Evaluating the role and designation of critical habitat for conserving Canadian marine species at risk: a decision framework

By

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DEDICATION PAGE

To my supportive and patient partner in crime, Jeff; to my wonderfully supportive family and friends that have encouraged me throughout this extensive educational journey; and finally, to my fellow MMMers:

"Good company in a journey makes the way seem shorter."

- Izaak Walton

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ABSTRACT

Human-induced activities are increasing the rate at which species and their habitats are declining. The Canadian *Species at Risk Act* (SARA) offers a protective framework for species and their habitat. To receive full habitat protection, however, requires that the critical habitat be identified in the recovery planning process. The designation of critical habitat for marine species is a particularly challenging task due to a limited understanding of marine species and their habitats. For many reasons, the federal government struggles to meet the legal requirement of defining the critical habitat of marine species when, for many, habitat loss or destruction is a minor threat. The assessment of COSEWIC status reports and SARA recovery strategies for marine species at risk demonstrated that the primary threat to these species is overexploitation, resulting from either direct (extraction) or accidental (bycatch, vessel strikes) mortality. Human activities that have the potential to physically destroy the habitat include commercial or industrial activities, such as dredging and bottom trawling, as well as threats that result in the depletion of prey or degradation of prey quality. Given the multitude of threats facing marine species at risk, and the limited capacity for dealing with conservation issues, efforts must prioritize where time and money is spent. This report proposes a decision-framework meant to be used as a tool to determine the amount of time and resources that should be invested in the designation of critical habitat during the recovery planning process for species at risk, with the overall goal of rendering recovery planning under SARA more transparent, defensible, and efficient.

Keywords: marine; critical habitat; Species at Risk Act; SARA; habitat loss; threats; decision-making; biodiversity; endangered species

LIST OF ABBREVIATIONS USED

CBD – Convention on Biological Diversity

COSEWIC – Committee on the Status of Endangered Wildlife in Canada

DFO – Fisheries and Oceans Canada

DU – Designatable Unit

ESA – Endangered Species Act

GIC – Governor in Council

IUCN – International Union for the Conservation of Nature

NGO – Nongovernment Organization

SAR – species at risk

SARA – Species at Risk Act

TAP – Threat Abatement Plan

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CHAPTER 1: INTRODUCTION

1.1 The Importance of Conserving Biological Diversity

With a vast array of natural habitats that include coastal communities, forests, wetlands, tundra, and grasslands, it is not surprising that Canada contains a rich diversity of wildlife. Its geographic area covers over 15 million square kilometers of land and water, making it the second largest country on Earth. While over 70,000 plant and animal species have been recorded in Canada, there is potentially at least two to three times more species to be found (Hutchings et al. 2012). Many of these species are either rare or at risk of becoming extinct because of human and environmental pressures. In recent years the increasing intrusion of human activities has advanced the rate at which species are disappearing (Wilcove et al. 1998). Natural biological diversity has ecological, economic, social, cultural and intrinsic values, helps maintain the stable functioning of our environment and improves the productivity and resilience of ecosystems (Wilson 1992). Important services provided by natural systems include flood control, water purification, seed dispersal, pollination, pollutant removal, nutrient cycling, habitat provision and shelter. These services support a wide variety of industries (agriculture, cosmetics, pharmaceuticals, pulp and paper, construction), as well as many services we require in our daily lives (food security, cultural well-being, waste treatment). As a result, the loss of biodiversity, by natural means or from human activities is undesirable. Canada depends on biodiversity and diverse natural habitats and wildlife are a part of our national identity. It is the basis of our economy and our culture and as such, the protection and conservation of this diversity is fundamental.

1.2 Species Protection in Canada

Answering an international call to take action against environmental destruction and loss of species and ecosystems, Canada was the first major industrialized nation to ratify the Rio Convention on Biological Diversity (CBD) at the meeting of world leaders in 1992 (Mooers et al. 2007). The Convention supports the growing global commitment to sustainable development by representing a critical step forward in the conservation of biological diversity, the sustainable use of its components, and the fair and equitable

sharing of benefits arising from the use of genetic resources (Minister of Supply and Services Canada 1995). The acknowledgement that each species plays a role in an ecosystem, the limited understanding of the functional importance of different species and populations, and the impact of their loss on the functional integrity of ecosystems, has prompted the adoption of a precautionary approach to the assessment, conservation, and protection of Canadian biodiversity (Hutchings et al. 2012). As part of its commitment to the conservation and sustainable use of biodiversity, in 2002 Canada passed the *Species at Risk Act* (SARA) to offer some legal protection to rare species and those threatened by human activities, as well as a framework for the recovery of species at risk of extinction. As of mid-2012, approximately 470 species of plants and animals have been classified under SARA as being extirpated, threatened, endangered, or of special concern (Government of Canada 2011).

1.3 Causes of Species Loss

Knowing the causes of species loss and reduced genetic diversity is critical to eliminating this potential loss of biodiversity. Venter et al. (2006) report that habitat loss is responsible for over 80% of species decline in Canada. Urbanization and agricultural development are primary causes of loss of habitats on land and in coastal habitats (Primack 2006, Hutchings & Festa-Bianchet 2009). Other human-based threats that cause a loss of species include pollution, overharvesting, artificial introduction of invasive species, the spread of disease and various threats associated with climate change (changing temperature regimes, sea level rise, ocean acidification, and UV exposure; Crain et al. 2009).

Overexploitation has been and continues to be a formidable threat to marine species and ecosystems due to our reliance (economic and consumptive) on living resources of the sea (Crain et al. 2009). Overexploitation is a major problem for many species because it is a direct (harvesting) and indirect (bycatch) cause of mortality, it depletes prey, alters habitat and can have a variety of negative indirect effects (Kappel 2005, Venter et al. 2006). Other ocean uses are also threats to species at risk (SAR); ship collisions, whale watching, offshore exploration for oil and gas, military activities, land- and vessel-based pollution, and coastal aquaculture operations (Vanderzwaag & Hutchings 2005).

1.4 The SARA Process

To reduce mortality or increase recruitment it is imperative to create an action plan that addresses known and potential threats to species and their habitat. SARA requires that focus be given to preventing the destruction of significant habitat by defining and designating critical habitat for species conservation. Determining what is critical to the survival of a species in an enclosed and directly observable area, such as a marsh, pond, or terrestrial habitat, is relatively less complex than for a species living below the surface of the vast reaches of the open ocean. For example, the Greater Sage-Grouse, a bird with a Canadian range of southeastern Alberta, and southwestern Saskatchewan, is associated year round with sagebrush habitat, relying on it for feeding, breeding, nesting, and brood-rearing (Government of Canada 2012a). Without these specific conditions the Sage-grouse cannot survive.

It is far more complicated to draw boundaries in the ocean, particularly for very mobile species such as large whales or leatherback turtles. For many marine species, it is the dynamic features of the locations they frequent that determine their presence in that location. For example, leatherback turtles come to Atlantic Canada every year to feed on jellyfish. If the jellyfish move, then the turtles move. Therefore, it seems relevant to place greater importance on the functional aspects of the habitat (e.g., prey availability, water quality and noise) and to manage these.

For many reasons, the federal government often struggles to meet the legal requirement of defining the critical habitat for many marine species, even when habitat is not considered to be a limiting factor for species recovery. A lack of knowledge, such as habitat requirements of a species at various life stages or the size of habitat required to meet the recovery objectives, are frequently cited as the primary impediment to the identification of critical habitat when developing recovery strategies (Office of the Auditor General of Canada 2008).

1.5 Project Goal

Here we propose that many marine SAR are not actually threatened by the physical destruction or loss of their immediate habitat, and that the designation of critical habitat under SARA is tailored more toward the terrestrial environment such that under certain

circumstances the same criteria for designating marine critical habitat may not be relevant. This report will test these predictions and evaluate the results based on the following questions: (1) how common is the loss of habitat listed as a threat for marine species at risk? (2) What human activities cause this loss of habitat? (3) What constitutes the destruction of marine critical habitat? (4) Does defining critical habitat (as it is currently done) improve the conservation of marine species at risk, and is there a need to define it to the extent it is? (5) What are the management options, or alternative mechanisms, available to deal with critical habitat? Furthermore this paper will make recommendations on how to meet the obligations for species listed under SARA and to improve the conservation of marine species at risk through SARA.

CHAPTER 2: THE SPECIES AT RISK ACT (SARA)

The government of Canada states that wildlife and nature are an integral part of our national identity and history, as well as a part of the world's heritage, and that it is committed to conserve and protect natural areas, species, and their habitat. Canada's *Species At Risk Act* (SARA) is one of several tools to help protect wildlife species and their habitat, and ultimately prevent the loss of biodiversity. SARA became federal law in 2003 and was created to prevent wildlife species from "…becoming extirpated or extinct, to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity, and to manage species of special concern to prevent them from becoming endangered or threatened" (SARA 2002, Section 6, p.8).

Established under SARA, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), an independent scientific advisory body, is responsible for the biological assessment of wildlife species considered to be at risk of extinction in Canada (Table 1). The committee is comprised of members from academia, several levels of government, nongovernmental organizations (NGOs), independent scientists and the aboriginal community. Many of the latter are specialists in the specific study of birds, terrestrial and marine mammals, freshwater fishes, marine fishes, amphibians and reptiles, plants and lichens, and molluscs and Lepidoptera (COSEWIC 2011a).

Table 1. Definitions of endangerment levels for species at risk in Canada (COSEWIC, 2011a)

Level of Endangerment	Definition
Extinct	A wildlife species that no longer exists.
Extirpated	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered	A wildlife species facing imminent extirpation or extinction.
Threatened	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern	A wildlife species that may become a threatened or an endangered wildlife species because of a combination of biological characteristics and identified threats.
Not at Risk	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient	A category that applies when the available information is insufficient (a) to resolve a wildlife species' eligibility for assessment or (b) to permit an assessment of the wildlife species' risk of extinction.

COSEWIC meets annually to assess the status of wildlife species and reports this assessment to the competent Ministers responsible for SARA. The three lead agencies responsible for protecting SAR are Environment Canada, Fisheries and Oceans Canada (DFO), and Parks Canada. The Minister of DFO is the responsible Minister for all aquatic (freshwater and saltwater) species other than those on lands owned by Parks Canada. Upon receiving an assessment of a species from COSEWIC, the Minister decides if a species will be protected by (i.e. listed under) the SARA and makes the recommendation to the Governor in Council (GIC). The GIC, the subcommittee of the federal Cabinet responsible for rendering legal listing decisions on each species assessed by COSEWIC, makes the final listing decision, which involves three options: accept COSEWIC's recommendation, decline the recommendation, or return the recommendation to COSEWIC for further clarification (SARA 2002, Section 27(1.1)).

The Act recognizes that knowledge of wildlife species and ecosystems is critical to their conservation. Perhaps more importantly, it acknowledges that the habitats of SAR play a key role in their conservation. Thus, to protect SAR the Act explicitly provides tools to address threats to populations and to prevent any loss of habitat.

There are three schedules attached to SARA: Schedule 1 is the official List of Wildlife Species at Risk, and comprises the only species that are afforded legal protection under SARA by means of prohibitions; Schedules 2 and 3 are lists of endangered or threatened species and species of special concern respectively that have yet to be reassessed by COSEWIC (Environment Canada 2003). Listing under Schedule 1 of SARA activates a number of regulations. Individuals listed are protected from being killed, harmed, harassed, captured or taken (SARA 2002, Section 32). Sanctions also exist for damaging or destroying the residences of those species (SARA 2002, Section 33), as well as the destruction of their critical habitats (SARA 2002, Section 58). These prohibitions apply automatically to all species on federal land, including aquatic species and migratory birds. The province and territories have jurisdiction over species protection on non-federal lands. The Minister my make a recommendation to the GIC that the first-order prohibitions under SARA be applied to SAR on non-federal lands if it is determined that provincial or territorial jurisdiction is not sufficient to provide protection to the species or population in question (Environment Canada 2009). Protection of SAR

on privately owned property is achieved through a conservation agreement made between the competent Minister and the landowner (SARA 2002, Section 11).

As part of the recovery planning process, the preparation of recovery strategies and action plans is required for species that are under the endangered, extirpated, or threatened risk categories, and management plans are necessary for species under the special concern risk category. The development of a recovery strategy for listed wildlife is an important step in this process, as it identifies the critical habitat to be protected, and leads to the action plan that establishes the management measures to assist the recovery of the species at risk, including measures to protect critical habitat (Vanderzwaag & Hutchings 2005).

2.1 Critical Habitat

In order to maintain, protect and restore the habitat needed to ensure the survival of a species, that habitat must first be identified. The Act requires that critical habitat - the habitat necessary for the survival or recovery of wildlife species (SARA 2002, Section 2.1) - must be identified in a recovery strategy "to the extent possible, based on the best available information" (SARA 2002, Section 41.1). Critical habitat can include breeding sites, nursery areas, or feeding grounds. The purpose of critical habitat in SARA is to maximize the chances of species recovery while minimizing the risk of species loss by ensuring that the identified critical habitat is protected from human activities that would result in its destruction (Environment Canada 2009).

