fishing. (need to clarify or quantify "sustainable")
2. Ensure fisheries management supports a local fishing economy.

Benchmark

SC-4. Locally-harvested marine species pose insignificant risks to human health, given local rates of consumption, by 2017.

Strategies

1. Promote water quality protection through best management practices.
2. Determine scope and nature of the water quality problem and develop implementation plan.

Benchmark

SC-5. In San Juan County, the majority (greater than 50% percent) of people are aware, involved, and feel ownership of the MSA.

Strategies

1. Communicate a clear, inspiring stewardship message to the public.
2. Foster projects that engage the public (seasonal and year-round residents) in marine stewardship
3. Identify and engage key partners as active marine stewards. (need to refine with help from stakeholder groups)

Benchmark

SC-6 Placeholder for a non consumptive enjoyment benchmark, such as: a scenic, functional and natural marine environment is available for human enjoyment.

Strategies

1. Recommend that county plan for sea level rise and other climate change implications.
2. Recommend that county policies & regulations are directed at achieving this benchmark.
3. Help marine managers address the pressures on marine resources associated with increased population and demand.

Benchmarks

B-1. Increase lingcod populations to greater than 25% of unfished spawning biomass by 2027 and increase rockfish populations to greater than 25% of unfished spawning biomass by 2037. Maintain kelp greenling populations at 2006 levels.

T-1. Impacts of harvest activities within the MSA on the rate of rockfish species recovery are within 10% of the time it will take to recover rockfish populations under zero harvest-related mortality by 2037.

Strategies

1. Reduce bycatch of select species.
2. Suspend direct harvest of select species until recovery goals are met.
3. Promote public awareness of the status of and threats to rockfish, lingcod, and greenling [objective: Public is involved, understands, and takes ownership over the problem and action toward a solution.

Benchmark

B-3. Restore herring spawning to all historic areas.

Strategies

1. Protect and restore spawning habitat
2. Support regional herring recovery efforts

Benchmark

T-3. Ensure that there are enough salmon of the right sizes and species available within the MSA at the right times of year to support restored marine mammal populations.

Strategies

1. Implement local salmon recovery plan
2. Connect with regional efforts

Benchmark

T-4. Reduce the number of miles of armored shoreline by 2016.

Strategies

1. Minimize new armored shoreline
2. Remove shoreline armoring where appropriate (soft shore blueprint)
3. Education & outreach on the benefits of “softshore”

Benchmark

T-5 The probability of a catastrophic oil affecting the San Juan Islands is less than .0005 per year. Amount of chronic oil pollution is reduced by 2016.

Strategies

1. Minimize chronic pollution from land and marine sources (includes medium spills and chronic events like bilge pumping.)
2. Support efforts to reduce risk and improve response to oil spills.

Benchmark
T-6. Reduce greenhouse gas emissions from San Juan County according to the same standards adopted by Seattle.

Strategy

1. Promote concept of the county doing its part to reduce greenhouse gas emissions (think globally, act locally)

Benchmark
T-7. Nitrogen inputs from human sources do not exceed more than 10 percent of natural levels by 2017 – considering changing to capture all pollutants that we care about.

Strategy

1. Draw attention to/include marine issues (stormwater, wastewater, etc) within watershed management plans and programs

Socio-cultural Target: Thriving marine based livelihoods

Benchmark
SC-2. By 2017, there is a reliable marine transportation infrastructure with limited and properly sited facilities for vessels with freight movement capacity at all ferry-served islands and access available to transfer passengers from small boats (from other islands) to ferries at all WSF ferry landings.

Strategy

1. Work with county and port districts on criteria for facility sighting, operation and maintenance. (Facility includes barge landings)

Benchmark
SC-4. Locally-harvested marine species pose insignificant risks to human health, given local rates of consumption, by 2017.

Strategies

1. Promote water quality protection through best management practices.
2. Determine scope and nature of the water quality problem and develop implementation plan.

Benchmark
SC-5. In San Juan County, the majority (greater than 50% percent) of people are aware, involved, and feel ownership of the MSA.

Strategies

1. Communicate a clear, inspiring stewardship message to the public.
2. Foster projects that engage the public (seasonal and year-round residents) in marine stewardship
3. Identify and engage key partners as active marine stewards. (need to refine with help from stakeholder groups)

Benchmark
SC-7 Healthy marine environment that sustains thriving marine-based livelihoods. (needs wordsmith).

Strategy

1. Incorporate this vision into a communication strategy (A-1).

Benchmark
T-7. Nitrogen inputs from human sources do not exceed more than 10 percent of natural levels by 2017 – considering changing to capture all pollutants that we care about.

Strategy
1. Draw attention to/include marine issues (stormwater, wastewater, etc) within watershed management plans and programs

Socio-cultural target: cultural traditions, ceremonial, subsistence, sustenance and spiritual uses and aspects

Benchmark
SC-3. There is a general acceptance and awareness of marine related cultural practices and traditions, including treaty fishing rights by 2017.
Strategies
1. Continue and build upon MRC, county and others' outreach efforts with the tribes.
2. Support others' efforts to highlight traditional marine practices.

Benchmark
SC-4. Locally-harvested marine species pose insignificant risks to human health, given local rates of consumption, by 2017.
Strategies
1. Promote water quality protection through best management practices.
2. Determine scope and nature of the water quality problem and develop implementation plan.

Benchmark
SC-5. In San Juan County, the majority (greater than 50% percent) of people are aware, involved, and feel ownership of the MSA.
Strategies
1. Communicate a clear, inspiring stewardship message to the public.
2. Foster projects that engage the public (seasonal and year-round residents) in marine stewardship
3. Identify and engage key partners as active marine stewards. (need to refine with help from stakeholder groups)

Benchmark
T-7. Nitrogen inputs from human sources do not exceed more than 10 percent of natural levels by 2017 – considering changing to capture all pollutants that we care about.
Strategy
1. Draw attention to/include marine issues (stormwater, wastewater, etc) within watershed management plans and programs

All Conservation targets, Socio-cultural targets and all Benchmarks

Strategy
1. A-1. Develop a comprehensive communication strategy to deliver our messages to the public

IV. CONCLUSION & NEXT STEPS

Following the development of draft strategies, the MRC led a review process to give marine managers and community members throughout the county another opportunity to learn about the process, the threats facing marine resources, and the strategies developed to address them. With help from Norton-Arnold & Company, the MRC interviewed key stakeholders, held a meeting with tribal managers, organized the third Marine Managers Work Session and facilitated four public workshops on four different islands. These meetings gave community members and key parties an opportunity to understand the process, comment on the draft plan and identify the strategies that are most important to them. For compiled notes of this feedback, see Appendix B.3.

Public comments were considered by the MRC along with the outcomes of the Marine Managers Work Session and the entire planning process to determine the strategies that the committee will promote first. However, the Committee feels strongly that all the strategies laid out in this plan are important if the marine ecosystem is going to thrive under current pressures. In addition, this planning process identified many gaps in information that members of the core planning team, technical advisors and marine managers agree are important for understanding the condition of local marine resources and the necessary actions to protect them. Filling these "data gaps" is a priority and need to be incorporated into the future work of research organizations including schools, agencies, and nongovernmental organizations.

Over the next few years, the MRC will incorporate the outcomes from this plan into their work plan. In addition, the Committee will advocate for moving these outcomes forward through other means, such as the San Juan Initiative[4], policy recommendations to San Juan County government and marine managers, collaborative efforts with governmental and non-governmental partners, to give just some examples. This plan will be most effective if it becomes a core around which numerous marine ecosystem protection and restoration efforts can coalesce. The MRC will continue to emphasize coordination of marine managers' authorities and responsibilities towards implementing this plan's strategies as well as coordination of marine managers' policies and actions with the work of the MRC and other citizens' and non-governmental organizations.

At the time of adoption, the monitoring plan for the Marine Stewardship Area is not final. In the upcoming year, the Core Team will work with technical advisors to develop a detailed monitoring plan based on the benchmarks identified through this planning process. Over time, the MRC will track available information to assess whether or not the targets are achieving the benchmarks. If benchmarks are not being met or approached, strategies will be reviewed and modified as necessary using the same approach used here to develop them. These important changes will be reflected in the workbook. Thus, this is an adaptive plan.

While the MRC took the lead on this planning process, the outcomes are the result of the combined efforts of many organizations, interest groups, managers, community leaders, and citizens who care deeply for the long-term health of San Juan County's marine resources. If the same energy and commitment goes into implementing the draft strategies and monitoring their effectiveness, then this

[4] The San Juan Initiative began in January 2007 and is a two-year public-private partnership between San Juan County and Shared Strategy for Puget Sound. Led by local and regional leaders, the initiative aims to prioritize protection measures based on existing planning efforts, including the Marine Stewardship Area plan, assess how effective programs are in protecting the ecosystem and then generate recommendations for improvements. These recommendations will be presented to local leaders as well as regional, state and federal managers. This process will help to inform the regional efforts of the Puget Sound Partnership.

plan will be a success and the benefits will be realized through a healthier ecosystem and more vibrant economy.

The MRC encourage others working to protect and restore the marine resources in the San Juan Islands to carefully review this plan and incorporate the outcomes into your efforts. If you would like a presentation on the plan and/or accompanying workbook, please contact the Marine Resources Committee: 360-370-7592.

THANK YOU

The MRC extends enormous gratitude to the numerous individuals, agencies and organizations throughout Puget Sound who played a significant role in creating the stewardship area plan. We could not have completed this project without you. Below are the primary partners and financial contributors. For a more complete list of supporters, please refer to the key contributors starting on page 3.

