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Pacific Region Cold-Water Coral and Sponge Conservation Strategy

2010-2015

Canada

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EXECUTIVE SUMMARY

The Pacific Region Cold-water Coral and Sponge Conservation Strategy identifies key objectives, strategies and actions for cold-water coral and sponge conservation to guide the Department of Fisheries and Oceans Canada (DFO) managers throughout the Pacific Region. The strategy is intended to support DFO's mandate to develop and implement policies and programs in support of Canada's scientific, ecological, social and economic interests in oceans and fresh waters.

The national legislative and policy context for the strategy can be found in the *Oceans Act* and *Fisheries Act*. More specifically, the strategy aligns with existing policies such as Canada's Oceans Strategy and the *Policy for Managing the Impacts of Fishing on Sensitive Benthic Areas*.

This strategy was developed to meet several needs. These include:

- To describe the state of knowledge of cold-water corals and sponges on the Pacific Coast of Canada, including key issues related to the biology of cold-water corals and sponges;
- To discuss a variety of known impacts to cold-water corals and sponges in the Pacific Region;
- To identify conservation, management and research objectives and associated strategies and actions;
- To identify gaps in information and issues where more work is needed;
- To discuss socio-economic and conservation implications with respect to cold-water coral and sponge conservation measures; and
- To identify management tools to aid in cold-water coral and sponge conservation.

This strategy is consistent with and follows the Department's existing policies, including the Sustainable Fisheries Framework, Canada's Oceans Strategy and the Policy for the Management of Fish Habitat. Goals of the strategy will be achieved, through the application of these existing policies using the best science and information available in order to obtain long-term economically and ecologically viable sustainable use.

The goal of the strategy is to: *Conserve the health and integrity of Canada's Pacific Ocean cold-water coral and sponge species, communities and their habitats as integral components of a healthy and productive ecosystem providing for economic and ecological value and sustainable use*. The objectives and associated strategies and actions within the strategy reflect and support the Department's mission and mandate, including its work to ensure healthy and productive aquatic ecosystems, and sustainable fisheries and aquaculture on behalf of Canadians. The strategy therefore not only identifies objectives, strategies and actions for cold-water coral and sponge conservation, management and research, but also considers relevant and related socio-economic implications.

The strategy strives to meet three objectives:

> **Conservation Objective:** *To conserve the health, composition and function of cold-water coral and sponge species, communities and habitats in support of a healthy ecosystem.*
>
> **Management Objective:** *To manage human activities with impacts on cold-water coral and sponge communities efficiently and effectively in support of a healthy ecosystem and sustained economic benefits, within a risk assessment framework.*
>
> **Research Objective:** *To support decision making through the provision of scientifically based peer-reviewed advice on the health and integrity of cold-water corals and sponges and their contributions to the conservation of a healthy ecosystem.*

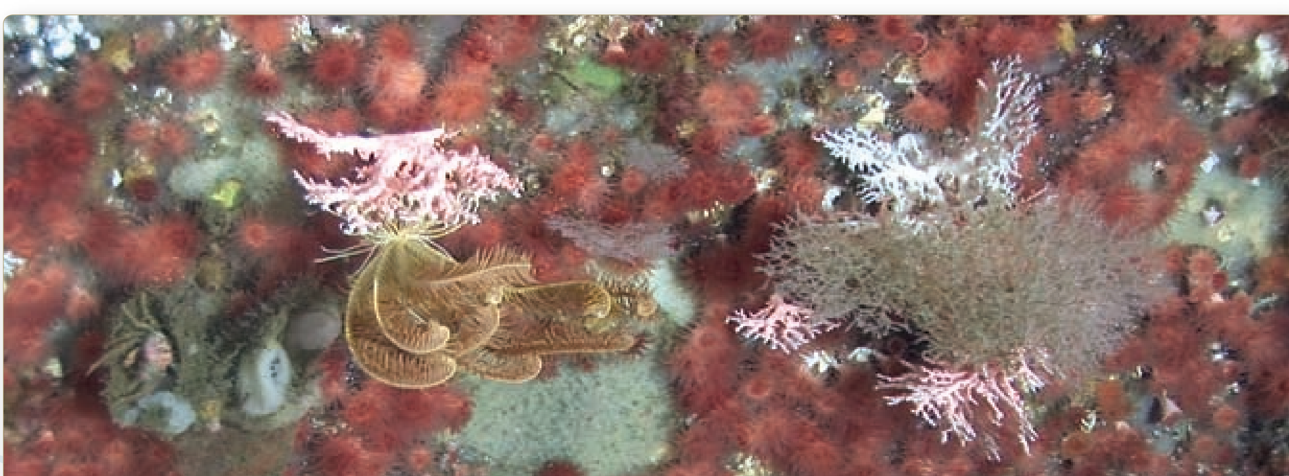
It identifies strategies for achieving these objectives, and identifies a number of actions for

conservation and management. The short-term (to initiate within two years) actions are summarized below:

- Assemble and map existing data and information to determine the extent and location of cold-water corals and sponges.
- Define the attributes of 'Important Cold-water Coral and Sponge Areas' using advice from Canadian Science Advisory Secretariat (CSAS) review and appropriate regional processes.
- Develop proxies to estimate cold-water coral and sponge distribution, abundance and/or aggregations.
- Assemble and map existing information and data on fishing and non-fishing activities in cold-water coral and sponge areas.
- Identify fishing and non-fishing activities that may cause damage to cold-water corals and sponges.
- Develop encounter protocols consistent with the DFO Sustainable Fisheries Framework policies on *New Fisheries for Forage Species* and *Managing the Impacts of Fishing on Sensitive Benthic Areas*.
- Consider long-term management measures for cold-water coral and sponge areas identified as high risk by the ERAF or Habitat Risk Management Framework.
- Within DFO, develop internal communication and integration protocols within existing processes to improve coordinated cold-water coral and sponge management and make appropriate linkages with other government agencies.
- Develop a Communications Strategy that includes using existing and new DFO communications and outreach tools and processes to increase awareness of cold-water corals and sponges.

Three short-term research actions are also identified:

- Research, develop, and implement methods to detect and assess cold-water coral and sponge species and communities (i.e. rapid assessment, predictive models, field studies, development of metrics, bathymetric, and multibeam bottom typing studies, oceanographic variable measurement and modeling, habitat characterization).
- Develop protocols and tools to standardize quality and nature of collected data (i.e. observer taxonomic guides, standard data collection, sample collection and storage, access protocols, metadata standards).
- Develop ecosystem metrics that fit into an Ecological Risk Assessment Framework of extent and nature of human impacts on cold-water coral and sponge habitats.



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1. INTRODUCTION

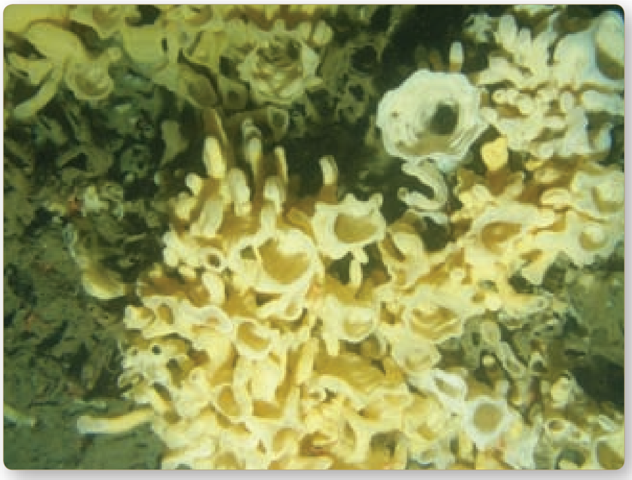
There are over 80 species of cold-water corals in BC and some 250 species of sponges (Gardner 2009) that exist on Canada's Pacific Coast. Cold-water corals and sponges can occur in both shallow coastal and deep offshore waters and provide a number of ecosystem functions that are not yet fully understood (Diaz et al. 2003). Although some research on human impacts exists (Conway et al. 2005a; Ardron and Jamieson 2006, Cook et al. 2008), the limited available knowledge of cold-water corals and sponges in Canada's Pacific waters highlights a need to further investigate the impacts of current and future human activity to cold-water coral and sponge species and habitats. This will result in increased knowledge and support better decision making, management and conservation.

Coral and sponges are central to the Convention on Biological Diversity's (CBD) commitment to the protection of marine biodiversity (Convention on Biological Diversity 2008). The need for heightened protection of cold-water corals and sponges has been recognized around the world. The Fisheries and Agriculture Organization (FAO) of the United Nations explicitly recognizes cold-water coral reefs, aggregations and individual corals as meriting vulnerable marine ecosystem (VME) status given their vulnerability to most kinds of bottom fishing (FAO 2008). The United Nations has also passed two resolutions calling for the protection of VMEs from bottom fisheries (2006, 61/105; 2009, 64/72). Fisheries and Oceans Canada (DFO) identifies cold-water corals and sponge reefs as key structural habitat that could be considered in managing impacts of fishing on sensitive benthic areas (DFO 2009a).

In Canada, Parliament has set out an agenda for sustainable development of our oceans based on a balanced approach to development and conservation of oceans resources through integrated management. Canada's legislative framework for integrated management is viewed as an international best practice, and Canada's *Oceans Act* and Oceans Strategy assign a number of responsibilities to the Minister of Fisheries and Oceans. The national legislative and policy context for the strategy can be found in the *Oceans Act* and *Fisheries Act*, as well as the Department's mandate and mission. More specifically, the strategy has been written to align with existing policies such as Canada's Oceans Strategy (2005) and the *Policy for Managing the Impacts of Fishing on Sensitive Benthic Areas*.

Within DFO, the Oceans Program is responsible for two overarching program areas of Integrated Oceans Management and Marine Conservation Tools. The Pacific Region Cold-Water Coral and Sponge Conservation Strategy has been developed to ensure that considerations around cold-water coral and sponge conservation are integrated into ongoing Oceans Program activities and programs such as marine protected areas and integrated management planning processes, in addition to program areas of other branches, agencies and interests. More broadly, the objectives and associated strategies and actions in the strategy are situated in a Departmental context that recognizes

DFO's mandate and mission to ensure safe and accessible waterways, healthy and productive aquatic ecosystems, and sustainable fisheries and aquaculture on behalf of Canadians. The strategy therefore not only identifies objectives, strategies and actions for cold-water coral and sponge



conservation, management and research, but also considers relevant and related socio-economic implications, and supports the sustainable use of Canada's marine resources.

This strategy was developed to meet several needs. These include:

- To describe the state of knowledge of cold-water corals and sponges on the Pacific Coast of Canada, including key issues related to the biology of cold-water corals and sponges;
- To discuss a variety of known impacts to cold-water corals and sponges in the Pacific Region;
- To identify conservation, management and research objectives and associated strategies and actions;
- To identify gaps in information and issues where more work is needed;
- To discuss socio-economic and conservation implications with respect to cold-water coral and sponge conservation measures; and
- To identify management tools to aid in cold-water coral and sponge conservation.

1.1 Purpose of the Strategy

The goal of the Pacific Cold-water Coral and Sponge Conservation Strategy is to: *Conserve the health and integrity of Canada's Pacific Ocean cold-water coral and sponge species, communities and their habitats as integral components of a healthy and productive ecosystem providing for economic and ecological value and sustainable use.*

This strategy has been developed to consolidate information on cold-water corals and sponges and outline the Department's approach to managing ocean-based activities that may impact these species and their key roles in healthy ecosystem function in the Pacific Region. The strategy is a living document; strategies and actions identified throughout the document may be updated as our knowledge base expands.

The strategy strives for a more comprehensive approach to coral and sponge conservation through increased coordination of management and research efforts. The strategy provides guidance to managers on how to integrate existing mandates and management methods to improve overall understanding and conservation of cold-water corals and sponges through collaboration among a variety of groups, risk assessment, mitigation and engaging and informing the public.

1.2 Rationale for Protecting Cold-Water Corals and Sponges

Cold-water corals and sponges are defined as both fish and habitat under the federal *Fisheries Act* (DOJ 1985a). Many cold-water corals and sponges provide structural habitats for a number of other fish and invertebrate species that are of economic and social importance to Canadians. For example, live glass sponge reefs have been shown to be important nursery habitat for juvenile rockfish, and high-complexity reefs are associated

with higher species richness and abundance (Cook 2005; Marliave et al. 2009).

Cold-water corals and sponges tend to be long-lived, sensitive to physical disturbances and subject to a variety of stressors in the Northeast Pacific, which makes their conservation a concern. Given these characteristics, the presence of long-lived corals or sponges in an area may indicate that the area has both a high degree of naturalness and a low degree of resilience, as defined by the Canadian Science Advisory Secretariat (CSAS 2004). Cold-water corals serve as important recorders of past oceanographic and climatic conditions, increasing our understanding of changes in the ocean environment and the effects of climate change (Smith et al. 1997).

To date, international conservation efforts have largely concentrated on tropical corals and much less attention has been paid to cold-water corals and sponges, although this is starting to change (Brock et al. 2009). Like tropical species, cold-water corals and sponges can be impacted by human activities such as fishing, mineral resource extraction, energy exploration, cable and pipeline placement, log dumps and sorts, net pen aquaculture, ocean dumping, and pollutions such as untreated effluents and acid rain (Jamieson et al. 2007a). In addition to direct threats, the relatively slow growth rate, long lifespan, physical fragility, and late age of sexual maturity of some corals and sponges make them particularly sensitive or vulnerable to indirect human and/or natural threats such as climate change, ocean acidification, pollution, disease and aquatic invasive species. Thus, there is a need for appropriate protection and conservation of these animals and their associated communities in order to preserve our natural heritage, protect biodiversity and maintain key ecosystem dynamics.

Cold-water sponges in British Columbia have reported growth rates of less than one centimeter per year up to a few centimeters per year (Leys and Lauzon 1998). Cold-water corals and sponges can live for decades and in some cases over two thousand years (Andrews et al. 2002, Leys and Lauzon 1998, Krautter et al. 2001).

In 1988, four large Hexactinellid (glass) sponge reefs were discovered in Hecate Strait / Queen Charlotte Sound (Conway et al. 1991). The four

reefs are the largest known of their kind anywhere in the world to date, with individual reefs measuring up to 35 km long, 15 km wide, and 25 m tall. The Hecate Strait / Queen Charlotte Sound glass sponge reefs have existed in iceberg-furrowed troughs for an estimated 9000 years. When discovered, the reefs were the only known 'living fossil', or modern analogue of ancient sponge reefs that lived during the Jurassic era (Conway et al. 2001, Krautter et al. 2001, Krautter et al. 2006). Subsequent discoveries of smaller glass sponge reefs in the Strait of Georgia and northern fjords indicate that the waters of BC are particularly suitable for glass sponge reefs, and recent exploration has also identified smaller glass sponge reefs in Washington and Alaska.