The first step in the process of designating critical habitat is to describe any attributes of the habitat that are required for the listed species to carry out the life history processes necessary for its survival or recovery (Environment Canada 2004, 2009). These attributes can include geological, vegetative, topographical, climatological, physical, chemical, or biological conditions. Next, geographical location is identified and described to the extent possible of all habitats within the range. The final steps include the rationalization of the particular habitat area including an indication of any potential need to create or restore habitat, threats to the habitat, and implementation factors, as well as the determination of the critical habitat by the Competent Minister followed by its formal declaration in a recovery strategy (Environment Canada 2004). If the designation of critical habitat in the

recovery strategy is not feasible, it is mandatory to include within this document a schedule of studies to facilitate the determination of the critical habitat. Recovery strategies are required to indicate the potential threats to the survival of the species and threats to their critical habitat. Moreover, these documents must outline approaches for addressing potential threats.

While the designation of critical habitat represents a major component of the recovery planning process required under SARA, there remain numerous implementation limitations that can hamper critical habitat designation. First, the definition of critical habitat is somewhat circular. It is described as the habitat necessary for the survival or recovery of wildlife species and identified in the recovery strategy or action plan, but there is limited guidance as to what is included in the definition. The Act does not define the terms 'survival' and 'recovery,' leaving this open to broad interpretation. In addition, the fact that critical habitats only need to be identified "to the extent possible" is a limiting factor (Vanderzwaag & Hutchings 2005). This frequently delays conservation efforts for wildlife SAR, particularly in the marine environment due to a limited understanding of the ecology of many marine populations (Rosenfeld & Hatfield 2006). The lack of a clearly defined process for critical habitat identification, clarity for how the destruction of critical habitat will be prohibited, and regulation for potential compensation for individuals that might suffer losses from the designation of critical habitat are also among the impediments to critical habitat designation (Vanderzwaag & Hutchings 2005). Consequently, not only have recovery strategies often failed to identify critical habitat when it was possible to do so, the majority of recovery strategies have been delayed, ignoring legal timelines (Moorers et al. 2010). Despite the legal mandate, critical habitat has only been designated for four marine SAR. The absence of a specific definition of critical habitat means there is no explicit habitat protection, a significant obstacle to effective preservation of biodiversity.

2.2 Protection of Critical Habitat

Once critical habitat is identified under SARA, the Competent Minister must ensure that it is legally protected; either directly under SARA through the issuance of a protection order, or indirectly with a protection statement. A protection statement

describes how critical habitat is already protected under other acts of Parliament, whereas a protection order applies the SARA prohibition against the destruction of critical habitat (SARA 2002, Section 58). The federal government has had a tendency to rely on protection statements, which mainly depend on the discretionary laws of the *Fisheries Act* for the protection of critical habitat (David Suzuki Foundation et al. v. the Minister of Fisheries and Oceans and the Minister of the Environment 2010). Furthermore, they fail to address the non-physical threats to critical habitat, such as reduced prey availability, environmental contamination, and acoustic disturbance (Environmental Law Centre University of Victoria 2010). Until recently, a protection order had never been issued. Therefore, it is not surprising that the protection of critical habitat for SAR has been slow and problematic (Mooers et al. 2010). A frequently cited problem is that they are inclined to only account for the geophysical and/or geospatial elements of the critical habitat of SAR within the protection order, and use their discretion to manage the functional attributes (Environmental Law Centre University of Victoria 2010).

A recent example of SARA's strong protections for SAR comes from a case that Ecojustice brought forward on behalf of nine environmental groups to protect the killer whaler (*Orcinus orca*) and their habitat. The groups challenged the suitability of a protection statement issued by the DFO to protect the orca critical habitat (David Suzuki Foundation et al. v. the Minister of Fisheries and Oceans and the Minister of the Environment 2010). The Federal Court ruled the protection statement as unlawful, and that it could not be substituted for the protection of critical habitat required by SARA because of the unlimited discretion of the Competent Minister to authorize activities that destroy the habitat described therein. An important consequence of this ruling is that the federal government has had to revise their approach to critical habitat identification to include the features that support the function of the habitat. It is now required under SARA to protect these key components of the critical habitat of the northern and southern resident killer whales off the coast of B.C. The DFO must now ensure that the whales get enough fish to eat and that they are protected from increasing pollution and noise caused by vessel traffic. Thus, it is compulsory that a certain portion of Chinook salmon is allocated to the whales and their young in years when the population abundance of the salmon is low (Ecojustice 2012). It is noteworthy that, while this judicial ruling sets a

precedent for the protection of critical habitat, litigations are not the most efficient or cost-effective method of achieving species conservation.

An overarching issue is whether critical habitat designation actually helps recover threatened and endangered species. Under the United States (US) *Endangered Species Act* (ESA), for example, critical habitat designations have not substantially increased the likelihood that species will exhibit improving status trends (Clark et al. 2002). It is important to note that the critical habitat designation process in the US differs from Canada in that critical habitat must be defined at the time of listing, which may be the reason for the status trend that Clark et al. (2002) observed. Yet this finding is still cause for concern, as the practice of naming critical habitat can delay the recovery plan implementation, both in the US and Canada. Further confusing matters is the variability with which the concept of habitat is understood and SARA's poor definition of 'destruction'. As such, there are two issues that must be considered: the definition of habitat and the interpretation of destruction.

CHAPTER 3: WHAT IS HABITAT?

The concept of habitat is one of the oldest and most central to ecology and has had a contentious history (Yapp 1922, Naiman & Latterell 2005). Relationships between animals and their particular environment are used to determine species distribution, evaluate population dynamics, predict abundance, and to assess the impacts of anthropogenic activities. However, to define habitat unambiguously is difficult (Krausman 1999, Mitchell 2005) because organisms interact with their surroundings at different scales and in different manners such that the habitat of one species is not necessarily the same as the habitat of another that lives in the same area (Kotliar & Wiens 1990, Johnson et al. 2002). Furthermore, the habitat of a species can change temporally as a species grows and moves through each life history stage. As a result, the use of the term 'habitat' is diverse.

There have been numerous and, at times, complex attempts to definitively characterize the concept of habitat (Corsi et al. 2000). Habitat is typically conceived as the range of environments or communities over which a species occurs (Whittaker et al. 1973). The Oxford English Dictionary (OED) defines habitat as, "the natural home or environment of an animal, plant, or other organism" (OED 2012a). This is consistent with Krebs' (2001) ecological definition of habitat as, "...any part of the biosphere where a particular species can live, either temporarily or permanently". In more general terms, habitat is a proxy for place and, according to some (Odum 1971, Dennis et al. 2003, Morrison et al. 2006), an animal's habitat is the place where it lives out its life cycle that has physical and biotic features important for growth and survival. This concept connects the presence of a species to an area's physical and biological characteristics, suggesting influences beyond vegetation or vegetative structure. The space must include food, water, living space, and shelter from weather events and predation. In this context, habitat is species-specific and can vary over space and time.

Most animals occur in specific areas that provide the basic necessities of food, water, and shelter. The characteristics of an area or the requirements of a species may alter, and thereby lead to non-occupancy in, that area. In the case of mobile organisms these changes precipitate movement to locations that have conditions more suitable for their

requirements. Therefore, the definition of habitat is often extended to include not just the location, but also the resources and conditions necessary for its occupancy by a specific species. Accordingly, migration and dispersal corridors and the land that animals occupy during breeding and nonbreeding seasons are considered habitat (Hall et al. 1997).

With regard to SAR, the most important definition of habitat is that of Canadian legislation because the characterization of critical habitat is a subset of this. SARA identifies "habitat" (s. 2(1)) as:

> "(a) in respect of aquatic species, spawning grounds and nursery, rearing, food supply, migration and any other areas on which aquatic species depend directly or indirectly in order to carry out their life processes, or areas where aquatic species formerly occurred and have the potential to be reintroduced; and
>
> (b) in respect of other wildlife species, the area or type of site where an individual or wildlife species naturally occurs or depends on directly or indirectly in order to carry out its life processes or formerly occurred and has the potential to be reintroduced." (p. 5)

The conventional approach to defining the habitat of a species is physical-, or location-based. While this method is used to develop general descriptors of the distribution and abundance of animals and may offer insight into the factors that affect survival and fitness, it is only part of the picture (Morrison et al. 2006). The distribution of species is very much tied to the concept of niche, which is essentially a species' "ecological position in the world" (Vandermeer 1972). A niche determines the distribution of a species, as it is based on an organism's morphological, physiological, and behavioral adaptations to its environment (e.g. dietary constraints, limitations due to competition or predation; Moyle 2012). A profusion of a species is a function of its ecological niche, or the total abiotic and biotic requirements of a species determining where it can live and its abundance at that place (Krebs 2001). A species' physiological niche is the potential distribution of a species when it is free from competitive exclusion and predation (Morrison et al. 2006). Overall, the niche-based method of defining habitat considers all of the components upon which the animal-habitat relationship depends and the role of the species within its environment.

The importance of a 'niche'-based approach to understanding habitat is increasingly

recognized. To illustrate this, Environmental Defence Canada brought forward a case to protect the Nooksack Dace (*Rhinichthys cataracta*) and its critical habitat. The Federal Court ruled that a location is only identifiable because of the special features within that location upon which the species depends to carry out its life processes, and habitat is not just an area on a map (Environmental Defence Canada v. Fisheries and Oceans Canada 2009). In other words, the location of a habitat and its features are inextricably linked.

3.1 Habitat of Marine Species

In the ocean there are many different types of habitats, or environments, in which marine species live. Marine habitats can be divided into coastal and open ocean habitats. Coastal habitats are dynamic environments that extend from the shoreline out to the continental shelf. Alternatively, marine habitats can be divided into pelagic (near surface or in the open water column), demersal (near or on the bottom of the ocean), or benthic (ocean bottom including sediment surface or subsurface) zones. Types of marine habitats vary in regard to physical characteristics and features that include hard bottoms, rocky or soft shorelines, and marine/brackish marshes. In addition, various organisms can modify the habitat such that new habitat is created that may benefit other organisms (e.g. coral reefs, mangroves, sea grasses, and kelp). Each habitat supports a distinct assemblage or marine life.

3.2 Structural and Functional Characteristics of Habitat

All habitats have distinct structural and functional elements. The structural components of a habitat include the physical, chemical, and biological characteristics that define that habitat (Thayer 2003). These characteristics may include light levels, water temperature, composition of substrate, and the chemical nature of water. The functional characteristics of a habitat are generally biological or ecological, and include rates of predation, rates of breeding success, availability of energy (food), and acoustic conditions (DFO 2004). These components contribute to the suitability of a habitat for marine species and they can vary spatially and temporally. For example, some species are more dependent on the physical structure of habitat at certain life history stages. The Atlantic Cod (*Gadus morhua*) is dependent on bottom structures such as rock bottoms and

seagrass during juvenile stages for protection from predation (COSEWIC 2010a). The specific location of functional habitats may not always be known or may not be able to be determined. However, structural components can typically be geographically referenced such that the habitat can be mapped (DFO 2004).

3.3 Habitat of Marine Species at Risk

Habitats of marine species are poorly understood because there is a greater diversity of habitats in the ocean and because it is often difficult to determine these habitats below the surface of the ocean. Habitats of Canadian marine SAR range from the pelagic zone (blue shark, porbeagle) to benthic habitats (Northern wolffish). Some species spend a portion of their life cycle in the upper water column of the pelagic zone and then settle to benthic habitats (rockfish species). Others migrate from freshwater spawning habitats to marine feeding areas (salmon species), and some even rely on patches of beach in shallow waters (Northern resident killer whale). While some species undertake large migrations and traverse the open ocean from tropical breeding grounds to cooler, more productive ocean basins (North Atlantic right whale), others range less, but frequent many habitats including those beyond the ability of humans to explore (e.g. Northern bottlenose whales in the deep water canyons of the Scotian Shelf year-round). This variability and limitation in our understanding of marine habitats present a challenge for defining the critical habitat of marine species.

3.4 Critical Habitat

Every species requires a specific habitat to survive. If this habitat is destroyed, individuals may not be able to survive or reproduce, increasing the likelihood that they will become extinct (Tilman et al. 1997, Wilcove et al. 1998). Critical habitat is primarily used as a legal term. It describes the physical and biological features essential to the conservation of a species (Krausman 1999). The purpose of identifying critical habitat within SARA is to ensure that it is protected from human activities that would result in its destruction (Environment Canada 2009). The concept of critical habitat must also be linked with the concept of habitat quality, or the ability of an area to provide resources for the persistence of a population (Krausman 1999). As such, in distinguishing critical

habitat, the amount, quality and locations of habitat needed to sustain the population and distribution objectives established in the recovery strategy are taken into account (Environment Canada 2009). In defining critical habitat under SARA, not only must the geographic location of the critical habitat be specified, but there must also be a description of the biophysical features required by the listed species to carry out life processes necessary for its survival or recovery, such as prey, water temperature, or a riffle in a stream (Environment Canada 2009).

Habitat selection is one of the most poorly understood ecological processes (Krebs 2001). Consequently the identification of a species' critical habitat remains a challenge, and particularly so for marine species. The primary challenge to accomplishing this is limited resources, but other challenges include incomplete knowledge of the distributional patterns of many migratory species, the manner in which they use habitats, and the abundance and distribution of species (Rosenfeld & Hatfield 2006).

Many species-habitat relationships are intuitive and readily observable. For example, the black footed ferret that is limited by the prairie dog habitat, or the piping plover that is restricted by beach habitat for nesting (Mitchell 2005). Ultimately, in many terrestrial situations, actions can be initiated that result in a cause-and-effect relationship (Mitchell 2005); when the threat is removed (i.e. habitat loss due to agriculture and urbanization), there is a population increase.