Charlotte Martin Foundation
Friends of the San Juans
Northwest Straits Commission
NOAA MPA Center
Puget Sound Action Team
San Juan County
SeaDoc Society
Shared Strategy
Surfrider Foundation
The Nature Conservancy
The Port of Friday Harbor
The University of Washington Friday Harbor Labs
The Whale Museum
Tulalip Tribes
WSU Beach Watchers

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APPENDICES

APPENDIX A. MRC Vision and goals

Goals of the San Juan County Marine Resources Committee
Adopted 11/7/01, revised 4/4/03

Ecological/biological

a. To protect and restore the marine biological diversity, ecosystem processes, representative ecosystems and special natural features.
b. To conserve fish populations and the upland, nearshore, and deepwater habitats that support them. The initial goal will be to increase the abundance and productivity of selected populations.
c. Prevent further reductions in marine populations including marine birds and habitats within the San Juans and increase populations of marine species to levels exceeding present levels, within the range of natural variability.

Cultural, social & economic

d. To recognize and appreciate the existence values, especially cultural and spiritual values, provided by a fully functioning marine ecosystem. To protect and restore the marine ecosystem so that these benefits will be available for future generations.
e. To recognize and protect direct use benefits for marine resources, including ceremonial, subsistence, recreational and commercial fishing. To protect and restore the marine ecosystem so that these benefits will be available for future generations.
f. To acknowledge cultural heritage resources and encourage understanding and appreciation of them.
g. To recognize the need for scientific research opportunities and the benefits that accrue from this research.
h. To promote increased education and awareness of the marine environment. To encourage all participants to be open to others' perspectives concerning the marine environment so that all relevant players will be encouraged to participate in developing protection/recovery plans.
i. Protect marine-based recreational resources, including fishing, recognizing that on (and in) the water recreation and enjoyment is an important part of not only our local economy but also our community, culture and the coastal legacy we leave for our children.

Approach/Guiding Principles for How

j. To use both indigenous knowledge and the results of scientific research to inform adaptive management.
k. To better protect beaches, coasts and the marine environment from pollution, relying upon existing Clean Water Act, Hydraulic Code and Shoreline Management Act Authorities, water quality overlay areas shall be designated to ensure appropriate levels of protection for the marine environment. Such regulations may include the identification of areas that warrant additional pollution protections and the enhancement of marine water quality standards.
l. To promote increased education and awareness of the marine environment. To encourage all participants to be open to others' perspectives concerning the marine environment so that all relevant players will be encouraged to participate in developing protection/recovery plans.

APPENDICES B 1-3 Community Involvement

B.1 MRC Marine Stewardship Outreach Campaign in 2004: meetings, presentations and displays

- Small personal presentations for communities on Stuart, Johns and Waldron Islands and in Deer Harbor on Orcas. Summer-fall 2004
- Several public presentations at MRC meetings on San Juan Island. Summer-winter 2004
- Full page ad published in the San Juan Journal, smaller ads in the Sounder and Weekly. June, July and August 2004
- Whale Museum's Environmental Forum. July 2004
- San Juan Lions Club. July 2004
- Orcas Island Lions Club. July 2005
- San Juan County Fair. August 2004
- San Juan BOCC. August 2004
- Waldron Island Community Outreach Meeting. November 2004
- NWSC MPA Mangers Work Session. November 2004
- Deer Harbor, Orcas Island Community Outreach Meeting. November 2004
- Power Squadron. December 2004
- Marine Science Lecture Series hosted by the SeaDoc society and the San Juan Nature Institute. February 2005
- Roche Harbor Salmon Fishing Derby. February 2005.
- Board of County Commissioners (BOCC). February 2005
- Puget Sound Georgia Basin Research Conference. March 2005
- Eastsound, Orcas Community Outreach Meeting. April 2005
- Shaw Island Community Outreach Meeting. May 2005
- Anacortes Swap Meet/Opening day at the Flounder Bay/Sky Line Yacht Club. May 2005
- Roche Harbor Bayliner Rendezvous. June 2005
- Rotary Club. June 2005
- Environmental fair on Orcas Island. June 2005

APPENDIX B.2 MSA planning workshops, work sessions, and meetings spring 2005 – 2007

Table a. List of MSA planning meetings, workshops and work sessions

Date	Type of meeting	Topic(s)
April 20, 2005	MRC	Discussion of draft targets
April 20, 2005	Science Subcommittee	Discussion of Five-S process design
May 4, 2005	MRC	Five-S briefing
May 18, 2005	MRC	Five-S briefing & feedback
June 1, 2005	MRC	Five-S process design briefing
June 6, 2005	Core Team	Five-S training w/Betsy
June 7, 2005	Core Team	Five-S training w/Betsy
June 14, 2005	Core Team + interested MRC	Technical Panel Workshop
June 15, 2005	MRC	Tech Panel workshop results; planning process discussion
July 6, 2005	MRC	Brief discussion of MOU
July 20, 2005	MRC	Work session: Target selection
August 2, 2005	Core Team	Mtg with Terry Williams
August 3, 2005	MRC	Briefing/update
August 27, 2005	NW Straits	Briefing on Five-S
September 22, 2005	Core Team	Review Technical Panel member comments on target selection; October workshop planning.
September 27, 2005	Core & experts on rocky habitats	Rocky habitats viability analysis
October 5, 2005	MRC	Work session/update
October 5, 2005	Core Team	Review viability analysis; finalize October workshop agenda
October 19, 2005	MRC	Work session - review viability analysis for workshop
October 20-21, 2005	Core Team + interested MRC	Stakeholder Workshop
November 2, 2005	MRC	Work session: discuss results of stakeholder workshop
November 16, 2005	MRC	Work session - complete rockfish situation analysis
December 7, 2005	MRC	Short work session - review workshop targets
December 7, 2005	Core Team	Workbook demonstration; discussion of workshop threat analysis
January 4, 2006	MRC	Status update
January 4, 2006	Core Team	Planning session for marine managers meeting; Five-S next steps
January 30-31, 2006	Blitz - Core Team	Biodiversity target viability and stress-source analyses
February 1, 2006	MRC	Status update
February 15, 2006	MRC	Work session: update on & review of biodiversity targets viability assessment
February 15, 2006	Core Team	Blitz results; continue biodiversity targets viability & threat assessments
February 27, 2006	Core Team - conference call	Finalize biodiversity viability analysis and review stress-source for nearshore targets
March 1, 2006	MRC	Work session: human benefits (socio-cultural) targets

Date	Type of meeting	Topic(s)
March 1, 2006	Core Team	Review threat assessment; prep. for marine managers workshop
March 7, 2006	Ad-hoc Socio-cultural targets team	Viability analysis for socio-cultural targets
March 13-14, 2006	MRC + marine managers work session	Strategies development and opportunities for implementation
April 25, 2006	Core Team - conference call	Review marine mammal and seabird threat assessments
May 3, 2006	Science Subcommittee	Discuss technical review
May 10, 2006	Blitz - Ad-hoc Socio-cultural targets team	Socio-cultural targets “blitz” work session: viability & threat assessments
June 12, 2006	Core Team	GIS component
June 21, 2006	MRC	Update on Blitz results
June 21, 2006	Core Team	Review socio-cultural target viability & threat assessments
July 5, 2006	MRC	Work session: situation assessments
July 5, 2006	Core Team	Work on objectives, socio-cultural viability & threat assessments; replacing Kirsten
July 13, 2006	Core Team conference call	Work on objectives
July 19, 2006	MRC	Work session: situation assessments
July 19, 2006	Core Team	Work on objectives
August 3, 2006	Core Team work session	Work on objectives
August 16, 2006	MRC	Brief work session: objectives
August 16, 2006	Core Team	Work on objectives; MSA planner transition
October 24, 2006	Strategies work session	Develop draft strategies
November 15, 2006	MRC	Adopt draft strategies
March 24, 2007	Public Workshop on Shaw Island	Public review of draft strategies
April 7, 2007	Public Workshop on San Juan Island	Public review of draft strategies
April 14, 2007	Public Workshop on Lopez Island	Public review of draft strategies
April 21, 2007	Public Workshop on Orcas Island	Public review of draft strategies
May 14 -15, 2007	MRC + marine managers work session	Review strategies and identify opportunities for implementation
June 20, 2007	MRC	Vote on the Final MSA Plan
July 17, 2007	MRC presentation to the San Juan County Council	Presentation of the final plan for adoption.

APPENDIX B.3 Compiled notes from public meetings

See Report: Public and Marine Managers' Review of the San Juan County Marine Stewardship Area Plan (provided on compact disk).

APPENDICES C 1-2 Stewardship Area Benchmarks & Objectives

APPENDIX C.1 Long term benchmarks & findings

LT=Longer-term objective-strategies to be developed down the road;
F=Finding – no objectives/strategies to be developed

LT-1. Wintering harlequin duck population size and pelagic cormorant colony size remain stable at 2006 levels over or are increasing over a four year timeframe by 2025.
LT-2. Sedimentation rates are within 20% of historical rates in all embayments by 2025.
LT-3. Reduce rate of decline and restore coastal wetland habitats so that more than 75% of the fringing wetlands show less than a 10% decline in areal coverage by 2027.
LT-4. Overall native species richness and abundance of indicator species are 90% of historic levels and increasing, and invasive species coverage and distribution does not exceed 2007 levels in sand and gravel or rocky intertidal and subtidal areas by [to be determined (TBD)].
LT-5. The number of small spills reported to IOSA is reduced to 8 per year. (Current is 17-18)
LT-6. Reduce human disturbance along shorelines in sensitive areas by [TBD] (amount) by [TBD] (year).
LT-7. There is greater predictability in harvest openings from year-to-year.
LT-8. All identified physical marine cultural sites are protected from further degradation by 2017.
LT-9. On each ferry-served island, [TBD] % of the shoreline is publicly accessible by [TBD] (year). (Note, this is a combination of the miles of public shoreline and public access sites)
LT-10. The level of PAHs in sediments/clams are maintained below [TBD] in all areas of the MSA by [TBD].
LT-11. Locally-caught seafood is available for purchase from two or more vendors on each ferry-served island by [TBD] (year).