1.3 Scope

This strategy applies to all cold-water corals and sponges and their entire supporting habitat within federal jurisdiction located in the northeast Pacific Ocean off the west coast of British Columbia, Canada. It prioritizes measures and actions for cold-water coral and sponge conservation based on existing information on the biology, distribution and abundance of these animals, and other factors such as the known impacts and developing threats. However, given the relative paucity of BC-specific information and knowledge, the strategy will necessarily be informed by work done in other jurisdictions.

DFO cannot hope to accomplish its goals alone, as conservation of cold-water corals and sponges in the Pacific Region is the responsibility of a number of regulators (see Appendix C) and the marine user community at large.

The strategy must also be considered in the context of ongoing integrated management efforts on the Pacific North Coast and West Coast of Vancouver Island. In practice, this means integrating regional data, monitoring efforts, information sharing, communication and education on cold-water corals and sponges. It means considering cold-water corals and sponges as integrated management planning processes develop, and ensuring flexibility and adaptive management when dealing with uncertainty. Finally, it means ensuring consistency with and applying departmental policies, management strategies, and tools in managing activities that may impact corals and sponges in the Pacific Region.

1.3.1 Species & ecosystem function

The strategy considers the importance of and the need for conservation of cold-water coral and sponge species, aggregations or areas that provide habitat or help deliver and maintain ecosystem functions. It focuses on protecting the ecosystem functions that cold-water coral and sponges provide in terms of habitat, as well as protecting the diversity of species of cold-water corals and sponges.

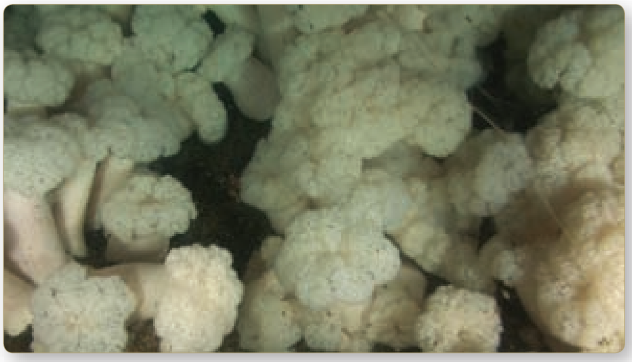
1.3.2 Out of scope of this document

The strategy will identify objectives, strategies and actions related to DFO's conservation and sustainable fisheries mandate. In cases where activities potentially affecting cold-water coral and sponge conservation are outside DFO's mandate, statutory authorities retain their decision-making authority, regardless of their involvement in the development of this strategy.

This document has been produced to guide the Department in its cold-water coral and sponge conservation efforts, and therefore does not identify strategies and actions for other federal agencies, provincial ministries, First Nations or stakeholder groups.

This is not a management document, as the Department currently utilizes specialized management processes to manage Canada's fishery and marine resources (e.g. Integrated Fisheries Management Plans (IFMPs), Habitat Assessments, *Oceans Act* MPA designation processes, integrated management planning, etc.). These processes are used to develop management plans which are developed based on input from DFO managers and scientists, First Nations, stakeholders, and public consultations. For these reasons, the strategy does not provide:

- A quantitative accounting of the costs and benefits of cold-water coral and sponge conservation to the people of Canada;



- A statement on the amount (percentage or quantity) of cold-water coral and sponge habitats that need to be protected;
- An inventory of management plans for protection of all sensitive benthic habitats in BC; or
- A comprehensive plan showing all areas within the strategy's geographic scope of where protection measures will be put in place.

1.4 Principles

The strategy is guided by a balanced set of principles consistent with Canada's *Oceans Act* (DOJ 1996) and Canada's Oceans Strategy (DFO 2002). These are ecosystem-based management, precautionary approach, integrated management, and sustainable development.

1.4.1 Ecosystem-based management

Ecosystem-based management is an integrated approach to management that considers the entire ecosystem, including humans. The goal of ecosystem-based management is to maintain an ecosystem in a healthy, productive and resilient condition so that it can provide the services humans want and need. Ecosystem-based management differs from current approaches that usually focus on a single species, sector, activity or concern; it considers the cumulative impacts of different sectors (COMPASS, 2005). Specifically, ecosystem-based management:

- Emphasizes the protection of ecosystem structure, functions, and key processes;

- Is place or location-based in that it focuses on a specific geographic – and volumetrically bounded ecosystem plus the range of activities affecting it;
- Explicitly accounts for the interconnectedness within systems, recognizing the importance of interactions between many target species or key services and other non-target species and their services;

- Acknowledges interconnectedness among systems, such as between air, land and sea; and;
- Integrates ecological, social, economic, and institutional perspectives, recognizing their strong interdependences.

1.4.2 Precautionary approach

Canada is committed to the application of the precautionary approach to the conservation, management and exploitation of marine resources in order to mitigate risk to both the biological viability of the resource and the socio-economics of stakeholders using that resource.

The precautionary approach is a key and balanced component of an effective risk management strategy, particularly when supported by the principles of Ecosystem-Based Management, Integrated Management and Sustainable Development. It recognizes that if there is both high scientific uncertainty and a risk of serious or irreversible harm, a lack of adequate scientific information will not be used as a reason for failing to take, or for postponing, cost-effective measures for the conservation or protection of fish or fish habitat that are considered proportional to the likely severity of the risk (EC 1999, DFO 2009a).

The precautionary approach is particularly relevant to protecting long-lived, slow-growing organisms such as cold-water corals and sponges, given that relatively minor action may cause serious or irreversible harm to the species. Considering the knowledge gaps that exist for cold-water corals and sponges, the precautionary approach requires that action be taken to mitigate risk to these organisms until their stock status and role in the ecosystem is better understood. Invoking the precautionary approach through marine protected areas is considered an accepted and pragmatic response (NRC 2001). While some interim protective measures such as fisheries closures have been implemented for sponges in the coastal waters of BC, there are currently no protective measures in place expressly to protect cold-water corals. However, there are other areas that have been set aside for various reasons (i.e. Rockfish Conservation Areas and Marine Protected Areas) that may benefit cold-water corals and sponges.

1.4.3 Integrated management

Canada promotes the integrated management of oceans and marine resources, a collaborative process that enables inclusive, multi-stakeholder dialogue and input to the planning and management of all ocean activities while seeking balanced consideration of biological, social and economic objectives.

Implementation of the strategy will require an open integrated approach to management that considers all users' needs and priorities, area-specific threats and their cumulative effects, local and traditional knowledge, and the need for strengthening the foundation of science and management in each area. Effective management and conservation should not take a one-size fits all approach, but should be based on the needs of ecosystems, communities and users.

1.4.4 Sustainable development

DFO places a high priority on sustainable development to ensure environmental, social, economic and cultural values are taken into account when making management decisions. The Department aims to meet the needs of the present without compromising the ability of future generations to meet their needs. In practice, this means management decisions must consider the best science and information available, socio-economic implications, and local and traditional knowledge. Management regimes should be updated or modified as new information becomes available and the effectiveness and impacts of management decisions should be evaluated regularly in order to achieve long term sustainability.

The Department is committed to managing the impacts of fishing activities on sensitive benthic areas and aims to mitigate those impacts for areas identified as particularly sensitive. The *Policy for Managing the Impacts of Fishing on Sensitive Benthic Areas* within the Sustainable Fisheries Framework (SFF) will provide for an Ecological Risk Analysis framework to determine the likelihood of risk of serious or irreversible harm that fishing activity may have on ecologically and biologically significant benthic areas. The framework will be used to help determine appropriate management actions (DFO 2009a, DFO 2009b). The strategy is consistent with the objectives of DFO's Sustainable Fisheries Framework (DFO 2009b), and recognizes that not all cold-water coral and sponge species and benthic areas require equal levels of protection. Cold-water coral and sponge species and areas will be assessed based on their sensitivity and threats in order to evaluate the level of risk associated with the potential impacts and determine whether mitigation measures may be required. Risk assessments will be consistent with risk management frameworks (i.e. Habitat Management), and the emerging Sustainable Fisheries Framework's Ecological Risk Analysis Framework (ERAF).

1.5 Mandate and Policy Context

1.5.1 International commitments

Canada is signatory to a number of international agreements identified below that include obligations for management activities regulating

ocean use. The following instruments make specific reference to protecting ecosystem features:

- **United Nations Convention on Biological Diversity (1992)**
  The United Nations Convention on Biological Diversity (CBD) is an international framework whose objectives are the conservation of biodiversity, the sustainable use of its components, and the fair and equitable sharing of benefits arising out of the use of genetic resources. The CBD's 1995 Jakarta Mandate identified marine and coastal diversity as a specific priority (CBD 1997).
- **World Summit on Sustainable Development (Johannesburg Summit) (2002)**
  At this summit, nations agreed to "maintain the productivity and biodiversity of important

and vulnerable marine and coastal areas…" which included a commitment to establish representative networks of marine protected areas by 2012 (WSSD 2002).

- **UN Resolutions on Sustainable Fisheries (2006 & 2009)**
  Through these resolutions, the General Assembly of the UN agreed "In respect of areas where vulnerable marine ecosystems, including seamounts, hydrothermal vents and cold-water corals, are known to occur or are likely to occur based on the best available scientific information, to close such areas to bottom fishing and ensure that such activities do not proceed unless conservation and management measures have been established to prevent significant adverse impacts on vulnerable marine ecosystems" (UN 2006, UN 2009).
- **FAO Technical Consultation on the International Guidelines for the Management of Deep-sea Fisheries in the High Seas (2008)**
  The scope and principles of this document highlight the need to protect Vulnerable Marine Ecosystems (VMEs). Areas that should be considered VMEs include areas that support "ecological processes that are highly dependent upon complex physical structures created by biotic features (e.g. corals, sponges, bryozoans)…" (FAO 2008).

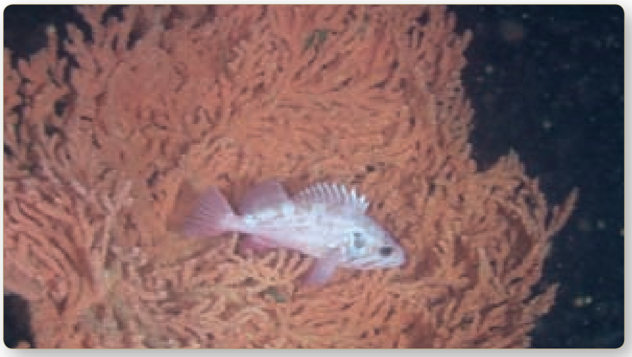
1.5.2 National context

Under the *Constitution Act* (1982), the federal government has legislative responsibility for Canada's fisheries. DFO's mandate under the *Fisheries Act* (DOJ 1985a) is for the conservation and sustainable use of fish and fish habitat and the protection of fish and fish habitat from disruptive and destructive activities. Canada's *Oceans Act* (DOJ 1996) identifies DFO as the coordinating federal agency for oceans management. In developing and implementing an oceans management strategy, the *Oceans Act* directs DFO to be guided by sustainable development, integrated management and the precautionary approach.

Other legislation relevant to cold-water coral and sponge conservation and management on the Pacific coast includes the *Canada National Marine Conservation Areas Act* (DOJ 2002b), which provides for the establishment of National Marine Conservation Areas (NMCAs) to protect and conserve representative marine areas, and the *Species at Risk Act* (DOJ 2002a), which provides for legal protection and recovery of species at risk in Canada, including aquatic species.

Canada's *Oceans Strategy* (DFO 2002) defines the vision, principles and policy objectives for oceans management in Canada and provides the policy framework for implementing the *Oceans Act*. Particularly relevant to cold-water coral and sponges is the Oceans Strategy's "Understanding and Protecting the Marine Environment" objective, which underlines the importance of protecting unique, sensitive and ecologically significant areas of the marine environment that require special protection and remediation.

The Eastern Scotian Shelf Integrated Management (ESSIM) Planning Office of DFO has produced a *Coral Conservation Plan* for the Maritimes Region (DFO 2006) that identifies objectives and

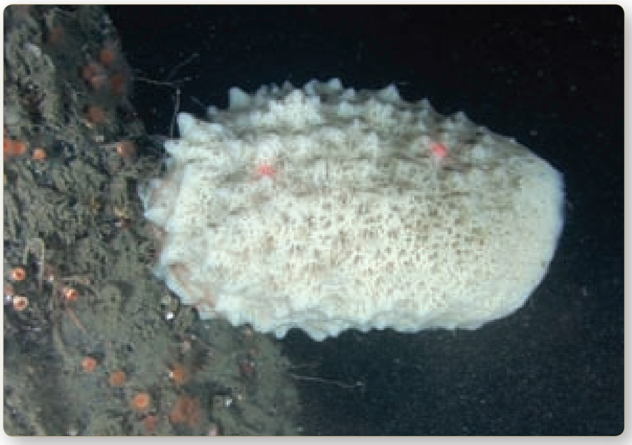


priority actions for conservation, management and research of coral conservation areas. The plan also puts forth a site evaluation process for considering appropriate management measures for areas with corals.

DFO's Sustainable Fisheries Framework (2009b) is a suite of existing, evolving and new policies that form the basis for decision-making in Canadian fisheries. Its primary goal is to ensure that Canada's fisheries are environmentally sustainable, while supporting economic prosperity. This means maintaining a balance between healthy fish stocks and marine environments while allowing for economically viable fisheries.

Additional guidance for establishing marine protected areas, protecting sensitive marine areas and applying the precautionary approach is provided by a number of federal policies:

- DFO's *Policy for the Management of Fish Habitat* (1986) supports the goals of the World Commission on Environment and Development. The policy objective is net gain of fish habitat, achieved through the goals of 1) conservation of fish habitat, guided by the principle of no net loss of the productive capacity of habitats; 2) fish habitat restoration; and 3) fish habitat development. DFO recognizes the potential impact of fish habitat decisions on regional development, industrial development, other resource sectors, and public projects. The Department will consider the interests of other resource users and will strive under this policy to take reasonable, timely and consistent decisions to maintain and improve the productive capacity of fish habitats.
- Canada's *Framework for the Application of Precaution in Science-Based Decision Making about Risk* (2003) was designed to strengthen and support federal decision-making based on the precautionary approach, and sets out guiding principles for the application of the precautionary approach and developing precautionary measures.
- DFO's *Policy for Managing the Impacts of Fishing on Sensitive Benthic Areas* (DFO 2009a) explicitly recognizes the ecological and biological value of benthic ecosystems and aims to guide DFO in managing fisheries to mitigate impacts of fishing on sensitive benthic areas or avoid impacts of fishing that are likely to cause serious or irreversible harm to sensitive marine habitat, communities and species.
- *Canada's Federal Marine Protected Areas Strategy (2005)* was developed to clarify the roles and responsibilities of the three federal authorities (Fisheries and Oceans Canada, the Parks Canada Agency and Environment Canada) with separate but related MPA mandates The Strategy describes how federal MPA programs can collectively contribute to a network of MPAs.
- *Framework for Canada's National Network of Marine Protected Areas* (in draft) sets out how a network of MPAs will be designed to meet Canada's domestic and international commitments to establish a national network of marine protected areas by 2012. It presents a federal-provincial-territorial approach to network design, building on international guidance, the experience of other countries, and on the scientific, traditional and community knowledge of Canadians. The Framework will be finalized following input and advice received through national and regional engagement processes in 2010-2011.