Threats to marine species are more complex and are difficult to contain or correct. This is because often it is not changes to the structural components of the marine habitat that cause a population to decline. Often it is functional factors like resource availability and trophic relationships that are disrupted by human activities, and thus require attention. Drawing lines on a map do not necessarily adequately protect a species or its habitat in the marine environment. Yet, conservation efforts remain focused on designating and protecting critical habitat.

CHAPTER 4: DEFINITION OF DESTRUCTION

Habitat changes are a natural process, often with temporary or reversible effects. Species tend to adapt to natural variations in habitat. In contrast, human-induced habitat changes are often sudden, large, and may last longer, subsequently stressing on the species or a population.

Habitat destruction is thought to be the leading cause of endangerment for species at risk of extinction, and therefore the primary reason for the trend of decreasing biodiversity (Ehrlich 1988, Tilman et al. 1997). This is particularly true of terrestrial and freshwater environments, a result of land-use changes associated with the expansion of human populations and activities (Primack 2006, Venter et al. 2006). In this sense, the most important means of protecting biodiversity is through habitat preservation. Accordingly, identifying critical habitat and protecting it from destruction are key strategies of SARA. A limitation to this, however, is that destruction is not defined in SARA and is often broadly interpreted.

In general, destruction is defined as either, "the process of causing so much damage to something that it no longer exists or cannot be repaired", or "the action or process of killing" (OED 2012b). With regard to the threats to marine SAR, these definitions relate to destruction of habitat and destruction of organisms.

4.1 Destruction of Critical Habitat under SARA

In ecology, habitat destruction generally refers to a change in the physical or structural features that distinguish one area from its surrounding areas (Primack 2006). On land, these changes are often readily observable. Examples of human activities on land that meet this description include agriculture, commercial and residential development, livestock grazing, pollution, and the ever-increasing development of road networks (Primack 2006). Human impacts on the marine environment are less conspicuous, more difficult to measure and have received considerably less study (Primack 2006). Nevertheless, commonly recognized examples of threats to marine habitats include pollution, dredging, sedimentation, destructive fishing practices, aquaculture development and invasive species (Kappel 2005, Primack 2006, Venter et al.

2006). A vital question remains: do these activities constitute destruction within the legislation contained by SARA?

Under SARA, destruction of critical habitat is typically determined on a case-by-case basis, and "would result if any part of the critical habitat were degraded, either permanently or temporarily, such that it would not serve its function when needed by the species. Destruction may result from single or multiple activities at one point in time or from cumulative effects of one or more activities over time" (Government of Canada 2009). More specifically, destruction can be interpreted as when the habitat no longer exists, spawning habitat is no longer suitable for successful breeding, food supply habitat no longer produces sources of food, a permanent change to the habitat that renders it unsuitable or functionally unable to support the species originally present, or a permanent loss of functions supplied by the habitat (Clark et al. 2010, DFO 2010a). In this sense, destruction of critical habitat is linked to the destruction of the components of the habitat that affect life history processes important for species survival and recovery.

The Federal Court has supported the inclusion of the destruction of the components of a species' critical habitat in the definition of destruction. In a case brought forward to protect the Nooksack Dace (*Rhinichthys cataractae*) and its critical habitat, the court ruled that a place or geo-spatial coordinates could not be destroyed in their entirety (Environmental Defence Canada v. Fisheries and Oceans Canada 2009). It was decided that critical habitat designation and protection must include the area that contains the biological and physical features needed to carry out essential life processes otherwise the area would not be necessary for the survival and recovery of a species, and would therefore not satisfy the definition of "critical habitat" under SARA. From this, it becomes imperative that the definition of destruction specifies the destruction of the components of that habitat. So, even though the location is not annihilated, when a particular activity deteriorates features of a habitat that reduces the capacity of the species to survive or recover, this must also be considered destruction of critical habitat.

4.2 Destruction of Habitat versus Destruction of Organisms

The general prohibitions contained in SARA (S.32) against the harm, harassment, or killing of SAR are in effect in all areas under federal jurisdiction, which in the marine

environment includes most of Canada's oceans. There are many anthropogenic activities that potentially violate the general prohibitions without physically destroying critical habitat. To illustrate this, habitat loss has been indicated as a threat to the endangered North Atlantic right whale (*Eubalaena glacialis*; Brown et al. 2009). Yet the recovery of this species is primarily threatened by direct and accidental mortality from vessel strikes and entanglement in fishing gear, respectively (Kraus 1990, Kraus et al. 2005). Additionally, consider the proliferation of fishing gear in an area frequented by a marine SAR. For example, incidental capture in fisheries has been cited as a leading cause of decline for the leatherback turtle (*Dermochelys coriacea*; Lewison et al. 2004). James et al. (2005) suggest that fixed gear fisheries in shelf waters leads to high mortality because turtles become entangled at depths such that they will almost certainly drown. Though this does not damage or destroy the habitat in any way, it does potentially contravene the general prohibitions. Furthermore, the issuance of permits or licenses for marine application (fishing and aquaculture operations) demands the question as to whether this is in violation of the general prohibitions (Vanderzwaag & Hutchings 2005). Ministerial discretion continues to be in favour of commercial interests and pressures and contraventions to the general prohibitions like incidental take are authorized via fisheries licenses, and harm to critical habitat can sometimes be authorized under the *Fisheries Act*. For instance, consider the Atlantic cod (*Gadus morhua*). Effort is directed toward defining their critical habitat as a measure of conservation. Yet a small fishery is permitted to exist. Therefore, designating and protecting critical habitat from destruction for the conservation of marine SAR may not adequately address the non-habitat factors that cause mortality either directly (extraction) or accidentally (vessel strikes, bycatch).

4.3 Destruction versus Disruption

There are many human activities that threaten species persistence that do not involve widespread habitat destruction, nor lead to direct mortality. Habitat disruption may be a more appropriate and accurate term to elucidate the consequences of these types of threats. Anthropogenic activities likely to result in the disruption of a species' habitat include acoustic disturbance from vessels or military and seismic activities, human disturbance from nature watching and other recreational activities, and possibly pollution.

These are activities that can render the habitat temporarily unsuitable without causing its permanent destruction. In addition to habitat disruption, these activities can cause direct disturbance to the organism.

Human practices that result in the disruption of habitat, or disturbance of organisms, are in contravention of the general prohibitions of SARA, rather than the physical destruction of habitat. These activities could effectively constitute harm and harassment of animals. However, SARA does not exactly nor practically define the terms harm or harass, and thus these words are subject to broad interpretation. In plain language, harm is generally understood to mean a deliberately inflicted physical injury (OED 2012c). Harass is defined in a number of ways that include to be "subject to aggressive pressure or intimidation," or to "make repeated attack on" (OED 2012d). Results from a government workshop held to develop guidelines for the clarification of specific terms and concepts used in the SARA program demonstrated how each of the terms, harm and harass, should be interpreted (DFO 2010). Harm is described as "the adverse result of an activity where a single or multiple events reduce the likelihood of survival or recovery of the species/population by impacting the fitness (survival, reproduction, growth, movement) of individuals" (DFO 2010, p. 2). Harass is defined as "an activity, associated with an individual or a population, which by means of its frequency and magnitude could reduce the likelihood of recovery or survival of the species by changing its behaviour and thus impacting a life history function" (DFO 2010, p. 3). Acoustic disturbance from vessels, military activity, and seismic activity can have behavioural impacts that affect important life history processes (Nowacek et al. 2007, Weilgart 2007). In addition, human disturbance from whale watching or other recreational activities can temporarily alter animal behaviour that can prove to be energetically costly (Williams et al. 2006). Neither of these activities destroy habitat. However, these disruptive actions can impact important life history functions, and would therefore constitute harm or harassment, which is prohibited under SARA.

4.3.1 Pollution: a grey area

Pollution is the most subtle and universal form of environmental degradation (Primack 2006), and maybe considered ambiguous in classifying it as either harmful to a

species or as destructive to habitat. Land-based sources of pollution can severely impact marine ecosystems, resulting in algal blooms, coral bleaching and smothering, loss of biodiversity, and mass deaths in marine animals and fish (Williams 1996). The effects of this type of pollution are mainly physiological and have been observed across all types of marine organisms (Islam & Tanaka 2004). Oil spills are another major source of pollution in the marine environment. Effects of oil on fish, marine mammals, and seabirds are most often studied, and include physical abnormalities, blindness, cancer, and mortality (Crain et al. 2009). Therefore, while it is apparent that pollution has a significantly detrimental impact on species and their habitat, it does not necessarily result in overt habitat destruction. The exception might be instances where pollution destroys important biogenic structures such as coral reefs, kelp forests or seagrasses.

4.4 Forms of Habitat Destruction

Like the terrestrial environment, habitat for marine organisms may include structural components (geological and biogenic structures), but the habitat of marine organisms can also be comprised of features such as depth, temperature, light, density and substrate (Environment Canada 2009). Although the potential for their modification exists, in general, these features are not easily destroyed. There are several human activities, however, that can lead to the physical destruction of marine habitat. Processes that disturb surficial sediments and seabed physiography are particularly relevant. Extensive fishing activities, like bottom trawling in which a giant net is dragged along the ocean floor, are widely considered to be the most disruptive and destructive form of commercial fishing (Messieh et al. 1991, Jones 1992). Bottom trawling can produce irreversible changes in sediment characteristics and benthic community structure (Messieh et al. 1991).

Dredging and dumping can also affect marine habitat. The need for channel dredging has increased due to the growth of marine traffic and increased vessel size (Messieh et al. 1991). Channel dredging can occur as one-off events or annual operations and their effect on benthic communities varies according to a variety of factors (amount and type of gear, frequency and extent, depth, nature of the seabed, local conditions; Messieh et al. 1991, Jones 1992, Brylinsky et al. 1994, Thrush & Dayton 2002). Permanent changes that result

from dredging activities include increased erosion and alteration of seabed topography, which could result in modified benthic communities or destruction of spawning beds (Messieh et al. 1991).

In addition to destructive fishing practices and industrial activities, the removal or exclusion of the prey of a species must be considered as destruction of critical habitat. For example, recent evidence indicates that reduced abundance of Chinook salmon attributable to fisheries leads to nutritional stress and subsequently impedes the recovery of the endangered Southern resident killer whale (*Orcinus orca*) (Hilborn et al. 2012). According to the SARA requirements to include biological and physical factors (prey, noise, water quality) as critical habitat, a situation where the carrying capacity of a species is limited by the availability of its prey, and human practices are preventing access to or are in competition for that resource must be considered destruction of habitat.

In summary, from a geographical perspective, the habitat of most marine organisms is not easily destroyed, with the exceptions described above. Although some effort on habitat protection is important, management efforts should be directed at mitigating the threats to recovery, as area management does not offer the same protection for migratory species as it does for those that are more sedentary in nature (Elvin & Taggart 2008).

CHAPTER 5: EVALUATION OF MARINE SAR CRITICAL HABITAT (ANALYSIS AND RESULTS)

5.1 Methodology

To evaluate threats to marine SAR in Canada, 59 COSEWIC assessment reports and status reports covering 48 marine wildlife species (84 populations) and 19 SARA recovery strategies representing 21 marine species (25 populations) were examined (Appendix A). The threats listed by each have been compiled. A major assumption of this analysis is that the data obtained from both the COSEWIC status reports and SARA recovery strategies are based on the best available scientific knowledge. Although the SARA recovery strategies are government reports, a recovery team of scientists is tasked with presenting expert knowledge and peer-reviewed documents. COSEWIC assessments are peer-reviewed based on scientific evidence and are conducted independent from government by leading experts that cover each taxonomic group. These reports are the current state of knowledge and are among the tools upon which many conservation decisions are made.

Species assessed by COSEWIC or listed under SARA are identified as designatable units (DU). A species, subspecies, population or group of populations can be recognized as a DU if it has attributes that make it discrete relative to other species, subspecies, or populations (COSEWIC 2011g). In this report a DU is representative of a population. Although species with recovery strategies also had a COSEWIC assessment, only the recovery strategy was examined in order to avoid duplicating threats for the same population. As a result, a total of 76 reports, encompassing 69 marine wildlife species (109 DUs) of birds, fishes, marine mammals, molluscs, or reptiles were examined (Table 2).

Major and minor threats to each population were not consistently prioritized within these reports. As such, all threats were recorded. For the purpose of this report all applicable historical, current, and potential threats were included and considered equivalent for each species. The original wording of the threats from the reports was retained to ensure accurate reporting and to avoid assumptions about the nature of the threat, but where wording or descriptions were similar, the threats were included in the same category. Consequently, numerous threats were recorded that are especially similar

and may all be related to the same anthropogenic activity (e.g. industrial development, oil and gas, and seismic surveys were each considered separate threats). In addition, single threats that were described in a manner that included them in multiple categories were recorded in both (e.g. seismic activity was counted as both seismic activity and acute noise).

Table 2. Summary of the marine taxa assessed, and number of species in each level of endangerment from the COSEWIC status assessments and the SARA recovery strategies.