F-1. Levels of boating are such that on summer days: remote marine campsites do not have sites available, the level of boat traffic in certain channels is too high, remote anchorage sites are too crowded and safe and legal anchoring locations may not be available.
F-2. The current ratio of demand for boat moorage and storage to supply should be maintained. This is a combination of dry dock capacity, the number of long-term berths, and the number of safe and legal mooring locations.
F-3. The number of waterfront campsites accessible by land are insufficient.
F-4. The current number of shoreline public access sites and miles of accessible shoreline are insufficient.
F-5. The number and diversity of living-wage marine-based jobs are insufficient.
F-6. Marine views and view sheds are impaired by buildings and light pollution.
F-7. There is insufficient access to shell fishing areas.
F-8. Locally-caught and –raised seafood is too expensive.
F-9. Too few local fishermen are involved in commercial fisheries.

APPENDIX C.2 MSA Priority Research Objectives

Conservation Target: Rocky intertidal and rocky subtidal communities

R-6. Determine current viability/status of rocky intertidal target within the MSA.

R-7. Determine current viability/status of rocky subtidal within the MSA.

R- Better understand the role of kelp habitat and community dynamics. [strategies workshop 10/24]

Conservation Targets: multiple targets/system wide

R-1. Determine the cumulative impacts of docks and other over-water structures on habitats of interest.

R-2. Determine the current levels of PCBs, mercury, tributyl tin, flame retardants and other bioaccumulating contaminants in fish and shellfish in the San Juans that may have biological impacts, including to human health, identify which are priority causes for concern and establish appropriate threshold amounts. Determine local levels of consumption so that the threshold for human health risks is adjusted for local consumption rates.

R-3. Identify significant local sources of priority contaminants listed above and establish specific timelines to reduce these inputs.

R-4. Determine current and sustainable levels of PAHs by looking at sediments, the water column, or clams.

R-5. Determine the current abundance of sand lance and smelt in the MSA

R-8. Identify the current level of greenhouse gas emissions in San Juan County and a target and timeline for reduction.

R-9. Determine number and condition of physical marine cultural sites within the MSA.

R-10. Determine what level and frequency of fishing opportunities are needed to be considered viable (per SC-1).

Conservation Targets: rockfish, lingcod and greenling

R-. Follow-up on Eisenhardt research: repeat dive survey of other four sites in 2007. Repeat fishing pressure assessment. [MRC meeting, Nov 2006]

R - Research the population processes that control the abundances of rockfish, greenling and lingcod, and what role humans play in these processes. [Art Kendall technical review comments]

R - Determining the size structure of the adult populations in 1975 (used as a baseline year for the indicator) to provide the basis for comparison with existing size structures. [Todd Anderson technical review comments]

R - Looking at relative estimate of the density of recruits, use 30-m long transects, surveying a corridor of 2 meters wide x 2 meters high to count young-of-year rockfishes. [Todd Anderson technical review comments]

Conservation Target: Nearshore, sand, mud and gravel communities

R - Compile or collect better data on soft sediment environments [Jennifer Ruesink technical review comments.]

R - Determine how much the biological key attributes have changed (how much wetland loss? how much harder is it to find native clams? how much loss of Zostera japonica and gain of Spartina anglica?) [Jennifer Ruesink technical review comments.]

R - Determine how much shoreline modification has already happened, and the current rate of conversion. [Jennifer Ruesink technical review comments.]

R - Determine how many ships pass through San Juan County annually and rates of different sizes of spills. [Getting at oil spill threat. Jennifer Ruesink technical review comments]

Conservation Target: Pacific Salmon

R - Determine fragmentation of habitat as measured by the amount of piers, docks, groins, breakwaters per mile of shoreline as an indicator for the attribute, Condition of habitat present in the San Juan Islands. Condition: Migration Corridor. [Kurt Fresh Technical review comments]

R - Numbers of bulkheads in divergence zones as an indicator for the attribute, "Condition of habitat present in the San Juan Islands." [Kurt Fresh Technical review comments]

R - Determine salinity measurements as an indicator for the attribute "Distribution of Fraser Water in the SJI" [NOTE: This would be a hard index to make meaningful. The intent would be to reflect long term changes in salinity in the SJIs which refers to both amount and distribution. Perhaps there is a data record at FHL. I would use some sort of deviation from the mean to construct an indicator. Kurt Fresh Technical review comments]

Indicators without data that are either not rated or are rated fair to poor

Target	Key Attribute	Indicator	Current Rating
Rock Intertidal	Height and width of zones	need indicator	
	Age and stage structure	need indicator	
	Water column characteristics	Air and water temperature regime (need to define an indicator)	
	species composition/dominance	native species richness	
	Population size of selected species	abundance of barnacles	
	Population size of selected species	abundance of Fucus	
	Population size of selected species	abundance of limpets	
	Vegetative canopy	mean % cover of kelp	
Rocky Subtidal	Water column characteristics	sedimentation (need to define an indicator)	
	species composition/dominance	native species richness	

Target	Key Attribute	Indicator	Current Rating
	Population size of selected species	sea cucumber abundance in subtidal (-5 to -10 m)	
	Population size of selected species	sea urchin density in subtidal (-5 to -10 m)	
	Vegetative canopy	% cover of Nereocystis	
	Vegetative canopy	abundance of understory kelps	
Nearshore	Associated wetlands coverage for beaches	wetlands (areal coverage? Need to define indicator)	
	Associated wetlands coverage for embayments	wetlands (areal coverage? Need to define indicator)	Fair
	Substrate structure and characteristics in embayments	depth of anoxic horizon in embayments	Fair
	Substrate structure and characteristics in embayments	sedimentation rates in embayments	Fair
	water column characteristics in embayments	dissolved oxygen concentration in embayments	Fair
	Native aquatic vegetative canopy	year to year regional change in Zostera marina area in beaches	Fair
Rockfish, Lingcod, Greenling	juvenile rockfish refuge and foraging habitat	no indicators at this time (may include understory kelp)	
	Recruitment	Sufficient young of the year to fill available habitat in randomly sampled reefs	
	Rockfish species richness	Number of species using randomly sampled sites	Fair
	Population abundance of rockfish, lingcod, and greenling	Population size as estimated from harvest records	Poor
Pacific Salmon	abundance of prey items for salmon up to 100 mm	crab larvae/amphipod/zooplankton indicator	
	abundance of prey items for salmon up to 100 mm	surf smelt/sand lance larvae abundance	
	Juvenile habitat abundance along beaches	year to year regional change in Zostera marina area in beaches	Fair
	juvenile salmon population abundance	abundance of juveniles by species (to be decided)	
Seabirds	Nesting success	oystercatchers: # hatchlings/#nesting pairs	
	Nesting success	pelagic cormorants: # hatchlings/ # nesting pairs	Fair
	seabird food resource availability	forage fish abundance	Fair
	seabird food resource availability	zooplankton (euphausiid) abundance	
	Population size of selected species	Pelagic cormorant colony size	Fair
Marine Mammals	Food resource availability and quality	prey abundance for resident killer whales (salmon)	Fair

Target	Key Attribute	Indicator	Current Rating
	intraspecific communication	background noise levels? Frequency shift in communication?	
Human Enjoyment	Availability of locally-caught and -raised seafood	number and type of vendors (place holder)	
	Views and viewsheds	Views from water - % of shoreline with intact shoreline vegetation	Fair
	opportunities to learn about the marine environment	indicator TBD - should incl. cultural, nat. history and science	
Marine-based Liveli-hoods	Commercial marine harvest opportunities (tribal and non-tribal)	# of vessels fishing?	
	Diversity (variety) of living wage marine-based livelihoods	index of livelihoods (TBD)	Fair
	Diversity (variety) of living wage marine-based livelihoods	number of living wage marine-based jobs	Fair
	Ecologically sustainable marine transportation infrastructure	intermodal access (moving people)	Fair
	Ecologically sustainable marine transportation infrastructure	availability of mooring facilities for commercial vessels with freight movement capacity	Fair
	Opportunities for marine-based research	funding levels for research in the San Juans	
	Condition of physical marine cultural sites	condition of physical marine cultural sites	Fair
Cultural Traditions	appreciation of marine cultural sites and traditions	Extent to which (5?) representative cultural traditions are practiced	
	Recognition and acceptance of treaty rights by non-Indian public	Non-Indian public recognizes the existence and importance of tribal treaty rights.	Fair
	Subsistence Harvest Opportunity	Availability of commonly harvested species (e.g. hardshell clams, crabs, shrimp, salmon), year-round, in quantities suitable for subsistence purposes for tribal members.	Fair
	Subsistence Harvest Opportunity	Availability of commonly harvested species that are healthy to eat.	Fair
	Commercial Harvest Opportunity	Availability of commercially harvested species (e.g. hardshell clams, crabs, shrimp, herring, halibut, salmon), year-round, in quantities suitable to provide a moderate living to 75% of members of tribes with U&A rights in the San Juan Islands.	Fair
	Sustenance harvest opportunities	access to harvested resources	fair

APPENDIX D MSA Plan Technical Review Comments Summary

Reviewers

Rocky Intertidal Habitats & Rocky Subtidal Habitats (2 targets)
  Megan Dethier
Nearshore Sand, Mud and Gravel Communities
  Jennifer Ruesink
Rockfish, Lingcod & Greenling
  Art Kendall
  Todd Anderson
Seabirds
  Kolleen Irvine
Pacific Salmon
  Kurt Fresh
  Si Simenstad
Marine Mammals
  Robin Baird
  Brad Hanson
  Glenn R VanBlaricom

Rocky Intertidal and Subtidal Habitats

Reviewer: Megan Dethier

Megan Dethier
UW Friday Harbor Laboratories
mdethier@u.washington.edu

General Comments

Completing the viability and threat analysis for this target is hindered by lack of data. For most targets and attributes (with the exception of things like Orcas, a few seabirds), there are no historical data - anecdotes, or scattered quantitative data for a few spots might exist, but never enough to establish a 'baseline' against which we could really measure change, or at least not at the scale of the Stewardship area. Suggests planners pick some targets and attributes and start gathering detailed data now.