1.5.3 Regional context

- **Fisheries and Oceans Canada/Province of BC Oceans MoU (2004):** The governments of Canada and British Columbia have signed the *Memorandum of Understanding respecting the implementation of Canada's Oceans Strategy on the Pacific Coast of Canada, September 18, 2004*. Under the Canada-BC MoU an Oceans Coordinating Committee (OCC) was established, and several working groups such as the MPA Implementation Team (MPAIT) were initiated. MPAIT provides recommendations to the OCC on the establishment of a network of Marine Protected Areas (MPAs) on the Pacific Coast.

- **British Columbia:** DFO, the Groundfish Trawl Advisory Committee and the Canadian Groundfish Research and Conservation Society have worked together to prohibit commercial and research groundfish trawl activity within the Hecate Strait glass sponge reefs since 2002. In 2006 the original closure boundaries were increased and the closure expanded to include shrimp trawl fishing activity providing greater protection for the reefs from possible bottom trawl interaction. Protection measures for other purposes including DFO fishery closures, Rockfish Conservation Areas and MPA designation for the Bowie Seamount, as well as marine protection measures developed by other Federal agencies and the Province of British Columbia, can provide protection of cold-water coral and sponge communities on the Pacific Coast.

1.5.4 Geographic context

- **United States of America, west coast**: In 2000, the National Marine Fisheries Service approved a plan prohibiting bottom trawling in over 42% of the Exclusive Economic Zone (EEZ) in Washington, Oregon and California, including areas that may contain coral and sponge habitats (Lumsden et al., 2007). In addition, selected areas of known deep coral such as the Davidson Seamount are protected from all bottom-contacting fishing gear (Lumsden et al., 2007). In the Aleutian Islands and the Gulf of Alaska over 50% of previously trawled areas have been closed to bottom trawling, and areas of sensitive coral habitat have been closed to all bottom-contacting gear (Lumsden et al., 2007). Areas that have not been trawled extensively have also been closed, "freezing the footprint" of bottom trawl activity on the west coast of the United States. The Aleutian Islands Habitat Conservation Area is the largest bottom trawl closure in the United States, and the first in Alaska directed at protecting sensitive deep coral habitat. Areas that have been identified as Essential Fish Habitat, Habitat Areas of Particular Concern (HAPC), or areas known to support abundant and diverse deep coral are primary priority for mapping, research, reductions in fishery effort, procedures for adaptation to new information, and development of protected areas. Habitat Areas of Particular Concern are also used to focus conservation efforts related to non-fishery activities through the existing Essential Fish Habitat consultation process (Lumsden et al., 2007). In January 2009, the South Atlantic Fishery Management Council designated 8 Coral HABCs to aid in protection cold-water corals vital to deep-water fish species (Brock et al. 2009).

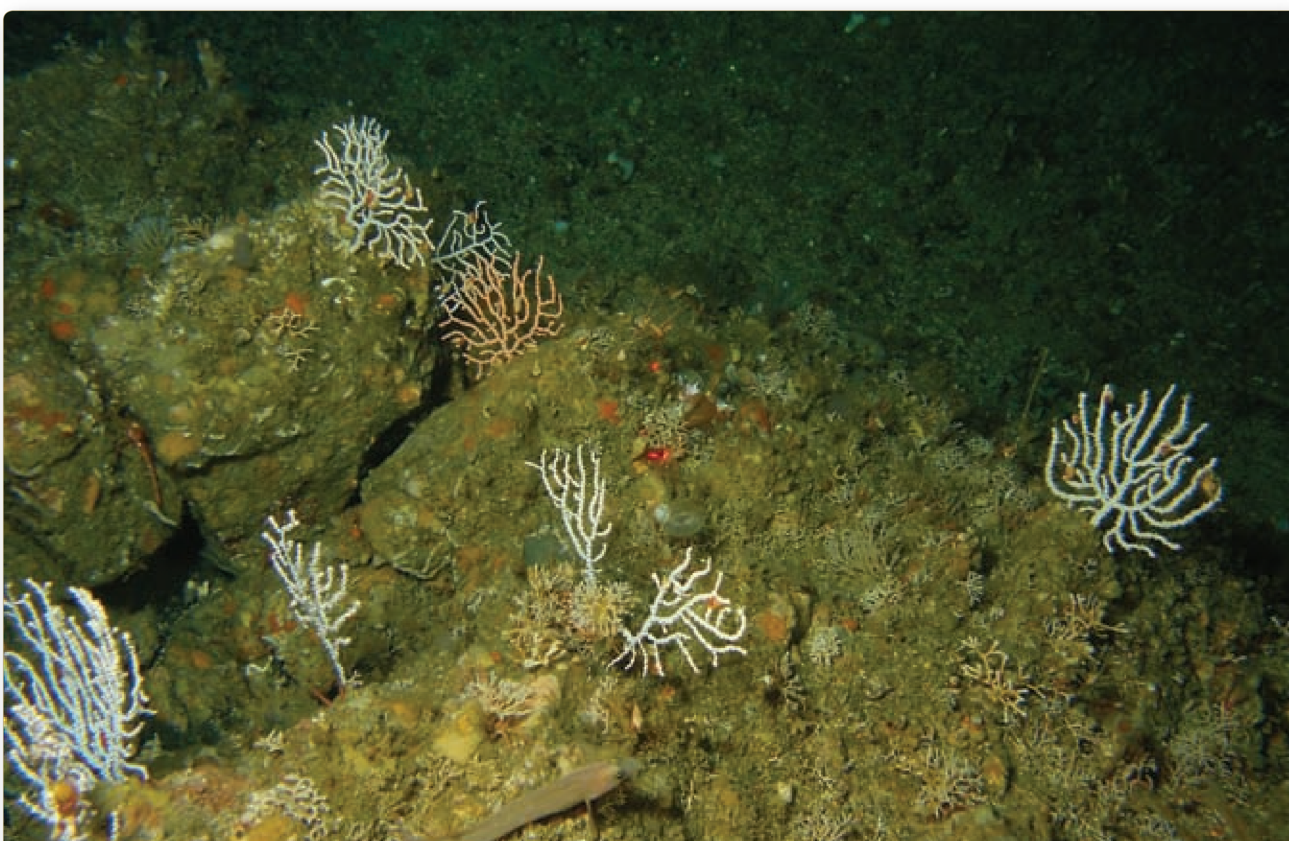
- **Canada, east coast:** In the Maritimes Region, DFO has established two Coral Conservation

Areas. In June 2002, a 424-sq. km. Coral Conservation Area was established in a portion of the Northeast Channel (parts of NAFO Divisions 5ZE and 4X), with the objective of protecting high densities of intact octocorals (*Paragoria arborea*, bubblegum coral and *Primnoa resedaeformis*, seacorn coral). In June 2004, a 15-sq. km. Lophelia Coral Conservation Area was put in place and closed a small area surrounding the entire reef to all bottom fisheries. The objective is to protect the reef complex from further damage and allow for recovery. In 2009, the Northwest Atlantic Fisheries Organization (NAFO) closed 11 areas of coldwater sponge and coral habitat to bottom fishing. The closures, which cover a total area of more than 8500 km^2, are in international waters more than 200 nm off the Atlantic coast of Canada.

2. OBJECTIVES

Conservation and management objectives are closely related and must be clearly linked. How they are framed and developed within any strategy depends on the overarching goal. In some instances research and conservation objectives are guided by overarching management objectives, and in other instances management and research objectives are guided by overarching conservation objectives.

The three objectives that flow from the goal of the strategy will serve as the basis for developing clear targets and strategies to guide future decisions and discussions on cold-water corals and sponges. In this strategy, the conservation objective drives the management and research objectives; together all three objectives guide the development of individual strategies and actions that can be implemented by identified sectors (see Tables 1 and 2).



The objectives and associated strategies and actions that follow are situated in a broader context that recognizes the Department's mission to deliver Canadians the outcomes of safe and accessible waterways, healthy and productive aquatic ecosystems, and sustainable fisheries and aquaculture.

2.1 Conservation Objective

In keeping with the precautionary approach, the conservation objective developed for the purposes of this strategy is:

> *To conserve the health, composition and function of cold-water coral and sponge species, communities and habitat in support of a healthy ecosystem.*

Feedback from a 2008 workshop on the development of a cold-water coral and sponge conservation strategy (DFO and CPAWS 2009) indicated that species structure, composition and function are all relevant to the conservation of cold-water corals and sponges. There is value in protection at both the species and community levels due to their respective contributions to ecosystem function (most of which are habitat-related).

2.2 Management Objective

To achieve the strategy's goal and conservation objective, the management objective is:

> *To manage human activities with impacts on cold-water coral and sponge communities efficiently and effectively in support of a healthy ecosystem and sustained economic benefits, within a risk assessment framework.*

A precautionary approach will need to be applied in many situations due to insufficient data and information regarding the distribution and abundance of cold-water coral and sponge communities in BC. It is recognized that not all marine benthic areas require equal levels of protection. Habitat and fisheries management risk assessments will help identify human activities to be managed around coral and sponges and gaps in our understanding of the nature and extent of the impacts of these activities.

2.3 Research Objective

In support of the conservation and management objectives, the research objective is:

> *To support decision making through the provision of scientifically based peer-reviewed advice on*
>
> - *human caused impacts on cold-water corals and sponges; and*
> - *the health and integrity of cold-water corals and sponges and their contributions to the conservation of a healthy ecosystem.*

There is an ongoing effort to bring together the relevant science information and threat evaluation as part of the conservation strategy for corals and sponges. The Pacific Scientific Advice Review Committee (PSARC) process will be used for review of suggested data collection, evaluation and interpretation, as well as the development of tools to determine human impacts, risks, and to gain a greater understanding of cold-water coral and sponge distribution. Participants from a 2008 workshop on the development of this strategy (DFO and CPAWS 2009) recommended that science and management develop the risk assessment framework together, so that research priorities in support of cold-water coral and sponge conservation can be effectively and fully identified.

3. STRATEGIES & ACTIONS

In order to achieve the above objectives, clear strategies have been developed. These strategies are a starting point for a living strategy. They will be updated and adapted as our knowledge and understanding of Pacific cold-water corals and sponges grows. The sequencing of actions identified in tables 1 and 2 is based on a logical flow of activities that are either ongoing or need to occur in the future. However, the order in which actions appear in the tables does not necessarily indicate that they will occur in that sequence.

3.1 Conservation and Management Strategies and Actions

While the purpose of this strategy is to outline the Department's approach to managing and conserving cold-water corals and sponges, it is important to note that conservation of cold-water corals and sponges in the Pacific Region is the responsibility of a number of regulators and the marine user community at large. These include all federal and provincial agencies whose mandate has implications for managing the use of marine areas and resources (e.g. Department of Fisheries and Oceans, Environment Canada, Parks Canada, Natural Resources Canada, and the Provincial Ministry of Environment, Ministry of Energy, Mines and Petroleum Resources, and Integrated Land Management Bureau), and marine users whose activities may impact cold-water coral and sponges (e.g. commercial, recreational and First Nations fishers and tourism operators) (see section 4.1). There are a variety of management tools available in Canada to manage human impacts on cold-water corals and sponges (see Appendix C). It may be necessary to use different tools or a combination of tools appropriate to specific areas and/or to meet various objectives.

The application of specific management tools, industry consultation, public education and outreach programs are important for the success of all management measures. They support improved stewardship by helping the public and marine users gain a better understanding of the conservation measures that have been put in place and the rationale behind them.

Table 1 describes specific strategies, actions and timelines in place in order for the Department to meet the conservation and management objectives of the strategy. Short-term actions indicate actions to occur within a 2-year time frame. Long-term actions indicate actions to occur beyond a 2-year time frame.

Table 1. Strategies (S) and actions (A) in support of the conservation and management objectives of the Cold-water Coral and Sponge Conservation Strategy. Short-term is less than 2 years, long-term is greater than 2 years.

S1. Define and Identify Important Cold-water Coral and Sponge Areas			
Action	**Timeline**	**Lead Sector**	**Support Sectors**
A 1.1 Assemble and map existing data and information to determine the extent and location of cold-water corals and sponges.	Short-term	Science	FAM, Habitat, Oceans, Policy
A 1.2 Define the attributes of 'Important Cold-water Coral and Sponge Areas' using advice from Canadian Science Advisory Secretariat (CSAS) review and appropriate regional processes.	Short-term	Science	FAM, Habitat, Oceans, Policy
A1.3 Develop assessment tools to estimate cold-water coral and sponge distribution, abundance and/or aggregations.	Ongoing	Science	FAM, Habitat, Oceans,
A 1.4 Identify 'important' cold-water coral and sponge areas using data gathered in A1.1 or estimates per A1.3, and the definitions developed in A1.2.	Ongoing	Science	-
S2. Identify Threats and Stressors to Cold-water Corals and Sponges			
Action	**Timeline**	**Lead Sector**	**Support Sectors**
A 2.1 Define 'Threats' and 'Stressors' to Cold-water Corals and Sponges using advice from Canadian Science Advisory Secretariat (CSAS) review and appropriate regional processes.	Ongoing	Science	FAM, Oceans, Habitat
A 2.2 Assemble and map existing information and data on fishing and non-fishing activities in cold-water coral and sponge areas, and identify areas with high interaction.	Short-term	Oceans	Science, FAM
A 2.3 Identify fishing and non-fishing activities that may cause damage to cold-water corals and sponges.	Short-term	FAM	Oceans, Science
S3. Assess Risks to Cold-Water Coral and Sponge Areas and Determine whether Management Measures are Needed			
Action	**Timeline**	**Lead Sector**	**Support Sectors**
A 3.1 Use tools such as Risk Management Frameworks (i.e. Habitat Risk Management Framework), and the emerging Sustainable Fisheries Framework's Ecological Risk Analysis Framework (ERAF) to conduct risk analyses to determine the risk of serious or irreversible harm to cold-water corals and sponges resulting from human activities, and submit for review by managers, scientists, and stakeholders.	Ongoing	Science	FAM, Habitat
A 3.2 Use the ERAF and science advice from CSAS to assess the likelihood of serious or irreversible harm from fishing activities consistent with the Policy to Manage the Impacts of Fishing on Sensitive Benthic Areas.	Ongoing	FAM	Science, Oceans

...Continued

Table 1 Continued...