	Taxon	Extirpated	Endangered	Threatened	Special Concern	Not at Risk	Data Deficient	Total
COSEWIC Status Assessments	Birds			1	1			2
	Fishes		15	15	20	1	1	52
	Mammals		3	4	17	2	1	27
	Mollusca			1	1			2
	Reptiles		1					1
	Total		19	21	39	3	2	84
SARA Recovery Strategies	Birds			2				2
	Fishes	1*	2	2	1			6
	Mammals	2	5	6	1			14
	Mollusca		1					1
	Reptiles		2					2
	Total	3	10	10	2			25

*Striped Bass (St. Lawrence Estuary population). COSEWIC listed as extirpated and no status under SARA

The threats of all species were ranked to identify the most common threats to marine SAR. This was done by the species and by DU, but the results in each case were similar (Appendix B). Therefore, the threat analysis is presented for individual species only to avoid calculating threats multiple times for the same species. Specific threats (fine-scale threats) were grouped into nine broad-scale threat categories: overexploitation, pollution, natural mortality, habitat loss, industrial activities, acoustic disturbance, human disturbance, climate change, or data deficient and presented in a frequency distribution (Table 3). These categories are consistent with a previous study (Venter et al. 2006). The threats from non-human sources (i.e. often referred to as "natural" threats; predation, prey availability, ice entrapment) were removed from the final analysis, as the purpose of the

report is to evaluate anthropogenic threats to marine SAR.

Using the information provided in the COSEWIC assessments and the SARA recovery strategies, threats of critical habitat destruction, loss, or displacement from habitat (hereafter collectively referred to as habitat loss) were categorized according to how they affect the SAR. These categories were: kill (direct mortality), harm/harass, potential effects on prey, direct habitat destruction, and destruction of non-marine habitat (Table 4).

Table 3. Definitions of the broad-scale threat categories developed from the fine-scale threats listed in the SARA recovery strategies and COSEWIC status assessments (adapted from Venter et al. 2006).

Broad Threat Categories	**Fine-scale threats**
Pollution	Chemical contaminants, toxic spills, discharge, marine debris, harmful algal blooms
Overexploitation	Fisheries related - directed, accidental, illegal, entanglement in mobile or fixed gear, destructive fishing practices, prey depletion, egg harvesting
Natural Causes	Any natural event/factor inherent to species - disease/pathogens/parasites, ecological/environmental shifts, predation, prey availability, ice entrapment, genetic diversity, recruitment limitations (depressed population)
Industrial Activity	Any activity relating to industry (aquaculture, oil and gas, mining, dredging, coastal development)
Habitat Loss	Reduction or degradation of required habitat (includes loss, displacement, degradation)
Introduced Species	Interactions with non-native species
Human Disturbance	Recreation/tourism, military activities, scientific research, whale-/nature-watching, dams and other barriers to migration, human presence
Data Deficient	Lack/no data
Climate Change	Changes due to anthropogenic induced climate change
Acoustic Disturbance	Noise related activity (chronic noise due to shipping, fishing, or recreational vessels; acute noise due to industrial activity; seismic activity

Table 4. Definitions of the results of habitat loss as indicated in the COSEWIC status assessments and SARA recovery strategies.

Results of Habitat Loss	**Definition**
Non-marine habitat or natural causes	Activities that threaten non-marine habitat: loss of nesting beaches, barriers to migration, water loss. Natural causes: ice scour, competitive exclusion.
Kill	Activities that result in direct mortality: vessel-strikes, siltation/sedimentation, target fisheries, and bycatch.
Harm or Harass	Activities that disturb species leading to changes in behaviour, or displace animals from their habitat: pollution, aquaculture, acoustic disturbance, climate change, industrial activities, and human disturbance.
Potential effect on prey	Competition from fisheries, reduced prey quality from anthropogenic activities.
Direct Habitat Destruction	Mobile fishing gear, harbour/channel dredging, invasive species.

5.2 Results

Thirty types of anthropogenic threats were identified for marine species in 59 COSEWIC species assessments and 19 SARA recovery strategies (Table 5). The four most commonly listed threats to marine species at risk were directed mortality or extraction by fisheries (45 occurrences), pollution (44 occurrences), accidental mortality caused by fisheries (43 occurrences), and habitat loss or degradation (37 occurrences), respectively. There were also other threats related to these categories but these were kept separate because they were distinctly identified by the reports. These included entanglement in fishing gear (23 occurrences), mobile fishing gear (7 occurrences), poaching (9 occurrences), depletion of prey by fisheries (13 occurrences), vessel strikes (18 occurrences), human presence / disturbance (18 occurrences), industrial development (20 occurrences), oil and gas mining (22 occurrences), among others.

The most frequent broad-scale threat category to marine SAR was overexploitation, which included direct mortality from fishing or hunting, the highest ranked fine-scale threat. Of the 44 occurrences of directed fishing mortality, 31 were current instances of fisheries activity, whereas the remaining occurrences were due to historic fisheries (e.g. whaling).

There were differences in how the threats ranked between the COSEWIC and the SARA reports. Direct mortality by fisheries was the most commonly listed threat among the COSEWIC status assessments (33 occurrences), but it was ranked eighth among the SARA recovery strategies (12 occurrences). Pollution was ranked first among the SARA recovery strategies (19 occurrences) and third among the COSEWIC assessments (25 occurrences). Accidental mortality caused by fisheries ranked second for species assessed by COSEWIC, while habitat loss and entanglement in fishing gear both ranked second among SARA recovery strategies.

Habitat loss was the fourth most commonly listed threat among the COSEWIC status assessments, and second in the SARA recovery strategies. There were 21 COSEWIC species (43 populations) and 15 SARA species (18 populations) for which habitat loss was listed as a threat (Table 6).

Table 5. Summary of the ranked fine-scale anthropogenic threats identified for marine species in the 59 COSEWIC status assessments and 19 SARA recovery strategies.

Threats	COSEWIC (n=48)	COSEWIC Rank	SARA (n=21)	SARA Rank	Total (N=69)	Total Rank
Hunted/Fisheries - directed	33	1	12	8	45	1
Pollution - Total (spills, contamination, debris)	25	3	19	1	44	2
Fisheries - accidental	30	2	13	7	43	3
Habitat degradation/loss/displacement	22	4	14	4	36	4
Entanglement in fishing gear	8	7	15	2	23	5
Climate Change	11	5	12	8	23	5
Oil and Gas and Mining	8	7	14	4	22	7
Shipping/Ship strikes	6	10	15	2	21	8
Industrial Activities/Development	10	6	10	11	20	9
Human presence / disturbance (incl. nature watching, science)	4	15	14	4	18	10
Seismic Activity	6	10	12	8	18	10
Acute Noise	5	14	10	11	15	12
Prey Availability - depletion by fisheries	7	9	6	15	13	13
Chronic Noise	2	23	10	11	12	14
Coastal Development/construction/dredging	6	10	6	15	12	14
Military Activity	3	20	9	14	12	14
Exotic/invasive species	6	10	3	19	9	17
Poaching	4	15	5	17	9	17
Mobile Fishing Gear	4	15	3	19	7	19
Aquaculture	3	20	3	19	6	20
Barriers/impounds/dams	4	15	2	22	6	20
Harmful Algal Blooms	2	23	4	18	6	20
Data Deficient/Lack of Info	4	15			4	23
Water levels / flow	3	20	1	23	4	23
Egg Harvesting	1	25	1	23	2	25
Artificial light			1	23	1	26
Broodstock Collection	1	25			1	26
Hatcheries	1	25			1	26
Random Events	1	25			1	26
Relocation from CH	1	25			1	26

When combined into the nine broad-scale threat categories, overexploitation was the most pervasive threat to marine SAR. Pollution ranked second, followed by habitat loss (Figure 1). According to the COSEWIC status assessments and SARA recovery strategies, most of these species are not at risk because of a loss of habitat. For the majority of these species, the loss of habitat is related to habitat disruption that renders

the habitat temporarily unsuitable, a result of human disturbance, the presence of pollution, or acoustic disturbance.

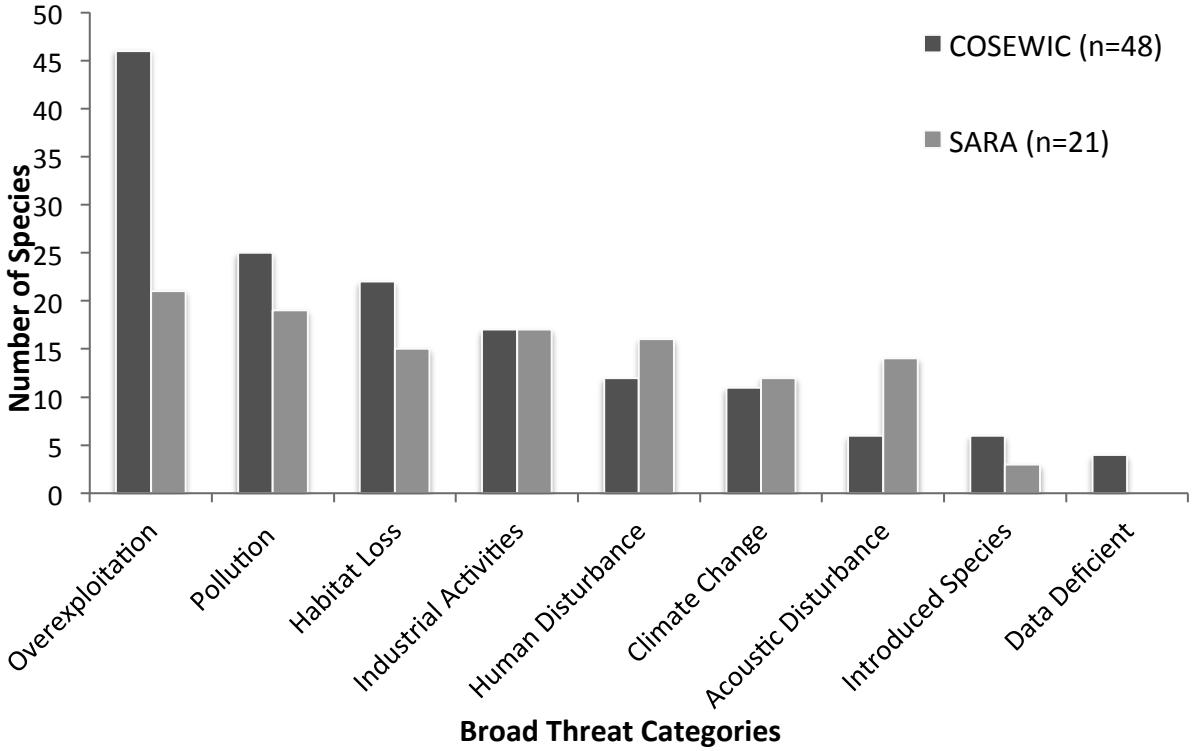

Figure 1. Frequency distribution of the number of species in the COSEWIC status assessments (n = 48) and SARA recovery strategies (n = 21) within each broad threat category.

Of the marine species threatened by habitat loss, 18 species (25 DUs) were marine fish (Table 6). Of these, the American Eel, Atlantic salmon, Chinook salmon, Coho salmon, Eulachon, Green Sturgeon, Sockeye salmon, and the Striped Bass spend part of their life cycle in freshwater river systems. Although these species may be at risk because of habitat loss in their freshwater environment, habitat loss was not considered a primary threat in their marine habitat.

Twelve of the species (22 DUs) threatened by habitat loss are marine mammals (Table 6). With the exception of the potential anthropogenic impacts on prey resources, which could impact carrying capacity within the critical habitat (Hilborn et al. 2012), in

most cases, the threats to habitat that were identified in the COSEWIC or SARA reports were human activities within critical habitats that lead to direct mortality, or harm and harass the animals. One exception is the Steller sea lion, which uses rocky outcrops as haul out sites for mating, nursing, and birthing. The COSEWIC status report (2003f) indicated that the Steller sea lion might suffer population declines due to the loss of this habitat.

Table 6. Species threatened by habitat loss according to the COSEWIC status assessments or SARA recovery strategies. The species name and designatable unit (DU) are in parentheses.