In the plan, definitions need to be clearer. Hard to understand when the plan is referring to Sources of Stress (eg oil spills) or Impacts of Stress on Attributes (eg compressed intertidal zones). Likewise, the term Irreversibility appears to be interpreted differently by different groups - does it or does it not encompass the likelihood/feasibility of the source of stress actually being stopped or removed (eg docks or boat wakes), or just the ability of the system/attribute to recover if the source of stress was removed. I believe it was the latter, so that is how I altered the ratings.

I was delighted to see, in the Overview, that the 'social-cultural targets' have been separated out from the resource targets - that way, for at least one set of targets, you are following the 5-S definition of a 'target' properly. It also makes it easier to acknowledge that improving a target on one list (a resource one) will often be directly at odds with improving a target on the other (social).

Viability Analysis

Additional comments were made directly to tables from the workbook. See these comments on page 57.

Nearshore Sand, Mud and Gravel Communities

Reviewer: Jennifer Ruesink

Jennifer Ruesink
University of Washington
ruesink@u.washington.edu

General Comments

The County Commissioners and San Juan MRC deserve high marks for embarking on this scientific process of evaluating conditions and changes in the marine environment. The Reviewer Instructions were complete and helpful – hopefully I have interpreted them correctly to provide feedback.

There is essentially no scientific justification provided for any part of the analysis of this marine resource. The Stress Source comments indicate substantial uncertainty (e.g. "placeholder", "do this differently", "guessing at this", "know more in next few months"). Also, the documents contain logical inconsistencies: 1) the threat comments include two stresses that are absent from the Excel spreadsheet (loss of terrestrial riparian vegetation, reduced sediment input); 2) the viability worksheet includes water column indicators for a key attribute that appears nowhere else; 3) multiplication of contribution and irreversibility give different answers (E23 and G41 = High x Medium = Low?; E35 = High x Very High = Medium?); 4) for some attributes, beaches and embayments are distinguished, whereas for others there is a single attribute with indicators separated for beaches and embayments.

It would be useful to know if the planning process is supposed to draw only from what's known about soft sediment environments in this particular area, or if scientific research in other places could also be applied. If the former, then I am a little surprised about how little soft-sediment research has apparently been carried out in San Juan County. If the latter, then this marine resource deserves substantial additional scholarship to document "integrative concepts" (structure-function relationships, major ecological processes) relevant to this habitat type.

Key Ecological Attributes

- Decline in native clam species diversity and abundance (2 indicators each for beaches and embayments)
- Change in sediment size distribution in embayments (3 indicators in embayments)
- Decline in native aquatic vegetation (2 indicators: beaches and embayments)
- Loss of wetland habitats (2 indicators: beaches and embayments)
- Change in sediment size class distribution on beaches (1 on beaches)
- Change in beach profile

Note: The viability worksheet includes 2 water column indicators that did not appear on the Stress-Source worksheet. The Comments Word document includes 2 additional indicators that did not appear on either Excel worksheet.

To summarize these key attributes: three emphasize species (native clams, aquatic vegetation, wetlands), and three emphasize physical variables (grain size in two areas, beach profile). These represent biological and abiotic characteristics – only the most basic aspects and a small part of the potential list, which could include ecological processes, interactions, critical causal links.

The biological key attributes make a lot of sense to me. That is, soft sediment environments are distinguished by the presence of clams and rooted macrophytes. I would also consider adding native oysters (certainly in Willapa Bay, where I work, they were structurally and functionally very important, formerly occupying up to 10% of bay area and providing hard substrate in a largely soft-sediment environment) and predators such as crabs and snails (this would add an ecological interaction to the list; in the broader scientific literature, predators are known to alter species composition in soft sediments, and J. Byers has published on the role of predators in the San Juan Islands). Finally, deposit-feeders in soft sediments can be major ecosystem engineers, but I do not know how common such species as Arenicola (polychaete worm) and Neotrypaea (ghost or sand shrimp) might have been in the area. They would be obvious candidates to add because they can actually modify local sediment grain size.

Sediment grain size, salinity, and temperature (water and air at low tide) are three critical abiotic variables that influence species composition in soft sediments. The selected key attributes disproportionately emphasize what can be measured at low water, thus missing any aspects of water quality (except for 2 indicators on the Viability worksheet that appear nowhere else). One of the most compelling indicators in Chesapeake Bay, for instance, is a long time series of how deep it's possible to wade before white tennis shoes disappear from view (a rudimentary secchi depth).

Much peer-reviewed work on soft sediment stressors addresses whole-community composition via multivariate analysis (see Warwick and Clarke references and Primer software). So this sort of key attribute seems notably absent (albeit difficult to measure without substantial statistical acumen; and also sometimes difficult to interpret).

1. Are the indicator rating criteria (columns D-G [F-I?]) appropriate? In many cases we were unable to identify criteria for each rating based on the information we had available. Where this is the case, please feel free to suggest criteria.

I had a difficult time interpreting some of these indicator ratings. I'll address them in order: A. <X% of wetlands show <Y% decline: the problem with these ratings is that X and Y both change across levels, so it's not clear to me that 75% showing 10% decline is worse or better than 25% showing 50% decline (and are the <signs in the correct direction?). B. The depth of anoxic horizon can sometimes be within a few mm of the sediment surface. A change of >5 cm might be interpreted as the anoxic layer becoming 5 cm deeper, which could be viewed as an improvement in conditions. C. Within 25% of historic seems better than within 50% of historic (25% is closer than 50%). In any case, for grain size, it is not clear what exactly will be measured - % fines? average grain size? silt:sand ratio? organic content? Many of these aspects of sediment co-vary, but from an indicator perspective it would be good to focus on just one. D. Sedimentation rates undoubtedly have varied more than 10-20% over time, due to natural watershed and hydrological changes. At the other end, it is certainly possible that they could depart >90% from historic rates – for instance, a doubling of sedimentation would exceed this "poor" level. I would guess that the literature contains substantial data on variation in sedimentation rate, although I am not familiar with it. E. For clams and aquatic vegetation, there is inconsistency in terms of what is good vs. very good: is an increasing trend good or very good?

2. Does the current status and ratings (columns E and F [J and K?]) match your view of the current status of this indicator within the San Juans? If you do not agree with our rating, please distinguish between instances where you believe our interpretation is incorrect (in which case, please correct it) and instances where there is significant uncertainty or lack of data relating to the criterion.

I'm familiar with only a few datasets that would allow these indicators to be rated: DNR's eelgrass mapping and DOE's water quality (although I'm not sure the sampling is dense enough to evaluate all of SJ County's embayments). The ratings match my intuition, based on global trends. I would caution, however, that anoxia in sediments can be quite natural, so a change from baseline is more relevant than an absolute level.

3. Are the indicators (column C) appropriate for the key attributes? If not, please suggest an alternative with a detailed rationale.

See question above on how grain size will be measured. In fact, it occurs to me that the key attribute should be "sediment properties", and some aspect(s) of grain size should be the indicator.
Also, many of these indicators vary naturally in time and space – clam density or grain size, for instance. Where and how often will they be measured? I know that DNR is tracking eelgrass distribution and abundance, including the San Juans. Their sampling regime would be usefully acknowledged. It is also quite complicated statistically, so they are able to track eelgrass throughout the state in an efficient and statistically powerful manner. Something similar for clams and for physical attributes would be wonderful, but probably not realistic. Is this list practical or ideal?

4. Is there a critical key attribute that we have overlooked? If so, please suggest what it is and an appropriate indicator (?). [See comments above]

Stresses and Threats

1. Are the stress ratings appropriate?

My understanding is that the stress ranks should emerge from the indicator ratings. Thus, for example, the indicators for clams are in "good" shape, so the stress rank is medium (or, one could argue, low). It does not intuitively make sense to me that sediments in embayments currently have high stress, but I am not sufficiently familiar with data in the San Juans to know for sure. More generally, it would be possible to cite literature about the vulnerability of bays to siltation due to land use change (at least, this is what I imagine prompts the high stress rank). It would be helpful to know how much the biological key attributes have changed (how much wetland loss? how much harder to find native clams? how much loss of Zostera japonica and gain of Spartina anglica?) This is the sort of information that would be very valuable in the comments provided with the table.

2. Have we overlooked any critical stresses?

Others that seem reasonable: Harmful algal blooms, local freshwater diversions and withdrawals, boat wakes, loss of eelgrass. I put these in because they are phenomena that tend to occur in more protected bays. "Loss of eelgrass" is sort of odd, because it's a key attribute (maybe the intention is to use loss of eelgrass as a threat for fish).

3. Do you agree with our assessment of how significant a contributor each source is to each stress?

Yes. High rankings are given to invasive species, shoreline modification, pollution, climate change and large oil spills. This list does point out something I find confusing, namely whether the ranks are based on actual or possible threats. For instance, shoreline modification has already claimed wetlands and altered sediments. Climate change may in the future cause sea level rise (presumably this affects wetlands) and shifts in species' distributions. (I'm not sure why sediment properties are expected to be so sensitive.) Again, for all of these evaluations, I can state that they make intuitive sense, but I have not found any scientific content to review. For factors such as shoreline modification, it would be useful to know how much change has already happened, and the current rate of conversion. For factors such as oil spills, it would be useful to know how many ships pass through San Juan County annually and rates of different sizes of spills.