Action	Timeline	Lead Sector	Support Sectors
A 3.3 Use the Habitat Risk Management Framework to assess the potential effects of development proposals (non-fishing activities) on fish and fish habitat that contain cold-water corals and sponges to determine the habitat protection requirements necessary to reduce risk to the lowest practical and acceptable levels.	Ongoing	Habitat	Science
A 3.4 Determine the appropriate socioeconomic and conservation management options to address risks identified in 3.1-3.3 in consultation with stakeholders.	Ongoing	FAM & Habitat	Oceans, Science, Policy
A3.5 Assess the potential effects of climate change on corals and sponges and determine any potential measures that may reduce their vulnerability to climate impacts.	Long-term	Science	Oceans, FAM, Habitat
S4. Protect Important Cold-water Coral and Sponge Areas through Implementation of New or Existing Management Measures			
Action	**Timeline**	**Lead Sector**	**Support Sectors**
A 4.1 Where relevant, incorporate management mitigation options into Integrated Fisheries Management Plans (IFMPs) and licensing requirements. A 4.1.1 Establish reporting and data collection protocols for cold-water coral and sponge encounters at sea.	Ongoing	FAM	Science, Oceans
A 4.2 Develop encounter protocols consistent with the DFO Sustainable Fisheries Framework policies on New Fisheries for Forage Species and Managing the Impacts of Fishing on Sensitive Benthic Areas.	Short-term /Ongoing	FAM	Science
A 4.3 Consider long-term management measures for cold-water coral and sponge areas identified as high risk by the ERAF or Habitat Risk Management Framework in actions 3.1-3.3.	Short-term	FAM & Habitat	Science, Oceans
A 4.4 Consider cold-water coral and sponge protection when developing conservation objectives for the PNCIMA initiative and other integrated oceans management initiatives.	Ongoing	Oceans	Science
A 4.5 Within DFO, develop internal communication and integration protocols within existing processes to improve coordinated cold-water coral and sponge management and make appropriate linkages with other government agencies.	Short-term	Oceans	Communications, Science, FAM, Policy, Habitat, SARA
A 4.6 Consider impacts on cold-water corals and sponges as part of activity approval process within existing MPAs and as part of exceptions and prohibitions during new MPA designation processes, as appropriate.	Ongoing	Oceans	FAM, Habitat
A 4.7 Consider impacts to cold-water corals and sponges as part of DFO's project review process under the *Fisheries Act* and Canadian Environmental Assessment Act.	Ongoing	Habitat	-
A 4.8 Incorporate consideration of cold-water corals and sponges into SARA recovery plans where relevant.	Long-term	SARA	Science, FAM, Oceans, Habitat

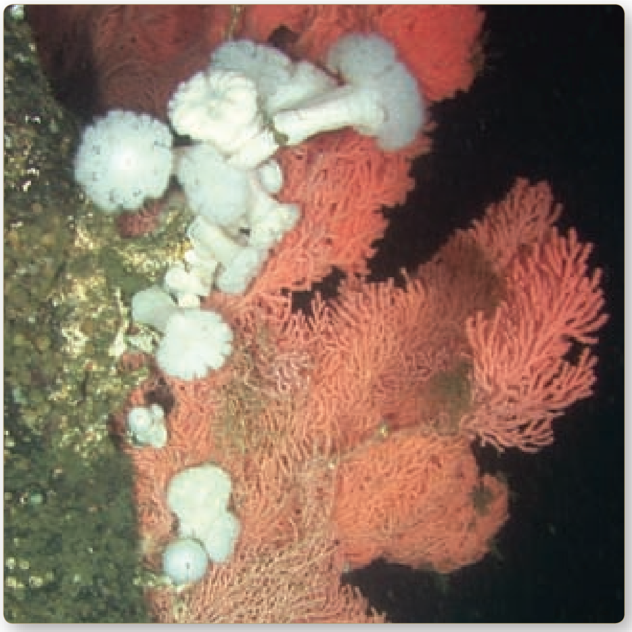
...Continued

Table 1 Continued...

S5. Monitor and Evaluate the Effectiveness of the Management Measures			
Action	**Timeline**	**Lead Sector**	**Support Sectors**
A 5.1 Develop and implement with Science pre- and post-impact monitoring standards.	Ongoing	FAM & Habitat	Science
A 5.2 Conduct IFMP post-season reviews to evaluate compliance in the delivery of management measures.	Ongoing	FAM	Science
A 5.3 Evaluate effectiveness of existing habitat management protection and mitigation measures in preserving cold-water corals and sponges through the Habitat Compliance Monitoring Program.	Ongoing	Habitat	Science
A 5.4 Identify socio-economic factors that benefit from the conservation of cold-water corals and sponges, including their potential to nurture commercially valuable species.	Long-term	Policy	FAM, Oceans
A 5.5 Consider corals and sponges when using Sustainable Fisheries Framework fisheries checklists to assess fishery performance against policy objectives.	Ongoing	FAM	Science
S6. Foster Public Involvement and Participation in Conservation and Management of Cold-water Corals and Sponges			
Action	**Timeline**	**Lead Sector**	**Support Sectors**
A 6.1 Foster stakeholder engagement in cold-water coral and sponge conservation and management through existing processes	Ongoing	-	FAM, Oceans, Science, Habitat, SARA, Policy
A 6.2 Develop a Communications Strategy that includes using existing and new DFO communications and outreach tools and processes to increase awareness of cold-water corals and sponges.	Short-term	Oceans	Communications
A 6.3 Provide regular, publicly available reports on measures developed and applied for cold-water coral and sponge conservation and management.	Ongoing	-	FAM, Oceans, Science, Habitat, SARA, Policy
A 6.4 Incorporate international initiatives into reporting on cold-water corals and sponges.	Ongoing	Policy	Science
A 6.5 Foster cooperative information sharing with other government agencies, First Nations and stakeholders to increase knowledge and fill information gaps on cold-water corals and sponges.	Ongoing	FAM	FAM, Oceans, Science, Habitat, Policy

* Where two sectors appear in the 'lead sector' column indicates FAM or Habitat sector has lead responsibility depending on activity associated with the action.
** Where columns are blank indicates no specific lead sector, but involvement of all sectors.

3.2 Research Strategies and Actions



In general, the identified priority actions seek to address the current data-poor situation by prioritizing research efforts and making use of existing information. Priority actions include continuing research on habitat, distribution and mapping; improving bycatch monitoring, development of field identification keys; improving observer training; the development of at-sea collection protocols for observers, and developing collaborative programs with industry, NGOs, researchers and other government agencies to improve data sharing and develop a common direction.

Science has been working on developing tools to assess risks associated with various human activities (e.g., pollution, fishing, oil & gas, aquaculture, urbanization, mining). Recommended protocols for data collection, collation, evaluation, and interpretation will be vetted through PSARC. The most immediate priority for DFO Science is to compile information on the diversity and distribution of cold-water corals and sponges in BC in preparation for meetings with industry. These meetings will discuss possible actions that can be taken to minimize human impacts on cold-water coral and sponge communities.

Table 2 describes research strategies and actions that support the goal and conservation objective of the Cold-water Coral and Sponge Conservation Strategy. Short-term actions indicate actions to occur within a 2-year time frame. Long-term actions indicate actions to occur beyond a 2-year time frame.

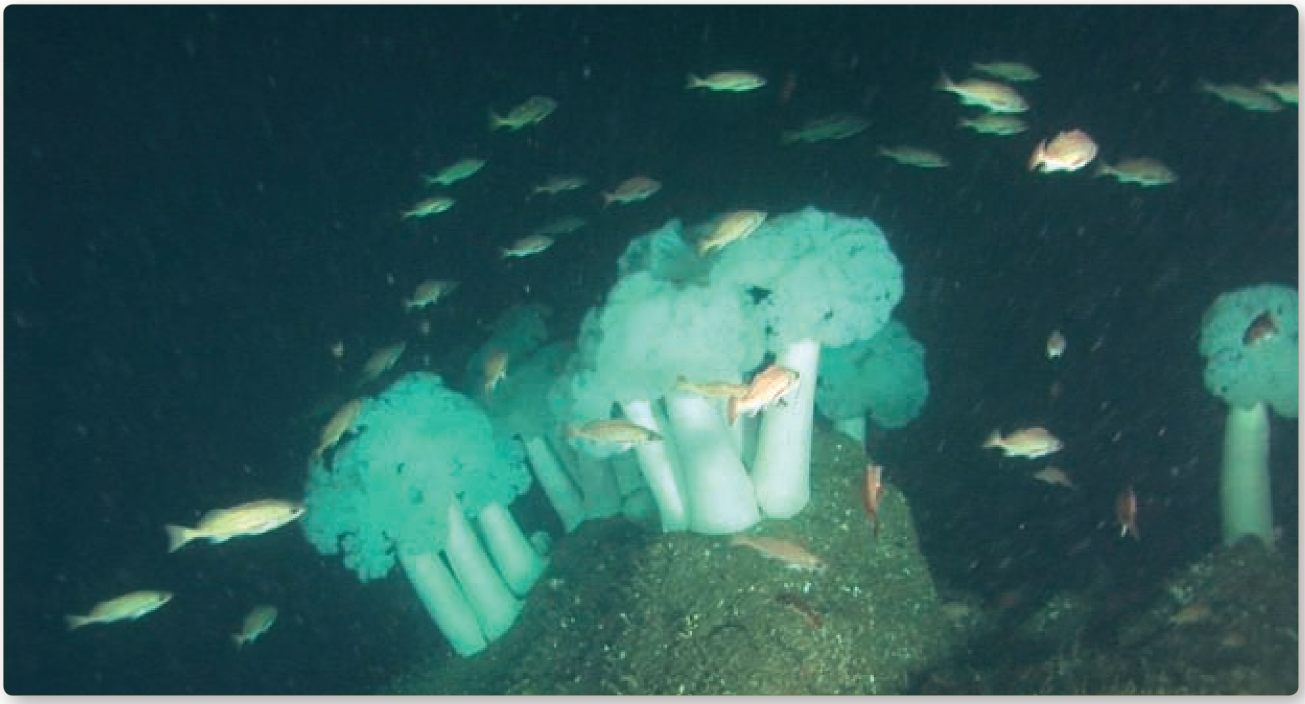


Table 2. Strategies (S) and research actions (RA) in support of the research objective of the Cold-water Coral and Sponge Conservation Strategy. Short-term is less than 2 years, long-term is greater than 2 years.

S1. Enhance Ongoing Benthic Habitat Research Activities to Include Cold-water Corals and Sponges			
Action	**Timeline**	**Lead Sector**	**Support Sectors**
RA 1.1 Identify and prioritize research needs and conduct research where data and information are insufficient.	Ongoing	Science	FAM, Oceans, Habitat,
RA 1.2 Research, develop and implement methods to predict, verify and assess cold-water coral and sponge species and communities (i.e. rapid assessment, predictive habitat models, field studies, development of metrics, bathymetric and multibeam bottom classification studies, oceanographic variable measurement and modeling, habitat characterization).	Short-term/ Ongoing	Science	Habitat, FAM
RA 1.3 Develop protocols and tools to standardize quality and nature of collected data (i.e. observer taxonomic guides, standard data collection, sample collection and storage, access protocols, metadata standards).	Short-term	Science	FAM
RA 1.4 Compile, analyze and assess existing and emerging data, including DFO Science field studies, bathymetric and bottom typing studies, oceanographic data, data informed by DFO Science taxonomic keys.	Long-term	Science	-
S2. Determine the Ecological Significance of Identified Cold-water Coral and Sponge Areas			
Action	**Timeline**	**Lead Sector**	**Support Sectors**
RA 2.1 Develop ecosystem metrics that fit into a Ecological Risk Assessment Framework of extent and nature of human impacts on cold-water coral and sponge habitats.	Short-term	Science	FAM, Oceans, Habitat
S3. Provide Opportunities for Information Sharing and Research Collaboration			
Action	**Timeline**	**Lead Sector**	
RA3.1 Promote and conduct collaborative research and enhance existing scientific surveys in support of current conservation measures and strategies (e.g. on DFO ROV and ROPOS surveys and other surveys conducted by academia, industry, NGOs and other government agencies).	Ongoing	Science	FAM, Oceans
RA3.2 Enhance information sharing opportunities presented by integrated management planning processes (e.g. data integration component of PNCIMA, West Coast Aquatic, Marine Protected Area Implementation Team, etc.).	Ongoing	Oceans	Science, FAM
RA 3.3 Support socioeconomic research related to cold-water coral and sponge conservation in collaboration with PNCIMA socio-economic and cultural overview and assessment work.	Ongoing	Oceans	Policy, FAM
RA3.4 Seek out opportunities for information sharing and research collaboration with international and Federal-Provincial working groups (i.e. Oceans Coordinating Committee, Marine Protection Areas Implementation Team, Oceans Information Management System Working Group), NEPTUNE, CHONe, and NMCA processes.	Ongoing	Science	Oceans
RA3.5 Participate in national and regional science advisory processes and National Centre of Expertise in Cold-Water Corals and Sponge Reefs.	Ongoing	Science	Oceans, FAM, Policy, Habitat, SARA
RA3.6 Develop a data assessment and dissemination tool for use by agencies to facilitate management decision-making.	Long-term	Science	Oceans, FAM, Habitat,

* Where two sectors appear in the 'lead sector' column indicates FAM or Habitat sector has lead responsibility depending on activity associated with the action.

** Where columns are blank indicates no specific lead sector, but involvement of all sectors.

4. CHALLENGES FOR COLD-WATER CORAL AND SPONGE CONSERVATION

4.1 Impacts to Cold-Water Corals and Sponges

Most impacts to cold-water corals and sponges caused by human activities can be classified broadly into either direct removal or damage, indirect damage, or climate change and ocean acidification-related threats. Each of these impacts or threats may directly kill or damage the organism, parts of a colony, or leave it more susceptible to disease or parasites. It is important to note that multiple impacts often act together, with additive or multiplicative impacts, and the scope or scale of impacts can vary depending on the threat.[1]

4.1.1 Bottom fishing

In BC waters, bottom fishing is the human activity most likely to cause the greatest impact due to direct removal or damage to cold-water corals and sponges. Bottom fishing activities may remove corals and sponges from the seabed (in whole or in part), or damage them by setting, dragging, or retrieval of fishing gear. Bottom fishing may also suspend or re-suspend sediment in the water column, which may have negative impacts on sponges. Some of these impacts have been studied and reported on in the Pacific Region (Jamieson and Chew 2005, Ardron and Jamieson 2006, Jamieson et al. 2007b, Cook et al. 2008, Finney 2009).

Globally, it has been shown that corals, and by inference sponges, can be damaged by most types of bottom fishing gear. A recent United Nations Environment Programme (UNEP) report considers active gear – i.e., mobile gear, such as trawls and dredges – a greater threat than passive (fixed) gear, such as lines, pots and traps, and gillnets (Nellemann et al. 2008). A committee of the U.S. National Research Council Ocean Studies Board reviewed ecosystem effects of fishing and published a report on the effects of trawling and dredging. It concluded that biogenic and stable habitats were most vulnerable to trawling and dredging activities (National Research Council 2002). They further advised that the differing impacts of fishing gear on benthic habitats were a function of the degree of bottom contact and sediment penetration of the gear.