	Common name	Scientific name	Designatable Unit (DU)	Taxon
SARA Recovery Strategies	Northern Wolffish	*Anarhichas denticulatus*		Fish
	Atlantic Wolffish	*Anarhichas lupus*		Fish
	Spotted Wolffish	*Anarhichas minor*		Fish
	Striped Bass	*Morone saxatilis*	St. Lawrence Estuary, Bay of Fundy, Southern Gulf of St. Lawrence population	Fish
	Atlantic Salmon	*Salmo salar*	Inner Bay of Fundy population (iBoF), Inner St. Lawrence population	Fish
	Sei Whale	*Balaenoptera borealis*	Atlantic, Pacific population	Mammal
	Blue Whale	*Balaenoptera musculus*	Pacific population	Mammal
	Fin Whale	*Balaenoptera physalus*	Atlantic, Pacific population	Mammal
	Beluga Whale	*Delphinapterus leucas*	St. Lawrence Estuary, Eastern Hudson Bay, Eastern High Arctic - Baffin Bay population	Mammal
	Grey Whale	*Eschrichtius robustus*	Atlantic, Eastern North Pacific population	Mammal
	North Atlantic Right Whale	*Eubalaena glacialis*		Mammal
	Northern Bottlenose Whale	*Hyperoodon ampullatus*	Scotian Shelf population	Mammal
	Killer Whale	*Orcinus orca*	Northeast Pacific transient, southern, northern resident population	Mammal
	Northern Abalone	*Haliotis kamtschatkana*		Mollusca
	Leatherback Sea Turtle	*Dermochelys coriacea*	Atlantic, Pacific population	Reptile

Table 6 continued

	Common name	Scientific name	Designatable Unit (DU)	Taxon
COSEWIC Status Assessments	Black-footed Albatross	*Phoebastria nigripes*		Bird
	American Eel	*Anguilla rostrata*		Fish
	Atlantic Cod	*Gadus morhua*	Newfoundland and Labrador, Laurentian North and South, Southern population	Fish
	Bering Wolffish	*Anarhichas orientalis*		Fish
	Chinook Salmon	*Oncorhynchus tshawytscha*	Okanagan population	Fish
	Coho Salmon	*Oncorhynchus kisutch*	Interior Fraser population	Fish
	Cusk	*Brosme brosme*		Fish
	Darkblotched Rockfish	*Sebastes crameri*		Fish
	Eulachon	*Thaleichthys pacificus*	Central Pacific Coast, Fraser River, Nass / Skeena Rivers population	Fish
	Green Sturgeon	*Acipenser medirostris*		Fish
	Sockeye Salmon	*Oncorhynchus nerka*	Cultus, Sakinaw population	Fish
	Winter Skate	*Leucoraja ocellata*	Southern Gulf of St. Lawrence, Georges Bank-Western Scotian Shelf-Bay of Fundy, Eastern Scotian Shelf population	Fish
	Yellowmouth Rockfish	*Sebastes reedi*		Fish
	Bowhead Whale	*Balaena mysticetus*	Eastern Canada-West Greenland, Bering-Chukchi-Beaufort population	Mammal
	Harbour Porpoise	*Phocoena phocoena*	Northwest Atlantic, Pacific population	Mammal
	Humpback Whale	*Megaptera novaeangliae*	Northwest Atlantic, North Pacific population	Mammal
	Steller Sea Lion	*Eumetopias jubatus*		Mammal
	Atlantic Mud-piddock	*Barnea truncata*		Mollusca
	Olympia Oyster	*Ostrea lurida*		Mollusca
	Loggerhead Sea Turtle	*Caretta caretta*		Reptile

An in-depth evaluation of the results of habitat loss (Table 7) provides evidence that more of these species (25) are threatened by practices that constitute harm or harassment than those threatened by the physical destruction of their habitat (15 species). Direct or

accidental mortality caused by fisheries, vessel strikes, or smothering from siltation in the case of Mollusca taxa, are identified as threats to critical habitat for 14 species (15 DUs). These threats actually kill these species, rather than destroy their habitat. Ten species (15 DUs) are threatened by limited or reduced prey availability as a result of competition for resources with commercial fisheries, or due to the anthropogenic effects on prey quality such as climate change, loss of habitat of prey species, pollution, and the impacts of industrial activities. The majority of these species are cetaceans. Ten species (12 DUs) are not applicable to this particular analysis because the species are considered at risk because of a loss of non-marine habitat, including freshwater and terrestrial areas. In addition to the species of marine fish already discussed, the Loggerhead and Leatherback Sea Turtles are identified here because their beach nesting areas are in jeopardy, but these areas are not in Canada and therefore are not considered in this report.

Finally, 15 marine species at risk are threatened by actual loss of habitat (Table 8) through either destructive fishing practices (i.e. bottom trawling), or industrial activities such as dredging, the presence of fixed structures concomitant with oil and gas development, or the construction of barrages, causeways and infrastructure, and tidal energy projects. Many of these species are strongly associated with benthic habitats that could potentially be negatively affected by human activities. Notably, no marine species is threatened by habitat loss alone. On average, each species faces ten fine-scale threats.

Table 7. Summary of the number of species categorized within each result of habitat loss as described in the SARA recovery strategies and COSEWIC status assessments. The number of designatable units (DUs) is in parentheses.

Result of Habitat Loss	**SARA**	**COSEWIC**	**Total**
Loss of non-marine habitat	3 (3)	7 (9)	10 (12)
Kill	8 (8)	6 (7)	14 (15)
Harm or Harass	13 (15)	11 (16)	24 (31)
Potential effect on prey	7 (9)	3 (6)	10 (15)
Direct Habitat Destruction	7 (7)	8 (8)	15 (15)

In summary, this evaluation indicates that only a small number of marine SAR is threatened by destruction of their critical habitat. While the initial analysis indicated that loss or degradation of habitat was ranked fourth as a threat to marine SAR, this subsequent detailed examination of the habitat threats ranked habitat loss 14th place and potential effects on prey (which is also considered a component of habitat) in 20th place.

Table 8. Summary of the species threatened by direct habitat destruction, as indicated by the COSEWIC status reports and SARA recovery strategies, and the associated human activities. Where a species is threatened by more than one activity, it is only counted once.

Common name	Scientific name	Construction / Industrial Activities	Degradation/Loss non-marine Habitat (FW, nesting, terrestrial)	Mobile Fishing Gear	Dredging
SARA Species					
Atlantic Wolffish	*Anarhichas lupus*			X	
Northern Wolffish	*Anarhichas denticulatus*			X	
Spotted Wolffish	*Anarhichas minor*			X	
Beluga Whale	*Delphinapterus leucas*				X
Northern Abalone	*Haliotis kamtschatkana*	X			
Northern Bottlenose Whale	*Hyperoodon ampullatus*	X			
Striped Bass	*Morone saxatilis*				X
COSEWIC Species					
Atlantic Cod	*Gadus morhua*			X	
Atlantic Mud-piddock	*Barnea truncata*	X			
Bering Wolffish	*Anarhichas orientalis*	X		X	
Cusk	*Brosme brosme*			X	
Darkblotched Rockfish	*Sebastes crameri*			X	
Steller Sea Lion	*Eumetopias jubatus*		X		
Winter Skate	*Leucoraja ocellata*			X	X
Yellowmouth Rockfish	*Sebastes reedi*	X		X	

5.3 Discussion

Habitat loss is not the primary threat to marine species at risk in Canada. This is consistent with results obtained by Venter et al. (2006) and Evans et al. (2011a), who showed that while habitat loss was the most significant threat to all imperilled species, overexploitation was the most prevalent threat to marine mammals and marine fishes. This is also true for marine and diadromous species listed on the United States (US) *Endangered Species Act* (ESA) and the International Union for the Conservation of Nature (IUCN) Red List (Kappel 2005). More than half of the marine species from this study were impacted by direct mortality from fisheries, either directly (e.g. extraction and harvesting), or incidentally (e.g. bycatch and entanglement). This result is not surprising as many of the species assessed by COSEWIC are not listed on Schedule 1 of SARA, and thus are not offered the legal protection afforded under SARA.

In the COSEWIC and SARA reports, many threats that directly kill or harm marine species at risk were identified as threats to their critical habitat, often because the threatening activities occur within the critical habitat of the species. Identifying these threats as loss of critical habitat is inaccurate and unnecessary. They are inaccurate because the activities generally do not result in the destruction of habitat and they are unnecessary because any activity that kills, harms or harasses a species at risk is already prohibited by SARA, regardless of the designation of critical habitat.

Human activities that have the potential to physically destroy the habitat include commercial or industrial activities, including dredging and mobile fishing gear, as well as threats that result in the depletion of prey, or degradation of prey quality. However, we are being liberal in this report in considering some of these activities as direct destruction rather than disruption because dredging and mobile fishing gear may not overtly destroy the habitat of some of these species. The impacts of these activities vary with life history stage of the organism (refer to Chapter 3) and with the extent of occurrence of the activity (refer to Chapter 4).

The results of this study are consistent with the theory that the designation of critical habitat under SARA is tailored more toward the terrestrial environment, and the same criteria for designating critical habitat may not be applicable in the marine environment. Designating the critical habitat of species at risk is challenging and expensive. Yet critical

habitat is largely irrelevant to the conservation of marine SAR, which are more threatened by activities that kill them directly (Rosenfeld & Hatfield 2006). This is not to say that critical habitat should never be defined. Protecting the habitat of marine species is of course important for their survival and furthermore, designating critical habitat is a legal requirement of SARA. However, this analysis has shown that for marine SAR, addressing activities that cause harm and harassment is of greater importance for their conservation. Legal requirements aside, efforts directed toward identifying and protecting critical habitat should be proportional to the benefits to the species. Identifying and protecting critical habitat is only one component of the management of species at risk, as activities beyond the critical habitat boundaries have a pervasive effect on species persistence.

There is no doubt that all animals have critical habitat, but the threats to the critical habitat identified in COSEWIC or SARA reports may not be related to the destruction or loss of habitat. Therefore, the question is: to what level do we need to define critical habitat? In circumstances where a species' survival and recovery is primarily threatened by habitat loss or degradation, then critical habitat should be identified as precisely as possible. However, all other threats can be addressed through the first-order prohibitions of SARA.

Given the multitude of threats facing marine species at risk, and the limited capacity for dealing with conservation issues, efforts must prioritize where resources are spent. A formal approach to evaluating the amount of time and resources that should be invested in the designation of critical habitat for each species at risk would be a beneficial way to determine where to allocate resources, especially with the focus of the federal government on "smart spending".

CHAPTER 6: A WAY FORWARD

Because of the rate that species are declining and with societal and political priorities to economic growth and streamlining environmental assessment, it is imperative to prioritize conservation efforts. The capacity of governments to undertake conservation activities is limited and, consequently, resources must be used efficiently to best ensure the protection and recovery of our biodiversity (Wilson et al. 2009, Evans et al. 2011b). A decision-framework applied to the recovery process prescribed under SARA, could help to reduce the time and resources spent defining critical habitat for species that are primarily threatened by non-habitat factors.

6.1 Background on decision analysis

Decision analysis is a formal analytical technique originally developed for application in business situations, but has evolved over time in its application to other disciplines (Thibodeau 1983). Deciding on which species to focus and how to manage activities in order to provide the greatest benefit to the species is often a major dilemma in conservation management (Maguire 1986). Managers are often required to make decisions and allocate resources on short timeframes and based on limited knowledge. Essential information regarding species biology and ecology is often missing, and decisions about which actions to take are frequently affected by environmental and political events outside the control of the manager (Maguire 1986). Integrating scientific knowledge with conflicting considerations (public opinion, socioeconomics) can be complicated. Decision analysis offers a framework where political, financial and scientific information can be weighed together for more responsible management of endangered species populations (Maguire 1986).

In decision analysis, information is structured to incorporate uncertainty in different management outcomes. Consequently, decision trees often include probabilities and tradeoffs (cost-benefit) for the different outcomes in order to increase confidence in the decision (Thibodeau 1983). A decision-framework is a useful tool that can show how scientific knowledge may be applied to the decision, making judgments consistent, explicit, and transparent. This process would both allow decisions to be clearly justified

and would hold authorities accountable. With this level of transparency in decision-making, court challenges would also likely be reduced (Hagen & Hodges 2006).

6.2 Decision-Framework for Determining the Level of Critical Habitat Description

The following decision-framework (Figure 2) is meant to be used as a tool to assist SARA recovery teams in decisions pertaining to designating critical habitat and it could be incorporated into the existing recovery planning process. The series of questions and their answers guides the process and leads to a recommendation of the time and resources that should be invested in the designation of critical habitat for a species or population based on the threats to the species or population and their habitat. This pathway is intended to produce a transparent, defensible, and consistent process for thinking about the most efficient way to conserve a species or population. The final decision will, however, ultimately rest with the biologists and managers responsible for recommending to the Minister on how to proceed with the recovery planning process.

6.2.1 The Decision Framework

Q1. Does sufficient knowledge currently exist to identify critical habitat or is it easily attained?

Answer to Q1: YES: Define critical habitat (Level A) **NO:** Proceed to Q2

An affirmative answer to this question requires that a clear description of the species or population distribution and its habitat needs is available or is easily attained (DFO 2004). The best available knowledge, including the quantitative evidence and qualitative descriptions, of basic life history, population ecology, habitat availability, recovery targets, habitat-abundance relationships, habitat requirements, geo-spatial locations and biophysical attributes required, must be available at this step (Environment Canada 2005, Rosenfeld & Hatfield 2006). Equally important, is information on the amount and quality of habitat available for survival and recovery. This will involve having knowledge of the functional and structural components of the habitat. In addition, identifying critical habitat involves characterizing the relationship between essential life history stages and habitat features (Environment Canada 2005).

Q2. Does the status assessment or recovery strategy identify the loss of habitat as a threat to the species at risk?

Answer to Q2: **YES:** Proceed to Q3 **NO:** Level B

Answering this question will involve characterizing and prioritizing existing anthropogenic threats to the species or population. While recognizing that habitat is important to all species, it will be necessary to identify the greatest threats limiting the recovery of the species or population. If habitat loss is not one of the primary threats to the species or population, then survival of the species does not depend on preventing habitat loss but rather on other factors that should be the focus of recovery efforts. As a result, critical habitat should simply be designated using the best available knowledge in order to meet the legal requirements of SARA. Although habitat protection is important, the goal here is to define the critical habitat as efficiently and quickly as possible so as not to delay the action planning stage of recovery that should lead to threat abatement. SARA allows amendments to modify critical habitat as new information becomes available should this be necessary at a later time (Environment Canada 2009).

Q3. Will designating critical habitat mitigate the identified threats?

Answer to Q3: **YES:** Level Group C **NO:** Level B

As demonstrated in this report, where habitat loss is identified as a threat to a species, this does not necessarily equate to the destruction of habitat that SARA is designed to offer protection from. This step is intended to draw attention to this point and will involve detailed analysis of the levels of habitat loss described for the species in a manner similar to the analysis undertaken in this report (Table 4, 7). If the analysis reveals that the loss of habitat identified by the assessment reports actually causes direct mortality to individuals, or constitutes harm or harassment under SARA, then for defining critical habitat, these species should be included in Level B; to define critical habitat based on the best available information.