Final comment: It's clear that these tables were created in a very rapid assessment of expert opinion. Consequently, there is little empirical support for any of the rankings – although they make intuitive sense to me. I suppose that means that, in a similar rapid expert assessment, I would come to similar conclusions. However, this process seems to miss the point of including actual data from the county or other soft sediment environments.

Rockfish, Lingcod and Greenling

Reviewers: Art Kendall, Todd Anderson

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General Comments

Thank you for the opportunity to participate in the process of identifying critical population problems with the rockfishes, lingcod and greenlings in the San Juans. The review might seem negative, but it is not because the Core Team didn't do a good job. It's just that to my understanding, scientific information is not available to give satisfactory answers to many of the questions posed by the format that they were working with. In my view most of these questions do need to be answered for effective management of these resources to occur. Let's all hope that through this process we can make progress toward increasing our understanding of these populations so we can develop scientifically based management strategies and plans.

Stresses and Threats

It is obvious that considerable time, energy and thought has gone into preparing the tables for the Stress Analysis. The uncertainty exposed in the tables is also abundantly obvious and the scientific literature is completely inadequate to accomplish this task with any degree of precision. We simply know very little about the population processes that control their abundances, and what role humans play in these processes. These processes probably vary considerably among the taxa that are considered here. For example, the population of Puget Sound rockfish seems to be doing quite well. These are small planktivorous fish whose reproductive season in out of phase with that of other rockfishes in the area. Their population actually seems to have increased in recent years, while the other rockfishes have decreased. Puget Sound rockfish are probably subjected to much less harvest than the other species, and this may relate to their different population trend, however changes in reproductive success due to environmental factors cannot be ruled out. Another pertinent example would be lingcod, the top piscivore in the system. Increases in their abundance (as seem to be occurring), may impact the other taxa under consideration negatively by increasing predation on them, particularly on their juveniles.

I agree with their first three sources of stress (historic harvest, present harvest, marine mammal predation). Historic over harvest probably decreased the populations before the impact was recognized. Further reductions in harvest, particularly of rockfishes, is probably not feasible: they are by-catch in both bottom fisheries and in salmon fisheries. Present regulations for recreational lingcod and greenling fisheries seem to be allowing these population to remain stable, or increase. As indicated here, population levels of several species of rockfishes may have been reduced to the point that reproductive potential has been affected. Rockfishes are slow growing fishes that take several years to reach first sexual maturity. Thus, it will take many years of continued restricted harvest to return the population to previous population levels and reproductive output. It has been shown in some species of rockfish that larval viability increases with the age of the parent, which further indicates that a quick fix is not likely. Also, larval survival and recruitment should be expected to be quite variable interannually, for causes that are largely unknown. In most fishes, there is a very weak link between reproductive output of adults and year-class strength, so strong recruitment might occur even at the present reduced population levels, and good recruitment cannot be guaranteed at much higher population levels. That is, even with adequate numbers of eggs (lingcod, greenling) or larvae (rockfishes) produced by the adults, successful recruitment in a given year is not assured.

Rockfish, Lingcod and Greenling

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Viability analysis table
Key attributes, indicators, ratings, and current status.

(1) *Intact natural rocky habitat*. The indicator status ratings of < 60%, > 60%, and 100% of existing condition seems to have no basis; why not use <25% = poor, 26-50% = fair, 51-75%=good, and > 75% = very good? I question whether this is an appropriate attribute to use because variation in cover of rocky habitat would be expected to be very low to nil unless sedimentation is a problem. I did notice that dock development may be an issue? Unless rocky habitat is expected to vary considerably, it will not have much potential in explaining variation in rockfish population size or other attributes. The current indicator status has been left blank, but I agree that rocky habitat is in very good condition (simply because I expect it does not vary much spatially or temporally). The indicator (areal coverage of intact rocky habitat) is fine, although by “intact”, does this mean that cobble or rip-rap habitats should not be included?

(2) *Age structure of the rockfish population*. Because the indicator is population spawning potential, I would recommend that the size structure of the population be used because fecundity (reproductive potential) is tightly coupled to female size (not age). Recent evidence does suggest, however, that older female rockfishes may produce larvae of higher quality.

I do not know where the indicator ratings come from, but if 1975 is the standard to use, then knowing something about the size structure of the adult populations at that time would provide the basis for comparison with existing size structures. The ratings for poor and fair are the same – it seems that you could use the same rating structure I suggest above (<25% = poor, 26-50% = fair, 51-75%=good, and > 75% = very good), but what do these percentages mean? Percentage of fish above a certain age (or size)? Because of natural variation in several of these attributes, it would seem that having ‘very good’ represent 100% of the existing condition is not reasonable. I would agree that the age structure of the population is “fair”.

(3) *Juvenile rockfish refuge and foraging habitat*. Although no indicators are currently provided, what is important to the early life stages of some rockfishes is the areal coverage of understory macroalgae such as *Laminaria*, *Costaria*, *Agarum*, etc. that provide habitat for benthic juveniles of rockfishes. Young juvenile copper rockfish, for example, are positively associated with kelps. The presence of bull kelp (*Nereocystis*) can also positively affect recruitment, creating a canopy in the spring and summer months. However, because of the strong tidal currents in the San Juan Islands, recruitment is lower when stronger current flow is observed. I would recommend using the percentage cover of kelp habitat in the indicator ratings, using the categories of percentage cover that I have mentioned above for those two attributes.

(4) *Recruitment*. Recruitment is highly variable spatially and temporally. Because rockfishes are long-lived and slow to mature (except for the Puget Sound rockfish) rockfish populations can be sustained by occasional banner years of recruitment separated by several years of low recruitment. Consequently, recruitment in itself is not necessarily a good indicator of the status of rockfish populations. The indicator "sufficient young of the year to fill available habitat in randomly sampled reefs" does not make sense. Habitat limitation of rockfish recruitment cannot be assumed. It would be better to use some sort of relative estimate of the density of recruits. If empirical data are to be collected, then using 30-m long transects, surveying a corridor of 2 meters wide x 2 meters high should be sufficient to count young-of-year rockfishes. As for the indicator ratings, some arbitrary densities could be used such as < 2 recruits per transect = poor, 2-5 = fair, 5-15 fish = good, and > 15 fish = very good. These numbers are not strictly defined, but they can allow you to detect 3- to 7-fold differences in recruitment among years. Current status is unknown, but I would judge the current rating to be fair to poor given what I have observed in the past.

(5) *Rockfish species richness*. This key attribute might be defined better by species diversity than by richness. Species richness only provides that a species is present, whereas diversity considers both the presence of a species and its relative abundance to other target species. In the case of diversity, the number of fish along transects at sampled sites would be used in addition to the number of species. I think it is unlikely that a particular species would be extirpated from the system, but low abundance relative to other species would result in lower species diversity. I don't know why the current indicators of 1 standard deviation below historic is used. Are their historic data that show the number of species and their relative abundances? This could be the benchmark by which the indicator rating categories are established. My guess is that species richness as a current condition would be good to very good because these species are found on reefs even if in low abundance.

(6) Population abundance of rockfish, lingcod, and greenling. Again, I would use the indicator ratings I've mentioned for other attributes. Using population size as estimated from harvest records as the indicator is okay in the absence of other data, but some estimate of catch-per-unit-effort (CPUE) such as catch divided by number of days fishing or other measure would standardize population size when fishing effort varies among years and could provide a better estimate. I agree that the current status of these populations is poor.

Stress-source analysis

Stresses

In looking at the seven stresses (altered key ecological attributes), #4 (direct mortality of larval rockfish, lingcod, and greenling) and #7 (direct mortality of pre-settlement juvenile rockfish, lingcod, and greenling) appear to differ only in that #4 are larvae and #5 are pelagic juveniles that have not taken up a benthic existence. This is different from settlement per se, which is the transition of competent larvae to a benthic existence. You might rename #7 direct mortality of pelagic juvenile rockfish, etc.

Does low reproductive success (#2) mean that individual rockfish fecundity will decline because of their smaller size or other factors or is it that because the populations are in low abundance there should be low reproductive success of the population? In either case, the severity could be considered to be high. I assume that #1 (direct mortality of post-settlement…) has a severity of medium because of current restrictions on fishing? Or is this direct mortality by predators?

Unless there is specific information that species have been extirpated, I don't agree that low rockfish species richness has a severity of high or the scope is very high. I think this would be low to medium.

Stresses #1 and #4 are listed as severity 'high' but #7 as severity 'low'. What is the reasoning here? Is it that predators are more abundant in rocky habitat than in pelagic zones?

Sources of stress (threats)
It is difficult to assess some of these sources of stress due to lack of detailed information. The number of sources (12) plus 3 others mentioned appear to encompass most if not all of the relevant threats. I would agree with many of the estimates (guesstimates) of threat ranks. However, I am not sure why harvesting of rockfish, etc. has a 'high' rank for irreversibility with regard to low reproductive success and low rockfish species richness. I would rank these as medium for irreversibility. Same comment for marine mammals, but perhaps there are more data available that irreversibility is very high? Or is it that nothing can be done to reduce mammal populations?

Seabirds

Reviewer: Kolleen Irvine

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Key Ecological Attribute: Nesting Success
Indicator: Oystercatches/ number of hatchlings/nesting pairs
Oystercatchers are a good choice for an indicator. Since there are no data on hatchlings or nesting pairs and this information is difficult to obtain, suggested using breeding territory as an attribute:

- Focus on occupancy of known breeding territories
- 1 to 2 birds comprise a viable breeding territory
- Indicator ratings could measure number of breeding territories occupied by birds during breeding season (i.e. poor: <20/65 territories occupied over 2 – 4 years)

Glaucous winged gulls may be a better way to measure nesting success of a colonial species. Nesting success for the gulls is being monitored on Protection Island and could be used as a model.