The Food and Agriculture Organization (FAO) of the United Nations commissioned a report on the impacts of scallop dredging on benthic habitats and communities (Løkkeborg 2005). The report noted the limitations of many trawling impact studies, with key limitations being their inability to replicate real fishing activities due to research design or the lack of a control site in cases where data from real fishing activities were used. It concluded that based on the available information, the most serious impacts on hard bottom habitats were in areas dominated by large sessile fauna that extended above the substrate, such as sponges and corals.

[1] For a more detailed discussion of threats see Gardner 2009, *Coldwater corals and sponge conservation on Canada's Pacific coast: Perspectives on issues and options*. Background paper to support discussions toward a conservation strategy. Submitted to the Organizing Committee for the Workshop, Developing a Conservation Strategy for Coldwater Corals and Sponges on the Pacific Coast. DFO, Vancouver, BC. 49.

All benthic types of fishing gear have the potential to be harmful to benthic environments but the nature and extent of this harm appears to depend on gear type and the level or intensity of the fishing activity (Butler and Gass 2001, Gass 2003). While a number of papers have ranked impacts from mobile gear on benthic habitats to be generally higher than those from fixed gear (DFO 2006b), this may be the result of a greater number of studies having been conducted on mobile gear than on fixed gear. As a result, the impacts of mobile gear on cold-water corals and sponges have been documented (Freese et al. 1999, Krieger 2001, Chuenpagdee et al 2003, Ardron and Jamieson 2006, Ardron et al. 2008), while the impacts of other gear types on cold-water corals and sponges are not as well documented.

4.1.2 Other commercial or recreational fishing techniques

Specific impacts of fishing in areas with cold-water corals and sponges generally include one or more of the following: 1) removal of a species or group of species impacting multiple trophic levels (i.e. through direct exploitation of fish and/or invertebrates for food, and/or catch and mortality of non-target species) and 2) physical impacts to benthic environments associated with fishing techniques, fishing gear, anchoring of fishing vessels (Waddell 2005) and impacts of lost 'ghost' gear (Chiappone et al. 2005). Such impacts may be exacerbated when coupled with other stressors.

4.1.3 Net pen aquaculture operations

British Columbia is the largest aquaculture producing province in Canada, and finfish aquaculture, particularly for salmon, is the provincial mainstay of the industry. As with any activity in the oceans, there are risks. Operational policies and a multi-level regulatory review process are in place to mitigate these concerns. These evaluated and mitigated risks of potential relevance to cold-water corals and sponges include the following: organic deposition (e.g. food, feces, etc) under finfish net pens, which can alter substrate composition and quality and reduce interstitial water quality (Levings et al. 2002, DFO 2003, DFO 2004), and the large size of arrays of net pens, which can alter local currents (Cimberg et al. 1981, Cromey and Black 2005, Stucchi et al. 2005). The unmitigated habitat degradation caused by these disturbances may have an effect on species of cold-water corals and sponges, but the degree of disturbance likely depends on the individual species susceptibility and proximity to net pen activities (Cimberg et al. 1981). There are no aquaculture facilities in the area of the Hecate Strait/Queen Charlotte Sound glass sponge reefs, but some may exist in other areas where unidentified cold-water coral and sponges may be located, such as coastal fjords. Monitoring work is ongoing to quantify area of impact around cage structures and clarify coral and sponge impacts.

4.1.4 Climate change and ocean acidification

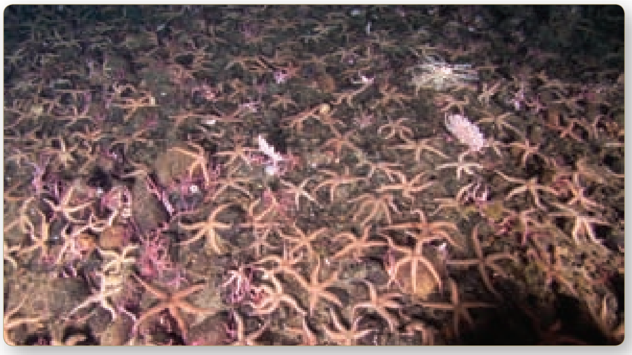
The global oceans represent earth's greatest natural carbon sink, holding more than 88% of all CO_2 on the planet and cycling a significant portion of human CO_2 emissions every year. However, increased atmospheric CO_2 is driving climate change, and increased concentration of CO_2 in seawater is causing the acidification of ocean water, which leads to reduced concentrations of ecologically vital carbonate (CO_3) ions. Both of these effects of excess anthropogenic CO_2 emissions are expected to have potentially severe impacts on marine ecosystem features.

The potential impacts of climate change on cold-water corals and sponges are not well understood, but warming ocean water is expected to be a stressor. In the Strait of Georgia, sea surface temperatures have been increasing at a rate of 1°C over 90 years, based on lighthouse records gathered throughout southern BC (Beamish et al. 2009). Many cold-water corals rely on zooplankton as their primary food source, and warmed water may reduce the availability of phytoplankton and zooplankton as prey items. Rising ocean temperatures may also lead to a change in the depths where carbonate is available in usable form, forcing coral populations to migrate or perish. Due to their slow growth and longevity, cold-water corals are not predicted to be capable of rapid adaptation to changing conditions (Schimel et al. 1997).

Over the next several decades, ocean acidification is expected to substantially decrease oceanic pH. Wootton et al. (2008) have documented a rapid drop in pH in the entrance to the Juan de Fuca Strait. Acidification results in a reduction in the availability of carbonate ions essential to calcifying organisms such as hard corals. In extreme cases, acidified waters may even corrode these organisms' shells and skeletons (Orr et al. 2005). The large shift in oceanic carbonate chemistry associated with ocean acidification is predicted to negatively impact calcification rates and the viability of cold-water corals. Roberts et al. (2006) predict that with a doubling of atmospheric CO_2, calcification of cold-water corals may be reduced by 54% or more.

4.1.5 Oil and gas exploration and development

The direct footprint of exploratory or production drilling for oil and natural gas has the potential to damage or destroy cold-water corals and sponges. If sited atop or in close proximity to cold-water coral or sponge communities, physical damage in the form of breakage and dislodgement of organisms and hard substrate, and/or crushing of cold-water corals and sponges can result



from anchoring of support and transport vessels, anchoring of semi-submersible drilling units, pipeline placement, platform installation and chains associated with moorings (Cimberg et al. 1981, Raimondi et al. 1997).

There is a large body of literature that exists regarding offshore oil and gas activities including environmental performance, impacts and effectiveness of mitigation that will require review and analysis to identify zones of influence and any gaps in knowledge. This analysis will allow planning to close any information gaps going forward in a timely manner, which may influence management decisions. Any offshore oil and gas activity would require an environmental assessment.

In 1972, the federal government halted offshore exploration through a federal moratorium. While the existing moratorium is in place, it is anticipated that the federal government will maintain its federal policy decision not to convert existing offshore British Columbia permits to exploratory licenses. The provincial government has recently committed, through the 2007 BC Energy Plan (Government of BC, 2007), to continue to work to lift the federal moratorium on offshore exploration and development and simultaneously lift the provincial moratorium. The provincial government has also committed to work with the federal government to ensure that offshore oil and gas resources are developed in a scientifically sound and environmentally responsible way.

4.1.6 Marine log handling facilities

As part of timber handling and transportation, logs are often dropped into the water from helicopters or delivered into the water on skidways for sorting and booming. In the process, significant debris fields (sunken trees, limbs, bark and bundling debris) can be generated in the marine intertidal and subtidal environment. As this material sinks and is redistributed by currents it can bury benthos, alter water quality and physically abrade intertidal and shallow sub tidal habitats while barges, log booms and other structures can shade the water column and reduce primary production and growth. In deep cold-water, decomposition of organic wood material is slowed and significant bacterial matting can occur which reduces water quality. Depending on the duration of the operations and the size and depth of the sort the debris fields may be very large and thick and may persist for months to decades (Kirkpatrick et al. 1998, Williamson et al. 2000, Picard 2002).

The number of small log dumps is increasing in the Pacific Region as companies move into more remote areas to access merchantable timber. In an effort to direct log handling activities out of the highly productive intertidal and shallow subtidal areas where logging companies prefer to operate, guidelines were developed in 2003 that directed operations into "steep and deep" areas which may increase the risk to cold-water corals and sponges (G3 Consulting Ltd. 2003).

4.1.7 Submarine cables

Cables for telecommunications and electricity are regularly laid across the ocean, buried in the seabed at water depths up to 1500 meters. Cable burial and repair processes have the potential to damage the benthos through multiple anchor settings of large support vessels and cable plowing, ditch digging, and burial. This can cause disturbance in the form of increased sedimentation and damage or destruction of benthic habitats and fauna (Butler and Gass 2001). The burial process also often uses ROVs with high powered water guns where plows are unsuccessful. This also increases sediment and potential damages to structures and habitat. Seafloor cables can also be used to conduct deep-sea research. If poorly sited, the potential impacts associated with research cable installation and maintenance could mirror those listed above.

4.1.8 Other

Seabed mining, particularly for manganese crusts, holds significant potential to directly damage cold-water corals and sponges. Seabed mining does not currently threaten cold-water corals and sponges in Canada's Pacific waters. Although potential exists for these activities to commence in coastal waters, which could negatively affect cold-water corals and sponges, there is a low likelihood of such activity taking place. Prior to any development, there would be an environmental assessment which would identify risks to habitats including cold-water corals and sponges.

The introduction of invasive species into receptor areas where they can thrive uncontrolled by predators or other limiting factors has long been recognized as a significant potential disturbance to native ecosystems. According to Coles and Eldridge (2002), "non-indigenous species can quickly monopolize energy resources, act as voracious predators, overcome endemic species, or transmit parasites and disease." *Carijoa riisei*, an octocoral native to the Western Atlantic, was discovered in 2001 overgrowing precious native black corals, *Antipathes dichotoma* and *Antipathes grandis* at depths of up to 110 m in the Au'au channel in Hawaii. In areas where *C. riiesei* had become established, up to 90% of the native black coral populations were killed or completely overgrown by the invader (Kahng et al. 2005). While this study provides evidence of alien invasion of deep-water corals, nothing similar has yet been reported or published for cold-water corals or sponges in the northeast Pacific. The risk to cold-water corals and sponges with regard to invasive species in the northeast Pacific is therefore unknown.

In other parts of the world, commercial harvesting of cold-water corals for jewelry and souvenirs presents a threat to their conservation (Laist et al. 1986). Some cold-water coral species harvested for trade in other parts of the world are found in Canada's Pacific coastal waters. As such, potential for their trade exists.

Land-based sources of pollution such as sedimentation, freshwater runoff, thermal and chemical pollution, sewage, dredging, and the presence of persistent organic chemicals have caused adverse effects on cold-water corals in addition to coral mortality (Laist et al 1986; McAllister and Alfonso 2001; Cimberg et al 1981; Rogers 1999; Etnoyer and Morgan 2004). The introduction of suspended or re-suspended sediment can potentially interfere with corals physiology and potentially hinder feeding and respiration processes (Cimberg et al. 1981, Raimondi et al 1997; Butler and Gass 2001; Gass 2003, NOAA 2004, Miller 2001). Some cold-water corals have the ability to cope with considerable amounts of sand deposition (e.g. sea pens and sea whips). It is unknown at this time if persistent organic chemicals affect the growth and/or long-term survival of corals (McAllister and Alfonso 2001, Fossa et al. 2002).

4.2 Lack of Information and Available Research

Under the National Framework for Species at Risk Conservation (Government of Canada1996) DFO has the responsibility to provide General Status Reports (GSRs) for all marine organisms. This commitment was adopted by the Canadian

Endangered Species Conservation Council (CESCC) and approved in 1998 by the Council of Ministers responsible for Wildlife in Canada as part of their commitment to prevent species in Canada from becoming extinct as a consequence of human activity.

DFO has been tasked with producing GSRs for coral and sponges. This task requires the compilation of all available information on the species of corals and sponges in Canada including their current and historic population size and distribution and the number of known occurrences records. The GSRs also require information on the nature and extent of anthropogenic impacts as well as the species' vulnerability to those impacts. Our current state of knowledge with regards to coral and sponges in Canada is so limited that in most cases the response to these questions is "undetermined".

Although several articles and reports have been published on the cold-water corals and sponges of Pacific Canada in recent years (Conway et al. 2001, Krautter et al. 2001, McAllister and Alfonso 2001, Leys et al. 2004, Conway et al. 2005a, Conway et al. 2005b, Ardron and Jamieson 2006, Cairns 2007b, Jamieson et al. 2007a), there is still a great deal we do not know about the abundance, distribution, and condition of BC species. Many aspects of cold-water coral and sponge biology and ecology are not well studied or understood, and are often based on speculation about possible similar traits with their warm, shallow-water counterparts (Jamieson et al. 2007a). In addition, our knowledge of the distribution of these animals is incomplete with only a few areas in BC identified through the use of video equipment and submersibles as potential habitat for cold-water corals or sponges (e.g., on DFO ROV and ROPOS and other surveys conducted by academia and NGOs. Also, Lynnes Aquarius surveys could be reanalyzed for corals and sponges). Future surveys may discover new areas of cold-water coral and sponge concentrations and perhaps new species.

The paucity of information on the distribution of cold-water corals and sponges combined with the current lack of species information in monitoring programs make it difficult to fully assess the extent of anthropogenic impacts and other risks to cold-water corals and sponges, including measures to enhance conservation. To address these gaps in knowledge, DFO Science must develop a strategic approach to provide relevant information. This information will allow for improved decision making and will help the responsible Ministers meet their commitment to prevent species in Canada from becoming extinct as a consequence of human activity.

5. IMPLEMENTATION, REVIEW AND RESPONSIBILITIES

5.1 Implementation

Within DFO Pacific Region, the Oceans Program will coordinate and facilitate implementation of the strategy through Cold-Water Coral and Sponge Conservation Strategy Working Group. The working group consists of DFO representatives from the Oceans, Science, Policy, Habitat, Fisheries and Aquaculture programs and branches. In addition, DFO will use existing governance structures such as the Regional Committee on Oceans Management, and processes such as the PNCIMA initiative and integrated fisheries management planning processes, to communicate and implement appropriate aspects of the strategy. This will include working closely with other federal government agencies, the Province of British Columbia, First Nations, industry, academia and ENGOs to implement the actions outlined in the strategy.

The conservation, management and research strategies in Tables 1 (section 3.1) and 2 (section 3.2) are based on the goal and objectives of the strategy. All strategies have an identified action, associated timeline and responsible branch. Each year the DFO working group will identify priority actions and detail associated activities, timelines, lead branch, and evaluation mechanism to provide accountability and transparency in implementing the actions. It will be the responsibility of the branches identified in Tables 1 and 2 to carry out the respective actions identified and monitor and track their progress. Working group representatives will be expected to provide annual branch updates to the working group, which the working group chair will collate into an annual progress report for the Regional Director General.