If it is determined that the recovery of the species or population is limited by loss of habitat and that this threat would be mitigated by being designated as critical habitat under SARA, then critical habitat should be defined as precisely as possible. The designation of critical habitat for this level of description will likely require much more

detailed knowledge and may involve functional components of the system (e.g. ecological processes, carrying capacity, life-stage habitat requirements) as well as details of locations. Therefore, a detailed schedule of studies must be included at this step.

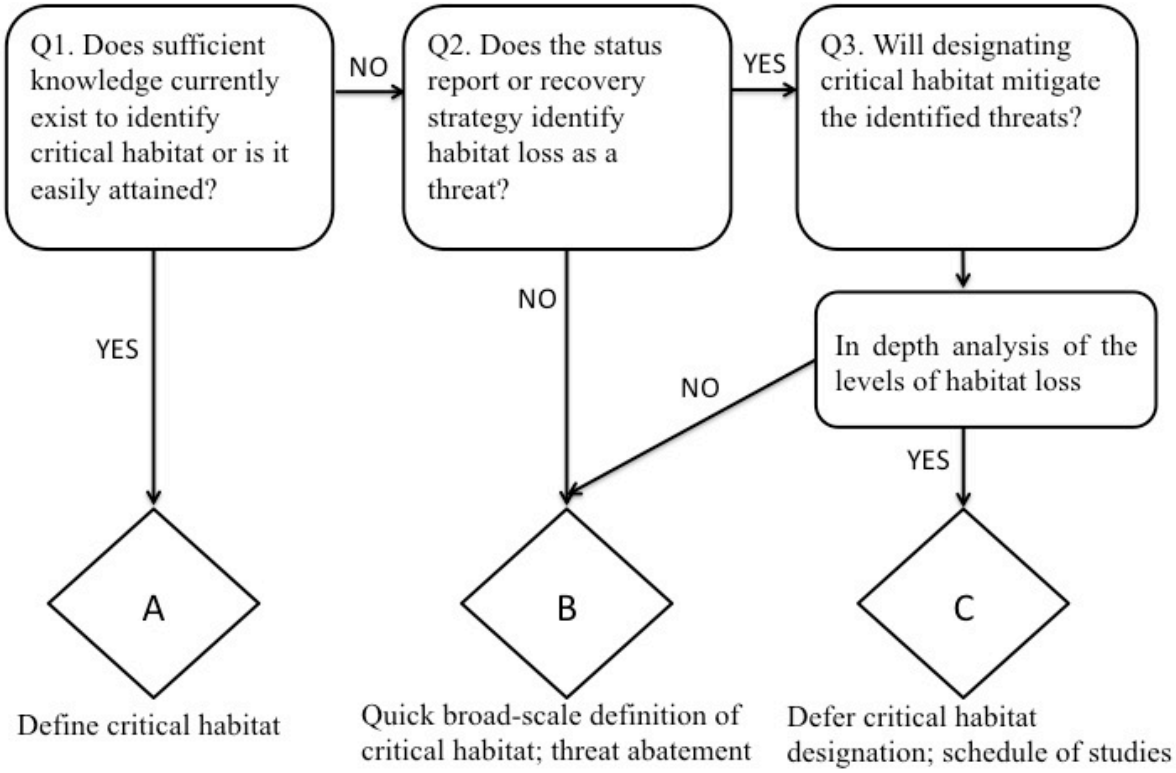

Figure 2. Decision-framework to determine the time and resources that should be invested in the designation of critical habitat during the recovery planning process for species listed as extirpated, threatened, or endangered on the Canadian *Species at Risk Act* (SARA).

6.2.2 Application of the decision framework

The following four examples illustrate the application of the decision-framework to determine the level of effort necessary in defining critical habitat for a selection of species.

Winter Skate (*Leucoraja ocellata*)

Q1. Does sufficient knowledge currently exist to identify critical habitat or is it easily attained?

While there are three DUs of winter skate (Southern Gulf of St. Lawrence, eastern Scotian Shelf, and the Bay of Fundy; COSEWIC 2005b), the critical habitat of this species is unknown.

Answer to Q1: NO: Proceed to question 2

Q2. Does the status assessment or recovery strategy identify the loss of habitat as a threat to the species at risk?

This species is regularly caught as bycatch in the groundfish fishery (COSEWIC 2005b). While bycatch is considered as the primary threat to this species, winter skate is a bottom dweller, and the COSEWIC status report indicated that it is also potentially threatened by habitat destruction. Therefore further analysis is required.

Answer to Q2: YES: Proceed to Q3

Q3. Will designating critical habitat mitigate the identified threats?

Destructive fishing practices, such as bottom trawling for fish and dredging for scallops and clams, have the potential to negatively alter bottom habitat for winter skate, or result in the re-suspension of bottom sediments that might smother spawning areas (Messieh et al. 1991, COSEWIC 2005b). Therefore, it can be assumed that the recovery of this species is threatened by destruction of its habitat. The locations of winter skate critical habitat will need to be identified and potentially, knowledge of how human activities cause this habitat destruction, as well as the nature of this destruction (e.g. loss of spawning habitat, loss of foraging habitat, destruction of prey). If knowledge on these factors is not available, then a schedule of studies will be required.

Answer to Q3: YES: Group C

Southern Resident Killer Whale *(Orcinus orca)*

Q1. Does sufficient knowledge currently exist to identify critical habitat or is it easily attained?

Although this information is currently known for this species (DFO 2011b), for the purposes of demonstrating the application of this framework, the example will proceed as if it is not.

Answer to Q1: NO: Proceed to question 2

Q2. Does the status assessment or recovery strategy identify the loss of habitat as a threat to the species at risk?

According to the SARA recovery strategy (2011b), the critical habitat of the resident killer whale is threatened by a variety of factors including environmental contaminants, reduced prey availability, disturbance, and noise pollution.

Answer to Q2: YES: Proceed to Q3

Q3. Will designating critical habitat mitigate the identified threats?

This report makes the case that pollution, noise, and disturbance are activities that constitute harm or harassment of a species and, therefore, are prohibited under SARA regardless of the designation of critical habitat. Thus, these do not constitute destruction of habitat in a manner than SARA is designed to prevent. Prey can now be considered as a component of critical habitat under SARA (David Suzuki Foundation et al. v. the Minister of Fisheries and Oceans and the Minister of the Environment 2010) and loss of prey, such as by resource harvesting, does constitute destruction of critical habitat. Studies suggest that the reduced availability from fisheries of Chinook salmon, the preferred prey of the southern resident killer whale, is potentially limiting their survival and recovery (Hilborn et al. 2012). Therefore, to designate critical habitat, knowledge is needed of the prey requirements of this population of killer whales and this may also require further information of the habitat needs of the prey species. A schedule of studies would be necessary to plan the research needed to address these needs.

Answer to Q3: YES: Group C

White Shark (*Carcharodon carcharias*)

Q1. Does sufficient knowledge currently exist to identify critical habitat or is it easily attained?

The COSEWIC status assessment (2006i) states that it is likely difficult to delineate the critical habitat of such a wide-ranging, highly migratory species that moves from coastal waters into oceanic waters far offshore.

Answer to Q1: NO: Proceed to question 2

Q2. Does the status assessment or recovery strategy identify the loss of habitat as a threat to the species at risk?

There are no known activities altering the habitat of white sharks in Canadian waters (COSEWIC 2006i). The primary cause of mortality in Canadian waters is bycatch in commercial fisheries (COSEWIC 2006i). Thus, critical habitat could be designated based on area of occurrence or based on the location of the threat, which in this case might be determined by the major areas that the sharks are caught as bycatch. This allows critical habitat for this species to be identified quickly and allow the process of threat abatement to move forward without requiring studies to determine details of the habitat requirements of this species in Canada when this is not likely a limiting factor to its recovery.

Answer to Q2: NO: Group B

Harbour porpoise (*Phocoena phocoena*, Northwest Atlantic population)

Q1. Does sufficient knowledge currently exist to identify critical habitat or is it easily attained?

The critical habitat of this species is currently unknown (COSEWIC 2006f).

Answer to Q1: NO: Proceed to question 2

Q2. Does the status assessment or recovery strategy identify the loss of habitat as a threat to the species at risk?

While not the primary threat to this species, habitat loss and degradation is indicated as a limiting factor that requires further investigation (COSEWIC 2006f).

Answer to Q2: YES: Proceed to Q3

Q3. Will designating critical habitat mitigate the identified threats?

According to the COSEWIC status report (2006f), habitat loss for this population is caused by environmental contamination and noise disturbance from acoustic harassment devices employed in aquaculture. These activities are more related to harm and harassment, rather than destruction of critical habitat in the way that is meant by SARA and are thus, prohibited by SARA regardless of the designation of critical habitat. Mitigation is better achieved through enforcement of these general prohibitions. Critical habitat should be defined with existing information based on population density or on the occurrence of the threat so that efforts to address the primary threats are not delayed.

Answer to Q3: **NO:** Group B

6.2.3 Management Implications

The benefit of this decision-framework is that if the information is available to show that habitat is not limiting a species' survival or recovery, the potential exists to move forward reasonably quickly with threat abatement via the creation of an action plan. Recognizably, knowledge of species occurrences and habitats is often incomplete because of the variability surrounding species ecology. A decision-framework can accommodate this uncertainty readily and transparently (Hagen & Hodges 2006) and it can help determine if this lack of knowledge will likely limit the recovery of a species or not. If the answer to any of the questions in the framework is unknown, then critical habitat could be provisionally awarded to the area, or deferred, until the question can be answered through research. This already occurs within the SARA recovery planning process. The goal of this decision-framework is to make the recovery planning process under SARA more transparent, defensible, and efficient such that the time it takes to get to the action phase is reduced. Ultimately, the resources saved by avoiding unnecessary studies of critical habitat requirements for a species when this knowledge will not directly or immediately ensure its recovery can be focused on addressing the greater, non-habitat threats potentially through application of the first-order prohibitions or the development and implementation of best practices and guidelines to mitigate the threats (e.g. vessel traffic, nature watching activities, noise and pollution reduction).

Notably, this is a comprehensive decision-framework that is not limited to the

assessment of critical habitat for marine SAR and could be applied in freshwater and terrestrial environments. The recommended decision analysis is simply a tool to help prioritize conservation efforts, and should be used to complement existing management and enforcement measures.

6.3 Limitations of the general prohibitions

In many cases the establishment of critical habitat will not ensure the persistence of a species and, therefore regulation of human activities inside and outside of the critical habitat must be sufficient to ensure species survival and recovery (Rosenfeld & Hatfield 2006). As previously mentioned, SARA S. (32) stipulates that it is an offence to kill, harm, harass, capture, or take any listed species, however, there are limitations to enforcing these prohibitions. Vanderzwaag and Hutchings (2005) explain that activities subject to the prohibitions of S. (32) and S. (33) are not clearly defined and any legal action would be a lengthy and subjective process. In addition, under certain circumstances permits are awarded that authorize these activities to take place. Vanderzwaag & Hutchings (2005) suggest a peer and public review process for activities that are likely to 'jeopardize' the survival and recovery of species. This would ease the amount of discretion allotted to the Minister for the authorization of permits to the prohibitions. Also, going forward it would be beneficial to clarify the definitions of the activities subject to the prohibitions and include examples in the recovery strategy.

6.4 Alternatives

6.4.1 Threat Abatement

An alternative to the SARA process that may provide some guidance for dealing with species not directly threatened by habitat destruction is Australia's approach to threat abatement. For species that are primarily threatened by non-habitat factors, an action plan could be developed in a similar manner to Australia's Threat Abatement Plans (TAPs). Established by the Australian Government Minister for Sustainability, Environment, Water, Population and Communities (the Minister) under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), these documents are designed to focus on strategic approaches to reduce the

impacts of key threatening processes that jeopardize the long-term survival of native species and ecological communities (Australian Government Department of Sustainability, Environment, Water, Population and Communities 2011). Threat abatement plans identify the research, management, and any other actions necessary to reduce the impact of key threats to species and ecological communities. Implementing the plan is meant to assist in the long-term survival of species by determining the most feasible, effective, and efficient way to mitigate, or reduce the human-induced impact (Australian Government Department of Sustainability, Environment, Water, Population and Communities 2011). The TAPs are action-oriented, and differ from the SARA process because they are triggered at the recovery plan stage. The research into the activities that would abate the threats could be part of the recovery strategy created under SARA and the action plan would describe how to implement those activities, which would not be considered as diverting too far from the current process. Therefore, there would be no added cost to implementation.

An additional factor to consider, particularly in the interest of efficiency, is to target areas where there are high densities of SAR and look for commonalities to the threats they face (Moore & Wooller 2003, Government of Canada 2009, Evans et al. 2011b). The competent Minister is provided with discretion under SARA to choose the contents of a recovery strategy in terms of regulations and management approaches (Elvin & Taggart 2008). Therefore, a multi-species approach to action implementation or threat abatement, which tends to be a more effective approach to threat management, could be employed to maximize conservation efforts (Moore & Wooller 2003, Government of Canada 2009). Due to the time limitations involved with developing a recovery strategy, this approach could be employed in the action or management plan phase (Sheppard et al. 2005). The feasibility of a multi-species approach will, however, depend on the species that are listed under SARA.