Key Ecological Attribute: Population size of a selected species
Indicator: Golden-eye winter population size
Concerned over current rating in the MSA plan: if a species is in slow decline, rating it as "good" according to the indicator status, means that we want to maintain the slow decline. The US Fish & Wildlife Seabird Conservation Plan suggests that even annual declines in populations can have long-term consequences since 25 years of slow decline can have devastating affects on a population.

Stress-Source Ranking

Threat: Human disturbance on water
Increased metabolic demands and failure to feed effectively resulting from human disturbance on water should be ranked as medium irreversible threats to seabirds.

Threat: Fishing/harvesting activities
Gill nets may be a major factor in declines of rhinoceros auklet at Protection Island National Wildlife Reserve. Gill nets may be a factor in mortality of murres, pigeon guillemots, marbled murrelets as well. Suggested change to "medium" threat contributing to nesting failure.

Fishing and harvesting activities identified as medium in terms of contributions and irreversibility of threat to direct juvenile and adult mortality. Suggest change from "low" threat rank.

Threat: Human disturbance on shore (walking, landing boats)
Sources of Stress--Nesting failure/Increased stress/Increased metabolic demand

Human disturbance on shorelines with nesting birds can result in increased predation, exposure of eggs or chicks to elements and even total abandonment of nests. This threat to nesting failure is not "easily reversible at relatively low cost" but will take aggressive education and enforcement. Suggest change to medium irreversibility for nesting failure, increased stress and increased metabolic demand.

Threat to system rank should be changed to critical because it has both short and long term consequences for bird populations through alterations in feeding, resting, and breeding behaviors.

Pacific Salmon

Reviewers: Kurt Fresh ,Si Simenstad

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General Comments

Conservation target for Pacific Salmon is too generic due to differences between species, prey, life-cycle, migration strategies, etc. Should include the rationale for ratings. Constructing indicator ratings that are defensible is a challenge. Did not see how to use data on stresses.

Site information should be defined explicitly to enable understanding of scale. Create better linkages (logic trees) using the four habitat functions listed above.
Choose indicators that can be measured and for which there are data.
Does not know why kelp habitat was chosen as an indicator for salmon.
Rephrase "juvenile habitat abundance" as it is a confusing term
Use indicators and attributes that are sensitive to long term changes in order to obtain trend analyses.
Improve match of attributes in the viability tables with the Stresses-Altered Key Ecological Attributes. (two reviewers suggested this)

Reword attributes to be neutral (i.e. Quality of Habitat instead of Reduced Juvenile Habitat). This would help line up concepts in the stress tables.

Uncertain about the usefulness of the attribute/indicator for the abundance of returning adults. Not sure that overall abundance of fish passing through the San Juan Islands is very useful.

Viability Analysis

The reviewer modified the elements in the framework for salmon categorized by the contributions of marine habitats to salmon population viability:

1) Food and place for high growth rates
2) Refuge from predators
3) Area for physiological transition
4) migration corridor

Additional comments were made directly to tables from the workbook. See these comments on page 61.

Stress-Altered Key Ecological Attributes and Threat Tables

Concerns/questions

Roll up for stress ranks were inconsistent and hard to understand in places. Could not understand weighting, relative importance between factors. Scale of sites was not clear (i.e. a single pier or all piers in San Juan County). Did not understand the terms "insufficient brackish water" and "non-local sources of salmon decline". Why was marine mammal predation treated as a threat and not as a factor affecting viability?

Recommendations
Include rationale (logic tree) for ratings with clear decision rules.
Manage expert opinion with a logically derived decision structure/rules not paragraphs for each decision.
Revise nomenclature—stress and threat appear to refer to two different things but are used interchangeably in places.
Reconsider including non-local sources of salmon decline if it is outside the geographic scope.

Pacific Salmon

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Concerns/questions
Rationale for choice of stressors. Some choices not fully grounded in literature—particularly regarding juvenile salmon migration in the Marine Stewardship Area. Should attributes and stressors be listed in order of significance?
Unclear how the water column will be considered in the assessment (e.g. how to associate a water column organism such as crab larvae to a particular marine resource, such as rocky subtidal habitat.)

General comments:
Rationale for choice of stressors is needed.
Include acknowledgement of limitations of data and logic used for decision/rankings.
Confine comments to scientific validity and in particular, to whether inferences are based primarily on published scientific literature or secondarily on rigorous logic.
Include evaluation of uncertainty in the data and assumptions behind the assessment.
Direct impacts are considered to be more important than secondary or tertiary impacts (e.g. direct effects on fish are more important and certain than indirect effects on prey)

Some noteworthy stressors are missing, (i.e. loss of riparian vegetation, aquaculture, hatchery fish, septic systems, and wastewater discharges and small chronic fuel. and oil spills while some of less significance remain.

Conservation Targets
Difficult to assess the viability of Pacific salmon without considering species and life history stages—vulnerability to stresses varies extensively among species and stages of life history.

There is no scope for assessing positive changes or reversals (e.g. effect of climate change on brackish water habitat.

Key Attributes
Most of the prey of juvenile salmon are predominately pelagic organisms, especially when fish are >50 mmFL; terrestrial organisms such as insects may be important for juvenile Chinook. Because the distribution and abundance of pelagic organisms are exceedingly patchy and variable, their utility as a quantitative indicator is suspect. A few shoreline associated prey, such as gammarid amphipods would provide a more quantitative viability indicator.

The availability of brackish habitat as rearing habitat needs clarifying. Although juvenile salmon may be attracted to freshwater at stream mouths, the rearing habitat required by juvenile salmon for physiological adaptation should have occurred in the estuary of their natal system. The only exception might be the area near the Fraser River plume where salmon may still be following brackish water into the marine stewardship area.

The importance of kelp mats may be questionable for juvenile salmon.

Since abundance of juvenile salmon is driven predominantly by forces outside the marine stewardship area, their selection as an important attribute of the health of the marine ecosystem should be assessed.

Indicators
Indirect associations of salmon prey production, such as forage fish larvae that can be linked to shoreline integrity and productivity for spawning habitat is an appropriate indicator.

Most of the prey of juvenile salmon are predominately pelagic organisms, especially when fish are >50 mmFL; terrestrial organisms such as insects may be important for juvenile Chinook. Because the distribution and abundance of pelagic organisms are exceedingly patchy and variable, their utility as a quantitative indicator is suspect. A few shoreline associated prey, such as gammarid amphipods would provide a more quantitative viability indicator.

The Department of Ecology Northern Puget Sound Baseline Study and NOAA MESA studies do not substantiate that *Zostera marina* is a major habitat of juvenile salmon in the marine stewardship area.

Are kelps mats important to juvenile salmon and if so, does kelp coverage in the marine stewardship area directly correlate to the availability of floating kelp mats in the region?

Stress and Threats Analysis
Difficult to understand the consistently "low" rank for direct mortality of juvenile salmon when direct mortality of resident adults is "high" and reduced juvenile habitat is "medium". Given both the vulnerability and sensitivity of juvenile salmon, this ranking appears reversed from what one would expect.

Sources of Stress Analysis
Nutrient discharge and eutrophication should be identified as a source of stress.

Question why shoreline modification is rated "high" in terms of irreversibility. Docks and shoreline armoring are both removable and degrade.

Shoreline fill does not appear in the stress analysis.

Threat rank for large oil spills is too low for juvenile prey abundance and lacks any rank at all for direct mortality.

There is no scientific basis that the reviewer is aware of, that would substantiate juvenile salmon preference for native submerged aquatic vegetation to *Sargassum* or that *Sargassum* harbors fewer prey.

Climate change may contribute freshwater to brackish water habitat in the region. How does "medium" impact fit this prediction?

Polluted stormwater runoff is a stressor on resident salmon and returning adults.

Question a "medium" ranking for local freshwater diversions and withdrawals for their significance of physiological adaptation in juvenile salmon.

Marine Mammals

Reviewers: Robin Baird, Brad Hanson, Glen R. VanBlaricom

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Viability Analysis

It is less important to consider absolute abundance of salmon as a food source for marine mammals than it is to consider the diversity of runs in terms of their spatial and temporal timing to provide year-round availability of prey.

There is a discrepancy between the indicator (population size) and ratings (declining, stable, increasing numbers in transects) for the population size and structure of harbor porpoises.

An indicator of good notes “stable numbers in areas of high vessel traffic transects” for harbor porpoises, however this implies that current numbers are what they should be rather than reflecting a historical reduction in population size. While populations have increased in the last ten years, it is not known whether they are back to historical status.

Why do the numbers used as indicator ratings for harbor seals include a range, with anything above the range considered bad? How is the upper limits chosen? Is this based on historical numbers? Increasing numbers reflect an increase carrying capacity.

Stresses and Threats

Stresses 1 – 5 and 7 – 8 are all influenced by humans (oil spills, persistent pollutants, over harvest of prey, disturbance, bycatch, climate change, but 6—does not fit in the mix, since an increase in harbor seal population size can only occur if carrying capacity increases.

Bycatch of harbor porpoises in gill and seine nets may be a significant source of mortality, yet is ranked “low” and would become a serious issue if these fisheries were to increase.

Marine Mammals

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Viability Analysis

Recent and ongoing research indicates that Chinook salmon appear to be important prey for the southern resident killer whales.

Affects of vessel sound on killer whale communication include the possibility of longer duration calls or increased amplitude of calls.