Implementation of this strategy will be phased in over time and management decisions to address potential impacts will factor in socio-

economic and ecological considerations and other departmental objectives. In particular, the need for mitigation measures and the nature of such measures will be determined based on balancing the need for mitigation with socio-economic benefits of the activity.

As the federal government department responsible for developing and implementing policies and programs in support of Canada's scientific, ecological, social and economic interests in oceans and fresh waters, DFO has a large role to play in implementing this strategy. However, it is important for other regulators to be involved in conserving sensitive marine habitat, especially as human activities move into deeper waters which have been little impacted by human activity. Copies of the strategy will be provided to regulators for their use and distribution.

Scientists, environmental organizations, and fishing groups have played an important role in achieving some of the sponge conservation measures currently in place. It is hoped that these groups will continue to foster collaboration and provide information and advice to regulators with respect to cold-water coral and sponge conservation.

Many of the actions proposed or currently in place are based on the provision of scientific advice. For that reason, seeking out ways to continue research and monitoring of cold-water corals and sponges will be a priority if this plan is to be properly implemented.

5.2 Implementation Considerations

5.2.1 Socio-economic implications

A major concern with cold-water coral and sponge conservation is the potential socio-economic impacts of conservation measures.

FISHERIES

The *Policy for Managing the Impacts of Fishing on Sensitive Benthic Areas*, developed under the auspices of the Sustainable Fisheries Framework, provides a framework to avoid or mitigate the impacts of fishing activity on sensitive benthic areas, including cold-water corals and sponge-dominated communities (DFO 2009a, DFO 2009b). Appropriate mitigation measures may include gear restrictions and modifications or area closures to avoid important cold-water coral and sponge communities. Area closures may force fishermen to cease fishing activities or operate in other areas with potential ecological and economic impacts.

Encounter protocols and monitoring requirements may impact fishing activities and opportunities in areas where fishing activities could impact cold-water corals and sponges.

Though mitigation measures may restrict the locations that can be fished, the fishing industry may still benefit from such management actions (Klein et al. 2008). Areas closed to fishing act as refuge areas, support higher fish populations, and provide spillover effects into open fishing areas (Stewart et al. 2008, Lester et al. 2009, Angulo-Valdes and Hatcher 2010). Reducing the impact of fishing activities on sensitive benthic ecosystems, including cold-water coral and sponge communities, also provides greater support for eco-certification for sustainable fishing practices.

OIL AND GAS

There is currently a moratorium in place prohibiting oil and gas exploration and exploitation off the west coast of Canada (see section 1.2.1). Should oil and gas exploration be approved in the future, the physical impacts of drilling, structure placement, anchorages and pipelines, rock cutting discharges and increased sedimentation would be evaluated when determining appropriate areas for oil and gas activity. Mitigation of impacts on coral and sponges during exploration and development would likely be required. Identifying areas of important cold-water coral and sponge species, communities and habitats and improving knowledge of offshore oil and gas environmental impacts and performance while there is a moratorium in place helps to ensure that these areas will be protected in the future, allowing appropriate development while reducing the potential for significant exploration investment in areas that are ultimately inappropriate for exploitation.

RENEWABLE ENERGY/ SUBMARINE CABLES

Project evaluation and placement of energy-generating structures and energy transmission cables should take into account direct physical impacts on cold-water coral and sponge communities and develop mitigation measures for areas of coral and sponge community locations and/or aggregations. Cables and pipelines and their anchors can shift and move creating a larger swath of physical damage than the actual width of the structure. Identifying areas of important cold-water coral and sponge species, communities and habitats helps to outline areas to be avoided early on in the planning stages.

AQUACULTURE/MARINE LOG HANDLING SITES

Restrictions may be placed on areas available for potential expansion of aquaculture or log dump sites based on the potential for sedimentation impacts on adjacent cold-water coral and sponge habitat (see section 1.2.1). For all future finfish sites, there is already a requirement by DFO-Habitat for industry to survey for cold-water coral and sponge species prior to installation, as well as for their protection when detected.

TOURISM/RECREATION

Where necessary, protected areas may restrict all human activities that may have a potential to damage cold-water coral and sponge species or communities, which may include recreational fishing activities, diving, anchoring, etc.

COASTAL COMMUNITIES

Coastal communities share a close link to their marine areas. These communities are made vulnerable by negative human impacts which may cause unpredictable and poor marine survival of aquatic species and degradation of habitat. Coastal communities are strengthened by stable, sustainable ocean use supported by healthy, productive ecosystems. Communities thus have a stake and a responsibility in the health and sustainable use of the marine environment. A comprehensive plan to conserve and protect cold-water corals and sponges provides a clear direction to guide responsible ocean activities in areas that may be important cold-water coral and sponge habitat.

5.2.2 Conservation applications

Cold-water coral and sponge conservation activities contribute to Canada's efforts to conserve marine biodiversity. Cold-water corals and sponges have gained increasing conservation attention as sensitive benthic habitats, both nationally and internationally. A successful cold-water coral and sponge strategy will help to achieve conservation targets recommended by the United Nations Environment Program as well as national and local agencies, non-governmental organizations, and environmental non-governmental organization recommendations. In addition, it will inform work underway by both federal and provincial governments to identify bioregional networks of MPAs in British Columbia.

5.3 Responsibilities

The responsibility for carrying out the research and management actions in support of the conservation, research and management objectives rests with managers.

While the Oceans Program will be responsible for coordinating the strategy's implementation within DFO, individual DFO sectors and programs will be responsible for ensuring that their priority actions identified in the strategy are implemented and considered through existing programs and processes. DFO staff in national headquarters will also be engaged to ensure that the strategy is incorporated into programs and policies that are coordinated in Ottawa. Adopting a shared stewardship approach for implementation, DFO will encourage support and participation from other federal government departments, the Province of British Columbia, First Nations, industry, ENGOs, and academia to move forward on the strategies and actions proposed in this strategy.

5.4 Review

The strategy will be reviewed and revised every five years or sooner if required under direction from the Department. Recognizing that the strategy is a living document, it is important that the strategy reflect changing circumstances and conditions as they arise.

Annual progress reports on the strategy objectives and actions will be prepared by the Department, providing the opportunity to reaffirm DFO's commitment to the strategy and direction to staff. A more formal review of the strategy and associated actions will be conducted by a DFO working group chaired by the Oceans Program 5 years after its release. Other federal departments, provincial ministries, First Nations, and stakeholders will be asked to elect representatives to participate in the 5-year review and provide feedback on the effectiveness of the strategy's actions and associated implementation.

5.4.1 Process and next steps

Some of the strategies and actions described in the plan are at the strategic planning stage rather than implementation stage. They have been included because they are considered important but will require further discussion and collaboration to elaborate how to specifically carry out those aspects. The purpose of the strategy is to give guidance on the full range of cold-water coral and sponge issues to DFO managers and others with an interest. The strategy will assist in setting direction and developing or furthering programs and projects on cold-water coral and sponge conservation and research.

The Department currently utilizes several management processes to manage Canada's fishery and marine resources (e.g. Integrated Fisheries Management Plans (IFMPs), Habitat Assessments, Canadian Environmental Assessment Act – Environmental Assessments, *Oceans Act* MPA designation processes, integrated management planning, etc.), where management decisions are made based on input from DFO managers and scientists, First Nations, stakeholders, and public consultations. Where appropriate, strategy implementation and actions will rely on these existing departmental processes.

If you would like more information on the strategy or wish to discuss research, conservation and related management measures in more detail, please contact the Pacific Region Oceans Program.

5.5 Funding

The strategy identifies several actions with associated priorities related to conservation, management and research of cold-water corals and sponges. These activities will provide direction in the short-term and allow DFO to consider what actions are required for strategy implementation. Gaps in capacity do exist, especially with respect to research and monitoring needs but these will have to be dealt with through strategic planning. Much of the strategy is within the scope of work already planned or underway and can therefore be managed within existing resources. However, some of the strategies and associated actions may lead to the identification of new work which will be implemented as funding permits.

APPENDIX A: Biology of Cold-Water Corals and Sponges in Canada's Pacific Waters

Cold-water corals and sponges are sessile multicellular animals that can occupy a range of substrate types, current speeds, sediment types, and depth ranges. Cold-water corals and sponges also display a wide range in life history and reproductive strategies, both across and within their taxonomic groups. Despite their differences, as sessile organisms they are all vulnerable to mechanical damage, sediment smothering, toxicity, and potential climate change effects.

This section provides a brief overview of the diversity and taxonomy of cold-water corals and sponges in BC. It also reviews reproductive strategies, recruitment mechanisms, and age and growth patterns which are aspects of biology that help define their sensitivity, vulnerability and resilience, and ultimately their conservation limit reference points.

A1 Cold-Water Corals

For the purposes of this strategy, cold-water corals are broadly defined as marine polyps in the Cnidarian classes of Anthozoa and Hydrozoa that either produce calcium carbonate skeletons, or that have a hornlike proteinaceous axis (Cairns 2007a).

Over 80 species of cold-water corals have been identified or are believed to exist in B.C. waters (J. Boutillier, pers. comm.). There have been a number of checklists produced ranging from Austin (1985) to Jamieson et al (2007a), but with new discoveries (Cairns 2007b), new taxonomic information (France 2007) and validation of voucher specimens associated with each species, even the most recent versions require updating.

A1.1 Reproduction

A basic understanding of reproduction and recruitment is required to develop appropriate management measures for activities that affect corals and for applying this understanding to develop methods that might support rehabilitation of damaged coral colonies, groves, and reefs (Richmond 1996) Cold-water corals employ reproductive strategies ranging from asexual budding to sexual fertilization with animals having either separate sexes or being hermaphroditic (Cimberg et al. 1981).

Asexual reproduction can occur in a number of ways including, among others, the division of an existing polyp (intratentacular budding) to the formation of a new polyp in the space between two existing polyps (extratentacular budding) (MacGinitie and MacGinitie 1968). This is particularly important in the growth of colonial species. Asexual reproduction can also occur by fragmentation, whereby pieces of a parent colony break off and form new colonies (Rogers, 1999).

Sexually reproducing corals may have separate sexes (gonochoric), may be hermaphroditic, or may even display both strategies (Richmond 1996). Sexually reproducing corals exhibit two modes of fertilization and larval development: internal brooding or broadcast spawning (Cimberg et al. 1981). For internal brooding species, the eggs are fertilized internally and develop inside the animal into planula larvae prior to being released. These well-developed planula larvae are able to settle and metamorphose immediately, which may indicate that the larvae do not settle far from the parent colony. For broadcast spawners the eggs and sperm are released into the water for fertilization. Free floating fertilized eggs then require a few weeks to develop into larvae that are ready to settle. This may reduce the likelihood of fertilization, but potentially allows for settlement further from the parent colony. Some hermaphroditic corals may bundle packages of sperm surrounded by eggs and release these bundles into the water column for subsequent fertilization. This insures that the sperm and eggs are in close proximity for fertilization.

A1.2 Recruitment

Site selection and metamorphosis have been identified as critical recruitment processes (Pawlik and Hadfield 1990). The selection of a site for coral larvae to settle can depend on a number of factors such as the texture of the substrate itself (most prefer a hard substrate) and chemical cues (Cimberg et al. 1981). Once the larvae settles it must then go through a successful metamorphosis into a juvenile with a mouth and feeding tentacles.

The process of metamorphosis in corals is a chain of reactions often triggered by chemical stimulus. The triggering process is very sensitive to pollution and the process can be impaired at chronic levels of pollution too low to be detected in acute toxicity tests (Cairns et al. 1978). Prevention of anthropogenic damage and protection of water and substratum quality are likely the most effective means of supporting successful reproduction and recruitment of corals (Richmond 1996).

A1.3 Age and growth

Corals have the capability of living for hundreds of years and generally have relatively slow growth rates (millimeters per year) (Risk et al. 2002, Roberts 2002, Rogers et al. 2007). Growth varies by species and is correlated to factors such as depth, temperature and current which generally combine to translate into available food (Cimberg et al. 1981). Little is known about the age of sexual maturity for most species of cold-water coral, though available information suggests generation times are quite long. For example, estimates range from 15-25 years for a family of alcyonacean coral (Grigg 1976) and 10-31 years for some antipatharians (Parker et al. 1997; Grigg 1976). Long generation times and slow growth rates reduce the capacity of coral to recover from damage caused by human or natural disturbances. The NOAA technical report on the deep water corals of the USA also points out that the age of sexual maturity can be as late as 32 years old for some species (Lumsden et al. 2007).

A2 Sponge-Dominated Communities

Sponges belong in the Phylum Porifera. Representatives of each of the three living classes of sponges (Calcarea, Hexactinellida and Desmospongiae) can be found in BC waters. Sponges are primitive sessile aquatic animals that lack organs, possess neither a mouth nor a gut, and have no neurons or true muscle tissue (Ruppert and Barnes 1994). Most sponges have internal canal systems that continually filter water, and as a result of this, directly interact with their external environment (Austin 1985, Blake and Scott 1997). Glass or hexactinellid sponges are unique when compared to other sponges in that most of the cytoplasm is not divided into separate cells by walls but form a continuous mass of cytoplasm with many nuclei (Leys et al. 2007).

Over 250 species of marine sponges are known to exist in or in close proximity to B.C. waters (Gardner 2009). Of those, 90 have yet to be named. Sponges have existed since at least the Late Proterozoic period (800 million years ago) (Leys et al. 2007). This group of animals has undergone a major taxonomic reworking in the last decade. With over 7000 described species of extant sponges (Hooper and Van Soest 2002), Porifera is one of the most diverse invertebrate phyla both for the number of species and the range of morphological features. There are still a number of contentious issues with sponge taxonomy but for this document we will be following the classification approach of Hooper et al. (2002) (three Classes: Calcarea, Hexactinellida, and Demospongiae).

A2.1 Reproduction

Sponges undergo both asexual and sexual forms of reproduction (Leys et al. 2007). The asexual forms may vary from regeneration from broken fragments to the development and release of gemmules which consist of nutrient filled amoeboid cells (archaeocytes) surrounded by cells which form a protective coat of spongin. The archeocytes are capable of producing all sponge cell types and thus a new individual (Rupert and Barnes 1994).

In terms of sexual reproduction, glass sponges (Hexactinellida) and calcareous sponges (Calcarea) are viviparous while most Demospongiae are oviparous (Leys and Ereskovsky 2006). Most sponges are hermaphrodites although there are some dioecious species. Hermaphroditic animals generally produce eggs and sperm at different times (Rupert and Barnes 1994). While little is known about sponge sperm production, two species have been studied revealing that production of sperm is the result of flagellated cells (choanocytes) which usually are noted to provide the water current in sponges (Leys and Ereskovsky 2006). In addition, it is speculated from these two species that eggs are produced by either archeocytes or choanocytes. While it is understood that sperm is released via the osculum, it is unknown how sperm find the oocytes or how fertilization occurs (Leys and Ereskovsky 2006). For one species of calcareous sponge, during internal fertilization a sperm is engulfed by a choanocyte which then transports it to an egg where either it transfers the sperm nucleus to the egg or the egg engulfs both the carrier and the sperm nucleus (Leys *pers. comm.*). A number of sponges are known to release both eggs and sperm for external fertilization such as *Suberites*, *Tethya, Aplysilla* and *Cliona* (Leys *pers. comm.*).