6.4.2 Stewardship

Legislation and management plans are not the sole measures of improving conservation of SAR. The overarching policy approach of SARA is cooperation and stewardship. The ethic of stewardship promotes the sustainable use of natural resources

and maintenance of healthy ecosystems (NRC 2008). While it is difficult to steward the ocean because it is not possible to own parts of it, there are examples in which promoting a sense of stewardship of resource users through public education and awareness can aid compliance and enforcement. For example, fishermen have voluntarily adopted best practices to reduce the risk of entangling SAR (T. Wimmer pers. comm.). To counter poaching of the northern Abalone, Fisheries and Oceans Canada enforcement patrols joined by First Nations communities have formed the Abalone Coast Watch program, which has led to convictions for illegal possession and harvest of this threatened species (Office of the Auditor General of Canada 2008). On the east coast of Canada, shipping lanes in the Bay of Fundy were reorganized to help protect the endangered North Atlantic right whale population from vessel strikes (Vanderlaan et al. 2008). In addition, the Roseway Basin, another known area of right whale aggregation, was designated as a voluntary Area to Be Avoided by the International Maritime Organization to encourage ocean-going vessels to avoid traversing the basin during seasonal periods of peak whale abundance.

CONCLUSION

This report has demonstrated that the most pervasive threat to marine SAR is mortality and not the destruction of habitat for which SARA is designed to protect. The mitigation of threats that result in direct or indirect mortality is essential to successful survival and recovery of marine SAR. Not only does Canada have the right to establish protection measures in territorial seas as party to the 1982 United Nations Convention on the Law of the Sea III (UNCLOS), it has an obligation to protect ecosystems, natural habitats, and populations having ratified the CBD (Elvin & Taggart 2008). As the leader for protecting aquatic species and populations, DFO has the authority and legal provisions necessary for the development of management strategies to avoid the listing of species under SARA by minimizing anthropogenic threats on marine species, particularly overexploitation (e.g. overfishing, bycatch, vessel strikes) and pollution. For example, complementary to SARA, the *Oceans Act* provides the mandate to protect areas and endangered species with regulations pertaining to environmental quality requirements and standards while taking into consideration the plethora of other ocean uses and users (e.g. fisheries, shipping, oil and gas development). Canada's *Oceans Act* requires the Minister of DFO to develop and carry out a national strategy based on the principles of sustainable development, integrated management and the precautionary approach (Fisheries and Oceans Canada 2002). Additionally, the *Fisheries Act* provides protection of aquatic habitat, as well as specific marine mammal regulations that allows prosecution of those activities causing unduly harm to marine mammals (Elvin & Taggart 2008). As the nearly sole agency responsible for our oceans, DFO is charged with ensuring the sustainable use and protection of our ocean resources, including the recovery of our marine SAR. Recognizing the amount of time and resources that should be invested in the designation of critical habitat for marine SAR is a responsible manner of doing this. To be successful in this process, however, DFO must be consistent and transparent in their decision-making process and provide clarity on how SARA is to be applied. In this report we have suggested a consistent and transparent way of determining the amount of time and resources that should be invested in the designation of critical habitat in the recovery planning process as a way for the federal government to meet their obligations under SARA and improve the conservation of marine SAR.

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APPENDIX A: LIST OF THE SARA AND COSEWIC SPECIES/POPULATIONS ASSESSED

SARA recovery strategies:

ID	Common name	Scientific name	Population	CH Delineated	How was it determined	Schedule of studies	Status Designation C/S	Author List
672	Atlantic Salmon	*Salmo salar*	Inner Bay of Fundy population (iBoF)	FW - yes	Live Gene Bank (LGB) rivers		Same - Endangered	DFO 2010b
				marine - no	Recovery Potential Assessment (RPA)	2009 - 2011	Same - Endangered	
128	Atlantic Walrus	*Odobenus rosmarus rosmarus*	Northwest Atlantic population	No- deemed impossible to ID	N/A	No	Non-active / Extirpated	DFO 2008
652	Atlantic Wolffish	*Anarhichas lupus*		No- deemed impossible to ID	N/A	2006 - 2008	Same - Special Concern	Kulka et a. 2007
667	Northern Wolffish	*Anarhichas denticulatus*		No- deemed impossible to ID	N/A	2006 - 2008	Same - Threatened	Kulka et a. 2007
669	Spotted Wolffish	*Anarhichas minor*		No- deemed impossible to ID	N/A	2006 - 2008	Same - Threatened	Kulka et a. 2007
977	Basking Shark	*Cetorhinus maximus*	Pacific population	No	N/A	2010 - 2015	Same - Endangered	DFO 2011a
102	Beluga Whale	*Delphinapterus leucas*	St. Lawrence Estuary population	Yes	area of occupancy approach (distribution, range, habitat requirements)	Deadline 2016	Same - Threatened	DFO 2012
717	Blue Whale	*Balaenoptera musculus*	Atlantic population	No	N/A	Deadline 2014	Same - Endangered	Beauchamp et al. 2009
718	Blue Whale	*Balaenoptera musculus*	Pacific population	No	N/A	2006 - 2011	Same - Endangered	Gregr et la. 2006
875	Fin Whale	*Balaenoptera physalus*	Pacific population	No	N/A	2006 - 2011	Same - Threatened	Gregr et la. 2006
755	Sei Whale	*Balaenoptera borealis*	Pacific population	No	N/A	2006 - 2011	Same - Endangered	Gregr et la. 2006
606	Killer Whale	*Orcinus orca*	Northeast Pacific transient population	No	N/A	underway - 2012	Same - Threatened	DFO 2007b
699	Killer Whale	*Orcinus orca*	Northeast Pacific southern resident population	Yes - may be others	based on prolonged seasonal occupancy	underway	Same - Endangered	DFO 2011b
698	Killer Whale	*Orcinus orca*	Northeast Pacific northern resident population				Same - Threatened	DFO 2011b
274	Leatherback Sea Turtle	*Dermochelys coriacea*	Atlantic population	No	N/A	started 2006 - ongoing	Same - Endangered	Atlantic Leatherback Turtle Recovery Team 2006
			Pacific population	No	N/A	2006 - 2011	Same - Endangered	Pacific Leatherback Turtle Recovery Team 2006
780	North Atlantic Right Whale	*Eubalaena glacialis*		Yes	RPA	started 2007 - ongoing (completed in 5 years)	Same - Endangered	Brown et al 2009
781	North Pacific Right Whale	*Eubalaena japonica*		Yes - not in Canadian waters	based on sightings data	2003 - 2019	Same - Endangered	DFO 2011c
603	Northern Abalone	*Haliotis kamtschatkana*		No	N/A	2007 - 2012+	Same - Endangered	DFO 2007c
162	Northern Bottlenose Whale	*Hyperoodon ampullatus*	Scotian Shelf population	Yes	RPA	Completion target 2011	Same - Endangered	DFO 2010c
819	Pink-footed Shearwater	*Puffinus creatopus*		No	N/A	2007 - 2013	Same - Threatened	Environment Canada 2008
797	Short-tailed Albatross	*Phoebastria albatrus*		No	N/A	2007 - 2013	Same - Threatened	Environment Canada 2008
149	Sea Otter	*Enhydra lutris*		No	N/A	2007 - 2012+	Same - Special Concern	Sea Otter Recovery Team 2007
833	Striped Bass	*Morone saxatilis*	St. Lawrence Estuary population	Yes - incomplete	zone of juvenile concentration	2011 - 2020	Extirpated / No Status	Robitaille et al. 2011
129	Grey Whale	*Eschrichtius robustus*	Atlantic population	No	N/A	No	Same - Extirpated	DFO 2007a

Appendix A continued (COSEWIC status assessments)

ID	Common name	Scientific name	Population	Status Designation C/S	Schedule	Author List
1097	Acadian Redfish	*Sebastes fasciatus*		Special Concern / No Status	No schedule	COSEWIC 2010d
1096	Acadian Redfish	*Sebastes fasciatus*	Atlantic population, Bonne Bay population	Threatened / No Status	No schedule	COSEWIC 2010d
891	American Eel	*Anguilla rostrata*		Special Concern / No Status	No schedule	COSEWIC 2006a
1052	American Plaice	*Hippoglossoides platessoides*	Newfoundland and Labrador population	Threatened / No Status	No schedule	COSEWIC 2009a
1053	American Plaice	*Hippoglossoides platessoides*	Maritime population	Threatened / No Status	No schedule	COSEWIC 2009a
1148	Atlantic Bluefin Tuna	*Thunnus thynnus*		Endangered / No Status	No schedule	COSEWIC 2011b
762	Atlantic Cod	*Gadus morhua*	Newfoundland and Labrador population	Endangered / No Status	No schedule	COSEWIC 2010a
764	Atlantic Cod	*Gadus morhua*	Laurentian North population	Endangered / No Status	No schedule	COSEWIC 2010a
1108	Atlantic Cod	*Gadus morhua*	Laurentian South population	Endangered / No Status	No schedule	COSEWIC 2010a
1109	Atlantic Cod	*Gadus morhua*	Southern population	Endangered / No Status	No schedule	COSEWIC 2010a
549	Atlantic Cod	*Gadus morhua*		Non-active / Special Concern	Schedule 3	COSEWIC 2010a
1065	Atlantic Mud-piddock	*Barnea truncata*		Threatened / No Status	No schedule	COSEWIC 2009b
1132	Atlantic Salmon	Salmo salar	Anticosti Island population	Endangered / No Status	No schedule	COSEWIC 2010b
1135	Atlantic Salmon	Salmo salar	Eastern Cape Breton population	Endangered / No Status	No schedule	COSEWIC 2010b
1136	Atlantic Salmon	Salmo salar	Nova Scotia Southern Upland population	Endangered / No Status	No schedule	COSEWIC 2010b
1141	Atlantic Salmon	Salmo salar	Outer Bay of Fundy population	Endangered / No Status	No schedule	COSEWIC 2010b
1130	Atlantic Salmon	Salmo salar	Quebec Eastern North Shore population	Special Concern / No Status	No schedule	COSEWIC 2010b
1131	Atlantic Salmon	Salmo salar	Quebec Western North Shore population	Special Concern / No Status	No schedule	COSEWIC 2010b
1133	Atlantic Salmon	Salmo salar	Inner St. Lawrence population	Special Concern / No Status	No schedule	COSEWIC 2010b
1134	Atlantic Salmon	Salmo salar	Gaspe-Southern Gulf of St. Lawrence population	Special Concern / No Status	No schedule	COSEWIC 2010b
1127	Atlantic Salmon	Salmo salar	South Newfoundland population	Threatened / No Status	No schedule	COSEWIC 2010b
915	Atlantic Walrus	*Odobenus rosmarus rosmarus*	Eastern Arctic & NW Atlantic combined	Special Concern / No Status	No schedule	COSEWIC 2006b
1120	Barndoor Skate	*Dipturus laevis*		Not at Risk / no designation		COSEWIC 2010c
976	Basking Shark	*Cetorhinus maximus*	Atlantic population	Special Concern / No Status	No schedule	COSEWIC 2009c
146	Beluga Whale	*Delphinapterus leucas*	Eastern Hudson Bay population	Endangered / No Status	No schedule	COSEWIC 2004a
189	Beluga Whale	*Delphinapterus leucas*	Ungava Bay population	Endangered / No Status	No schedule	COSEWIC 2004a
150	Beluga Whale	*Delphinapterus leucas*	Eastern High Arctic - Baffin Bay population	Special Concern / No Status	No schedule	COSEWIC 2004a
366	Beluga Whale	*Delphinapterus leucas*	Western Hudson Bay population	Special Concern / No Status	No schedule	COSEWIC 2004a
130	Beluga Whale	*Delphinapterus leucas*	Cumberland Sound population	Threatened / No Status	No schedule	COSEWIC 2004a

Appendix A continued (COSEWIC status assessments)