The annual rate of population increase is a commonly used measure because it incorporates mortality.

Estimates of harbor porpoise population are only obtained infrequently—about every 5 years. The confidence intervals associated with these estimates are relatively high so the ability to detect a decline is low. A better measure might be to look at distribution because if the population declines it is reasonable to expect that animals may disappear from the more marginal habitats first and this would be easier to detect.

Indicators of southern resident killer whale populations only express size, not structure. A possible metric to capture structure would be percentages of sex and age classes.

Questions why the Altered Key Ecological Threats didn't match to the Key Attributes listed in the target viability table.

Sources of Stress
Questions whether "disease" is being used synonymously for increased mortality.

Persistent Organic Pollutants aren't just from industrial sources, consumer products are likely sources of PBDEs.

Marine Mammals

Glenn R. VanBlaricom
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School of Aquatic and Fishery Sciences

Concerns/Questions
Questions why Dall's porpoises were not considered or mentioned. They forage across a broad range of depths, have a diverse diet and are prey for transient orcas so may be important to the structure and dynamics of the mid-water food webs in the San Juan region. They are subject to the same types of stresses and threats identified for killer whales and harbor porpoises.

Questions why Steller sea lions, minke whales, gray whales, humpback whales and river otters are not considered since they are subject to a wide range of effects from human activities.

Indictor ratings
The ability to detect trends over time in marine mammals is difficult—requiring intense, expensive effort. Consider other metrics for trends in harbor porpoise populations or recognize that trends will be detectable only with a multi-year survey plan.

While data indicates high levels of persistent organic pollutants in resident and transient killer whales in the region, no clear links between contaminant levels and population dynamics/disease susceptibility exist so caution is required.

Recent research links southern resident killer whale abundance and distribution to changes in salmon populations in the inland marine waters of Washington and British Columbia.

Recent research on space use and distribution of southern resident killer whale pods should be considered in marine conservation planning for the San Juan region.

It would be useful to provide a higher level of detail on the issue of reduced prey availability and quantity as a source of stress to marine mammals.

Lack of reproductive success as a source of stress for killer whales should be replaced by a population trend metric such as population growth per year. This metric incorporates juvenile survival along with reproductive success.

Questions the rating of "low" for the increased metabolic stress caused by human disturbance on the water.

Viability Table Comments

ROCKY INTERTIDAL & ROCKY SUBTIDAL – MEGAN DETHIER COMMENTS

			Entry assistance OFF		**Bold = Current**	Indicator Ratings		*Italics = Desired*			
Conservation Target Enter # of Target		Category	Key Attribute	Indicator	Poor	Fair	Good	Very Good	Current Indicator Status	Current Rating	ADDITIONAL MEGAN COMMENTS
1	Rocky intertidal	Condition	Height and width of zones	need indicator: Fucus zone (height and width), top of Hedophyllum zone, top of Chthamalus zone	upper limits change by >6"vertical			upper limits do not change over several years	(need some measurements)	good?	
1	Rocky intertidal	Condition	Age and stage structure	need indicator: I can't think of any good candidates for this, except maybe Semibalanus cariosus? (low zone barnacle)	absence of either very small or very large individuals			Broad mix of sizes, dominated by young but including some old	(need some measurements)	good?	
1	Rocky intertidal	Landscape Context	Water column characteristics	Air and water temperature regime (need to define an indicator); it doesn't seem to me that Air temperature is a 'water quality char' - I would just stick to water temperature (measured	long-term seasonal averages show clear trends			long-term seasonal averages do not change	(need some measurements)	good?	

				seasonally)							
1	Rocky intertidal	Condition	species composition/dominance	native species richness	less than 75%; I might make this lower - in the san juans, with rocky intertidal richness being relatively low, you could get short-term drops in richness to the less than 75% mark without something really drastic having happened.	75-90% of historical richness	90-97% of historical richness	97-100% of historical richness	(need some measurements)	good?	
1	Rocky intertidal	Condition	Population size of selected species	abundance of barnacles	40% or less of historical range	40-70% of historical range	70-90% of historical range	90-100% of historical range	(need some measurements)	good?	
1	Rocky intertidal	Condition	Population size of selected species	abundance of Fucus	40% or less of historical range	40-70% of historical range	70-90% of historical range	90-100% of historical range	(need some measurements)	good?	
1	Rocky intertidal	Condition	Population size of selected species	abundance of limpets	40% or less of historical range	40-70% of historical range	70-90% of historical range	90-100% of historical range	(need some measurements)	good?	

1	Rocky intertidal	Condition	Vegetative canopy	mean % cover of kelp	40% or less of historical range	40-70% of historical range	70-90% of historical range	90-100% of historical range	(need some measurements)	good?	
2	Rocky subtidal	Landscape Context	Water column characteristics	sedimentation (need to define an indicator); something like seasonal or annual deposition - seasonal probably a better measure, would let you get a handle on causes better, if a change was found. Defining a change would again involve a number of years of 'baseline' (already shifted, probably!)					(need some measurements)	good?	this one will need a lot of baseline data in a number of areas, ie lots of sites and replicates within sites - but I agree is an important parameter.
2	Rocky subtidal	Condition	species composition/dominance	native species richness	less than 75%	75-90% of historical richness	90-97% of historical richness	97-100% of historical richness	no data	good?	
2	Rocky subtidal	Condition	Population size of selected species	sea cucumber abundance in subtidal (-5 to -10 m)	40% or less of historical range	40-70% of historical range	70-90% of historical range	90-100% of historical range		fair?	
2	Rocky subtidal	Condition	Population size of selected species	sea urchin density in subtidal (-5 to -10 m)	40% or less of historical range	40-70% of historical range	70-90% of historical range	90-100% of historical range		fair?	
2	Rocky subtidal	Condition	Vegetative canopy	% cover of Nereocystis	40% or less of historical range	40-70% of historic	70-90% of historic	90-100% of historical		very good?	

						al range	al range	range			
2	Rocky subtidal	Condition	Vegetative canopy	abundance of understory kelps	40% or less of historical range	40-70% of historical range	70-90% of historical range	90-100% of historical range		good?	
	Rocky subtidal		maybe add age structure of urchins?		absence of either very small or very large individuals			Broad mix of sizes, dominated by young but including some old			
how about additional condition indicators, for both intertidal and subtidal, of Absence of Introduced Species? Or is that whole concept taken care of under Stressors?											
Each of these looks like a major research project to me, establishing some baseline data.											

PACIFIC SALMON – KURT FRESH COMMENTS

Assessment of Target Viability for Salmon (Chinook salmon).

			Indicator Rating				Current	Current	Desired	Comments
Condition	Attribute	Indicator	Poor	Fair	Good	V. Good	Status	Rating	Rating	
Feeding and Growth	Growth Rates of Chinook < 150 mm.	Otolith Increment widths for salmon < 150 mm								Numbers could be created for this metric from existing information.
Feeding and Growth	Growth Rates of Chinook < 150 mm.	Mean change in size of juveniles <150mm	< 0.25mm/d	0.25-0.75 mm/day	0.75-0.1.25 mm/day	>1.25m m/d	??	??	Good	Current status could be measured in situ. Numbers could be developed.
Feeding and Growth	Growth Rates of Chinook < 150 mm	Spawner biomass of herring in NPS.	declining	no change	increasing	steep increase	no change	fair	Good	Data is available. The herring that affect salmon in the SJI are not just local. I think having a more comprehensive index is advisable. I would use at least the SJI, Cherry Pt., Padilla, stocks.
Feeding and Growth	Growth Rates of Resident Chinook	Spawner biomass of herring in NPS.	declining	no change	increasing	steep increase	no change	fair	Good	Data is available. The herring that affect salmon in the SJI are not just local. I think having a more comprehensive index is advisable. I would use at least the SJI, Cherry Pt., Padilla, stocks.

Feeding and Growth	Amount of invertebrate food available to Chinook < 150 mm.	Total Biomass of crab larvae, euphausiids , amphipods, copepods in June and July.	declining	no change	increasi ng	steep increase	no change	fair	Good	This and next indicator would require some literature work to establish values for but I could do it if I had more time. I picked June and July assuming Chinook would be abundant. Could use July, August.
Feeding and Growth	Type of invertebrate food available to Chinook <150 mm.	Disribution of biomass by taxa of crab larvae, euphausiids , amphipods, copepods in June and July.	Sustained (5 consecuti ve years) disappear ance of 3 taxa.	Sustaine d (5 consecut ive years) disappe arance of 2 taxa.	Sustain ed (5 consecu tive years) disappe arance of 1 taxa.	No change of taxa.	??	??	??	Historical data would be useful. Could use data from other areas like Canadian. Disappearance really means probably substantial reduction.
Physiologic al Transition	Distribution of Fraser Water in the SJI.	Salinity measureme nts.								This would be a hard index to make meaningful. The intend would be to reflect long term changes in salinity in the SJIs which refers to both amount and distribution. Perhaps there is a data record at FHL. I would use some sort of deviation from the mean to construct an indicator.
Predation	Abundance of Predators-Orcas	Number of Orca days (number of whales present multiplied by number of days they are present)	Substanti al increase	Increase	No change	Decline	??	??	Decline	NWFSC or NOAA regional office should have data. Use this to define current status.

		each year.								
Predation	Abundance of Predators- Seals and Sea Lions	Annual (or other index) counts of seals and sea lions.	Substantial increase	Increase	No change	Decline	??	??	Decline	I would use marine mammal data from sources like the PSAT, WDFW to define indicators and status.
Predation	Abundance of Predators- Birds	Index Counts of Fish Eating Birds.	Substantial increase	Increase	No change	Decline	??	??	Decline	This could be colony counts on protection island or numbers of terns nesting on Dungeness Spit. Not sure what bird data is available.
Migration Corridor	Habitat quantity present in the San Juan Islands.	Total amount of eelgrass (including both bays, beaches) present in the San Juan Islands.	25% decline from current levels	10% decline from current levels	No change	> 10% increase	10% decline	Fair	Good	I am just guessing on this but DNR has good data that could be used to establish indicator levels and current rating.
Migration Corridor	Condition of habitat present in the San Juan Islands.	Fragmentation of habitat as measured by the amount of piers, docks, groins, breakwaters per mile of shoreline.								