A2.2 Recruitment

In most cases the fertilized eggs remain in the sponge until larval stage development is complete. Development of these larval stages varies considerably (Leys and Ereskovsky 2006). Larvae are generally free swimming for a few days prior to settlement. Most sponges will settle on a hard substrate but there are those that have adapted to anchoring in soft sediments (Leys et al. 2007).

A2.3 Age and Growth

Sponges can have life spans from one year to hundreds of years. Considering the diversity found in the phylum Porifera, growth rates are quite variable depending on the species and often difficult to determine as a result of their preferred habitat (deep water) and their unusual shapes (Leys et al. 2007). Studies on siliceous sponges from BC fjords, in particular *Rhabdocalyptus dawsoni*, have reported growth rates over the course of 3 years to average 1.98 cm/year^{-} (Leys and Lauzon 1998). Using this calculated growth rate (average rate of increase in volume), the age of an average-sized hexactinellid sponge in this study was estimated to be 35 years. With the assumption that growth rate is constant, large individuals (>1 m in length) were estimated to be about 220 years old. Austin et al. (2007) studied a different Hexactinellid sponge *Aphrocallistes vastus*, as the morphology of *A. vastus* is very different from *R. dawsoni*, and measured its growth rate by increase of surface area. An average surface area growth rate of 300 cm^2 per year was estimated. Based on this growth rate, Austin et al. (2007) estimated that a sponge with a surface area of 3.38 m^2 was about 100 years old.

In general, sponges can range in size from millimetres to over a meter in height. Bioherms or communities of several different reef building sponge species, can increase in size over the course of centuries to exceed 19 m in height, with living sponge reaching heights of up to 1.5 m (Conway et al. 2001, Krautter et al. 2001). Leys and Lauzon (1998) observed *Rhabdocalyptus dawsoni* to exhibit patterns of spicule coat thickness and sloughing that corresponded to seasonal plankton blooms. This may suggest that Hexactinellid sponges, despite their deep water habitat, experience seasonality and should be explored further with respect to potential seasonality in growth and reproduction.

Many sponges do not necessarily have a distinct growth form. Their shape is often dictated by available space, current direction and speed and slope of the substrate (Austin et al. 2007). Sponge shapes can range from upright urn-shaped, string-like and foliaceous forms to encrusting forms that inhabit vertical faces or confined spaces in crevices or under boulders (Rupert and Barnes 1994). There are also sponges that can burrow into calcareous shells of molluscs and corals.

APPENDIX B: Key Biological Factors in Cold-Water Coral and Sponge Conservation

Understanding the biology of coral and sponges is the first step to ascertaining the nature and extent of the impacts associated with various impacts and subsequently the risks to their conservation. Unfortunately the biology of B.C.'s cold-water corals and sponges is not well understood. This section discusses the feasibility of drawing conclusions for cold-water coral and sponge conservation management from their general biology. Some of the key biological and ecological factors relevant to cold-water coral and sponge conservation include: 1) the diversity, abundance and distribution of these animals; 2) their sensitivity, vulnerability and resilience to impacts and 3) their role in the ecosystem and the functions they provide.

B1 Diversity, Abundance and Distribution

As noted elsewhere in this document, we have only a cursory understanding of the diversity, abundance and distribution of cold-water coral and sponge species in Canada's Pacific waters. For example, glass sponges are thought to be abundant in the Pacific region due to the relatively high ambient silicate (as a nutrient) found in shelf depth waters (Whitney et al. 2005); however, this theory remains to be validated through surveys. Recent studies have discovered new sites of sponge reefs in shallow areas (Jamieson et al. 2007b). Information on distribution and abundance is necessary to help managers understand what proportion of the population is currently in areas of human use, whether the population is sustainable at the estimated level of impact, and whether there are areas outside of the impacted areas that may provide rescue effects for impacted areas. This information will help us understand the extent of human impacts in relation to the proportion of the total population size, whether there are possibilities for mitigation.

There are currently insufficient data to evaluate the diversity, abundance and distribution of cold-water coral and sponge species in BC. According to the precautionary principle, limited scientific data must not be used as a barrier to implementing protection. With that principle in mind, this strategy suggests a variety of science programs to rapidly assess the abundance and distribution of cold-water corals and sponges using the best available data and generating new and relevant data. These programs will inform risk assessment frameworks and allow managers to make informed protective measures in a timely fashion.

For example, species distribution models are currently being developed to predict the potential distribution of several taxa of cold-water corals and sponges in BC. Output from these models will indicate areas that are likely to have populations of cold-water corals and sponges, thus allowing us to concentrate research efforts in those areas. Other data mining activities using records from museums, observer bycatch programs and research surveys are being used to inform general status reports on the abundance and diversity of these animals. Despite the utility of these databases, it is important to note that many of these data are biased towards areas where fishing occurs and the lack of proper training on identification of these animals, at least in the case of observer records, compromises the extent to which these data can be utilized. Identification keys and other taxonomic tools are currently being developed to improve the quality of these data sources in the future.

B2 Sensitivity, Vulnerability and Resilience

Cold-water corals and sponges have come to the attention of scientists and the public due to certain biological characteristics make them particularly vulnerable to human activities. As sessile invertebrates, many of which are fragile, cold-water corals and sponges are intrinsically vulnerable to damage from bottom-contact fishing gear and other human impacts. Substantial damage to, and removal of cold-water corals and sponges by bottom-contact fishing has been documented in BC (Ardron and Jamieson 2006), Alaska (Krieger 2001, Stone 2006), the north-east Atlantic (Waller et al. 2007), on seamounts in Australia (Koslow et al. 2001) and New Zealand (Probert et al. 1997), and off the coast of Norway (Fosså et al. 2002). The long generation time and longevity of many cold-water corals and sponges decreases their capacity to recover from damage. In fact, surveys conducted in areas where trawling has not occurred for several years reveal little evidence of cold-water coral recolonization and recovery (Kreiger 2001, Waller et al. 2007).

Understanding the specific reproductive strategies used by cold-water corals and sponges is crucial for the assessment of their sensitivity, vulnerability and resilience to disturbances that may interfere with the production of potential offspring. In general, the wide range of reproductive strategies of cold-water corals and sponges reflects their ability as a group to adapt to their varied environments. However, populations that have been depleted by encounters with human activity may suffer from allee effects, inhibiting their ability to successfully reproduce. For example, species which have distinctly gonochoric individuals or colonies (e.g. Stylasterina (Fisher 1938)), may not be able to successfully reproduce if an individual of the opposite sex is not in close proximity. Brooke and Stone (2007) concluded that this reproductive trait in hydrocorals in the Aleutian Islands limits the potential for the animals to recolonize disturbed areas.

If damage from human activities is great enough, populations that are disrupted may be unable to replenish themselves and may require rescue opportunities from neighboring populations. To understand the potential for rescue effects we need to know more about the historic genetic filiations of the population and understand the biology and behaviour of the asexual and sexual reproductive products. For example, externally fertilized eggs need to develop into larvae before they are ready to settle. This may take weeks and thus subject them to extensive drift away from the parent population. This is in contrast to species where fertilization is internal and eggs are brooded until they are released as planula larvae that are immediately ready to settle. Richmond (1996) however points out that the release of fully developed larvae may actually be capable of surviving transportation over a longer period of time because of the stored food supply.

Understanding what triggers the actual settlement of the larvae is also key to evaluating the potential for recolonization of disturbed areas. Substrate, currents, siltation, sunlight, salinity, and chemical cues from specific algal species or biological films of diatoms and bacteria have all been found to be criteria for suitable sites for larval settlement. Re-establishment of disrupted patches may occur from asexual or sexual repopulation, encroachment from surrounding undisturbed assemblages, or growth of propagules that survive the disturbance (Sousa 2001). The success of these recruitment types will depend on the nature and extent of the disturbance in relation to the distribution and abundance of the population as a whole and if the receiving environmental quality is able to return to an acceptable state (Richmond 1996). Additionally, patch type, size, shape, surface characteristics, location and time of creation will also have an effect on the rate and pattern of recolonization (Sousa 2001).

Recolonization may take place using three successional species replacement models:

- facilitation – where successional species modify the environment to make it more acceptable for later successional species;
- tolerance – where early successional species have no impact on later successional species; and
- inhibition – where early successional species can pre-empt resources and inhibit settlement of late successional species as long as they remain healthy.

The succession patterns are driven by differences in species reproductive biology, growth, competitive abilities, vulnerabilities and extremes of the physical environment.

The biology related to age and growth give us an idea about the successional states of these organisms with some of the long lived, slow growing species representing late successional stages. This in turn gives managers an indication of the time it may take to recover from the disruption.

B3 Ecosystem Function

Although there has been an increase in research on the cold-water corals and sponges of Canada's Pacific Ocean in recent years, a great deal remains unknown. Many aspects of cold-water coral and sponge biology as well as the ecosystem services provided by these animals have not been described, and it is not currently known how a disruption to these key structural and functional organisms will impact other organisms in the ecosystem. Coral and sponges are key building blocks for a number of ecosystems; they are ecosystem engineers (Jones et al. 1991) in that they alter the physical environment (e.g. sedimentation, hydrodynamics) with their very presence, often referred to as foundation species (e.g. Bruno and Bertness 2001). As such they host distinctive communities of associated species that differ from the surrounding seabed in terms of taxonomic composition and biomass. They are the keystone structural and food web species in a number of unique ecosystems (bioherms, abyssal plains, seamounts). These suspension feeders are the primary benthic biomass in many deep water environments; this is an indication of their important role in the trophic dynamics of these areas.

The overall ecosystem role or function of cold-water sponges and corals in BC remains largely unknown. However, preliminary observations suggest that the increased habitat complexity provided by these animals on micro and macro levels may serve similar ecosystem functions as habitats developed by coral reefs elsewhere. Studies have identified a positive correlation between rugosity and species richness and abundance. Additionally, community structures associated with more rugose habitats (i.e. habitats having a rough or wrinkled surface) have been found to be significantly different than communities in habitats with less complexity (Jamieson et al. 2007a; Conway et al. 2007, Austin, *pers. comm.*). In general, three dimensional framework structures, such as those provided by cold-water corals or sponges, provide habitat for sessile and motile organisms of different phyla (Lehnert et al. 2005) including other sponges and demosponges, annelid worms, bryozoans, brachiopods, echinoderms, gastropods, shellfish, some bivalves and fish species (Jamieson and Chew 2002; Conway et al. 2005b, Marliave et al. 2009, Marliave and Challenger 2009).

Preliminary assessment of fisheries data indicates higher levels of fish production on sponge reef margins, which may suggest higher levels of biodiversity in general in fringe areas (Conway et al. 2007). Commercially important flatfish and rockfish species are known to use sponge reef habitat during both adult and juvenile stages (Cook 2005, Jamieson et al. 2007a). This association may suggest a refuge function (Jamieson and Chew 2005, Conway et al. 2005b), though further qualitative surveys are required to confirm this. In this context it is feasible to suggest cold-water corals and sponges in BC may play a similar role to coral reefs elsewhere.

In addition to providing habitat, sponges also act as water filterers within their ecosystem. A dive study conducted in 2008 demonstrated a flow rate of approximately 3 cm sec^{-1} and a volume of 18.4 cm^3 sec^{-1} for a specimen of *Aphrocallistes vastus* in Saanich Inlet. The sponge measured 95cm by 95cm by 70cm and contained 22 osculua; thus a sponge of this size can potentially filter up to 35 tonnes of water per day (Austin *pers. comm.*), removing small plankton. The biological and ecosystem service implications of sponge water filtration remain largely unexplored.

B4 Conclusion

To date, little research has been conducted on the impacts of fishing and other human activities on cold-water coral and sponges and their subsequent recovery rates. Recovery potential is a function of age, growth rate, recruitment, and reproduction and is complex and difficult to determine for cold-water coral and sponges. Some octocoral colonies are likely more than a century old, while some sponge reef complexes have taken thousands of years to develop. Recruitment and reproduction for BC cold-water corals and sponges are poorly understood, as is the extent of damage to colonies following encounters with fishing gear or other human activities. Based on the little information we do have on these species, it is likely that their recovery would take many decades, provided the extent of damage is not severe enough to render recovery impossible.

It is widely accepted that cold-water corals and sponges are very susceptible, and in some cases highly sensitive, to disruption and have very long recovery times. Internationally, a number of cold-water corals and sponges have been recognized as needing enhanced protection through listing under the Convention on International Trade of Endangered Species (CITES) Appendix II (http://www.cites.org/eng/app/appendices.shtml). Within Canada the federal/provincial/territorial governments are preparing a General Status of Species in Canada for 2010 (species report is published every five years).The goal of the report is to provide a general status of species in Canada to prevent them from becoming extinct or extirpated. The 2010 report will include coral and sponge species.

Ideally, risk assessments evaluating the impacts of human activities and the probability of recovery of cold-water coral and sponge populations would be conducted on a threat-by-threat and species-by-species basis. Unfortunately, given financial and time constraints, this level of detail is not possible. Impacts and taxonomic groups of cold-water corals and sponges will need to be collated according to similar effects or biological characteristics so that decisions regarding the conservation of these species can be made in a timely fashion. This pooled information can then be used to conduct risk assessments and prioritize future research. It should be noted that while threats and risk assessments are identified gaps, the studies required to fill these gaps are rather simple tasks compared to understanding how disruption of these keystone species will translate through their ecosystems.

APPENDIX C: Management Tools

There are a variety of management tools in Canada to protect cold-water corals and sponges. It may be appropriate to use different tools, or a different combination of tools to meet different goals and objectives depending on the area, type of activity, operational feasibility and costs. The Cold-Water Coral and Sponge Conservation Strategy outlines an approach to management that is objectives-based with strategies that incorporate both voluntary and regulatory measures.

As well as the management tools outlined below, public education and outreach programs are important for the success of all management measures. They will help the public gain a better understanding of the conservation measures that have been put in place and the reasons behind them.

C1 Voluntary Measures

Voluntary measures, such as agreement to avoid certain areas, may be a useful tool where risks to corals are low or where compliance with the voluntary measures is expected to be high. Voluntary measures require a high level of cooperation among users and may be difficult to achieve. They should be monitored for effectiveness and accompanied by education and outreach efforts to maximize success. Voluntary measures include formal or informal agreements by one or more industries to avoid specified areas with cold-water corals and/or sponges.

Voluntary measures may be implemented through *Codes of Practice* or management plans developed by particular industries, in conjunction with regulators. These may specify how to carry out activities in certain geographic areas, or provide general guidelines for carrying out activities.