›	Common name	Scientific name	Population	Status Designation C/S	Schedule	Author List
365	Beluga Whale	*Delphinapterus leucas*		Not at Risk / no designation		COSEWIC 2004a
86	Bering Wolffish	*Anarhichas orientalis*		Data Deficient / Special Concern	Schedule 3	COSEWIC 2002a
991	Black-footed Albatross	*Phoebastria nigripes*		Special Concern / no designation	Schedule 1	COSEWIC 2006c
90	Blackline Prickleback	*Acantholumpenus mackayi*		Data Deficient / Special Concern	Schedule 3	COSEWIC 2003b
925	Blue Shark	*Prionace glauca*	Atlantic population	Special Concern / No Status	No schedule	COSEWIC 2006d
	Blue Shark	*Prionace glauca*	Pacific	Data Deficient		COSEWIC 2006d
988	Bluntnose Sixgill Shark	*Hexanchus griseus*		Same - Special Concern	Schedule 1	COSEWIC 2007a
740	Bocaccio	*Sebastes paucispinis*		Threatened / No Status	No schedule	COSEWIC 2002b
054	Bowhead Whale	*Balaena mysticetus*	Eastern Canada-West Greenland population	Special Concern / No Status	No schedule	COSEWIC 2009d
131	Bowhead Whale	*Balaena mysticetus*	Bering-Chukchi-Beaufort population	Same - Special Concern	Schedule 1	COSEWIC 2009d
960	Canary Rockfish	*Sebastes pinniger*		Threatened / No Status	No schedule	COSEWIC 2007b
877	Chinook Salmon	*Oncorhynchus tshawytscha*	Okanagan population	Threatened / No Status	No schedule	COSEWIC 2006e
716	Coho Salmon	*Oncorhynchus kisutch*	Interior Fraser population	Endangered / No Status	No schedule	Irvine 2002
756	Cusk	*Brosme brosme*		Threatened / No Status	No schedule	COSEWIC 2003a
060	Darkblotched Rockfish	*Sebastes crameri*		Special Concern / No Status	No schedule	COSEWIC 2009e
100	Deepwater Redfish	*Sebastes mentella*	Gulf of St. Lawrence - Laurentian Channel population	Endangered / No Status	No schedule	COSEWIC 2010d
099	Deepwater Redfish	*Sebastes mentella*	Northern population	Threatened / No Status	No schedule	COSEWIC 2010d
163	Eulachon	*Thaleichthys pacificus*	Central Pacific Coast population	Endangered / No Status	No schedule	COSEWIC 2011c
164	Eulachon	*Thaleichthys pacificus*	Fraser River population	Endangered / No Status	No schedule	COSEWIC 2011c
162	Eulachon	*Thaleichthys pacificus*	Nass / Skeena Rivers population	Threatened / No Status	No schedule	COSEWIC 2011c
874	Fin Whale	*Balaenoptera physalus*	Atlantic population	Same - Special Concern	Schedule 1	COSEWIC 2005a
155	Fin Whale	*Balaenoptera physalus*		Non-active / Special Concern	Schedule 3	COSEWIC 2005a
98	Green Sturgeon	*Acipenser medirostris*		Same - Special Concern	Schedule 1	COSEWIC 2004b
356	Grey Whale	*Eschrichtius robustus*	Eastern North Pacific population	Same - Special Concern	Schedule 1	COSEWIC 2004c
493	Harbour Porpoise	*Phocoena phocoena*	Pacific Ocean population	Same - Special Concern	Schedule 1	Baird 2003a
147	Harbour Porpoise	*Phocoena phocoena*	Northwest Atlantic population	Special Concern / Threatened	Schedule 2	COSEWIC 2006f
595	Harbour Seal Atlantic and Eastern Arctic subspecies	*Phoca vitulina concolor*		Not at Risk / no designation		COSEWIC 2007c
148	Humpback Whale	*Megaptera novaeangliae*	North Pacific population	Special Concern / Threatened	Schedule 1	Baird 2003b, COSEWIC 2011d
160	Humpback Whale	*Megaptera novaeangliae*	Western North Atlantic population	Not at Risk / Special Concern	Schedule 3	Baird 2003b, COSEWIC 2011d
598	Killer Whale	*Orcinus orca*	Northwest Atlantic / Eastern Arctic population	Special Concern / No Status	No schedule	COSEWIC 2008a
700	Killer Whale	*Orcinus orca*	Northeast Pacific offshore population	Same - Threatened	Schedule 1	COSEWIC 2008a
090	Loggerhead Sea Turtle	*Caretta caretta*		Endangered / No Status	No schedule	COSEWIC 2010e
985	Longspine Thornyhead	*Sebastolobus altivelis*		Same - Special Concern	Schedule 1	COSEWIC 2007d

Appendix A continued (COSEWIC status assessments)

ID	Common name	Scientific name	Population	Status Designation C/S	Schedule	Author List
39	Marbled Murrelet	*Brachyramphus marmoratus*		Threatened / no designation	Schedule 1	Government of Canada 2012b
306	Narwhal	*Monodon monoceros*		Special Concern / No Status	No schedule	COSEWIC 2004d
782	Northern Bottlenose Whale	*Hyperoodon ampullatus*	Davis Strait-Baffin Bay-Labrador Sea population	Special Concern / No Status	No schedule	COSEWIC 2011e
325	Northern Fur Seal	*Callorhinus ursinus*		Threatened / No Status	No schedule	COSEWIC 2010f
645	Olympia Oyster	*Ostrea lurida*		Special Concern / Special Concern	Schedule 1	COSEWIC 2011f
106	Pacific Sardine	*Sardinops sagax*		Not at Risk / Special Concern	Schedule 3	Schweigert 2002
167	Polar Bear	*Ursus maritimus*		Special Concern / No Status	No schedule	COSEWIC 2008b
810	Porbeagle	*Lamna nasus*		Endangered / No Status	No schedule	COSEWIC 2004e
1062	Quillback Rockfish	*Sebastes maliger*		Threatened / No Status	No schedule	COSEWIC 2009f
135	Right Whale	*Eubalaena glacialis*		Non-active / Endangered	Schedule 2	Government of Canada 2012c
989	Rougheye Rockfish type I	*Sebastes sp. type I*		Same - Special Concern	Schedule 1	COSEWIC 2007e
996	Rougheye Rockfish type II	*Sebastes sp. type II*		Same - Special Concern	Schedule 1	COSEWIC 2007e
962	Roughhead Grenadier	*Macrourus berglax*		Special Concern / No Status	No schedule	COSEWIC 2007f
1032	Roundnose Grenadier	*Coryphaenoides rupestris*		Endangered / No Status	No schedule	COSEWIC 2008c
	Sei Whale	*Balaenoptera borea*	Atlantic	Data Deficient		COSEWIC 2003c
909	Shortfin Mako	*Isurus oxyrinchus*	Atlantic population	Threatened / No Status	No schedule	COSEWIC 2006g
730	Sockeye Salmon	*Oncorhynchus nerka*	Cultus population	Endangered / No Status	No schedule	COSEWIC 2003d
729	Sockeye Salmon	*Oncorhynchus nerka*	Sakinaw population	Endangered / No Status	No schedule	COSEWIC 2003e
169	Sowerby's Beaked Whale	*Mesoplodon bidens*		Same - Special Concern	Schedule 1	COSEWIC 2006h
1102	Spiny Dogfish	*Squalus acanthias*	Atlantic population	Special Concern / No Status	No schedule	COSEWIC 2010g
326	Steller Sea Lion	*Eumetopias jubatus*		Same - Special Concern	Schedule 1	COSEWIC 2003f
830	Striped Bass	*Morone saxatilis*	Bay of Fundy population	Threatened / No Status	No schedule	COSEWIC 2004f
829	Striped Bass	*Morone saxatilis*	Southern Gulf of St. Lawrence population	Threatened / No Status	No schedule	COSEWIC 2004f
972	Tope	*Galeorhinus galeus*		Same - Special Concern	Schedule 1	COSEWIC 2007g
899	White Shark	*Carcharodon carcharias*	Atlantic population	Endangered / no designation	Schedule 1	COSEWIC 2006i
854	Winter Skate	*Leucoraja ocellata*	Southern Gulf of St. Lawrence population	Endangered / No Status	No schedule	COSEWIC 2005b
881	Winter Skate	*Leucoraja ocellata*	Georges Bank-Western Scotian Shelf-Bay of Fundy population	Special Concern / No Status	No schedule	COSEWIC 2005b
855	Winter Skate	*Leucoraja ocellata*	Eastern Scotian Shelf population	Threatened / No Status	No schedule	COSEWIC 2005b
1020	Yelloweye Rockfish	*Sebastes ruberrimus*	Pacific Ocean outside waters population	Same - Special Concern	Schedule 1	COSEWIC 2008d
1023	Yelloweye Rockfish	*Sebastes ruberrimus*	Pacific Ocean inside waters population	Same - Special Concern	Schedule 1	COSEWIC 2008d
1103	Yellowmouth Rockfish	*Sebastes reedi*		Threatened / No Status	No schedule	COSEWIC 2010h

APPENDIX B: RANKED THREATS

Table of ranked threats demonstrating no difference in whether the threats were ranked according to species or population

Species Only

Threats	COSEWIC (n=48)	COSEWIC Rank	SARA (n=21)	SARA Rank	Total (N=69)	Total Rank
Hunted/Fisheries - directed***	33	1	12	8	45	1
Pollution - Total (spills, contam, debris)	25	3	19	1	44	2
Fisheries - accidental	30	2	13	7	43	3
Habitat degradation/loss/ displacement	21	4	15	2	36	4
Predation	18	5	6	17	24	5
Entanglement in fishing gear	8	10	15	2	23	6
Climate Change	11	6	12	8	23	6
Oil and Gas and Mining	8	10	14	4	22	8
Industrial Activities/Development	10	7	10	11	20	9
Shipping/Ship stikes	6	17	12	7	18	10
Disease/parasites/pathogens	10	7	8	15	18	11
Human presence / disturbance (incl. nature watching, science)	4	20	14	4	18	11
Seismic Activity	6	13	12	8	18	11
Acute Noise	5	17	10	11	15	14
Prey Availability - Natural	6	13	8	15	14	15
Environmental Shifts	9	9	5	20	14	15
Prey Availability - depletion by fisheries	7	12	6	17	13	17
Chronic Noise	2	30	10	11	12	18
Coastal Development/construction/ dredging	6	13	6	17	12	18
Military Activity	3	26	9	14	12	18
Exotic/invasive species	6	13	3	24	9	21
Natural Mortality	5	17	4	22	9	21
Poaching	4	20	5	20	9	21
Ice Entrapment	4	20	3	24	7	24
Mobile Fishing Gear	4	20	3	24	7	24
Aquaculture	3	26	3	24	6	26
Barriers/impounds/dams	4	20	2	29	6	26
Depressed Population	3	26	3	24	6	26
Harmful Algal Blooms	2	31	4	22	6	29
Data Deficient/Lack of Info	4	20		#N/A	4	30
Water levels / flow	3	26	1	30	4	30
Ecological Community Shifts	1	31	1	30	2	32
Egg Harvesting	1	31	1	30	2	32
Artificial light		#N/A	1	30	1	34
Broodstock Collection**	1	31		#N/A	1	34
Genetic Diversity	1	31		#N/A	1	34
Hatcheries**	1	31		#N/A	1	34
Random Events*	1	31		#N/A	1	34
Relocation from CH	1	31		#N/A	1	34

DUs

Threats	COSEWIC (N=93)	COSEWIC Rank	SARA (N=25)	SARA Rank	Total (N=118)	Total Rank
Hunted/Fisheries - directed***	64	1	10	13	74	1
Pollution - Total (spills, contam, debris)	47	3	23	1	70	2
Fisheries - accidental	48	2	12	9	60	3
Habitat degradation/loss/ displacement	44	4	18	2	62	3
Predation	40	5	5	20	45	5
Climate Change	26	7	12	9	38	6
Entanglement in fishing gear	18	11	16	3	34	7
Shipping/Ship stikes	15	17	14	5	29	9
Environmental Shifts	27	6	4	21	31	8
Oil and Gas and Mining	15	12	14	6	29	10
Acute Noise	15	12	13	7	28	11
Industrial Activities/Development	19	9	8	14	27	12
Disease/parasites/pathogens	20	8	7	15	27	12
Seismic Activity	15	12	12	9	27	12
Chronic Noise	13	18	13	7	26	15
Poaching	19	9	6	16	25	16
Human presence / disturbance (incl. nature watching, science)	8	23	16	3	24	17
Prey Availability - Natural	15	12	6	16	21	18
Prey Availability - depletion by fisheries	15	12	6	16	21	18
Coastal Development/construction/ dredging	12	20	6	16	18	20
Military Activity	6	27	11	12	17	21
Natural Mortality	10	21	4	21	14	22
Ice Entrapment	13	18	1	30	14	22
Aquaculture	9	22	4	21	13	24
Exotic/invasive species	8	23	4	21	12	25
Depressed Population	8	23	2	27	10	26
Mobile Fishing Gear	6	27	3	26	9	27
Water levels / flow	8	23		#N/A	8	28
Barriers/impounds/dams	4	31	2	27	6	29
Ecological Community Shifts	5	29	1	30	6	29
Harmful Algal Blooms	2	34	4	21	6	31
Data Deficient/Lack of Info	5	29		#N/A	5	31
Artificial light		#N/A	2	27	2	33
Egg Harvesting	1	34	1	30	2	33
Genetic Diversity	2	32		#N/A	2	33
Random Events*	2	32		#N/A	2	33
Broodstock Collection**	1	34		#N/A	1	37
Hatcheries**	1	34		#N/A	1	37
Relocation from CH	1	34		#N/A	1	37

APPENDIX C: RAW DATA FOR THE RESULTS OF HABITAT LOSS

(Yellow = loss of non-marine/FW habitat, Red = Kill (direct/accidental mortality), Green = harm/harass, Blue = potential effects on prey, Orange = Direct habitat destruction)

Common name SARA Species (n=15)	Acoustic Disturbance	Aquaculture	Bycatch	Climate Change	Commercial Fishing	Construction / Industrial Activities	Degradation/Loss non-marine Habitat (FW, nesting, terrestrial)	Mobile Fishing Gear	Dredging	Human Disturbance	Invasive Species	Pollution	Prey Quality (climate change, loss of prey habitat, industrial acitivity, pollution, reduced access to prey)	Sedimentation / Siltation	Shipping
Atlantic Salmon							1								
Atlantic Wolffish			1	1				1							
Northern Wolffish			1	1				1							
Spotted Wolffish			1	1				1							
Beluga Whale	1					1			1	1	1	1	1		
Blue Whale	1			1	1	1							1		1
Fin Whale	1			1	1	1						1	1		1
Sei Whale	1			1	1	1							1		1
Leatherback Sea Turtle							1								
North Atlantic Right Whale	1					1						1	1		1
Northern Abalone		1				1								1	
Northern Bottlenose Whale	1					1						1	1		
Striped Bass				1			1		1			1			
Grey Whale	1											1			
Killer Whale	1	1			1	1		1				1	1		

Appendix C continued