Migration Corridor	Condition of habitat present in the San Juan Islands.	Amount of salt marsh	25% decline from current levels	10% decline from current levels	No change	> 10% increase	10% decline	Fair	Good	
Migration Corridor	Condition of habitat present in the San Juan Islands.	Numbers of bulkheads in divergence zones.								I did not fully flesh this out or the next two I believe that various stresses can and should be used as habitat indicators.
Migration Corridor	Condition of habitat present in the San Juan Islands.	Population density, permanent and seasonal residents.								
Migration Corridor	Condition of habitat present in the San Juan Islands.	Road density within 200m of the shoreline.								
Viability (all functions combined)	Abundance of resident Chinook salmon	CPUE of resident Chinook salmon by sport fishermen in the area.	Steep decline.	Moderat e decreas e.	No change.	Increase	??	??	V Good	I assume WDFW has data that could be used.
Viability (all functions combined)	Abundance of Juvenile Chinook salmon	CPUE of juvenile Chinook salmon by beach seine and tow nets at indicator sites in area.	Steep decline.	Moderat e decreas e.	No change.	Increase	??	??	V Good	Would have to develop and implement this.

APPENDIX E. Threats Summary and Contaminants Assumptions

Table b. Threats Across Targets		Rocky intertidal	Rocky subtidal	Nearshore sand, mud & gravel communities	Rockfish, greenling and lingcod	Pacific salmon	Seabirds	Marine mammals	**Overall Threat Rank**
1	Large oil spills	Low	Low	High	Low	Medium	High	Very High	**High**
2	Climate change	Medium	Medium	High	Medium	Medium	Medium	Very High	**High**
3	Shoreline modification due to docks, shoreline armoring, boat ramps, jetties, etc.	Medium	Low	High	-	Medium	Low	High	**High**
4	Other (non-local) sources of salmon decline	-	-	-	-	High	-	High	**High**
5	Invasive species	Medium	Medium	High	Medium	Medium	-	-	**Medium**
6	Persistent organic pollutants from current industrial and historical sources (in biota and sediments)	-	-	-	Medium	Medium	Medium	High	**Medium**
7	Polluted stormwater runoff (metals, pesticides, PAHs from land sources)	Low	Low	High	Low	Medium	Low	-	**Medium**
8	Septic systems and wastewater discharge (including from vessels)	Low	Low	High	Medium	-	-	-	**Medium**
9	Predation by marine mammals	-	-	-	Medium	High	-	-	**Medium**
10	Historical harvest of rockfish, lingcod & greenling until 1999.	-	-	-	High	-	-	-	**Medium**
11	Disturbance by other wildlife	-	-	-	-	-	High	-	**Medium**
12	Fishing/harvesting activities	Low	Low	Medium	Medium	Medium	Low	Medium	**Medium**
13	Derelict fishing gear	-	Low	-	Low	Medium	Medium	Low	**Medium**
14	Small chronic fuel and oil spills	Low	Low	Medium	Medium	-	-	-	**Medium**
15	Human disturbance on shore (walking, landing boats)	Low	-	Low	-	-	Medium	-	**Low**
16	Sediment loading resulting from upland construction activities, logging, clearing and livestock (local and distant)	Low	Low	Medium	-	-	-	-	**Low**
Threat Status for Targets and Site		Medium	Medium	Very High	High	High	High	Very High	**High**

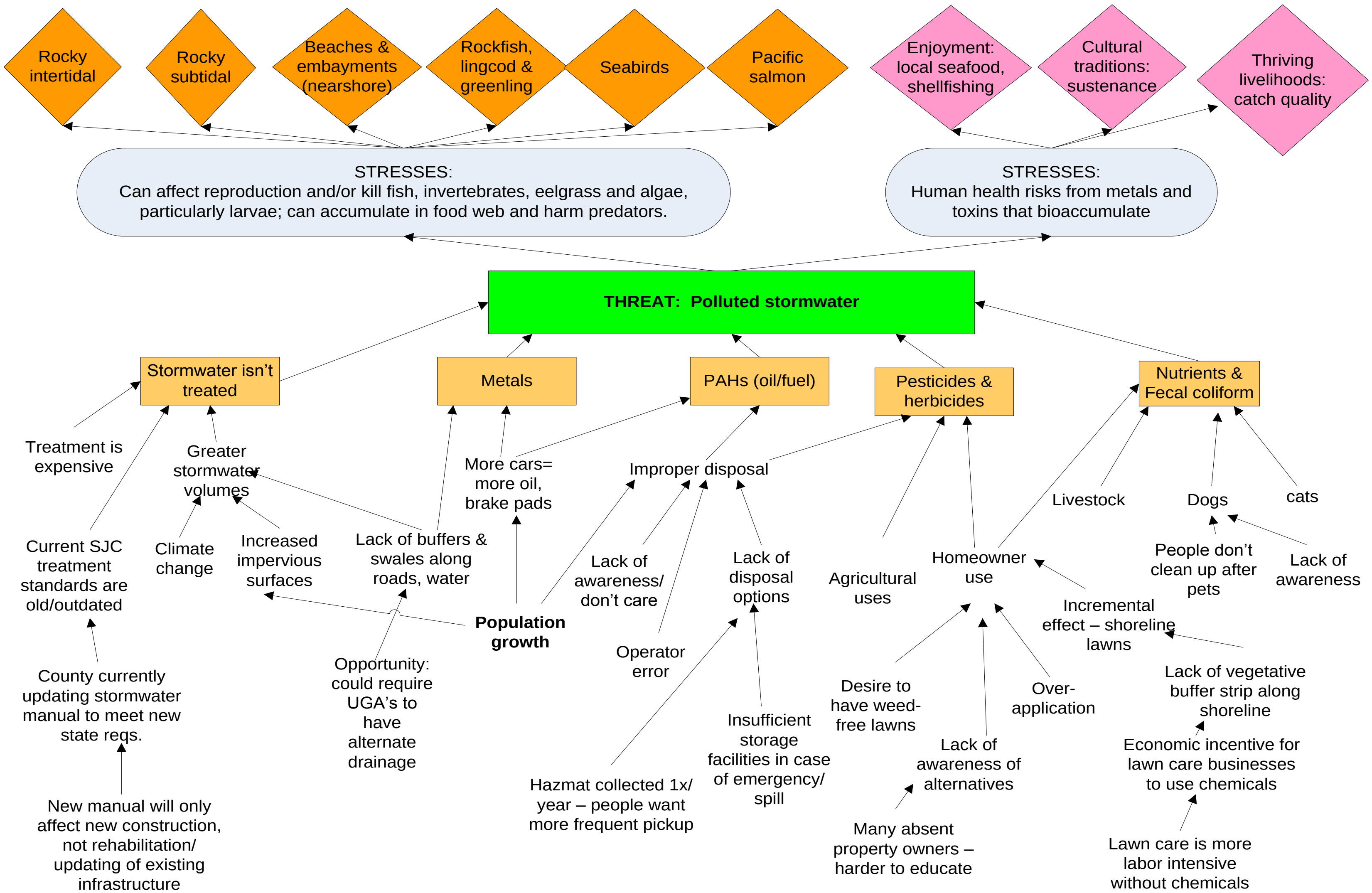
A note on contaminants:

We found it particularly difficult to address the threats posed by contaminants – compounds having adverse effects on marine organisms – using the Five-S Framework. In the Five-S Framework the stress is the impact(s) a particular contaminant has on an organism, such as disease, impaired reproduction and direct mortality, which, for many contaminants and species is not well understood. A source is defined as the human activity causing the stress, or in other words the human activities that result in a particular contaminant entering the system. Specific contaminants and the term "contaminant" in general do not fit into either category. Thus, we created the matrix shown in Table a. to document our assumptions about the likely sources of each contaminant. The detailed stress-source analyses done for each target as part of the threat assessment include the sources listed in the rows. The impact of each source on the target is based on our understanding of the most likely impacts of the contaminants listed across the top.

Table c. Assumptions made regarding the sources of contaminants affecting MSA marine resources.

	Type of Contaminant								
Source: How it enters the MSA	PCBs, DDT & POPs	PAHs	Mercury	Tributyl Tin	Other metals	Endocrine disruptors	Fire retardants	Fecal coliform	Pesticide/ herbicide
Resident in biota due to bioaccumulation	X		X						
Big oil spills		X							
Small oil spills		X							
2-stroke boat engines		X							
Hull paint				X	X				
Boat discharges (bilge, wastewater)		X				X		X	
Stormwater runoff (in MSA)		X			X			X	X
Stormwater runoff (outside MSA)		X	X?		X			X	X
Leaky septic systems							X	X	
Wastewater discharge		X?	X?				X	X	
From Puget Sound			X		X?	X?	X?		
From Georgia Basin/Frasier			X		X?	X?	X?		

APPENDIX F. Situation Assessment Diagram, Polluted Stormwater Example



Reviewed/edited by MRC on 7/19/06

Comments: Friday Harbor has a separate stormwater system (not CSO) with onsite oil/water separators. Eastsound has some type of system. Lopez – not known what kind of system. Concern raised: Fire retardants used in firefighting run into the drains/water. Do these affect and/ or bioaccumulate in fish? Are these the same kind of fire retardants used in clothing?