C2 Regulatory Measures

C2.1 Fisheries and Oceans Canada

C2.1.1 PACIFIC FISHERY REGULATIONS

The *Pacific Fishery Regulations* under the *Fisheries Act* may be used to implement area closures by variation order or within license conditions. These closures may specify certain gear types or vessel class. Penalties for contravening the order or the license condition are specified. Portions of the four largest Hexactinellid (glass) sponge reef complexes in Hecate Strait have closures under the *Fisheries Act.*

C2.1.2 FISHERY (GENERAL) REGULATIONS

The Section 22 of the *Fishery (General) Regulations* under the *Fisheries Act* identifies all the license conditions that can be placed on a license. This is the main tool used by DFO to require management measures such as gear, monitoring, reporting, harvesting, allocation, and catch requirements. For example, a management option may be to set a total allowable catch (TAC) for coral and allocate it out to vessels as coral bycatch quota (which cannot be retained). This would be implemented through license conditions pursuant to Section 22 of the *Fishery (General) Regulations*. Another example may be the requirement to hail-in the capture of any corals or sponges so that other vessels can be advised of where not to fish. This would also be implemented via license conditions. Another example may be the use of gear restrictions or the requirement of certain gear accessories. This would be done through license conditions.

C2.1.3 MARINE PROTECTED AREAS

Under the *Oceans Act* DFO can establish Marine Protected Areas (MPAs) that have prohibitions on specific activities within the entire MPA or within zones established within the MPA. An MPA is a tool that can provide comprehensive and consistent management of all activities based on their potential effects on cold-water coral and sponge communities. MPA designation provides permanent protection while allowing flexibility as management measures may be adapted to new activities or new information while maintaining consistency with the identified conservation objectives for the MPA.

DFO is proposing the Hexactinellid (glass) sponge reef complexes of Hecate Strait/Queen Charlotte Sound as our candidate Area of Interest (AOI) for consideration by the Minister. The proposed glass sponge reefs have been identified as an EBSA and occur in four complexes, with large (up to 25 m in height) steep reef mounds and ridges, and vast, flat sponge meadows. The largest complex is 35 km in length and 15 km wide. If the proposed AOI candidate is approved by the Minister, DFO Oceans – Pacific will be able to proceed with a comprehensive evaluation. The post-approval process will consist of inclusive and open consultation to develop a complete assessment of the ecological, social, economic and cultural implications of protection. Further participation will be sought to determine the feasibility of an MPA for the sponge reefs, develop appropriate conservation goals, develop statement of regulatory intent, design the size and shape of the protected area, determine how activities will be managed should the AOI be designated an MPA, and develop a management plan to guide operations within the MPA.

Now that planning of a national network of MPAs is underway, there is the potential for more comprehensive protection of cold-water coral and sponge communities using different ecologically-linked management measures (i.e., not just relying upon *Oceans Act* MPAs). The draft *Policy Framework for Canada's National Network of Marine Protected Areas* being prepared collaboratively by the federal, provincial and territorial government MPA authorities describes how a range of available tools could be applied more strategically to achieve network-level objectives in addition to site-specific objectives.

C2.1.4 FISHERIES MANAGEMENT MEASURES

The *Policy to Manage the Impacts of Fishing on Sensitive Benthic Areas*, implemented by the Fisheries and Aquaculture Management branch, provides a framework to employ appropriate management measures for effective conservation of sensitive areas, coldwater coral and sponge species, communities and ecosystems. The Policy outlines a framework to employ appropriate management measures for effective conservation of sensitive areas, including cold-water corals and sponges. Available tools include fisheries closures, gear modifications, and reporting, allocation and geographic and temporal harvesting requirements. Integrated Fisheries Management Plans (IFMPs) can also be utilized to implement management actions based on the results of risk analyses conducted under the auspices of the Policy.

C2.1.5 HABITAT MANAGEMENT MEASURES

Any work or undertaking that has the potential to negatively impact fish or fish habitat such as cold-water corals, sponges or their respective aggregations may require a review by the Habitat Management Program and consideration for authorization under the *Fisheries Act*. The program-wide Risk Management Framework (RMF) is a science-based decision making framework that categorizes risks to fish and fish habitat associated with development proposals, and identifies appropriate management options to reduce risks. The Risk Management Framework provides a structured approach to decision-making that takes into account the concepts of risk, uncertainty and precaution. Through this process DFO identifies and assesses the potential effects of development proposals on fish and fish habitat. Where potential effects are identified, DFO's first preference is always to avoid harmful impacts to fish habitat through relocation, redesign and mitigation. Where it is clear that despite efforts to relocate, design or mitigate, the project will result in harmful impacts to fish habitat, a *Fisheries Act* authorization with specific conditions related to area of impact and mitigation measures will be required.

C2.1.6 INTEGRATED MANAGEMENT PLANNING

As part of Canada's Oceans Strategy, DFO is initiating an integrated management planning process for the Pacific North Coast Integrated Management Area (PNCIMA). The PNCIMA is bounded by the BC-Alaska border, the base of the shelf slope and the mainland, stretching south to Campbell River and Brooks Peninsula. The PNCIMA initiative marks a shift toward a broader ecosystem approach to oceans management, which is consistent with the Government of Canada's overall direction. The PNCIMA initiative will bring the area's stakeholders together to develop an integrated management plan for the region that provides for conservation, sustainable resource use, and economic development for oceans and coastal areas. The PNCIMA initiative will also function as an umbrella for various ocean management processes, complementing and linking existing processes and tools.

DFO's Science sector is leading the development of conservation objectives for the PNCIMA. These conservation objectives are intended to be relevant to a wide range of ecosystems and species within PNCIMA. The PNCIMA initiative will use marine spatial planning to ensure that economic, conservation, and social needs are addressed. In addition, the PNCIMA initiative is explicitly identified in the actions to achieve Research Strategy #2: opportunities for information sharing and research collaboration. Data integration and socioeconomic research and analysis facilitated through the PNCIMA initiative will help to inform management decision making with respect to cold-water coral and sponge conservation and protection.

The integrated management plan developed through the PNCIMA initiative will provide a framework for the Pacific North Coast to coordinate existing fishery advisory, species at risk, habitat assessment and MPA development processes. This will help to achieve actions identified under Management Strategy #5: protect important cold-water coral and sponge areas through implementation of new or existing management measures.

The PNCIMA initiative will also provide important links to achieve public involvement and participation in cold-water coral and sponge conservation and management, as described in Management Strategy #5. DFO communications and outreach tools may be able to reach a broader audience through the PNCIMA initiative, and information sharing between government, First Nations, industry, academia, ENGOs and the public will be facilitated by a common table for integrated planning and management. Consultation to determine important cold-water coral and sponge areas in the north coast, and to develop appropriate management measures for conservation and protection can be facilitated through the PNCIMA initiative.

The PNCIMA initiative is still in the early stages of development and as it evolves the Cold-Water Coral and Sponge Conservation Strategy will be an important guidance document in coral and sponge conservation. As the PNCIMA plan is developed and implemented, close collaboration will be necessary to ensure that the Cold-water Coral and Sponge Conservation Strategy is incorporated.

C2.2 Other government departments and agencies

C2.2.1 PARKS CANADA AGENCY

The Parks Canada Agency has the mandate to develop and implement a system of national marine conservation areas (NMCAs). They are intended to protect and conserve the full range of Canada's representative marine areas for the benefit, education and enjoyment of the people of Canada and the world. The intent of the NMCA program is to protect the representative elements of these areas while at the same time to facilitate their use in ways that do not compromise the structure and function of the ecosystems. Activities are restricted within some locations of the NMCA. NMCAs will provide a viable tool to conserve and protect cold-water coral and sponge species, communities and their habitats.

Two NMCAs are planned for the Pacific Region at this time: Gwaii Haanas NMCA and Southern Strait of Georgia NMCA.

C2.2.2 ENVIRONMENT CANADA

Environment Canada has the responsibility for designating Marine Wildlife Areas and Migratory Bird Sanctuaries to protect and conserve habitat for a variety of wildlife, include migratory birds and endangered species. Often the boundaries extend into the coastal and inshore marine areas and could include areas with corals or sponges.

C2.2.3 OTHER FEDERAL AND PROVINCIAL DEPARTMENTS, AGENCIES, AND MINISTRIES

Other federal and provincial departments and agencies may regulate and restrict activities in the sectors that they have the legislated responsibility to regulate. They may require certain operating practices in specific geographic areas. This could include areas with corals or sponges.

C2.2.4 ENVIRONMENTAL ASSESSMENTS

For all government regulators, environmental assessment processes for activities may be used to identify special areas and to set up specific requirements for those areas.

APPENDIX D: Acronyms

CBD – Convention on Biological Diversity

CITES – Convention on International Trade of Endangered Species

COSEWIC – Committee on the Status of Endangered Wildlife in Canada

CESCC – Canadian Endangered Species Conservation Council

DFO – Department of Fisheries and Oceans Canada

EBSAs – Ecologically and Biologically Significant Areas

EEZ – Exclusive Economic Zone

ERAF – Ecological Risk Analysis Framework

FAO – Fisheries and Agriculture Organization

GSRs – General Status Reports

IM – Integrated Management

***Oceans Act* MPA** – Marine Protected Area designated under Canada's *Oceans Act*

MPA – Marine Protected Area

MPAIT – Marine Protected Area Implementation Team

MPnA – Marine Protection Area

NGSWC – National General Status of Wildlife in Canada

NMCA – National Marine Conservation Area

LOMA – Large Ocean Management Area

OCC – Oceans Coordinating Committee

PNCIMA – Pacific North Coast Integrated Management Area

ROV – Remotely Operated Vehicles

ROPOS – Remotely Operated Platform for Ocean Science

SARA – Species At Risk Act

SFF – Sustainable Fisheries Framework

UNEP – United Nations Environment Programme

VME – Vulnerable Marine Ecosystem

APPENDIX E: Definitions

Adaptive Management: Evaluation of management effectiveness and the application of new knowledge to adjust management regimes to achieve long term sustainability.

Anthropogenic: Human-caused impacts

Asexual Budding: Offspring are produced by growing out of the body of the parent and is genetically identical to the parent.

Benthic Ecosystem: An ecosystem found on the seafloor, including the slope of the Continental Shelf

Biodiversity: The variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.

Coral: Sessile marine organism belonging to Phylum Cnidaria that may be solitary or as part of a colony, inhabiting soft and rocky substrates from the intertidal to deep-sea environments.

Cold-water Corals: Animals belonging to Phylum Cnidaria encompassing stony corals (Scleractinia), soft corals (Octocorallia, including “precious” corals, gorgonian sea fans and bamboo corals), black corals (Antipatharia) and hydrocorals (Stylasteridae). They are azooxanthellate (lack symbiotic dinoflagellates) and often form colonies supported by a common skeleton.

Communities: A major concentration of biologically or ecologically significant corals or sponges in a notably higher density than other surrounding areas.

Coral Reef: A structure that is made from the skeletons of soft-bodied coral animals or polyps.

Ecologically and Biologically Significant Area (EBSA): An area which provides a biological or ecological function which is considered relatively more important than the surrounding areas. The identification of EBSAs is guided by Canadian Science Advisory Secretariat Ecosystem Status Report 2004/006, which advises the use of three primary criteria (uniqueness, aggregation and fitness consequences) and two secondary ones (resilience and naturalness).

Ecosystem Approach: An approach to the management that recognizes the complexity of ecosystems and the interconnections between populations, communities and habitat, as well as the impacts of the ecosystem on the state of the living resource.

Ecosystem-based Management: Management of human activities so that ecosystems, their structure, function, composition, are maintained at appropriate temporal and spatial scales.

Ecosystem Services: The benefits people obtain from ecosystems. These include provisioning services such as food; regulating services such as flood control and shoreline protection; cultural services such as spiritual, recreational and cultural benefits; and supporting services such as nutrient cycling that maintain the conditions for life on Earth.

Fish Habitat: All areas that fish depend on directly or indirectly throughout their life stages. It includes spawning grounds and nursery, rearing, food supply and migration areas.

Integrated Management (IM): A continuous process through which decisions are made for the sustainable use, development, and protection of areas and resources. IM acknowledges the interrelationships that exist among different uses and the environments they potentially affect. It is designed to overcome the fragmentation inherent in a sectoral management approach, analyzes the implications of development and conflicting uses, and promotes linkages and harmonization among various activities.

Keystone Species: A species that has a key role in an ecosystem, affecting many other species, and whose removal leads to a series of extinctions within the ecosystem.

Marine Protected Area (MPA): An area legally established to protect all or a portion of the sea surface, water column, seabed, and / or associated flora, fauna and recreational, scientific, cultural and historical features, and may include an area established under Canada's *Oceans Act, National Marine Conservation Areas Act, National Parks Act, Canada Wildlife Act, Migratory Birds Convention Act,* or British Columbia's *Park Act, Protected Areas of British Columbia Act, Ecological Reserve Act, Environment and Land Use Act, Land Act, or Wildlife Act.*

Ocean Acidification: A measurable reduction in ocean pH caused by increased concentrations of CO_2 in seawater.

Pacific North Coast Integrated Management Area (PNCIMA): One of several Large Ocean Management Areas created for ecosystem based management of human use in marine areas by DFO.

Polyp (zooid): The single form of organism in cnidarians; generally consisting of a soft-bodied individual with a mouth surrounded by tentacles. In solitary forms of cnidarians, the polyp attaches to the ocean floor or other organisms where as in colonial forms, will share a skeleton with other polyps.

Precautionary Approach: An approach to decision making and risk management that recognizes that if there is both high scientific uncertainty and a risk of serious or irreversible harm, a lack of adequate scientific information will not be used as a reason for failing to take, or for postponing, cost effective measures for the conservation or protection of fish or fish habitat that are considered proportional to the likely severity of the risk

Resilience: The capacity of a system to absorb stresses and continue functioning.

Risk Management: The identification, assessment, and prioritization of risks followed by coordinated and economical application of resources to minimize, monitor, and control the probability and/or impact of unfortunate events or to maximixe the realization of opportunities.

Sensitivity: The ability of an organism or part of an organism to react to a stimulus.

Sensitive Benthic Area: An area that is vulnerable to a proposed or ongoing anthropogenic impact. Sensitivity will be determined based on the level of harm that an impact may have on the benthic area by degrading ecosystem functions or impairing productivity.

Sponge: Sessile organisms, forming unique three-dimensional living habitat structures that occupy depths from the intertidal to the deep sea abyss, including seamounts.

Sexual Dimorphism: Distinct difference in appearance between males and females of the same species.

Spillover: The emigration of adults and juveniles across MPA borders.

Uniqueness: As described in the national EBSA guidelines, the degree to which the characteristics of an area are described as unique, rare, distinct, and have no alternatives.

Vulnerability: The degree to which a system is susceptible to, and unable to cope with, adverse impacts of stressors. Vulnerability is a function of the character, magnitude, variability, and rate of climate change to which a system is exposed, its sensitivity and its adaptive capacity.

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